

Baseline Aquatic Biomonitoring for the Red Dog Mine Life Extension, 2025

Formerly Known as the Aktigiruaq and Anarraaq Extension Project

By
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July 2026



Symbols and Abbreviations

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

TECHNICAL REPORT NO. 26-07

**BASELINE AQUATIC BIOMONITORING FOR THE
RED DOG MINE LIFE EXTENSION, 2025**

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July 2026

Cover photograph: The confluence of clearwater East Fork Ikalukrok Creek and heavy metal seep impacted mainstem Ikalukrok Creek, July 2025. Photograph by Lauren Yancy.

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This document should be cited as:

Edwards, O.N. 2026. Baseline Aquatic Biomonitoring for the Red Dog Mine Life Extension, 2025. Alaska Department of Fish and Game, Technical Report No. 26-07, Fairbanks, Alaska.

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ACKNOWLEDGEMENTS

We thank Teck American Incorporated and Teck Alaska Incorporated¹ (collectively referred to as Teck) for their financial and logistical support for aquatic biomonitoring in streams associated with the Red Dog Mine Life Extension (formerly known as the Aktigiruk and Anarraaq Extension Project). We specifically acknowledge the onsite assistance provided by Teck employees: Wayne Hall, Robert Napier, Darren Jones, Joseph Diehl III, Uula Sheldon, Tristen Pattee, Kelson Phillips, and Carla Nelson.

Alaska Department of Fish and Game (ADF&G) Habitat Section staff Chelsea Clawson, Lauren Yancy, Olivia Edwards, and Audra Brase participated in field sampling. Olivia Edwards and Lauren Yancy processed all periphyton samples in the ADF&G laboratory in Fairbanks. Matt Kern (Alder Grove Farm) was responsible for sorting, identification, and enumeration of aquatic invertebrates.

Lauren Yancy, Chelsea Clawson, Audra Brase, and Dr. Al Ott (ADF&G Habitat) and Jacob Rowland and Kyle Moselle (Teck) provided constructive reviews of this report.

¹ The aquatic biomonitoring for this report was collected for the Red Dog Mine Life Extension, which is a Teck American Incorporated project. While onsite, Teck Alaska Incorporated staff provided logistical support.

EXECUTIVE SUMMARY

This report summarizes results of 2025 biomonitoring work conducted in streams in the vicinity of the Red Dog Mine Life Extension (RDMLE; formerly known as the Aktigiruk and Anarraaq Extension Project) located northwest of the Red Dog Mine. Biomonitoring included sampling of water quality, periphyton, benthic macroinvertebrates (BMI), sediment, and fish. A total of 21 sites were sampled in 2025 with one sampling event in early July and a second in early August. Two new sites were added on Ikalukrok Creek, one upstream of the mouth of Grayling Junior Creek and another on Upper West Fork Ikalukrok Creek. Four legacy sites originally sampled in the early 2000s on tributaries to the Wulik River were added in 2025. Historic biomonitoring data from 2000–2002 are included for comparison (Weber-Scannell and Ott 2006).

Of the comprehensive water chemistry samples collected throughout the open water season at a subset of sample sites by Teck Alaska in 2025, Noa Creek had the highest mean concentrations of aluminum, cadmium, nickel, and zinc while East Fork Ikalukrok Creek had the lowest. Ikalukrok Creek downstream of Cub Creek had the highest mean lead concentration, while East Fork Grayling Junior Creek had the lowest.

In-situ water quality was measured at each site in July 2025. Upper Competition Creek had the highest turbidity at 50.6 NTU. Oak, Sourdock, and Sunday creeks also had relatively high turbidity levels exceeding 20.0 NTU. West Fork Ikalukrok, Noa, Upper West Fork Ikalukrok, and Upper Competition creeks all had a pH less than 4. Upper Competition and Noa creeks had the highest specific conductance ($>2,000 \mu\text{S}/\text{cm}$), while East Fork Ikalukrok Creek had the lowest. Dissolved oxygen among all sites ranged from 8.15 to 11.74 mg/L. Water temperatures were higher than recent years with a high of 16.2°C at Ikalukrok Creek upstream of Noa Creek and a low of 4.9°C at Upper West Fork Ikalukrok Creek.

Periphyton standing crop samples, as estimated by chlorophyll-a concentration, were collected at all 21 sites in July 2025 in 10 replicates. Ferric Creek had the highest chlorophyll-a concentration (mean = 14.2 mg/m²) followed by Noa Creek (mean = 5.2 mg/m²). All samples from Ikalukrok Creek downstream of Cub Creek had no detectable chlorophyll. The mean chlorophyll-a concentration at the remainder of the sites ranged from 0.01 to 4.62 mg/m².

BMI samples were collected at all 21 sites in July 2025 in 5 replicates. East Fork Ikalukrok Creek and Upper North Fork Red Dog North and South tributaries had the highest BMI densities. Sourdock Creek had the lowest density, followed by Noa, Lower Competition, and West Fork Ikalukrok creeks. Chironomids were most abundant and found at every site. Ephemeroptera, Plecoptera, and Trichoptera (EPT) taxa were present at all sites in 2025 except Sourdock, Upper West Fork Ikalukrok, West Fork Ikalukrok, and Noa creeks. The number of taxa present in BMI samples ranged from 2 taxa at Sourdock Creek to 19 taxa at Upper North Fork Red Dog Creek North Tributary.

One sediment sample was collected per site at eight total sites in July 2025. Sediment element concentrations were variable among sites. Square Creek had the highest concentration of cadmium, lead, and selenium but the lowest concentration of copper. Ferric Creek had the highest concentration of mercury but the lowest concentration of cadmium. Lower Competition Creek had the highest concentration of copper and Oak Creek had the highest concentration of zinc.

Fish sampling using minnow traps was conducted at 14 sites in August 2025. A total of 105 Dolly Varden were captured across 9 sites. A total of 3 slimy sculpin were captured across 2 sites. Dolly Varden fork length ranged from 53 to 170 mm among all sites. Dolly Varden catch per unit effort was highest at Ferric Creek at 53 fish. No fish were captured at Lower Competition, Upper Competition, Sourdock, West Fork Ikalukrok, and Ikalukrok upstream of West Fork Ikalukrok creeks.

INTRODUCTION

Teck American has been conducting mineral exploration drilling around the Anarraaq Prospect since the mid-1990s and the Aktigiruk prospect since around 2014. Both prospects are zinc and lead subsurface deposits collectively located in Sections 11, 14, and 23, T32N, R19W (De Long Mountains A-2) in the Wulik River drainage. The deposits are located approximately 15 km northwest of the Red Dog Mine, which is in the foothills of the western end of the Brooks Range and approximately 80 km northeast of the village of Kivalina.

Access for advanced exploration of the orebodies will be via an all-weather road beginning at Red Dog Mine, following Mainstem Red Dog Creek and Ikalukrok Creek, and crossing North Fork Red Dog, Grayling Junior, and Ikalukrok creeks. These creeks are anadromous waterbodies

that support Dolly Varden, as well as resident fish species Arctic grayling and slimy sculpin. Road construction began in winter 2024–2025 with completion of approximately 9 km of road and the bridges across North Fork Red Dog Creek and Grayling Junior Creek. Construction continued through winter 2025–2026 with completion of a 0.2-mile spur road and bridge upstream of Grayling Junior Creek to provide access to the exploration portal.

The Aktigiruaq and Anarraaq deposits may ultimately be developed as underground mine(s) located about 600 m below the ground surface. Details on potential mine development, operations, and closure are not available at this time, but will be developed and used for environmental analysis, permit issuance, and mine development.

Aquatic baseline data collection near the Anarraaq Prospect first began in 2000 and continued through 2002. Alaska Department of Natural Resources technical reports summarize water quality, periphyton, benthic macroinvertebrate, and fish data collected in 2000, 2001, and 2002 (Weber-Scannell and Ott 2006).

From 2014–2025, the ADF&G Habitat Section has collected pre-mining baseline aquatic data annually focusing on streams surrounding the Aktigiruaq and Anarraaq ore bodies. Most sites are spread throughout the Ikalukrok Creek drainage, with three sites in the Competition Creek drainage (Figure 1). Four additional sites that were sampled in 2000–2002 (herein referred to as legacy sites) were sampled in 2025 to compare historic data to current conditions as metal rich seeps in northwest Alaska increase in frequency (O'Donnell et al. 2024). Three primary types of data are collected: periphyton, benthic macroinvertebrates (BMI), and fish. In-situ water quality and sediment element concentration data have also been collected in recent years.

This report summarizes the 2025 in-situ water quality, periphyton, BMI, sediment element concentration, and fish data collected by ADF&G and water chemistry data collected by Teck Alaska.

LOCATION AND DESCRIPTION OF MONITORING SITES

Biomonitoring was performed at 21 sites in 2025 (Figure 1; Table 1). Two sites are new additions to the annual biomonitoring program (Ikalukrok Creek upstream of the mouth of Grayling Junior

Creek and Upper West Fork Ikalukrok Creek), and four are legacy sites. Distances in the site descriptions below are in river kilometers.

Competition Creek

- **Upper Competition Creek (Station 203)** is approximately 3.5 km upstream of its confluence with the Wulik River. Patches of thick vegetation line the banks with intermittent eroded rock outcrops (Figure 2). There are multiple metal rich seeps at the headwaters of Competition Creek, creating orange staining on the cobble substrate.
- **Sourdock Creek (Station 204)** is characterized by mostly dense willows that form an enclosed canopy over the stream except in a few locations, including the sample site (Figure 2). The sample site is approximately 0.1 km upstream of its confluence with Competition Creek. The predominant substrate is large boulders with orange staining.
- **Lower Competition Creek (Station 202)** is just upstream of the confluence with the Wulik River. There are dense willows along the stream banks with open canopy above the stream (Figure 2). The predominant substrates are gravel and small cobbles with orange staining.

Upper Ikalukrok Creek

- **Warf Creek (Station 233)** is a clear water tributary to West Fork Ikalukrok Creek. There is red and yellow staining on the deeply embedded substrate and a steep bank of loose shale near the sample site (Figure 3). The riparian area is dominated by grasses with sparse willow coverage. It is the farthest upstream site in the Ikalukrok Creek drainage.
- **Upper West Fork Ikalukrok Creek (Station 231)** is a shallow stream with small, red-stained cobble substrate. The stream runs through eroding banks with some willow colonization in the riparian zone but is dominated by open canopy. The sample site is approximately 0.5 km upstream of the confluence with Ikalukrok Creek.
- **West Fork Ikalukrok Creek (Station 205)** is just upstream of the confluence with Ikalukrok Creek and approximately 0.5 km downstream of the Upper West Fork Ikalukrok Creek sample site (Figure 4). The predominant substrate is medium gravel.
- **Ikalukrok Creek upstream of West Fork Ikalukrok (Station 206)** is directly upstream of West Fork Ikalukrok Creek mouth. The streambed has medium to large cobble substrate

with occasional white staining. There are depositional gravel bars at the sample site as well as established willow vegetation (Figure 4).

- **Ikalukrok Creek downstream of Cub Creek (Station 207)** is approximately 1.75 km downstream of the mouth of Cub Creek, and 0.45 km upstream of the confluence with East Fork Ikalukrok Creek. Sampling occurs at a riffle-run section of the stream that has small to medium orange stained cobble (Figure 5).
- **Ikalukrok Creek upstream of Grayling Junior Creek (RDMLE-02)** is approximately 0.5 km upstream of the mouth of Grayling Junior Creek and approximately 3.75 km downstream of Cub Creek. The sample site is at a riffle where the stream splits around a gravel island into two channels just downstream of an eroding cliff face (Figure 5). Substrate consists of orange stained cobble.
- **East Fork Ikalukrok Creek (Station 208)** is a clearwater system that joins with Ikalukrok Creek approximately 0.9 km downstream of the sample site. At the site, the stream has shallow riffle-run features (Figure 6). The substrate is composed of medium to large cobble and boulders with sparse and short shrub vegetation along the banks. Extensive aufeis occurs in the canyon area above the sample site.

Grayling Junior Creek

- **Grayling Junior Creek (Station 209)** is approximately 2.3 km downstream of the East Fork Ikalukrok confluence with Ikalukrok Creek. The sample site is just above the mouth of the creek, in a shallow riffle above an eroding bend that forms a deep pool on river right (Figure 6). The substrate consists of gravel and cobble.
- **North Fork Grayling Junior Creek** is a shallow clearwater tributary of Grayling Junior Creek. The sample site is approximately 2 km upstream of the confluence of the north and east forks of Grayling Junior and is at the base of an eroding cliff face with a unique poplar stand. Willows line the riverbanks and the predominant substrate is small cobble (Figure 7).
- **East Fork Grayling Junior Creek** is approximately 2 km upstream of the confluence with the North Fork Grayling Junior Creek and immediately downstream of a small red stained tributary (Figure 7). Substrate consists of small to medium cobble with minimal shrubs on gravel bars and along the riverbank.

Lower Ikalukrok Creek and Tributaries

- **Noa Creek (Station 210)** is a small tributary of Ikalukrok Creek with thick overhanging willow canopy (Figure 8). The channel is narrowly constrained with large boulders and some smaller embedded cobbles. There is abundant moss growing along the riverbank.
- **Ikalukrok Creek upstream of Noa Creek (RDMLE-03)** is approximately 0.17 km upstream of the mouth of Noa Creek. The substrate is dominated by boulders and large cobble (Figure 8).

North Fork Red Dog Creek

- **Upper North Fork Red Dog Creek North Tributary** (previously referred to as Upper North Fork Red Dog Creek 2) is a small tributary of North Fork Red Dog Creek that is characterized by tall grasses and sparse willows along the riverbanks (Figure 9). The sample site is approximately 1.2 km upstream of the mouth of the north tributary. The streambed is dominated by cobble and boulders covered in abundant moss.
- **Upper North Fork Red Dog Creek South Tributary** (previously referred to as Upper North Fork Red Dog Creek 1) sample site is approximately 1.8 km upstream of the confluence with North Fork Red Dog Creek. The site is approximately 0.3 km downstream of a major beaver dam. The substrate ranges from gravel to small cobble, with willows lining the banks (Figure 9).

Wulik River

- **Oak Creek (Station 216)** is a tributary in the upper Wulik River approximately 8.5 km upstream of Competition Creek. The site has open canopy, a meandering channel with orange stained gravel bars, and primarily small shrubs in the riparian zone (Figure 10). The stream at the sample site is entrenched with steep banks. Substrate near the active channel has thick layers of orange flocculant precipitate. The water is opaque and orange colored.
- **Sunday Creek (Station 215)** is a tributary in the upper Wulik River approximately 4.5 km upstream of Competition Creek. The site has open canopy and wide gravel bars with sparse willow colonization (Figure 10). The small cobble substrate is heavily stained with orange precipitate. The water is opaque and orange colored.

- **Square Creek (Station 214)** is a clearwater tributary in the upper Wulik River with open canopy and shrubs along the riparian zone (Figure 11). There are areas at the sample site where the riverbanks are bare and actively eroding. The substrate is composed of small to medium cobble.
- **Ferric Creek (Station 213)** is a clearwater tributary to the Wulik River with intermittent canopy cover and thick willows, moss, and grasses in the riparian zone (Figure 11). This site is downstream of a dark gray eroding cliff-face. The small to medium cobble substrate is fairly embedded and coated with orange precipitate and filamentous algae. Small boulders are present intermittently in the channel.

Table 1.—Locations of 2025 sample sites, parameters collected, and years sampled. Parameters include in situ water quality (W), periphyton (P), benthic macroinvertebrates (B), fish (F), and sediment (S).

Stream Name (Station)	Coordinates	2025 Parameters	Years Sampled
Upper Competition (203)	68.1409, -163.0027	W, P, B, F	2000–2002 and 2014–2025
Sourdock (204)	68.1398, -163.0045	W, P, B, F	2000–2002 and 2014–2025
Lower Competition (205)	68.1327, -163.0683	W, P, B, F, S	2000–2002 and 2014–2025
Warf Creek (233)	68.1795, -162.9830	W, P, B, S	2021–2025
Upper West Fork Ikalukrok (231)	68.1720, -162.9290	W, P, B, S	2025
West Fork Ikalukrok ¹ (205)	68.1719, -162.9090	W, P, B, F	2000–2002 and 2015–2025
Ikalukrok upstream of West Fork Ikalukrok ¹ (206)	68.1723, -162.9080	W, P, B, F	2000–2002 and 2015–2025
Ikalukrok downstream of Cub Creek Seep ¹ (207)	68.1544, -162.8637	W, P, B, F	1997–1998, 2000–2002, and 2016–2025
East Fork Ikalukrok ¹ (208)	68.1544, -162.8469	W, P, B, F	1997–1998, 2000–2002, and 2016–2025
Ikalukrok upstream of Grayling Junior (RDMLE-02)	68.1422, -162.8770	W, P, B, F, S	2025

Stream Name (Station)	Coordinates	2025 Parameters	Years Sampled
Grayling Junior ¹ (209)	68.1364, -162.8712	W, P, B, F	2000–2002 and 2016–2025
North Fork Grayling Junior	68.1549, -162.8041	W, P, B, F	2021–2025
East Fork Grayling Junior	68.1439, -162.7819	W, P, B, F	2021–2022 and 2025
Noa (210)	68.1266, -162.9022	W, P, B	2000–2002 and 2016–2025
Ikalukrok upstream of Noa (RDMLE-03)	68.1291, -162.8923	W, P, B, F	2024–2025
Upper NFRD North Trib	68.1115, -162.7342	W, P, B, F	2021–2022 and 2025
Upper NFRD South Trib	68.0900, -162.7353	W, P, B, F	2021–2025
Oak Creek (216)	68.1993, -163.0559	W, P, B, S	2001–2002 and 2025
Sunday Creek (215)	68.1896, -163.0791	W, P, B, S	2001–2002 and 2025
Square Creek (214)	68.1578, -163.0999	W, P, B, S	2001–2002 and 2025
Ferric Creek (213)	68.0739, -163.2048	W, P, B, F, S	2000–2002 and 2025

¹Site was not sampled in 2020.

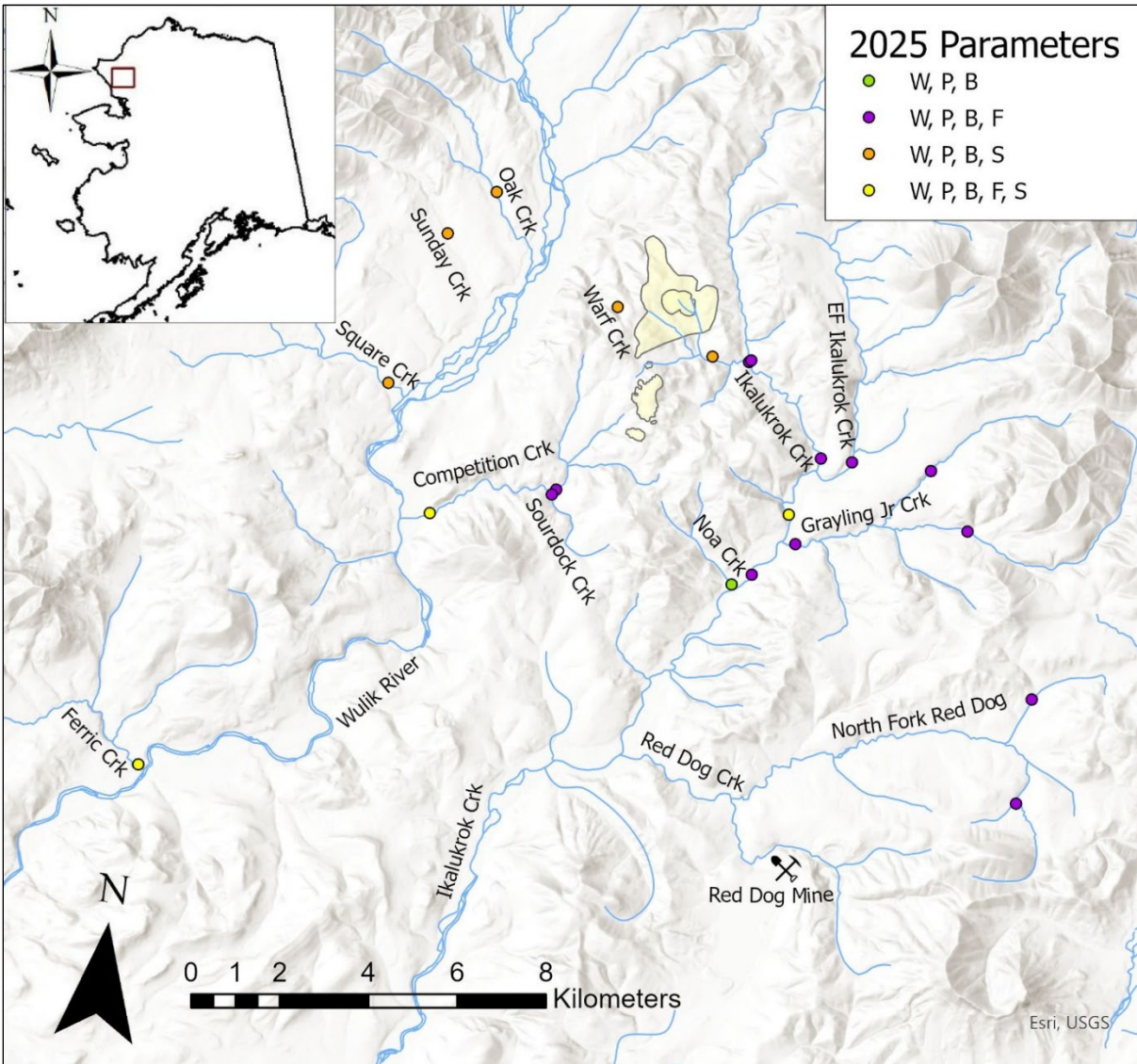


Figure 1.–July 2025 sample sites and associated parameters. Sample parameters are in situ water quality (W), periphyton (P), benthic macroinvertebrates (B), fish (F), and sediment (S). The general location of the Aktigiruk and Anarraaq deposits are depicted as yellow polygons.



Figure 2.—Sample sites on Upper Competition Creek (left), Sourdock Creek (middle), and Lower Competition Creek (right), July 2025.



Figure 3.—Sample sites on Warf Creek (left) and Upper West Fork Ikalukrok (right), July 2025.



Figure 4.—Sample sites on West Fork Ikalukrok Creek (left) and Ikalukrok Creek upstream of West Fork Ikalukrok (right), July 2025.



Figure 5.—Sample sites on Ikalukrok Creek downstream of Cub Creek (left) and Ikalukrok Creek upstream of Grayling Junior (right), July 2025.



Figure 6.—Sample sites on East Fork Ikalukrok Creek (left), July 2025 and Grayling Junior Creek (right), August 2025.



Figure 7.—Sample sites on North Fork Grayling Junior Creek (left) and East Fork Grayling Junior Creek (right), July 2025.



Figure 8.—Sample sites on Noa Creek (left) and Ikalukrok Creek upstream of Noa Creek (right), July 2025.



Figure 9.—Sample sites on Upper North Fork Red Dog Creek North Tributary (left) and Upper North Fork Red Dog Creek South Tributary Creek (right), July 2025.



Figure 10.—Sample sites on Oak Creek (left) and Sunday Creek (right), July 2025.



Figure 11.—Sample sites on Square Creek (left) and Ferric Creek (right), July 2025.

METHODS

SAMPLING OVERVIEW

The objective of the RDMLE biological monitoring program is to establish a baseline dataset that documents in situ productivity of aquatic communities at each sample site in the vicinity of future project facilities and roads. Where relevant, comparisons are made to prior work performed in 2000–2002 (Weber-Scannell and Ott 2006).

In 2025 there were two sampling events which took place from June 30–July 7 and July 29–August 5. During the first sampling event, in situ water quality parameters were recorded and replicate samples of BMI and periphyton were collected at 21 sites. One in-stream sediment sample was also collected at 8 of these sites (Table 1). Fish sampling was performed at 14 sites during the July 29–August 5 event (Table 1).

WATER QUALITY

Teck Alaska performed water quality sampling throughout the 2025 open water season following their standard methodology. Sample analysis was performed by external laboratories and results provided to ADF&G for inclusion in this report. All element concentration data from water samples in this report are presented as “total recoverable” unless otherwise specified. The number of water quality samples taken each year varies, but samples are generally collected twice each

month during the open water season. Not all sites sampled for biological parameters by ADF&G are sampled for water quality by Teck.

During the July sampling event, in situ water quality data was collected at each site concurrent with BMI and periphyton sampling. A handheld multiparameter YSI was used to measure water temperature (°C), dissolved oxygen (mg/L), specific conductance (µS/cm), conductivity (µS/cm), and pH. 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). The sample vial was rinsed with sample 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.

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.

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 (MgCO₃) 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. 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 with detectable chlorophyll was treated with 80 μ L of 0.1 N 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. Additional details can be found in ADF&G Technical Report 26-03 *Methods for Aquatic Life Monitoring at the Red Dog Mine Site* (Clawson 2026).

BENTHIC MACROINVERTEBRATES

Field Methods

At each sample site, five replicates were collected using a Hess sampler. 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 μ m 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.

Prior to 2022, BMI were collected with drift nets rather than Hess samplers. 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 captured by drift nets and thus provides a more accurate baseline for evaluating changes at each sampling location.

Laboratory Methods

Samples were sorted and invertebrates identified by a private aquatic invertebrate lab in Juneau. Insects of the orders Ephemeroptera (mayflies), Plecoptera (stoneflies), and Trichoptera (caddisflies) (EPT) 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. Oligochaeta, Ostracoda, Platyhelminthes, and Nematoda were identified to class level. 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. Since invertebrates belonging to the orders 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. Taxa richness is reported as the number of taxonomic groups identified to the lowest practical level. Terrestrial organisms were excluded from all calculations.

FISH

Ten baited minnow traps were placed at the sample sites during August sampling. Traps were placed in a variety of habitats, including cut banks, pools, and near submerged woody debris. Traps were left overnight and checked about 24 hours later. All captured fish were measured for fork length (FL) or total length (TL), depending on species. Dolly Varden results are reported as catch per unit effort (CPUE) which is the total number of fish caught at a site over a 24-hour period. This is calculated by dividing the number of fish caught by hours of actual effort then multiplying by 24. Length-frequency histograms are also presented for juvenile Dolly Varden.

SEDIMENT

In-stream sediment samples were collected at a subset of sites and analyzed for cadmium, copper, lead, mercury, selenium and zinc. A single sample per site of approximately 200 mL of sand or silt was collected from a sandbar or backwater pool using a clean plastic bag. Samples were frozen until analysis was performed by ALS Laboratories. Element concentrations are reported as mg/kg, with the number of decimal places based on the resolution of the original data for each element.

RESULTS

UPPER COMPETITION CREEK (STATION 203)

Water Quality

Upper Competition Creek has exhibited naturally degraded water quality since sampling first occurred in the early 2000s. Water samples had moderately low pH and elevated concentrations of aluminum, cadmium, nickel, and zinc in the early 2000s with most samples exceeding the chronic aquatic life criterion (EPA 2026; Weber-Scannell and Ott 2006). The substrate had a grayish-yellow precipitate in the early 2000s, but the precipitate in 2014–2025 has varied from white to orange. Concentrations of heavy metals at the site have increased since the early 2000s (Appendix A; Weber-Scannell and Ott 2006). The water clarity in Upper Competition Creek varies among years from opaque white to orange in color and typically has elevated turbidity. In July 2025, in situ water temperature, turbidity, and specific conductance were notably higher than previous years while pH and dissolved oxygen were lower (Figure 12). Water clarity was poor and orange in color. In situ water quality data from 2025 are presented in Appendix B.

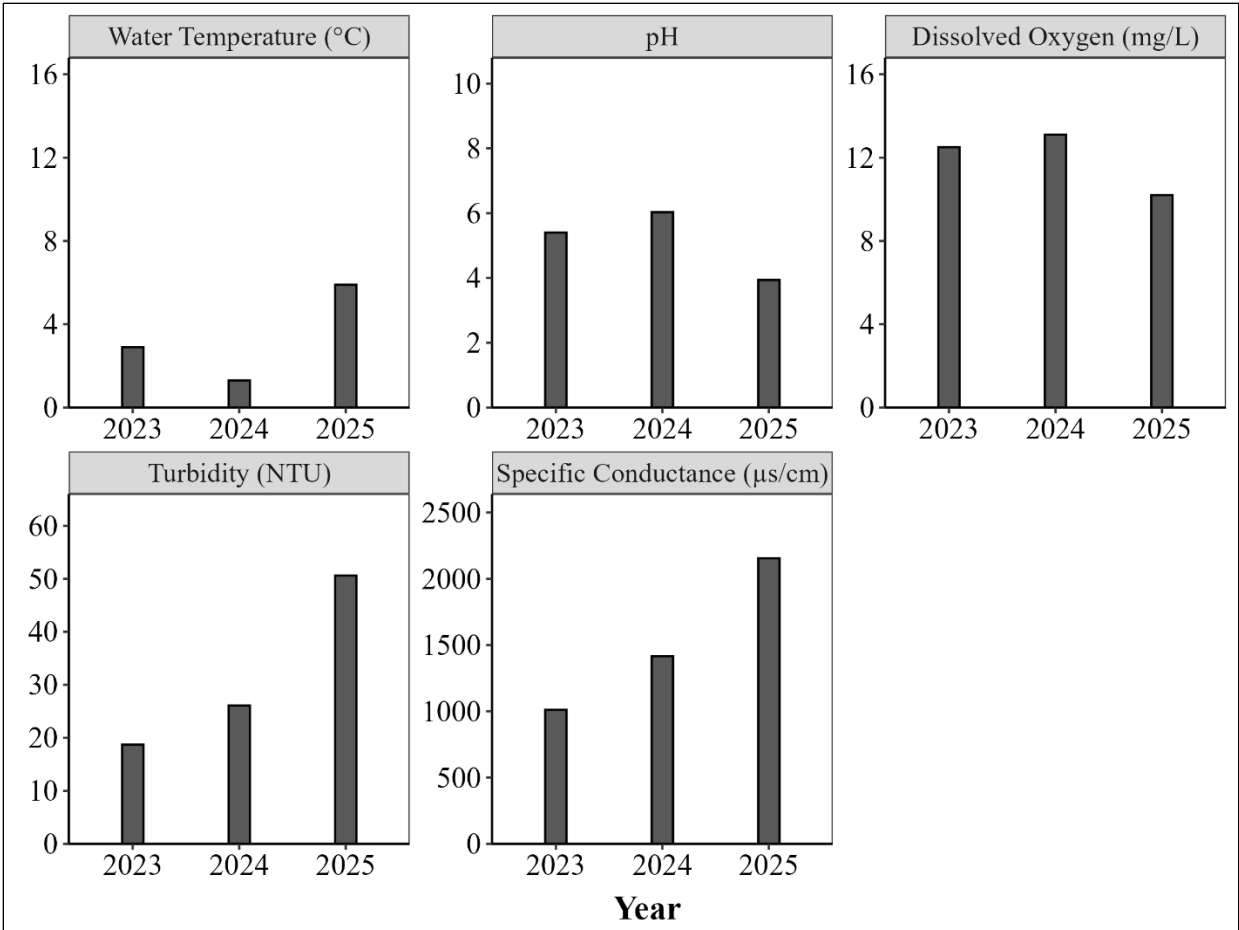


Figure 12.—In situ water quality at Upper Competition Creek, 2023–2025.

Periphyton

In 2025, the mean chlorophyll-a concentration in Upper Competition Creek was 0.05 mg/m^2 (SD = 0.05). This value is similar to the annual means over the last 10 years but well below the highest observed value of 0.42 mg/m^2 in 2002 (Figure 13). Mean chlorophyll-a concentrations have been consistently lower in Upper Competition Creek during the more recent sampling period (2014–2024) compared to the early 2000s. Notably, only 15 out of 100 samples have been above the estimated detection limit since 2014, 5 of which are from 2025. Periphyton data from 2025 are presented in Appendix C.

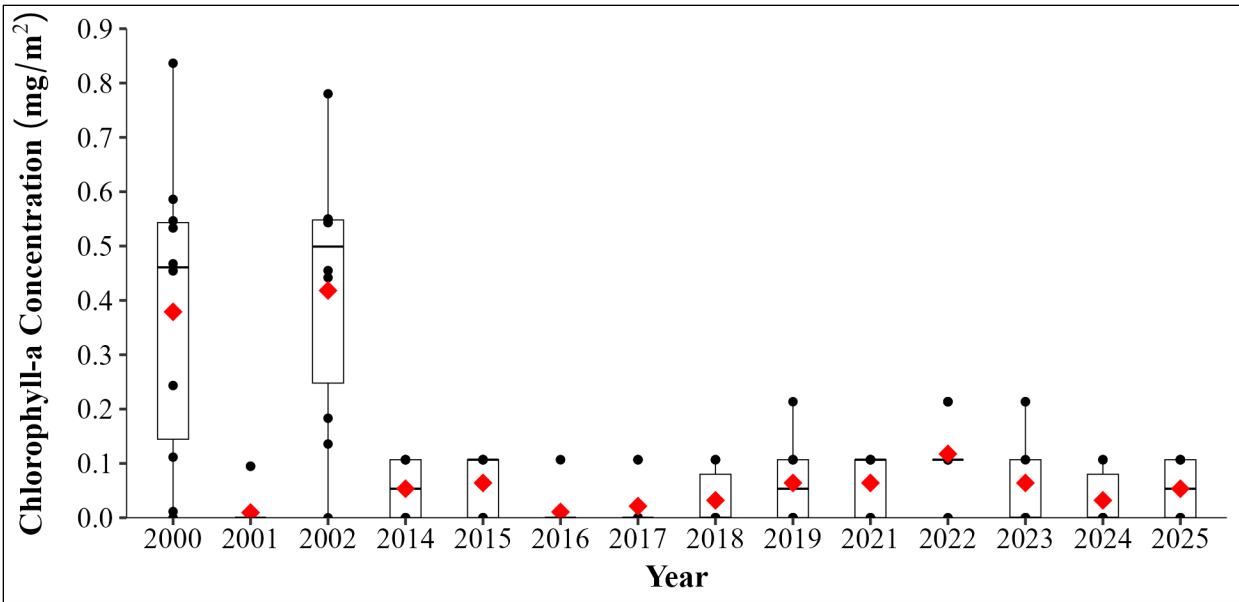


Figure 13.–Chlorophyll-a concentration boxplot at Upper Competition Creek, 2000–2002 and 2014–2025. Raw data are depicted by black dots and mean values are depicted by red diamonds.

Benthic Macroinvertebrates

The mean BMI density in Upper Competition Creek in 2025 was 72 BMI/m² (SD = 61; Figure 14). EPT taxa are not consistently present in Upper Competition Creek BMI samples. EPT taxa were present in the sample in 2025 for the second time in the last 5 years making up 3.6% of the sample. Diptera made up 67.8% of the sample and “other” taxa made up the remaining proportion (Figure 15). Taxa richness in 2025 was 7 taxa. Prior to 2022, taxa richness ranged from 12 to 22 taxa when drift nets were used (Figure 16). BMI data from 2025 are presented in Appendix D.

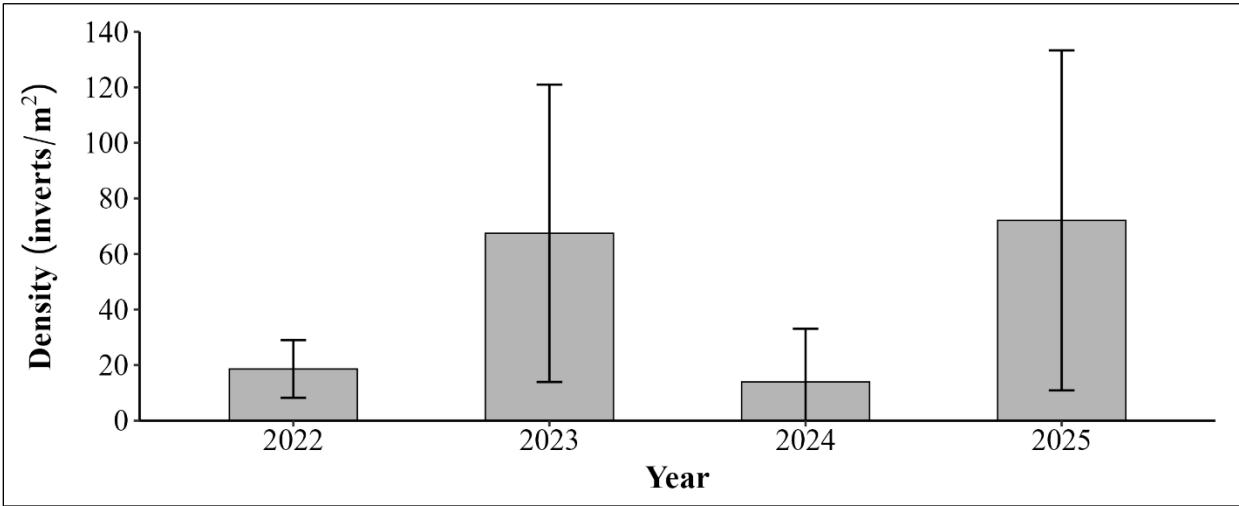


Figure 14.–Mean BMI density (± 1 SD) at Upper Competition Creek, 2022–2025.

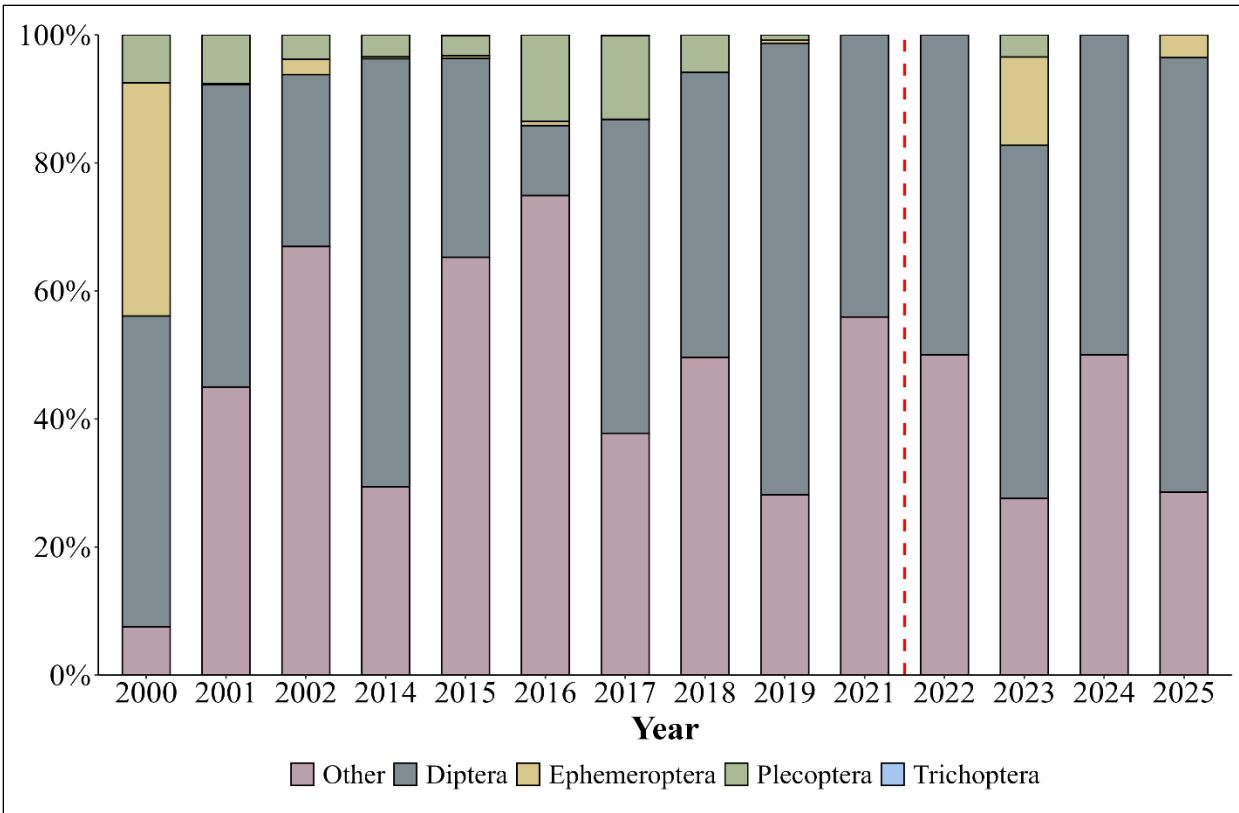


Figure 15.—Mean percent EPT, Diptera, and other taxa in Upper Competition Creek aquatic invertebrate samples, 2000–2002 and 2014–2025. Sampling method was changed from drift nets to Hess samplers in 2022 as indicated by the red vertical dashed line.

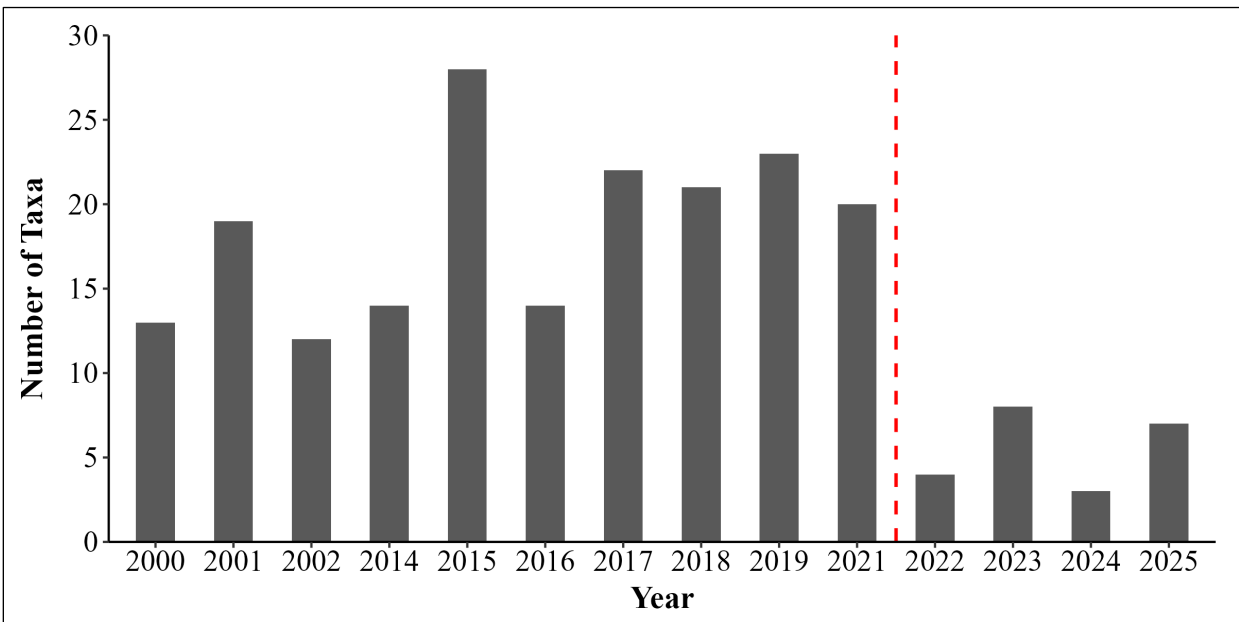


Figure 16.—Taxa richness in Upper Competition Creek aquatic invertebrate samples, 2000–2002 and 2014–2025. Sampling method was changed from drift nets to Hess samplers in 2022 as indicated by the red vertical dashed line.

Fish

Fish have not been captured at Upper Competition Creek since 2002. Dolly Varden CPUE was 5 fish in 2000 and 3 fish in 2002, which coincided with the two years that had the highest chlorophyll-a concentration (Figure 13).

SOURDOCK CREEK (STATION 204)

Water Quality

In the early 2000s, Sourdock Creek water quality was generally good with moderate alkalinity (as CaCO_3), neutral pH, and slightly elevated concentrations of aluminum, cadmium, and zinc (Weber-Scannell and Ott 2006). The large boulders in the stream were covered with a thick layer of moss from 2000–2002, but moss has been mostly absent during the 2014–2024 sample period, with orange precipitate in its place indicative of degraded water quality. Metal concentrations are now similar to those in Upper Competition Creek (Appendix A). In July 2025, in situ water temperature, turbidity, and specific conductance were notably higher than previous years while pH and dissolved oxygen were lower (Figure 17). In situ water quality data from 2025 are presented in Appendix B.

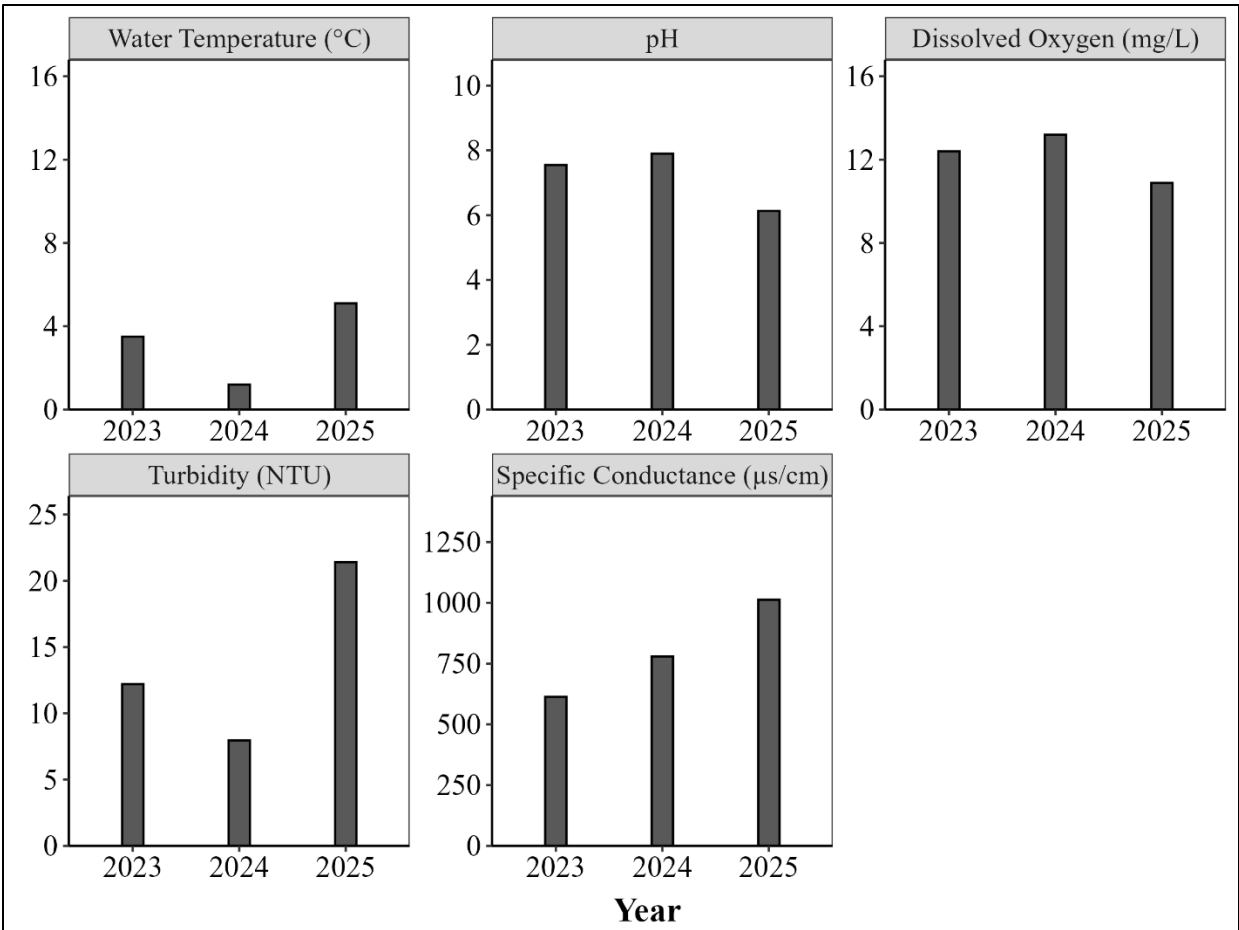


Figure 17.—In situ water quality at Sourdock Creek, 2023–2025.

Periphyton

In 2025, the mean chlorophyll-a concentration in Sourdock Creek was 0.12 mg/m^2 (SD = 0.08) which is similar to the means in 2022–2024 (Figure 18). The highest mean chlorophyll-a concentration observed in Sourdock Creek was 12.44 mg/m^2 in 2002 (Figure 18). There has been a marked decline in chlorophyll-a concentrations in Sourdock Creek since 2018. Historically, chlorophyll-a concentrations were considerably higher in Sourdock Creek than in Upper Competition Creek, but since 2022 both have been low. These two creeks join just downstream of the sample sites into Competition Creek. Periphyton data from 2025 are presented in Appendix C.

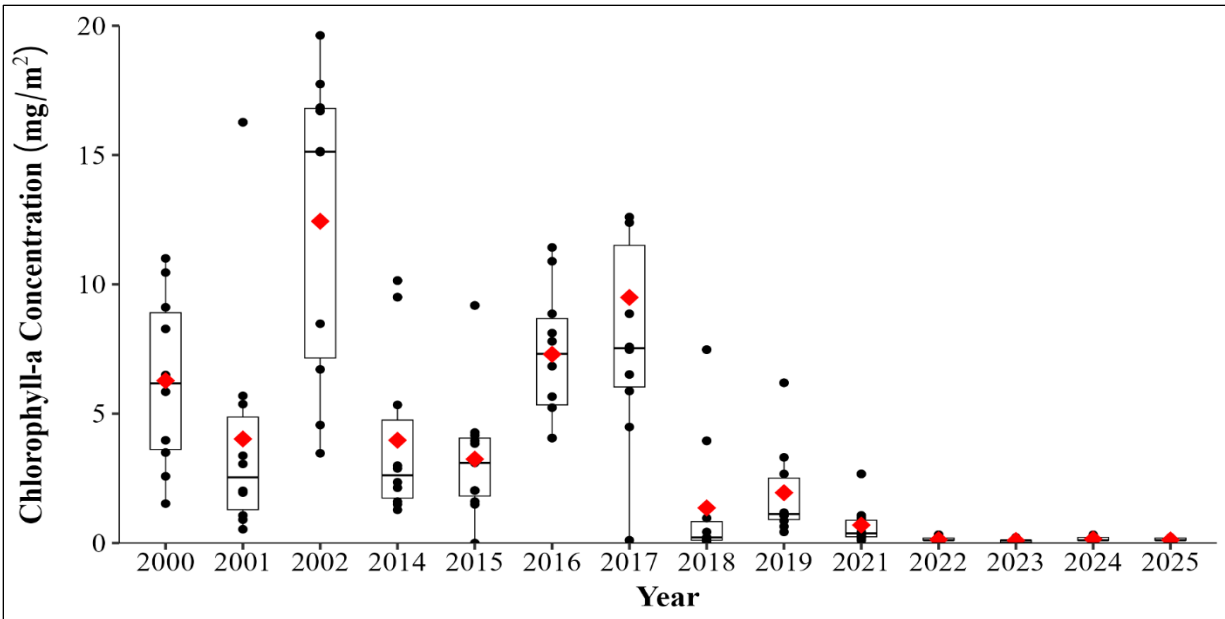


Figure 18.–Chlorophyll-a concentration boxplot at Sourdock Creek, 2000–2002 and 2014–2025. Raw data are depicted by black dots and mean values are depicted by red diamonds.

Benthic Macroinvertebrates

The mean BMI density in Sourdock Creek in 2025 was 16 BMI/m² (SD = 13; Figure 19). EPT taxa have not been present in Sourdock Creek BMI samples since 2021. In 2025, Diptera made up 85.7% of the sample and “other” taxa made up the remaining proportion (Figure 20). Taxa richness in 2025 was 2 taxa. Prior to 2022 when drift nets were used, taxa richness ranged from 12 to 26 taxa (Figure 21). BMI data from 2025 are presented in Appendix D.

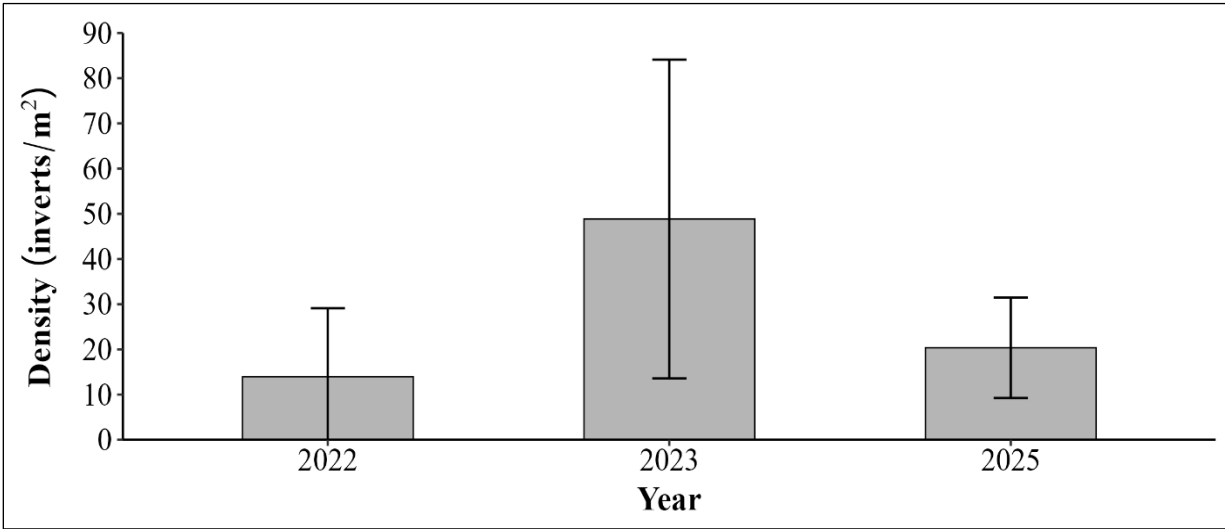


Figure 19.–Mean BMI density ($\pm$ 1 SD) at Sourdock Creek, 2022–2025. No BMI sampling occurred at this site in 2024.

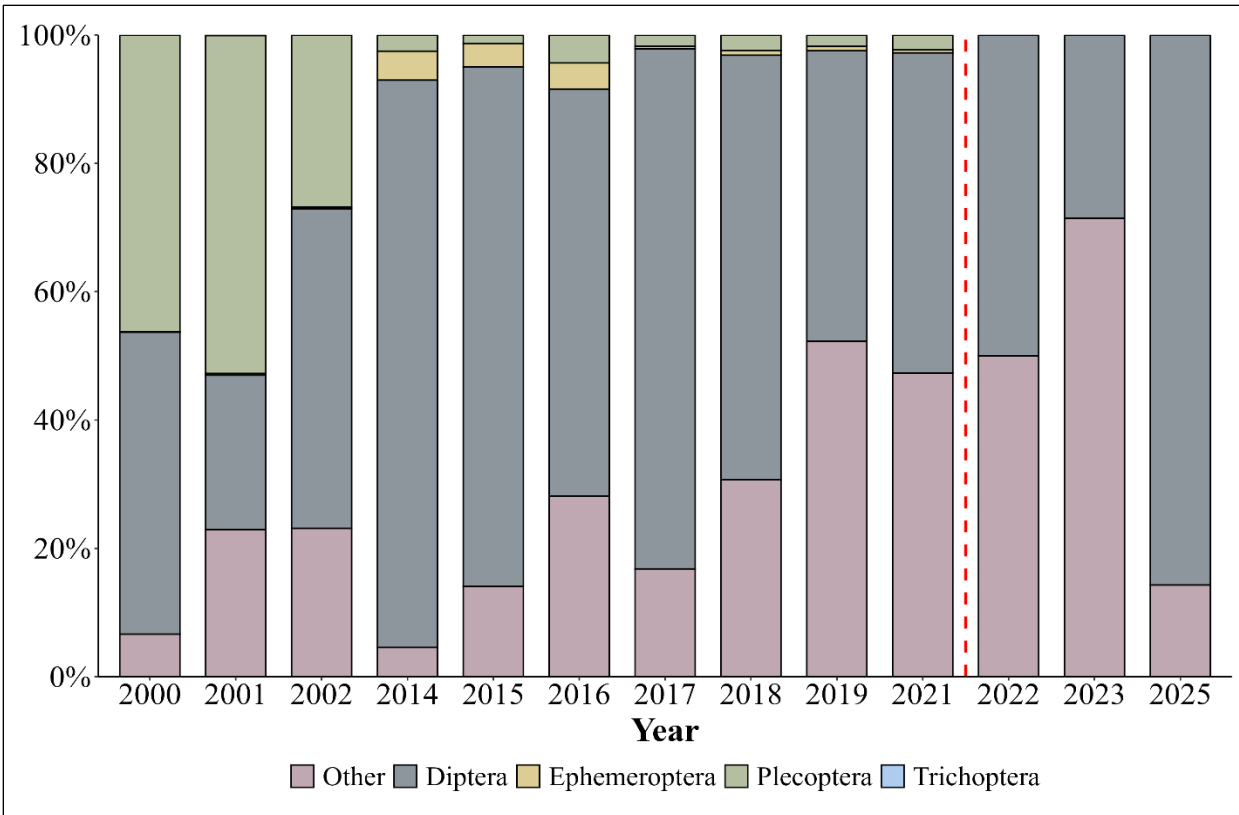


Figure 20.—Mean percent EPT, Diptera, and other taxa in Sourdock Creek aquatic invertebrate samples, 2000–2002 and 2014–2025. Sampling method was changed from drift nets to Hess samplers in 2022 as indicated by the red vertical dashed line. No BMI sampling occurred at this site in 2024.

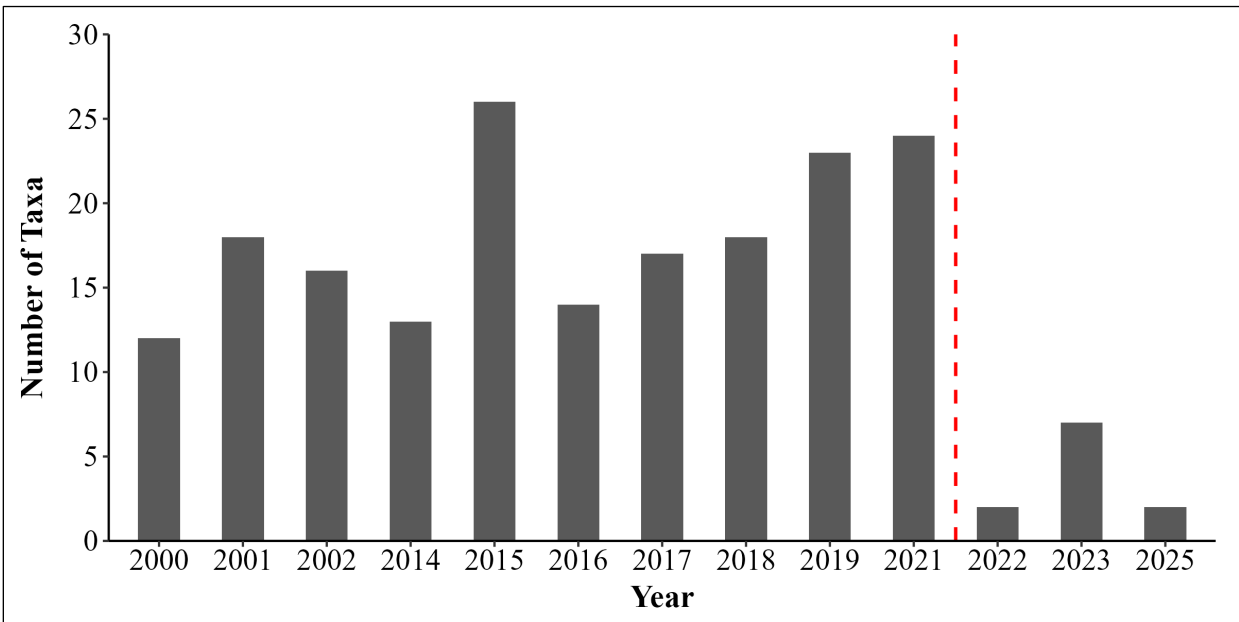


Figure 21.—Taxa richness in Sourdock Creek aquatic invertebrate samples, 2000–2002 and 2014–2025. Sampling method was changed from drift nets to Hess samplers in 2022 as indicated by the red vertical dashed line. No BMI sampling occurred at this site in 2024.

Fish

Fish have not been captured at Sourdock Creek since 2016 when 1 Dolly Varden was captured, coinciding with the degradation of water quality at the site. The highest Dolly Varden CPUE on record at Sourdock Creek was 20 fish in 2000 (Ott et al. 2019).

LOWER COMPETITION CREEK (STATION 202)

Water Quality

Historically, Lower Competition Creek water quality appeared to be moderated by input from Sourdock Creek. Metal concentrations in the water of Lower Competition Creek were substantially lower than at the Upper Competition Creek sample site in the early 2000s (Weber-Scannell and Ott 2006). Unlike the Upper Competition Site, no water samples from Lower Competition Creek contained concentrations of iron, nickel, or lead that exceeded the chronic criteria for aquatic life (Weber-Scannell and Ott 2006). Although no element concentration data has been collected in recent years, it was visually apparent beginning in 2018 that water quality had deteriorated from that observed from 2000–2002 (clear water) to reddish orange staining on the substrate with opaque water. In July 2025, in situ water temperature, turbidity, and specific conductance were notably higher than in 2023 while pH and dissolved oxygen were lower (Figure 22). In situ water quality data from 2025 are presented in Appendix B.

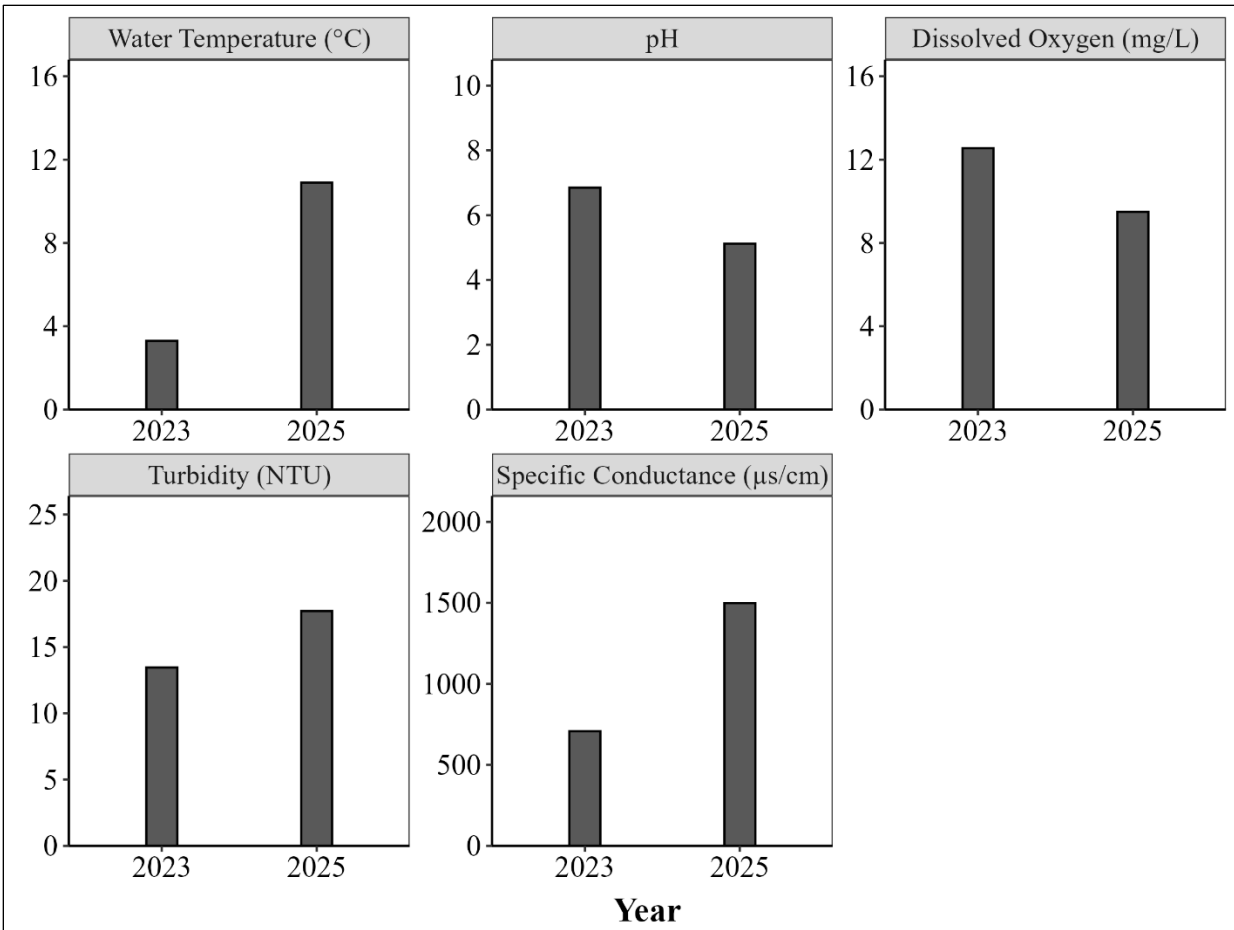


Figure 22.—In situ water quality at Lower Competition Creek, 2023 and 2025. No water quality sampling occurred at this site in 2024.

Periphyton

The mean chlorophyll-a concentration in Lower Competition Creek in 2025 was 0.01 mg/m^2 (SD = 0.03). Mean chlorophyll-a concentrations in Lower Competition Creek dropped from a maximum of 4.42 mg/m^2 in 2002 to 0.04 mg/m^2 in 2014 and have remained below 1.00 mg/m^2 since (Figure 23). This is an indicator of persistent degraded water quality at the site similar to the upstream Sourdock and Upper Competition sites. Periphyton samples were not collected at Lower Competition Creek in 2024. Periphyton data from 2025 are presented in Appendix C.

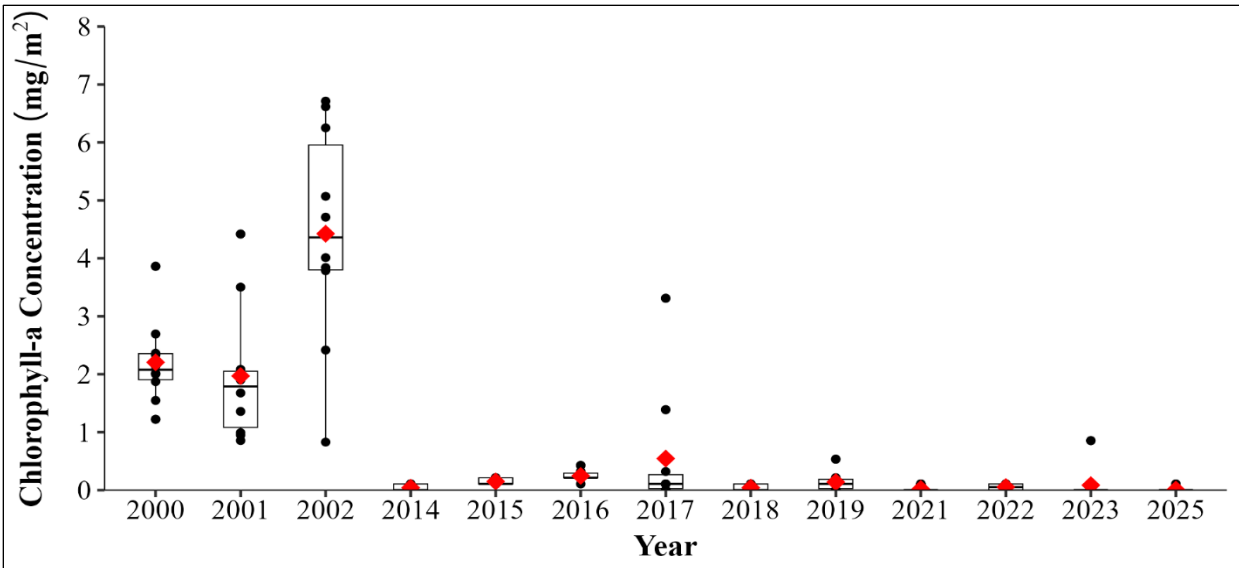


Figure 23.—Chlorophyll-a concentration boxplot at Lower Competition Creek, 2000–2002 and 2014–2025. Raw data are depicted by black dots and mean values are depicted by red diamonds. No periphyton sampling occurred at this site in 2024.

Benthic Macroinvertebrates

The mean BMI density in Lower Competition Creek in 2025 was 35 BMI/m² (SD = 25; Figure 24). EPT taxa have been present in Lower Competition Creek BMI samples in all years except 2023. In 2025, EPT taxa made up 6.7% of the sample, Diptera made up 80% of the sample, and “other” taxa made up the remaining proportion (Figure 25). Taxa richness in 2025 was 5 taxa, similar to values since 2022. Prior to 2022 when drift nets were used, taxa richness ranged from 13 to 27 taxa (Figure 26). BMI data from 2025 are presented in Appendix D.

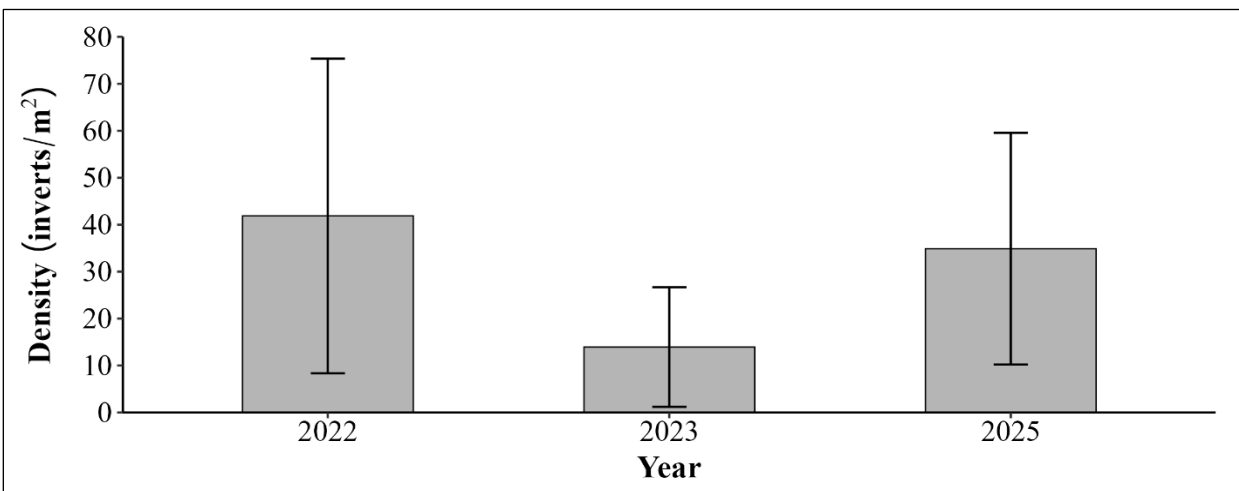


Figure 24.—Mean BMI density (± 1 SD) at Lower Competition Creek, 2022–2025. No BMI sampling occurred at this site in 2024.

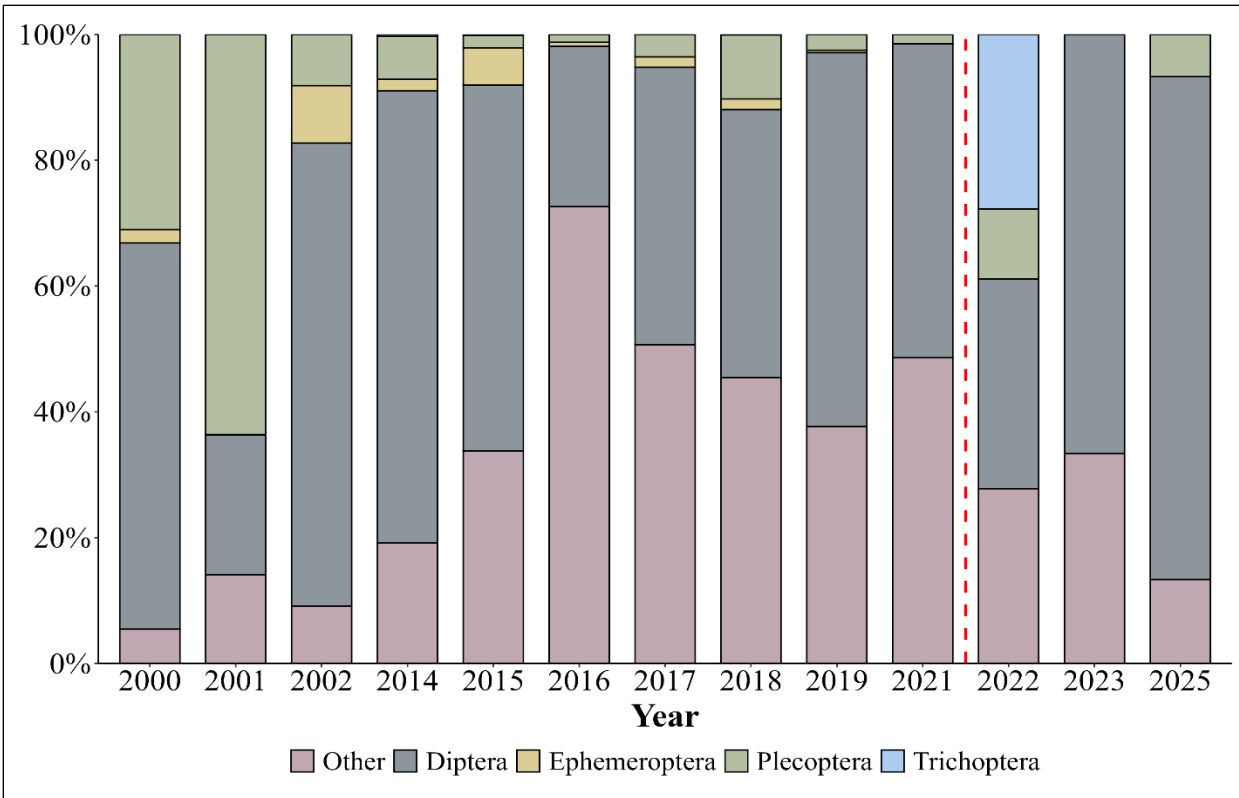


Figure 25.—Mean percent EPT, Diptera, and other taxa in Lower Competition Creek aquatic invertebrate samples, 2000–2002 and 2014–2025. Sampling method was changed from drift nets to Hess samplers in 2022 as indicated by the red vertical dashed line. No BMI sampling occurred at this site in 2024.

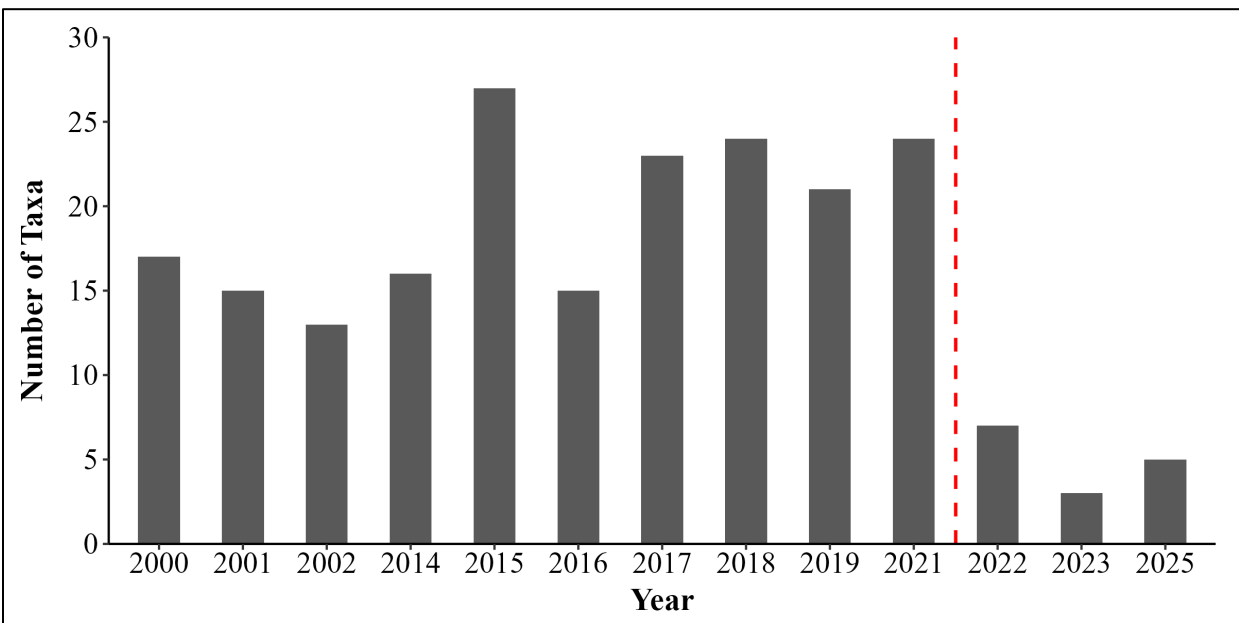


Figure 26.—Taxa richness in Lower Competition Creek aquatic invertebrate samples, 2000–2002 and 2014–2025. Sampling method was changed from drift nets to Hess samplers in 2022 as indicated by the red vertical dashed line. No BMI sampling occurred at this site in 2024.

Fish

Fish have not been captured at Lower Competition Creek since 2019 when the Dolly Varden CPUE was 24 fish. The CPUE has been variable since 2014 with zero fish caught in 2021–2025, and a high CPUE of 47 fish in 2016. Generally, the CPUE was higher from 2014–2019 than in 2000–2002 (Ott et al. 2019).

Juvenile Dolly Varden historically used Lower Competition Creek as rearing habitat during the ice-free season (Bradley and Ott 2018). In 2000, fyke nets were used to catch fish moving either upstream or downstream in early and late July. Catches yielded 4 juvenile Arctic grayling and 38 juvenile Dolly Varden (Weber-Scannell and Ott 2006).

Sediment

Sediment element concentrations in Lower Competition Creek and summary statistics from all 2025 sites are presented in Table 2. All elements from Lower Competition Creek were above the mean concentration of 2025 samples except mercury which was slightly below the mean. Sediment data from 2025 are presented in Appendix F.

Table 2.—Sediment sample element concentrations (mg/kg) in Lower Competition Creek in 2025 and summary statistics. Summary statistics were calculated with all sites (n = 8) sampled in July 2025. Due to non-detections, mercury summary statistics exclude two sites (n = 6).

Element	Lower Competition	All 2025 Sample Sites		
	2025	Mean	Minimum	Maximum
Cadmium	5.37	3.6	0.43	7.88
Copper	544	149.88	29.3	544
Lead	52.8	31.61	11.4	61.1
Mercury	0.094	0.15	0.06	0.498
Selenium	6.7	5.23	1.27	16.6
Zinc	1,210	1,170.88	134	4,070

WARF CREEK (STATION 233)

Water Quality

Warf Creek is a clearwater tributary to West Fork Ikalukrok Creek. There is some orange staining on the substrate and a steep bank of loose shale on river right at the sample site. In July 2025, in situ water temperature and pH were higher than in 2023 while dissolved oxygen was similar.

Turbidity and specific conductance were approximately one third of the values recorded in 2023 (Figure 27). In situ water quality data from 2025 are presented in Appendix B.

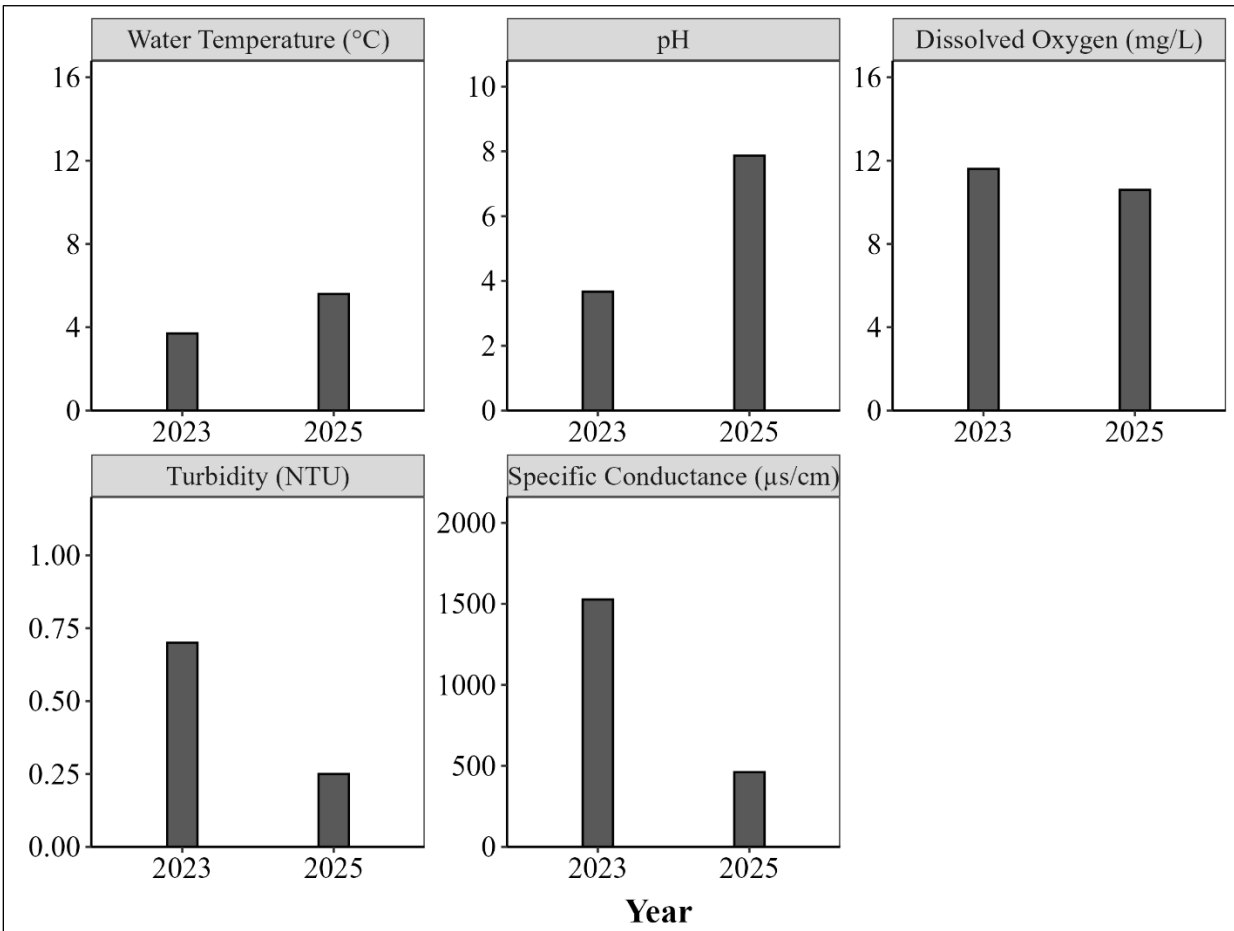


Figure 27.—In situ water quality at Warf Creek, 2023 and 2025. No water quality sampling occurred at this site in 2024.

Periphyton

Mean chlorophyll-a concentration in Warf Creek in 2025 was 0.17 mg/m^2 (SD = 0.10). Mean chlorophyll-a concentrations have been similar among years except in 2022 when the mean concentration was 2.26 mg/m^2 , approximately 15 times higher than all other years (Figure 28). Periphyton data from 2025 are presented in Appendix C.

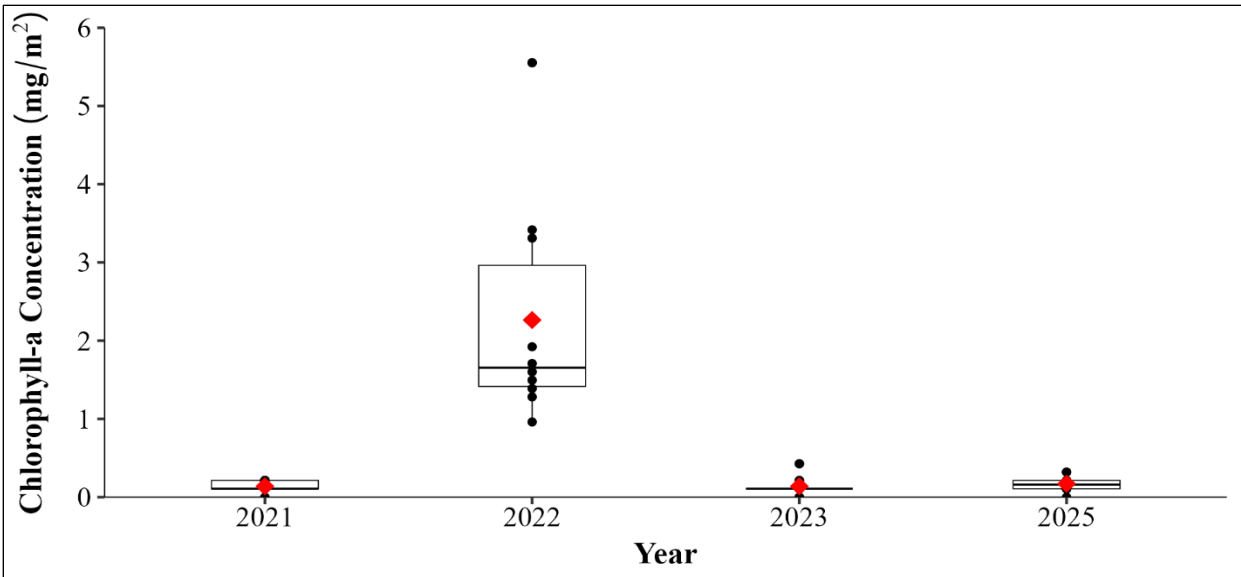


Figure 28.—Chlorophyll-a concentration boxplot at Warf Creek, 2021–2025. Raw data are depicted by black dots and mean values are depicted by red diamonds. No periphyton sampling occurred at this site in 2024.

Benthic Macroinvertebrates

The mean BMI density in Warf Creek in 2025 was 95 BMI/m² (SD = 40), the highest mean on record (Figure 29). In 2025, EPT taxa (Plecoptera) made up 2.4% of the sample, Diptera made up 87.8% of the sample, and “other” taxa made up the remaining proportion (Figure 30). Plecoptera were also present in the samples in 2021 and 2022. Taxa richness in 2025 was 7 taxa, similar to 2021 and 2022 (Figure 31). BMI data from 2025 are presented in Appendix D.

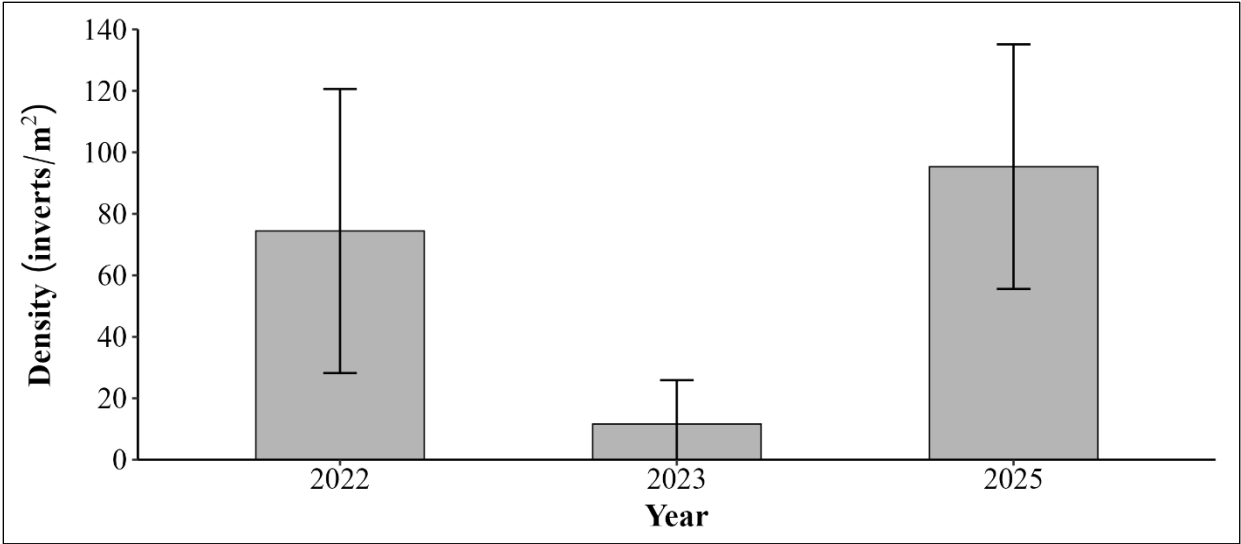


Figure 29.—Mean BMI density (± 1 SD) at Warf Creek, 2022–2025. No BMI sampling occurred at this site in 2024.

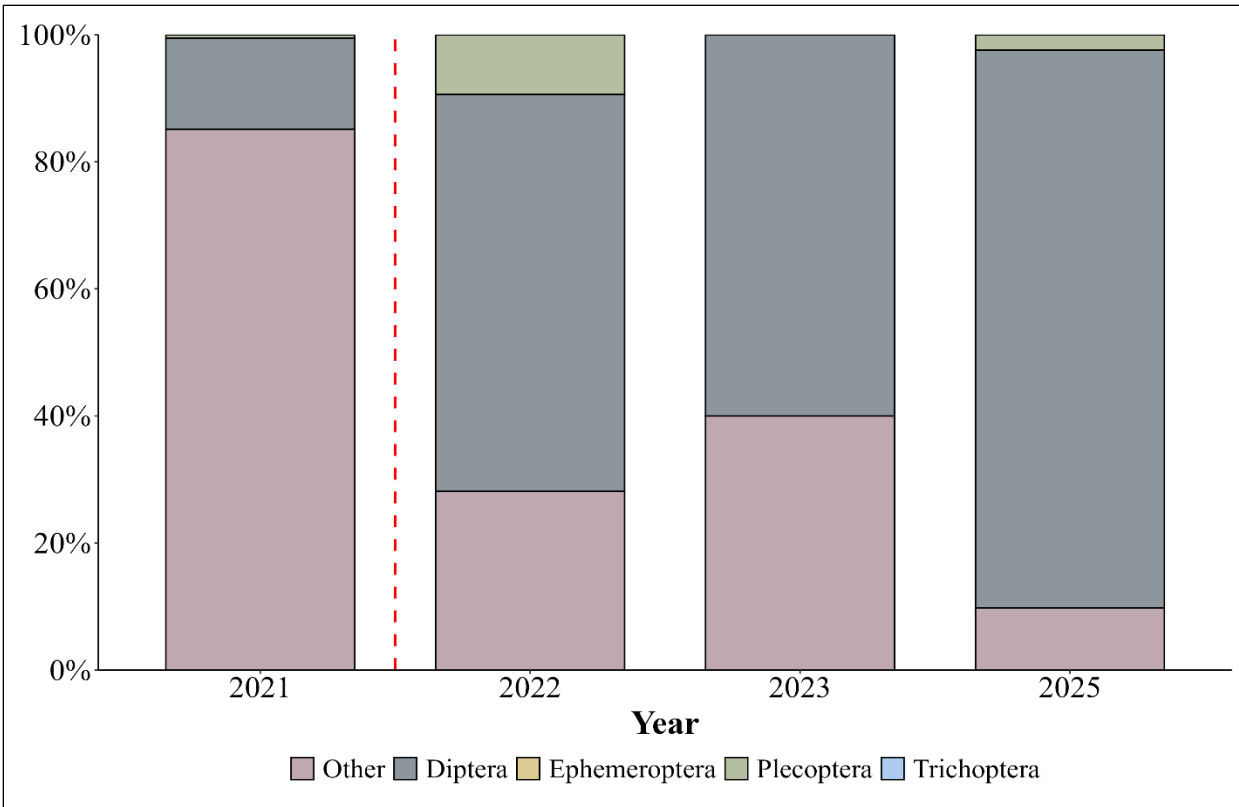


Figure 30.—Mean percent EPT, Diptera, and other taxa in Warf Creek aquatic invertebrate samples, 2021–2025. Sampling method was changed from drift nets to Hess samplers in 2022 as indicated by the red vertical dashed line. No BMI sampling occurred at this site in 2024.

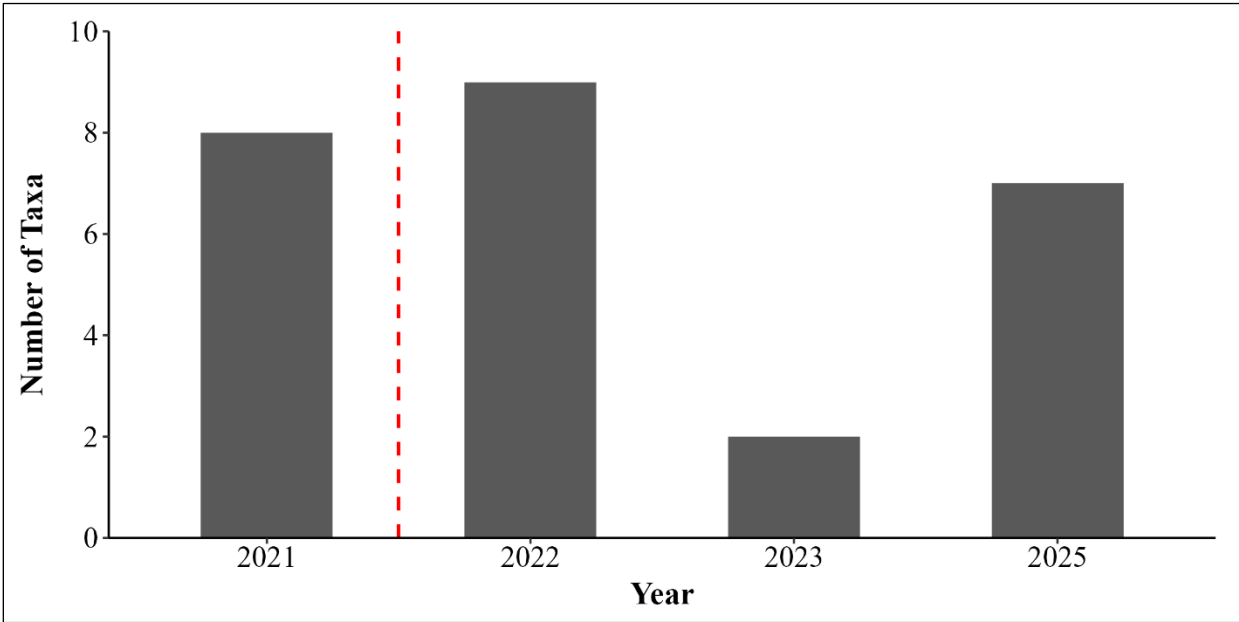


Figure 31.—Taxa richness in Warf Creek aquatic invertebrate samples, 2021–2025. Sampling method was changed from drift nets to Hess samplers in 2022 as indicated by the red vertical dashed line. No BMI sampling occurred at this site in 2024.

Sediment

Sediment element concentrations in Warf Creek and summary statistics from all 2025 sites are presented in Table 3. All elements in Warf Creek were below the mean concentration of 2025 samples and well below the maximums. Sediment data from 2025 are presented in Appendix F.

Table 3.–Sediment sample element concentrations (mg/kg) in Warf Creek in 2025 and summary statistics. Summary statistics were calculated with all sites (n = 8) sampled in July 2025. Due to non-detections, mercury summary statistics exclude two sites (n = 6).

Element	Warf	All 2025 Sample Sites		
	2025	Mean	Minimum	Maximum
Cadmium	0.433	3.6	0.43	7.88
Copper	127	149.88	29.3	544
Lead	11.4	31.61	11.4	61.1
Mercury	0.065	0.15	0.06	0.498
Selenium	3.9	5.23	1.27	16.6
Zinc	144	1,170.88	134	4,070

UPPER WEST FORK IKALUKROK CREEK (STATION 231)

Water Quality

Upper West Fork Ikalukrok Creek is a clearwater tributary to Ikalukrok Creek with heavy orange staining on the substrate. In 2025, water quality data were collected by Teck at Station 231. Element concentration data from the 2025 samples were consistent with early 2000s data collected ~1 km downstream at Station 205 (Appendix A; Weber-Scannell and Ott 2006). This was the first year that in situ water quality was recorded at Upper West Fork Ikalukrok Creek. In July 2025, in situ water temperature was 4.9°C, pH was acidic at 3.66, dissolved oxygen was 10.48 mg/L, turbidity was 0.21 NTU, and specific conductance was 1,703 µs/cm. In situ water quality data from 2025 are presented in Appendix B.

Periphyton

This was the first year that periphyton samples were collected at Upper West Fork Ikalukrok Creek. Mean chlorophyll-a concentration was 0.49 mg/m² (SD = 0.51). Periphyton data from 2025 are presented in Appendix C.

Benthic Macroinvertebrates

This was the first year that BMI samples were collected at Upper West Fork Ikalukrok Creek. The mean BMI density was 614 BMI/m² (SD = 394) and taxa richness was 5 taxa. EPT taxa were absent from BMI samples. Diptera made up 97% of the sample, and “other” taxa made up the remaining proportion. BMI data from 2025 are presented in Appendix D.

Sediment

Sediment element concentrations in Upper West Fork Ikalukrok Creek and summary statistics from all 2025 sites are presented in Table 4. All elements were below the mean concentration of 2025 samples. Sediment data from 2025 are presented in Appendix F.

Table 4.–Sediment sample element concentrations (mg/kg) in Upper West Fork Ikalukrok Creek in 2025 and summary statistics. Summary statistics were calculated with all sites (n = 8) sampled in July 2025. Due to non-detections, mercury summary statistics exclude two sites (n = 6).

Element	Upper WF Ikalukrok	All 2025 Sample Sites		
	2025	Mean	Minimum	Maximum
Cadmium	0.752	3.6	0.43	7.88
Copper	107	149.88	29.3	544
Lead	11.8	31.61	11.4	61.1
Mercury	ND	0.15	0.06	0.498
Selenium	1.27	5.23	1.27	16.6
Zinc	134	1,170.88	134	4,070

WEST FORK IKALUKROK CREEK (STATION 205)

Water Quality

In the early 2000s, water hardness and sulfate concentrations in West Fork Ikalukrok Creek were relatively high while alkalinity was low. The pH was also low ranging from 4.3 to 6.8 (Weber-Scannell and Ott 2006). Water samples had high concentrations of most elements analyzed in the early 2000s, especially aluminum, cadmium, copper, nickel, and zinc (Weber-Scannell and Ott 2006). Since sampling began in the area, a white precipitate has been observed at the confluence with mainstem Ikalukrok Creek. In July 2025, in situ water temperature and specific conductance were higher than in previous years while pH and dissolved oxygen were lower (Figure 32). Turbidity in 2025 was higher than in 2024 but lower than in 2023. In situ water quality data from 2025 are presented in Appendix B.

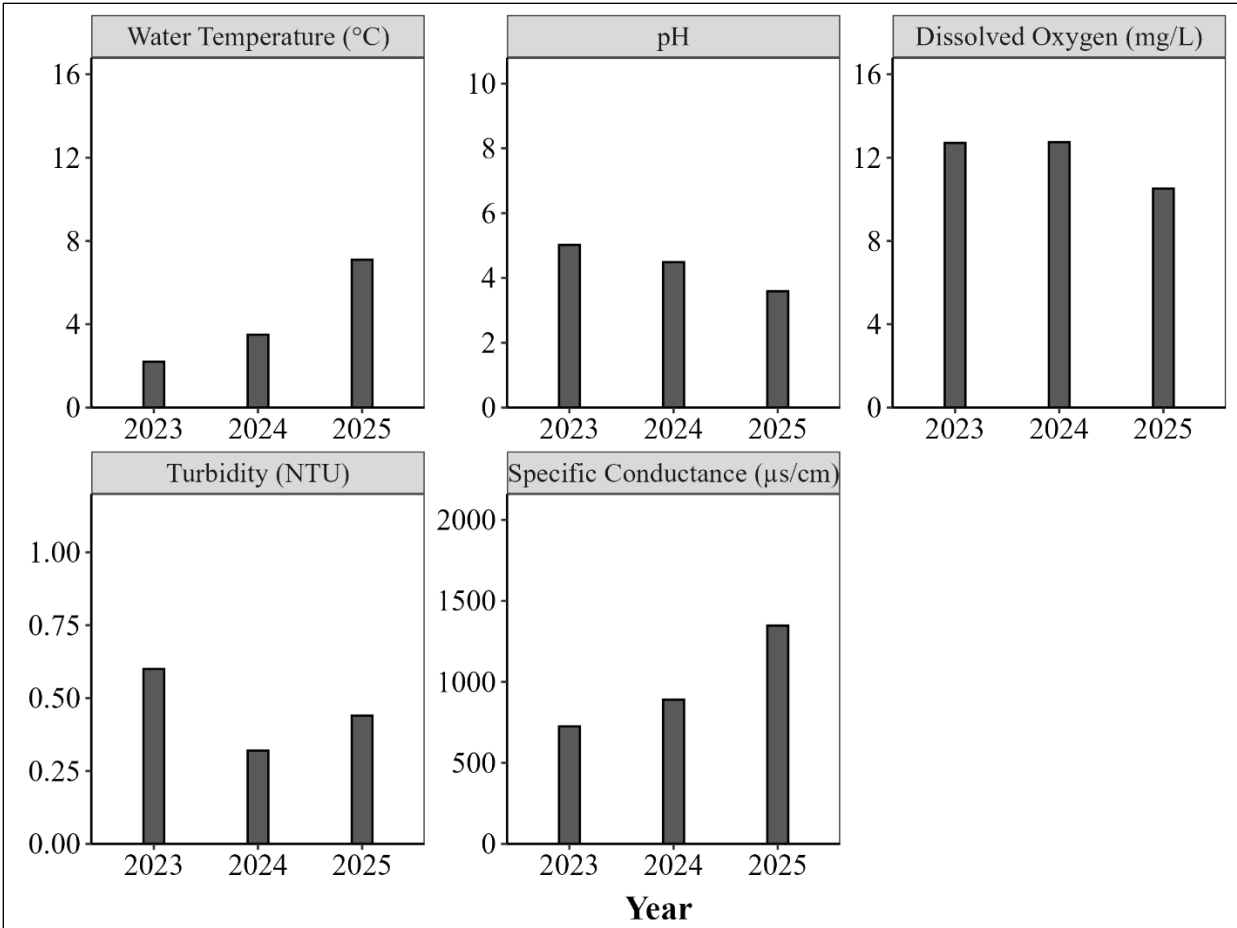


Figure 32.—In situ water quality at West Fork Ikalukrok Creek, 2023–2025.

Periphyton

Mean chlorophyll-a concentration in West Fork Ikalukrok Creek in 2025 was 0.12 mg/m^2 (SD = 0.03). Mean chlorophyll-a concentrations have ranged from a low of 0.04 mg/m^2 in 2018 to a high of 3.45 mg/m^2 in 2002 (Figure 33). The mean chlorophyll-a concentrations in West Fork Ikalukrok Creek from 2015–2025 were generally lower than those from 2000–2002 and have remained below 1 mg/m^2 since 2020 (Figure 33). Periphyton data from 2025 are presented in Appendix C.

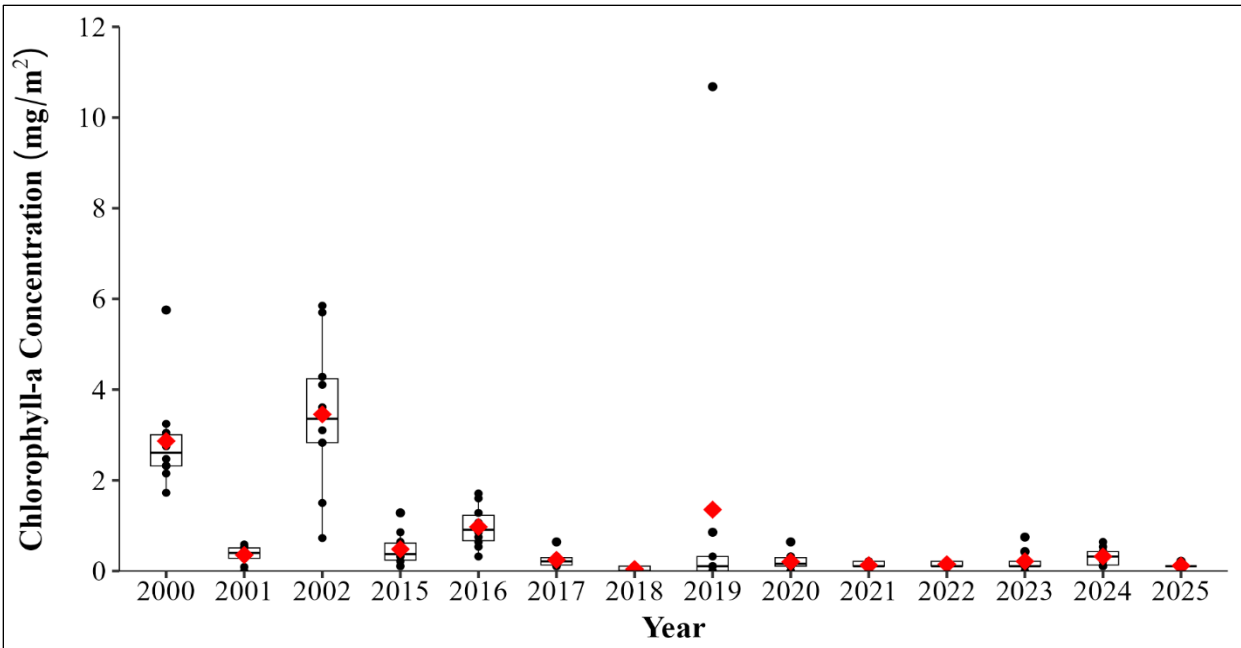


Figure 33.—Chlorophyll-a concentration boxplot at West Fork Ikalukrok Creek, 2000–2002 and 2015–2025. Raw data are depicted by black dots and mean values are depicted by red diamonds.

Benthic Macroinvertebrates

Mean BMI density in West Fork Ikalukrok Creek in 2025 was 70 BMI/m² (SD = 37; Figure 34). EPT taxa were not present in 2025 samples for the second year in a row but only the third time among all years of data (Figure 35). Diptera and “other” taxa made up 50% of the samples each. Taxa richness in 2025 was 6 taxa, which is similar to the previous 3 years (Figure 36). BMI data from 2025 are presented in Appendix D.

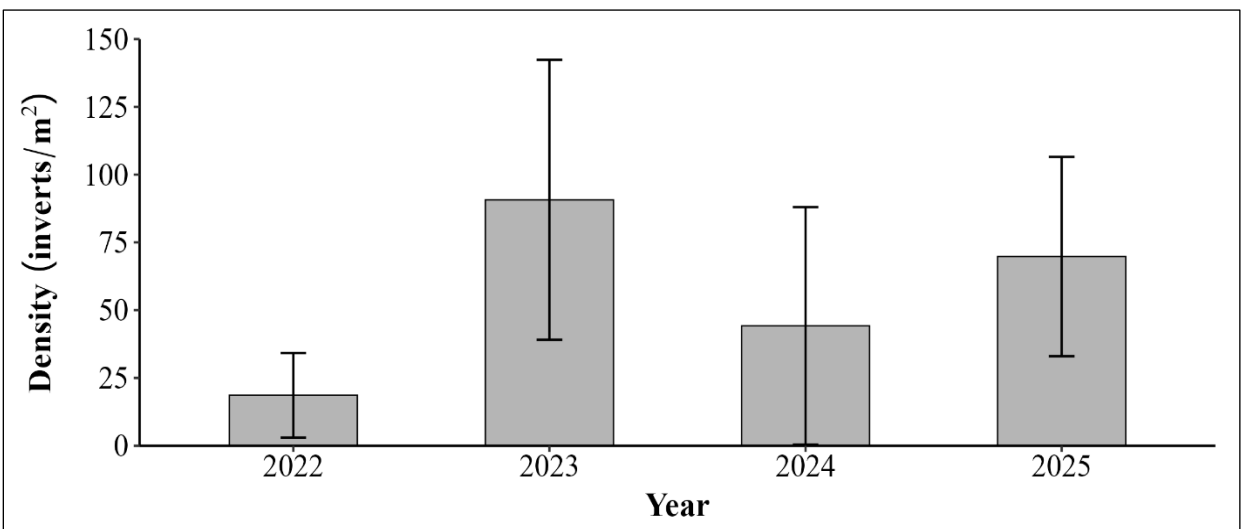


Figure 34.—Mean BMI density (± 1 SD) at West Fork Ikalukrok Creek, 2022–2025.

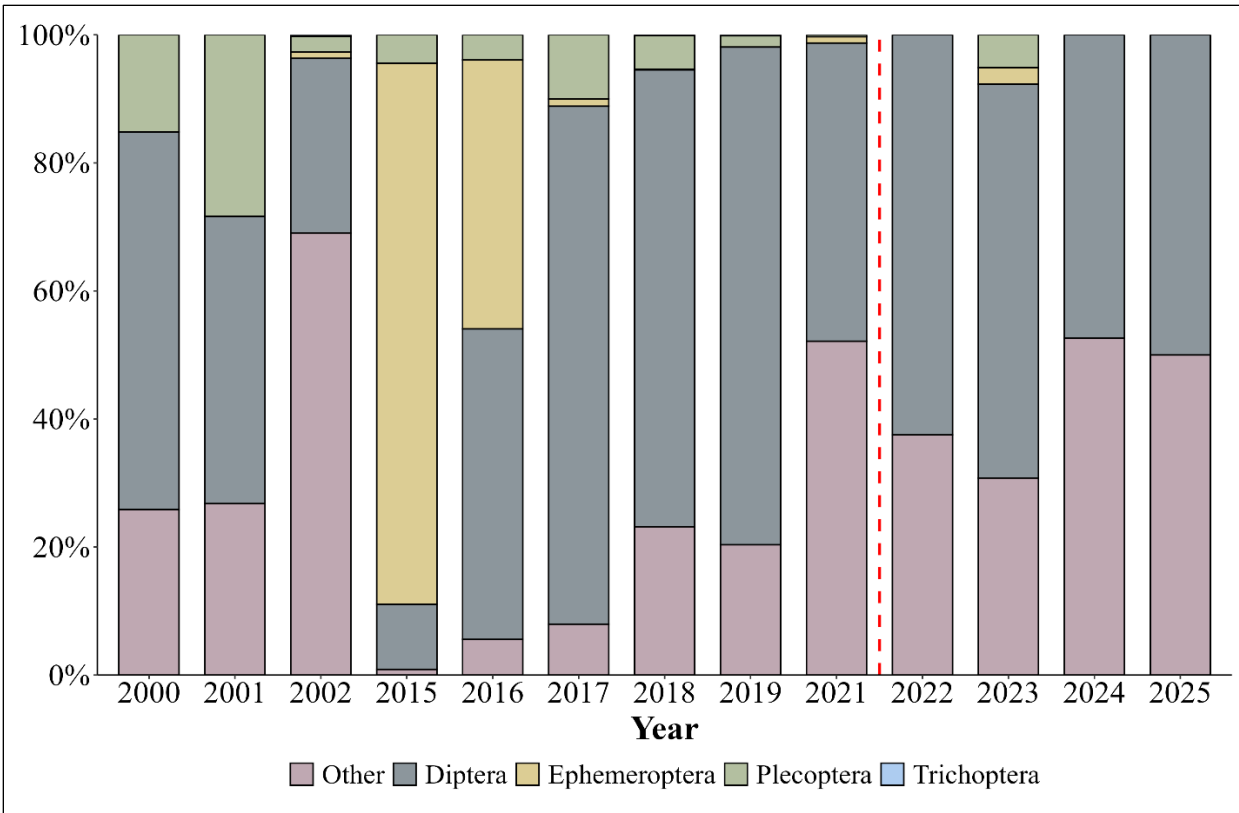


Figure 35.—Mean percent EPT, Diptera, and other taxa in West Fork Ikalukrok Creek aquatic invertebrate samples, 2000–2002 and 2015–2025. Sampling method was changed from drift nets to Hess samplers in 2022 as indicated by the red vertical dashed line.

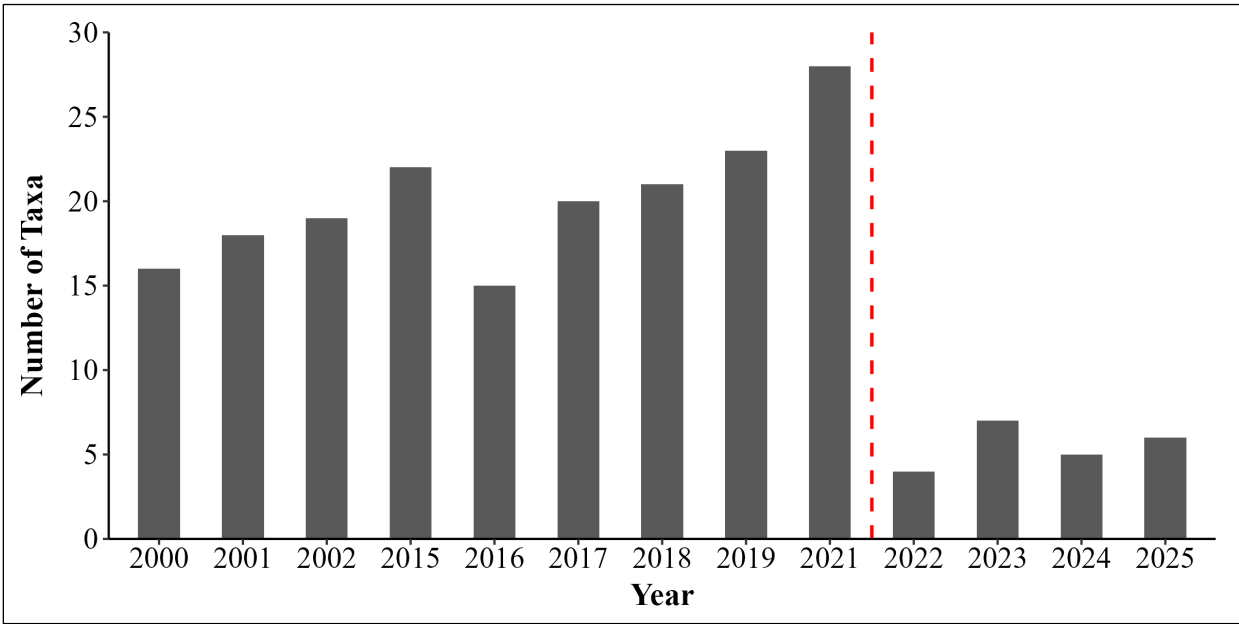


Figure 36.—Taxa richness in West Fork Ikalukrok Creek aquatic invertebrate samples, 2000–2002 and 2015–2025. Sampling method was changed from drift nets to Hess samplers in 2022 as indicated by the red vertical dashed line.

Fish

Fish have never been captured or observed in West Fork Ikalukrok Creek. Absence of fish may be due to degraded water quality downstream from various mineral seeps that create a chemical barrier precluding upstream movement of fish from downstream habitats.

IKALUKROK CREEK UPSTREAM OF WEST FORK IKALUKROK CREEK (STATION 206)

Water Quality

Ikalukrok Creek upstream of West Fork Ikalukrok Creek is a clearwater system with generally good water quality. In the early 2000s, concentrations of all elements in Ikalukrok Creek upstream of West Fork were substantially lower than in Ikalukrok Creek downstream of the Cub Creek seep (Station 207). From 2000–2002, the pH was near neutral and ranged from 6.5 to 8.1 (Weber-Scannell and Ott 2006). In July 2025, water temperature and specific conductance were higher than in 2024 while pH, dissolved oxygen, and turbidity were lower (Figure 37). In situ water quality data from 2025 are presented in Appendix B.

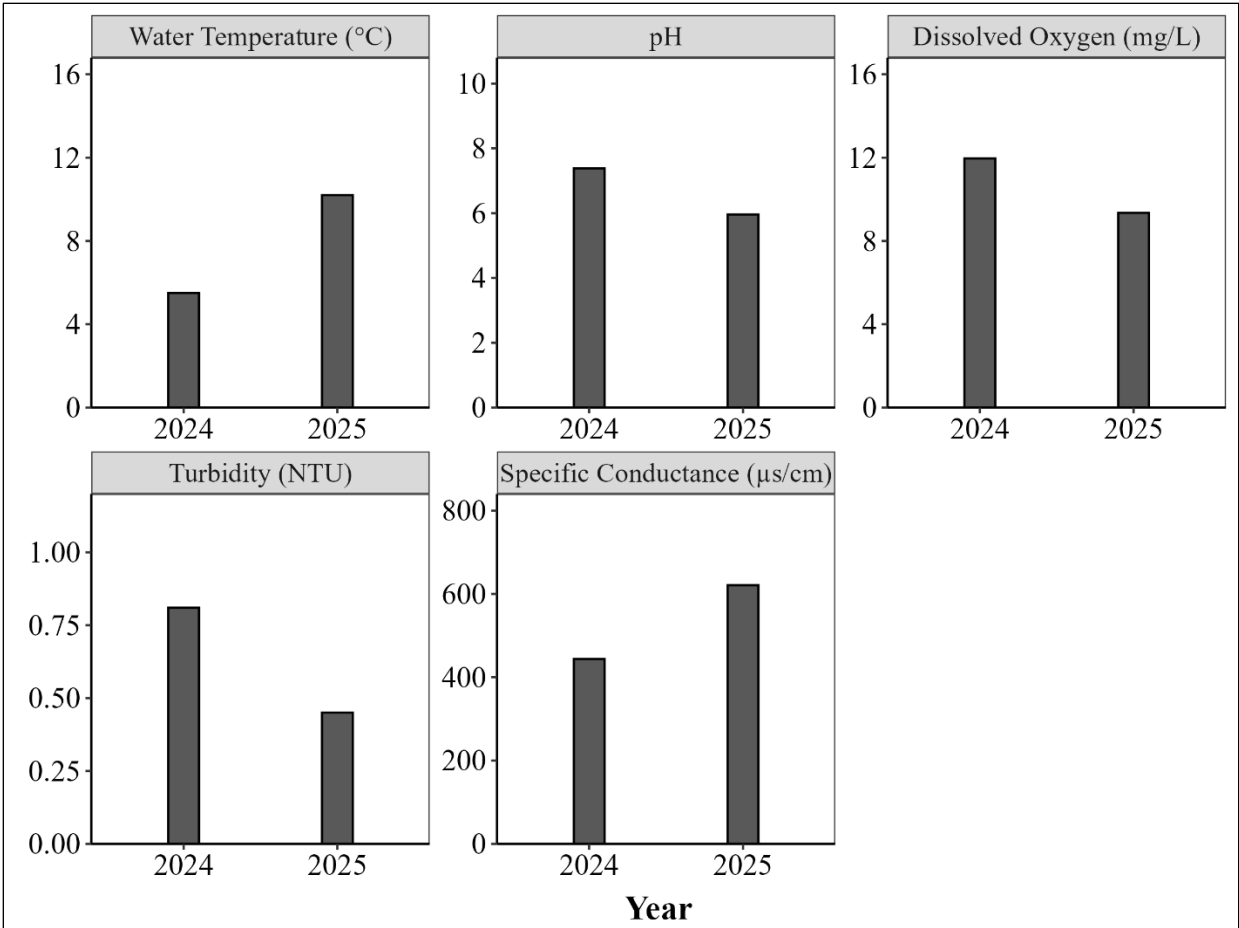


Figure 37.—In situ water quality at Ikalukrok Creek upstream of West Fork Ikalukrok Creek, 2024 and 2025.

Periphyton

Mean chlorophyll-a concentration in Ikalukrok Creek upstream of West Fork Ikalukrok in 2025 was 0.09 mg/m² (SD = 0.05), similar to the previous 6 years (Figure 38). Mean chlorophyll-a concentrations have ranged from 0.03 mg/m² in 2020 to 3.48 mg/m² in 2002 (Figure 38). Chlorophyll-a concentrations have remained notably low since 2019. Periphyton data from 2025 are presented in Appendix C.

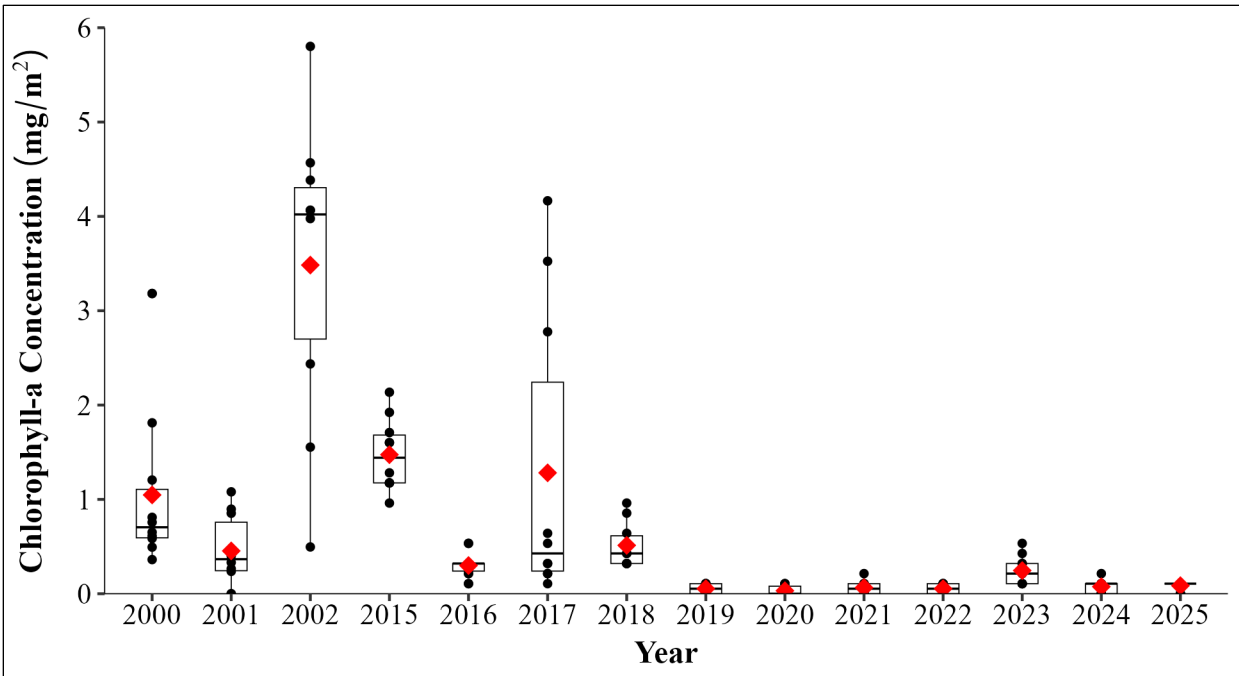


Figure 38.—Chlorophyll-a concentration boxplot by year at Ikalukrok Creek upstream of West Fork Ikalukrok Creek, 2000–2002 and 2015–2025. Raw data are depicted by black dots and mean values are depicted by red diamonds.

Benthic Macroinvertebrates

Mean BMI density in Ikalukrok Creek upstream of West Fork Ikalukrok Creek in 2025 was the highest on record at 647 BMI/m² (SD = 533; Figure 39). EPT taxa presence has been highly variable among years ranging from 3.1% in 2019 to 98% in 2016. For the sixth year in a row Diptera made up the majority of the samples in 2025 at 77.6% while EPT made up 17.3%, up from 7% in 2024 (Figure 40). Taxa richness in 2025 was 5 taxa, similar to 2022 and 2024 but less than half of 2023 (Figure 41). BMI data from 2025 are presented in Appendix D.

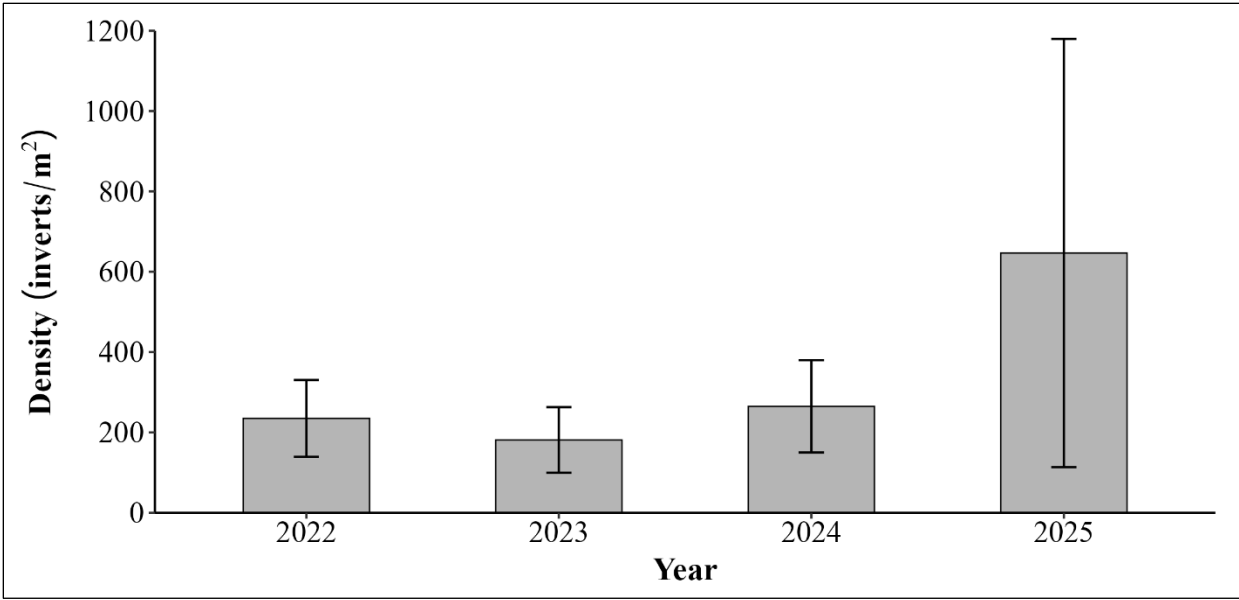


Figure 39.–Mean BMI density (± 1 SD) at Ikalukrok Creek upstream of West Fork Ikalukrok Creek, 2022–2025.

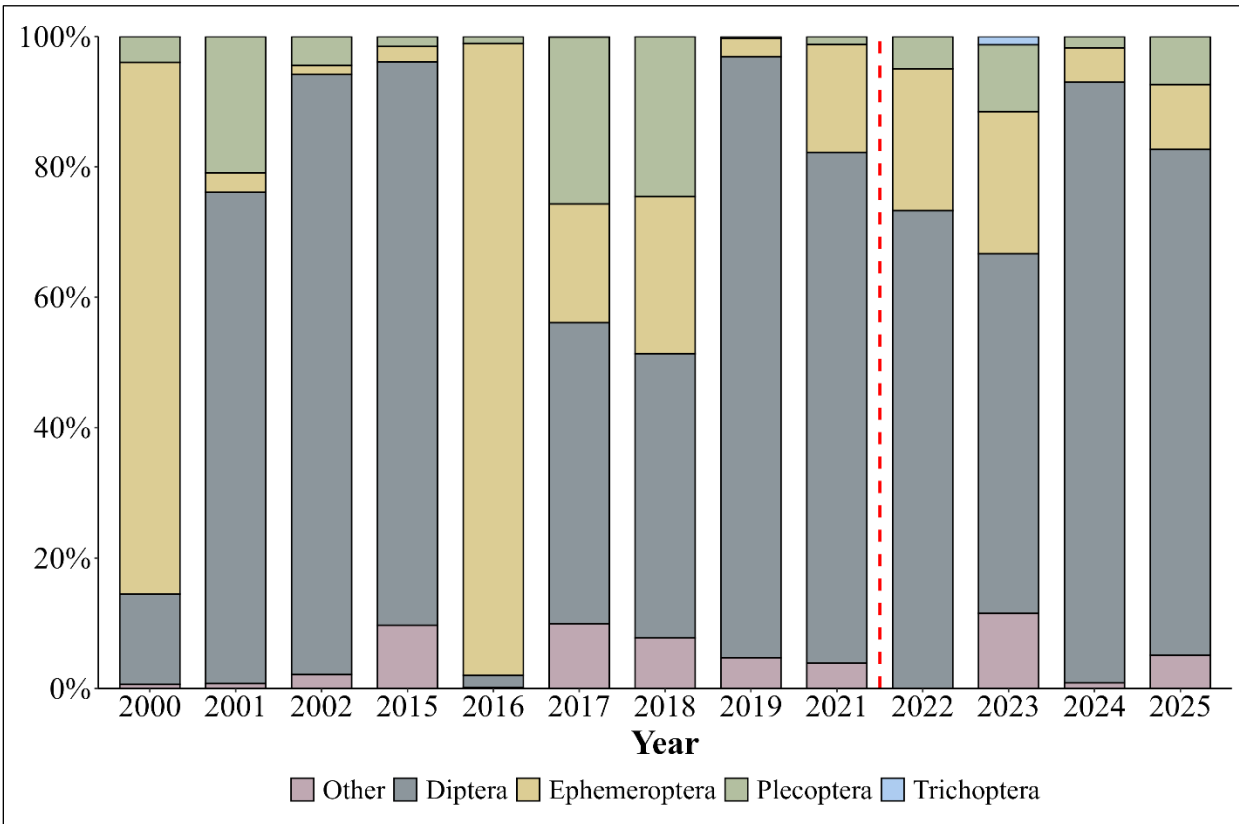


Figure 40.–Mean percent EPT, Diptera, and other taxa in Ikalukrok Creek upstream of West Fork Ikalukrok Creek aquatic invertebrate samples, 2000–2002 and 2015–2025. Sampling method was changed from drift nets to Hess samplers in 2022 as indicated by the red vertical dashed line.

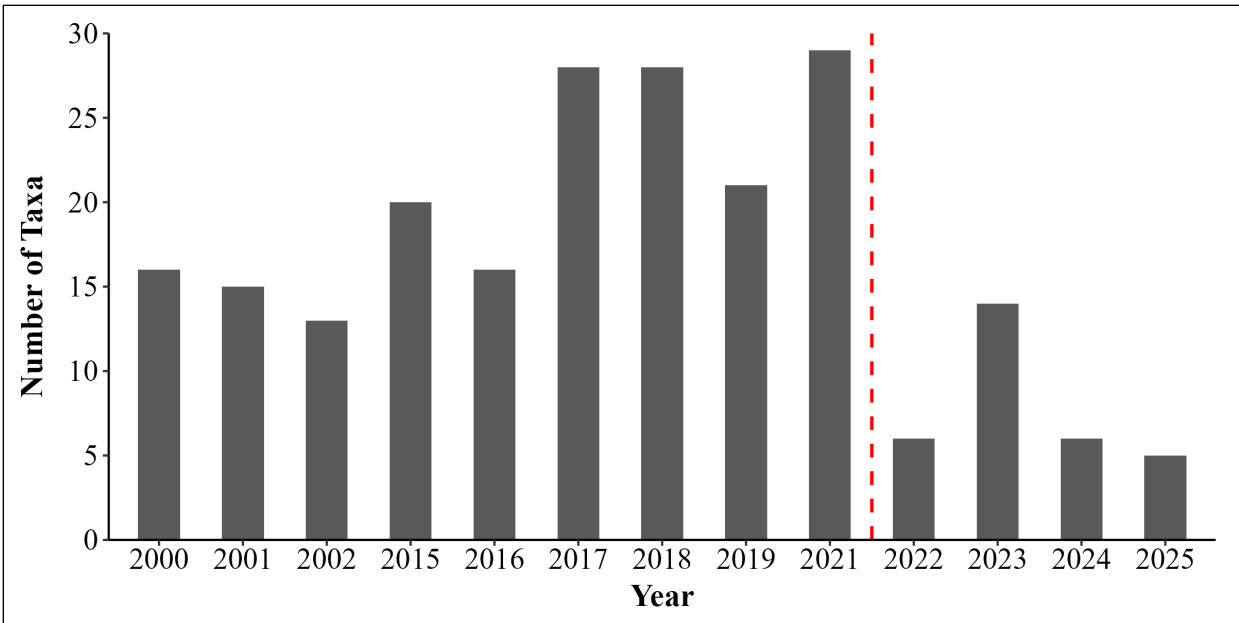


Figure 41.—Taxa richness in Ikalukrok Creek upstream of West Fork Ikalukrok Creek aquatic invertebrate samples, 2000–2002 and 2015–2025. Sampling method was changed from drift nets to Hess samplers in 2022 as indicated by the red vertical dashed line.

Fish

Fish have never been captured or observed in Ikalukrok Creek upstream of West Fork Ikalukrok Creek despite high quality fish habitat at the site. Absence of fish may be due to degraded water quality downstream from various mineral seeps that create a chemical barrier precluding upstream movement of fish from downstream habitats.

IKALUKROK CREEK DOWNSTREAM OF CUB CREEK (STATION 207)

Water Quality

Ikalukrok Creek downstream of Cub Creek is influenced by several metal rich seeps including the Cub Creek seep which has a very acidic pH. Specific element concentrations (aluminum, cadmium, copper, iron, nickel, lead, and zinc) in Ikalukrok Creek were high in the early 2000s and often exceeded the EPA chronic aquatic life criteria (Weber-Scannell and Ott 2006; EPA 2026). In 2025, concentrations of cadmium, lead, and zinc were generally lower than concentrations from 2000–2002, while nickel was higher, and aluminum was similar (Appendix A; Weber-Scannell and Ott 2006). In July 2025, water temperature, turbidity, and specific

conductance were higher than in 2024 while pH and dissolved oxygen were lower (Figure 42). In situ water quality data from 2025 are presented in Appendix B.

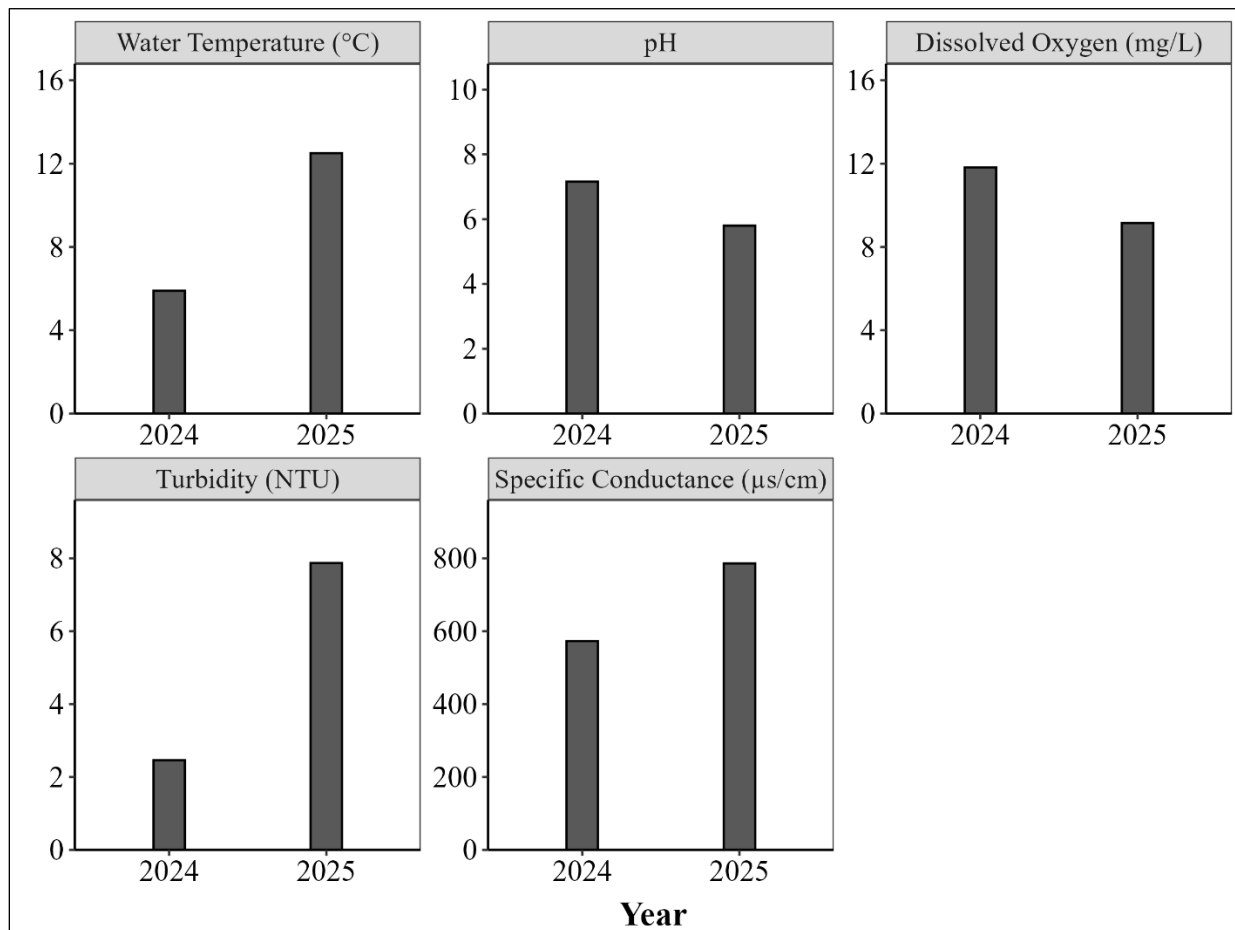


Figure 42.—In situ water quality at Ikalukrok Creek downstream of Cub Creek, 2024 and 2025.

Periphyton

Mean chlorophyll-a concentration in Ikalukrok Creek downstream of Cub Creek in 2025 was 0 mg/m² (SD = 0; detection limit = 0.08 mg/m²). Chlorophyll-a concentrations have been consistently low since sampling began. Mean chlorophyll-a concentration in 2021 was the highest on record at 0.11 mg/m² (Figure 43). From 2016–2025 only 16 individual data points out of 90 were above the annual minimum detection limit. Most of the samples collected from 1997–2002 were also below the annual minimum detection limit (Ott 1997). Periphyton data from 2025 are presented in Appendix C.

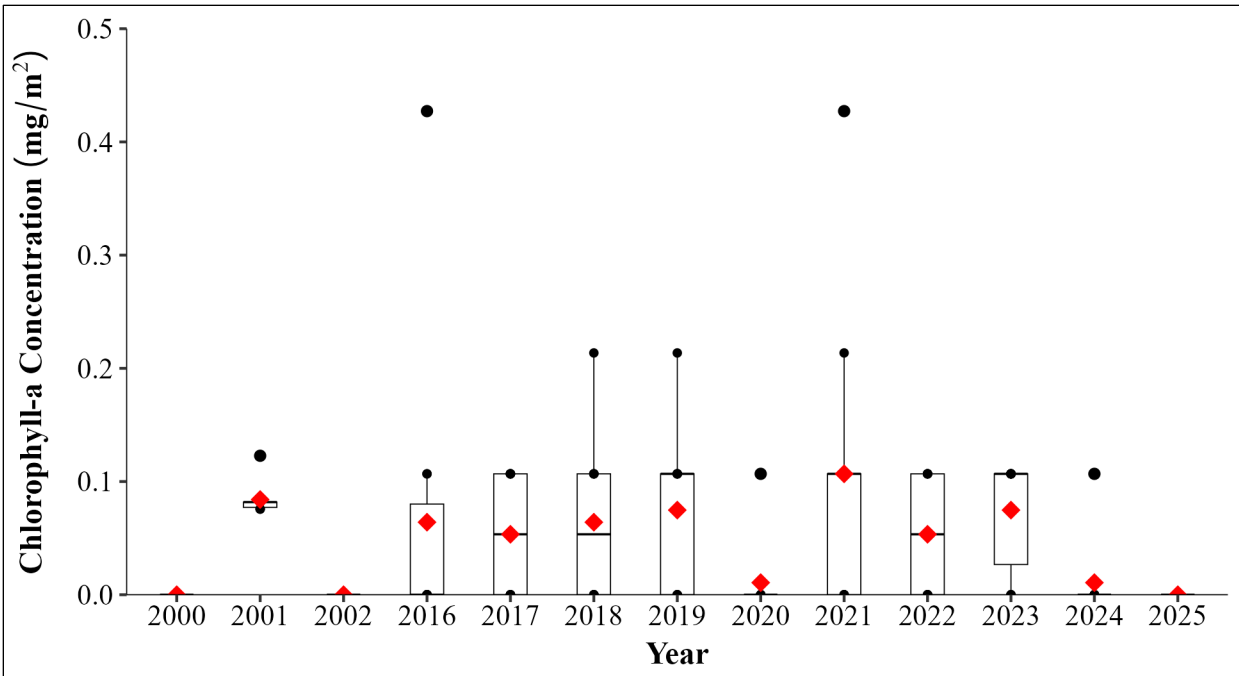


Figure 43.—Chlorophyll-a concentration boxplot at Ikalukrok Creek downstream of Cub Creek, 2000–2002 and 2016–2025. Raw data are depicted by black dots and mean values are depicted by red diamonds.

Benthic Macroinvertebrates

Mean BMI density in Ikalukrok Creek downstream of Cub Creek in 2025 was 781 BMI/m² (SD = 577), the highest on record (Figure 44). Sample composition has varied among years, with Diptera making up more than 50% of the samples in 7 out of 11 years of data, including every year since 2019 (Figure 45). EPT taxa made up 15.8% of the samples in 2025. Taxa richness in 2025 was the same as in 2024 at 7 taxa. Prior to 2022 when drift nets were used, taxa richness ranged from 15 to 29 taxa (Figure 46). BMI data from 2025 are presented in Appendix D.

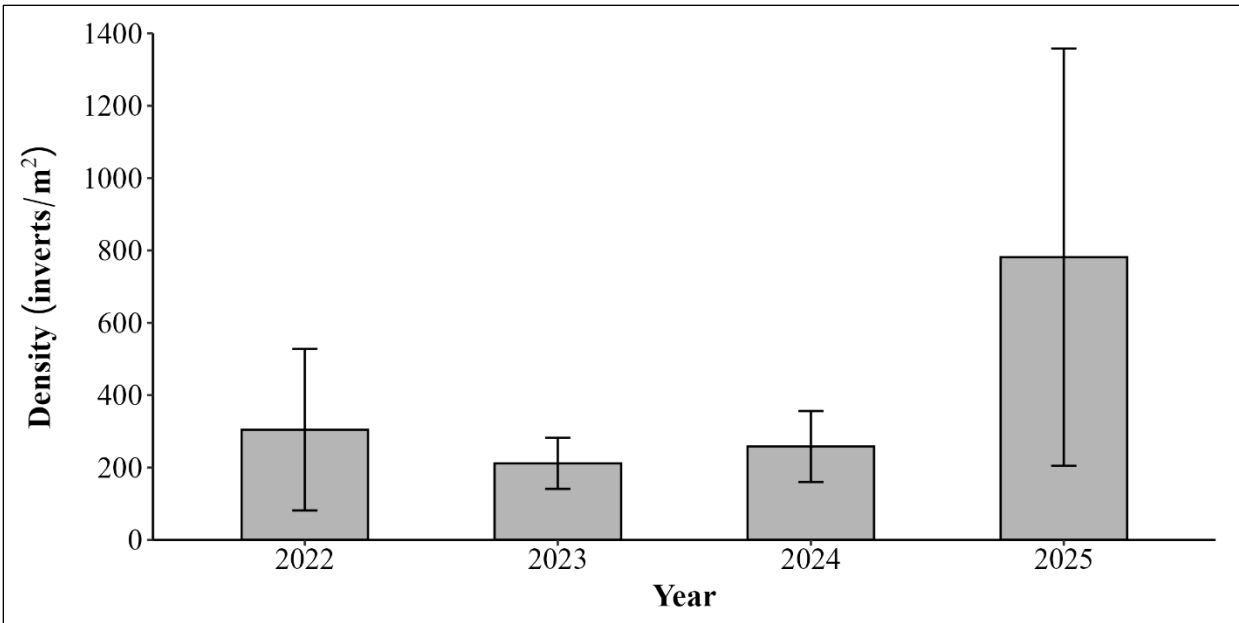


Figure 44.–Mean BMI density (± 1 SD) at Ikalukrok Creek downstream of Cub Creek, 2022–2025.

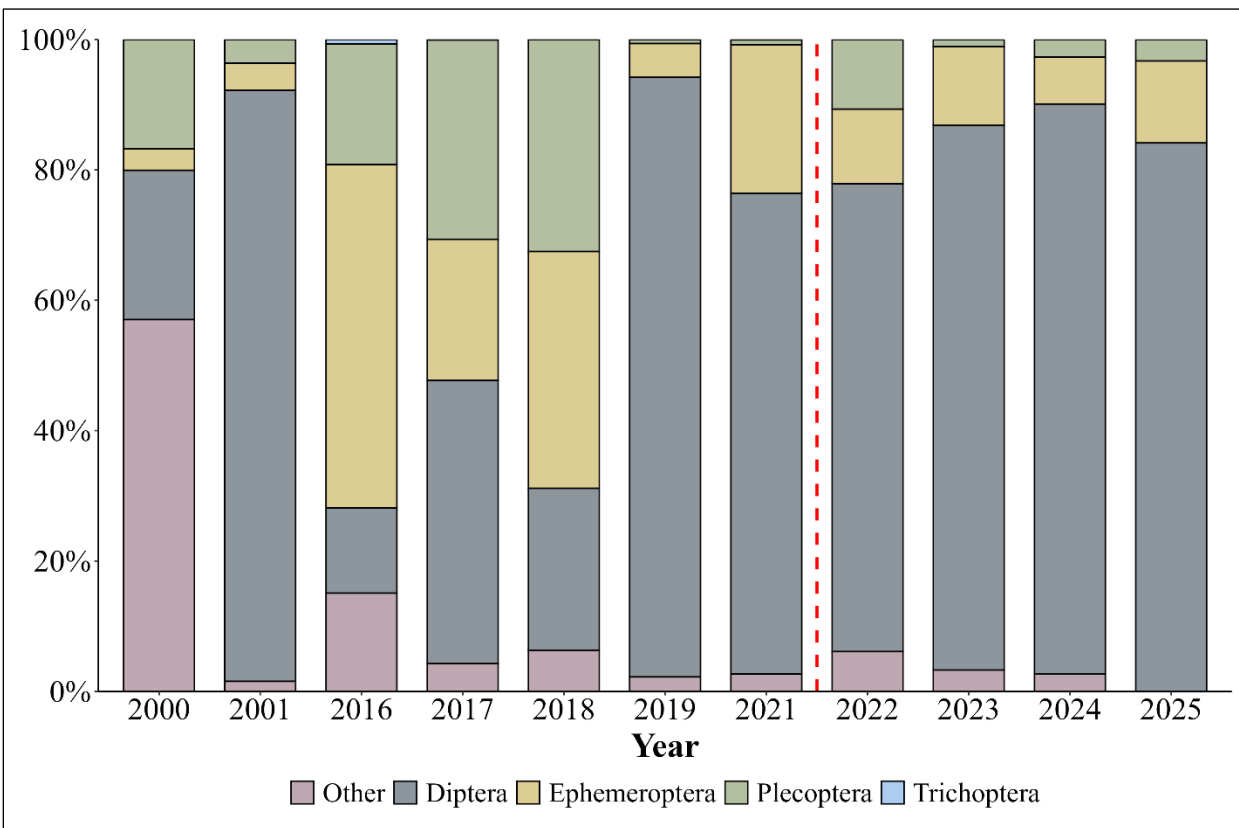


Figure 45.–Mean percent EPT, Diptera, and other taxa in Ikalukrok Creek downstream of Cub Creek aquatic invertebrate samples, 2000–2001 and 2016–2025. Sampling method was changed from drift nets to Hess samplers in 2022 as indicated by the red vertical dashed line.

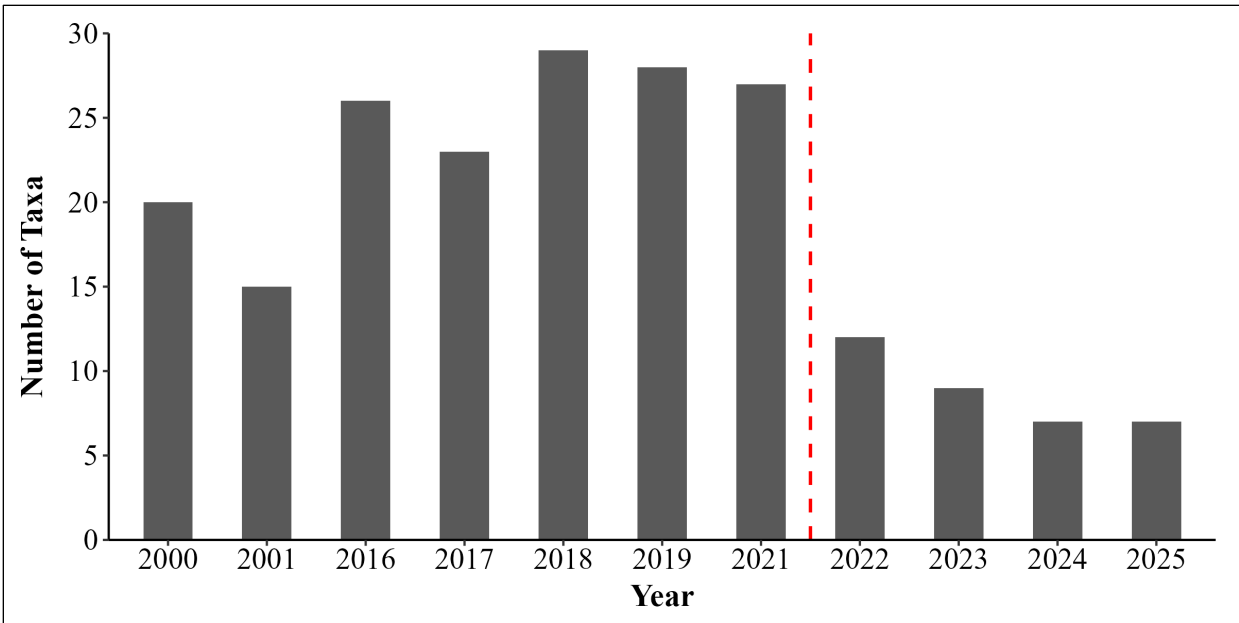


Figure 46.–Taxa richness in Ikalukrok Creek downstream of Cub Creek aquatic invertebrate samples, 2000–2001 and 2016–2025. Sampling method was changed from drift nets to Hess samplers in 2022 as indicated by the red vertical dashed line.

Fish

In 2000, one lethargic adult Arctic grayling was observed in Ikalukrok Creek near Station 207 (Weber-Scannell and Ott 2006). No fish were caught during minnow trapping in 2000, 2001, and 2002 and fish sampling has not been conducted since. Like West Fork Ikalukrok and Upper Ikalukrok creeks, mineral seeps downstream likely form a chemical barrier to fish passage precluding upstream movement of fish from downstream habitats.

EAST FORK IKALUKROK CREEK (STATION 208)

Water Quality

In the early 2000s, only one water sample exceeded the EPA aquatic life criteria for cadmium, lead, and zinc at East Fork Ikalukrok Creek (Weber-Scannell and Ott 2006). In 2025, East Fork Ikalukrok Creek had clear water with generally lower concentrations of aluminum, cadmium, nickel, and zinc compared to other sites where water sample element concentration data were collected (Appendix A). In July 2025, in situ water temperature and specific conductance were higher than in previous years while pH and dissolved oxygen were lower (Figure 47). Turbidity

was much lower in 2025 than in previous years. In situ water quality data from 2025 are presented in Appendix B.

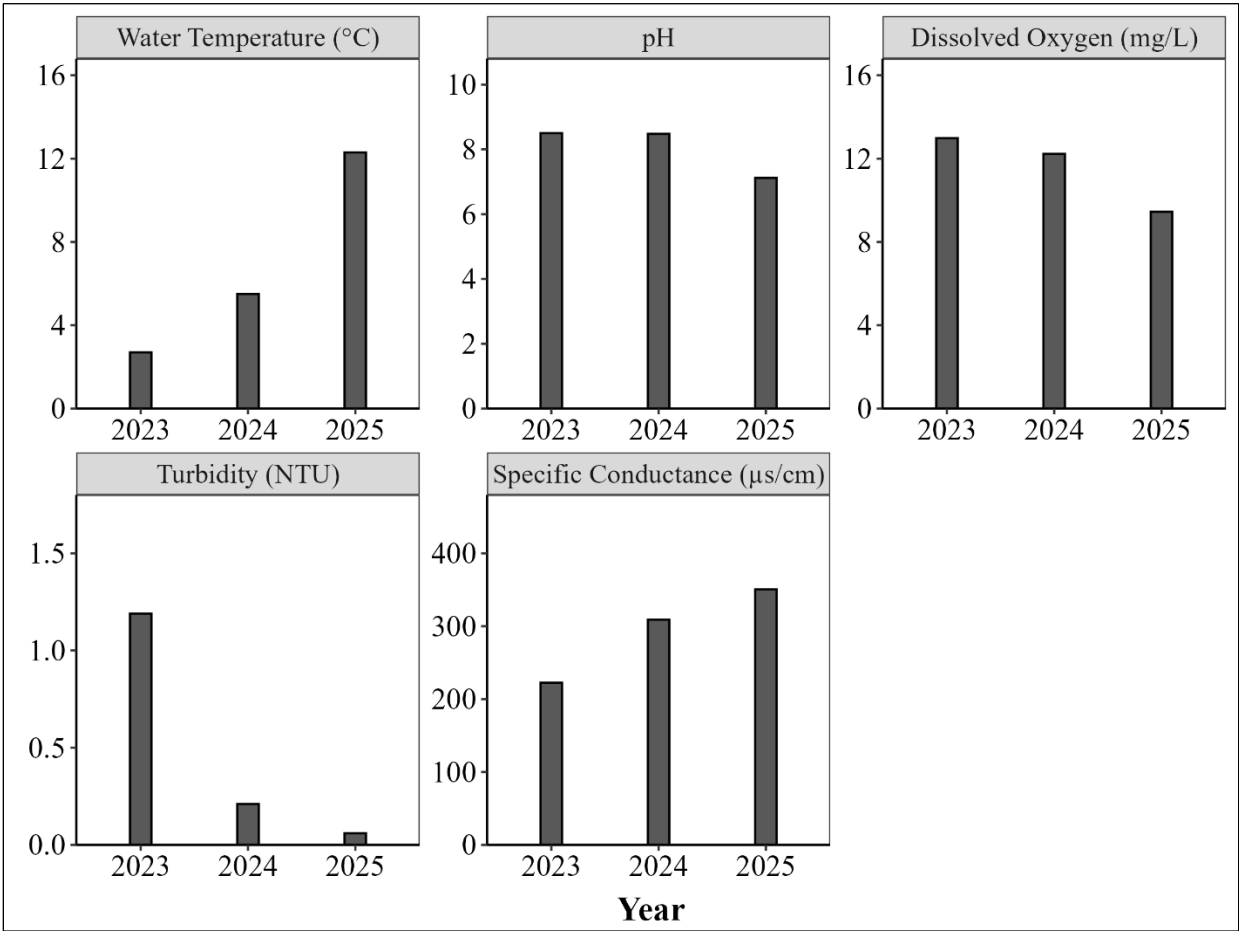


Figure 47.—In situ water quality at East Fork Ikalukrok Creek, 2023–2025.

Periphyton

Mean chlorophyll-a concentration in East Fork Ikalukrok Creek in 2025 was 1.51 mg/m² (SD = 0.45). East Fork Ikalukrok Creek is generally one of the more biologically productive sites in the upper Ikalukrok drainage, although chlorophyll-a concentrations have remained relatively low since 2016 compared to a high of 7.36 mg/m² in 2002 (Figure 48). Periphyton data from 2025 are presented in Appendix C.

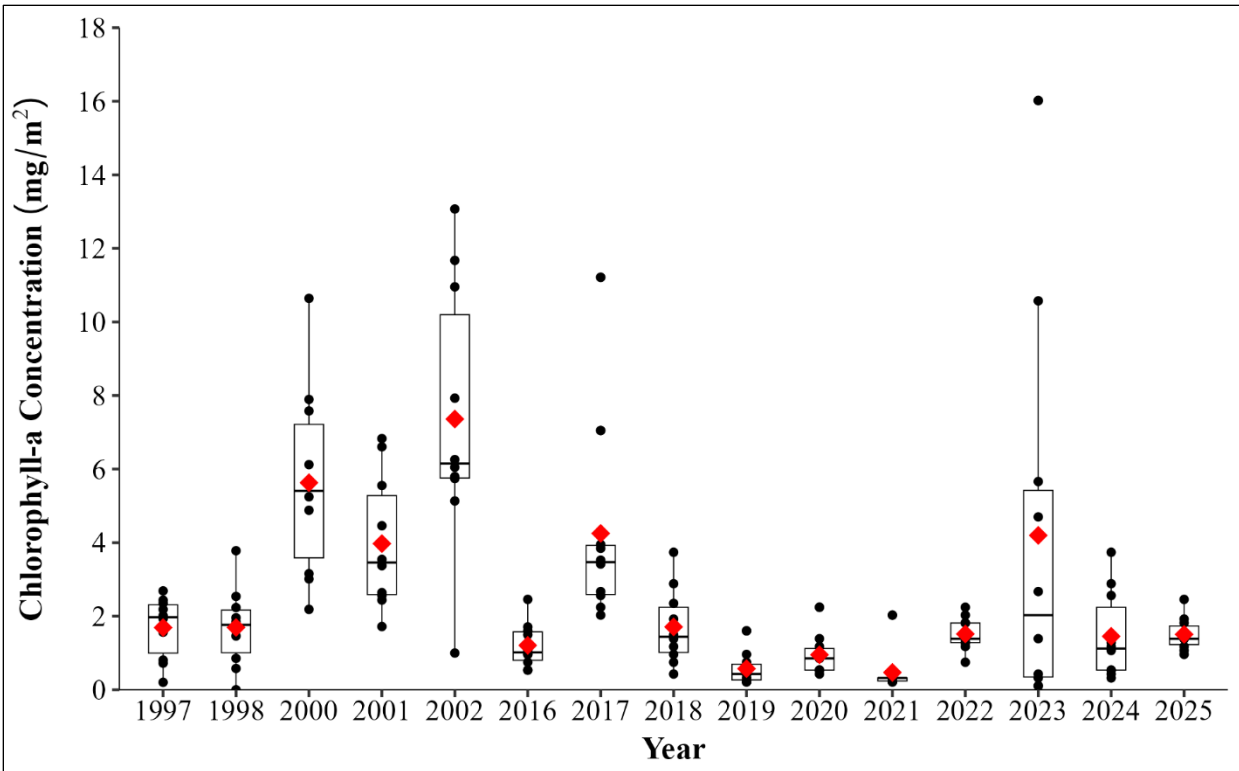


Figure 48.—Chlorophyll-a concentration boxplot by year at East Fork Ikalukrok Creek, 1997, 1998, 2000–2002, and 2016–2025. Raw data are depicted by black dots and mean values are depicted by red diamonds.

Benthic Macroinvertebrates

The mean BMI density in East Fork Ikalukrok Creek in 2025 was 7,354 BMI/m² (SD = 2,156) which is similar to previous years (Figure 49). Sample composition has varied among years, but Diptera have made up over 50% of the samples in 8 out of 12 years, including 2025 (Figure 50). EPT taxa made up 22.3% of the samples in 2025. Taxa richness in 2025 was 17 taxa and has ranged from 5 taxa in 2024 to 27 taxa in 2019 and 2021. Taxa richness in 2024 was notably low considering the next lowest richness observed is 15 taxa in 2000 and 2002 (Figure 51). BMI data from 2025 are presented in Appendix D.

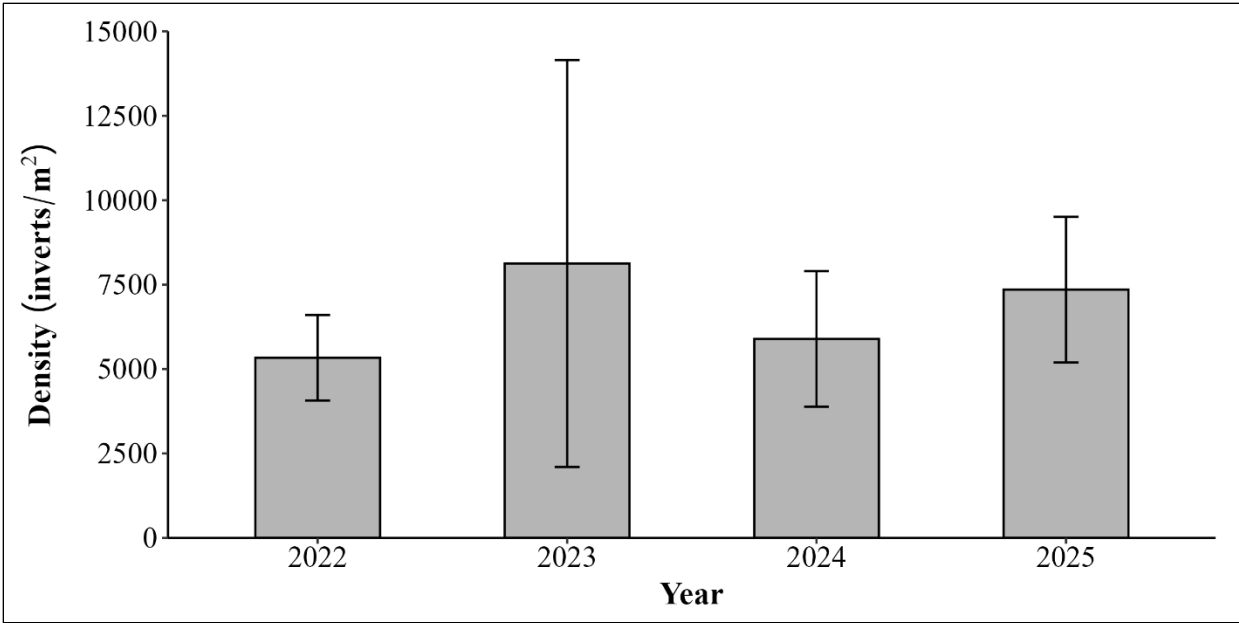


Figure 49.—Mean BMI density (± 1 SD) at East Fork Ikalukrok Creek, 2022–2025.

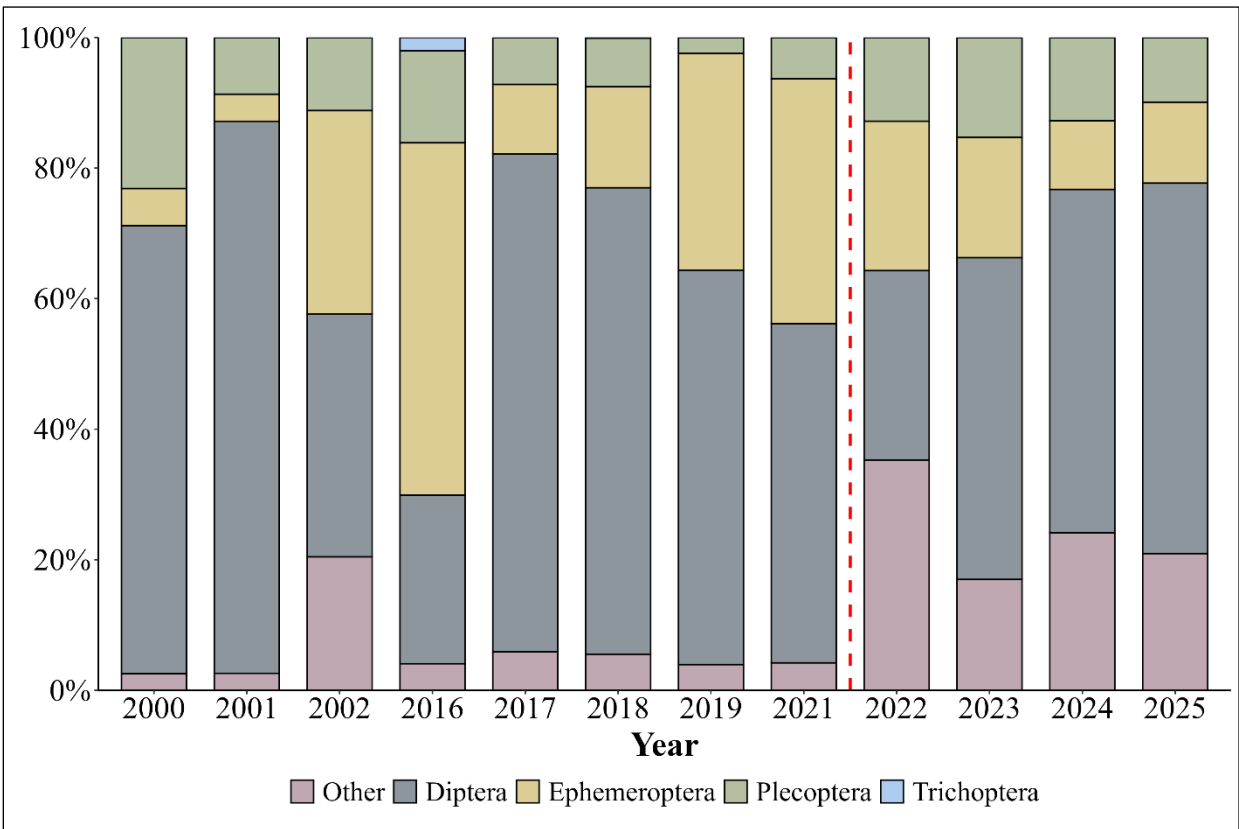


Figure 50.—Mean percent EPT, Diptera, and other taxa in East Fork Ikalukrok Creek aquatic invertebrate samples, 2000–2002 and 2016–2025. Sampling method was changed from drift nets to Hess samplers in 2022 as indicated by the red vertical dashed line.

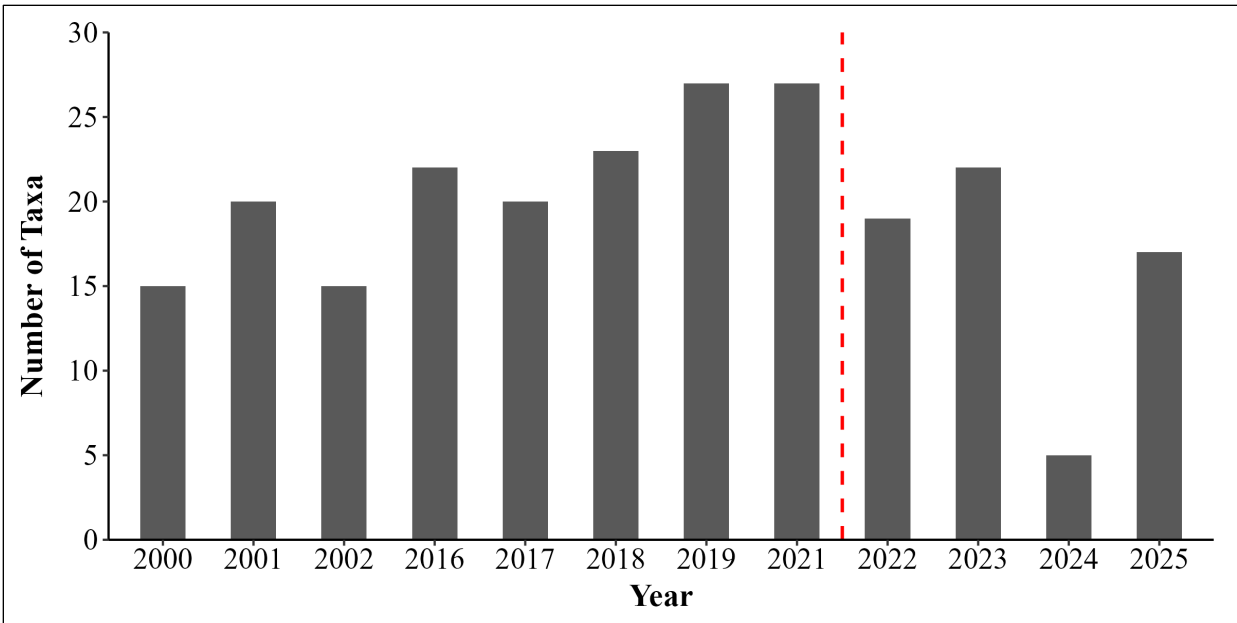


Figure 51.—Taxa richness in East Fork Ikalukrok Creek aquatic invertebrate samples, 2000–2002 and 2016–2025. Sampling method was changed from drift nets to Hess samplers in 2022 as indicated by the red vertical dashed line.

Fish

Dolly Varden CPUE in East Fork Ikalukrok Creek in 2025 was 2 fish. This is the first time fish have been captured at this site since 2019 (Figure 52). Multiple length classes are present in East Fork Ikalukrok Creek ranging from 54 to 82 mm among all years with a generally uniform distribution and mean of 115.2 mm (SD = 27.5; Figure 53). Two slimy sculpin were caught in 2016, and adult Arctic grayling were documented in the early 2000’s (Weber-Scannell and Ott 2006; Ott et al. 2019). Fish capture data from 2025 are presented in Appendix E.

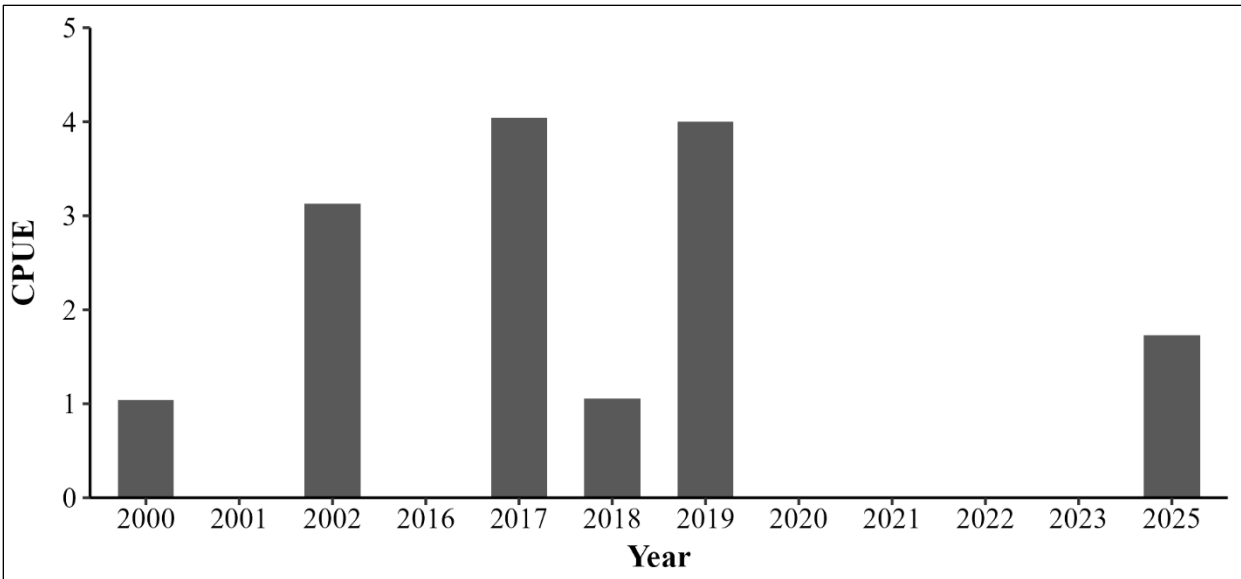


Figure 52.—Dolly Varden catch per unit effort (CPUE) captured in East Fork Ikalukrok Creek, 2000–2002 and 2016–2025.

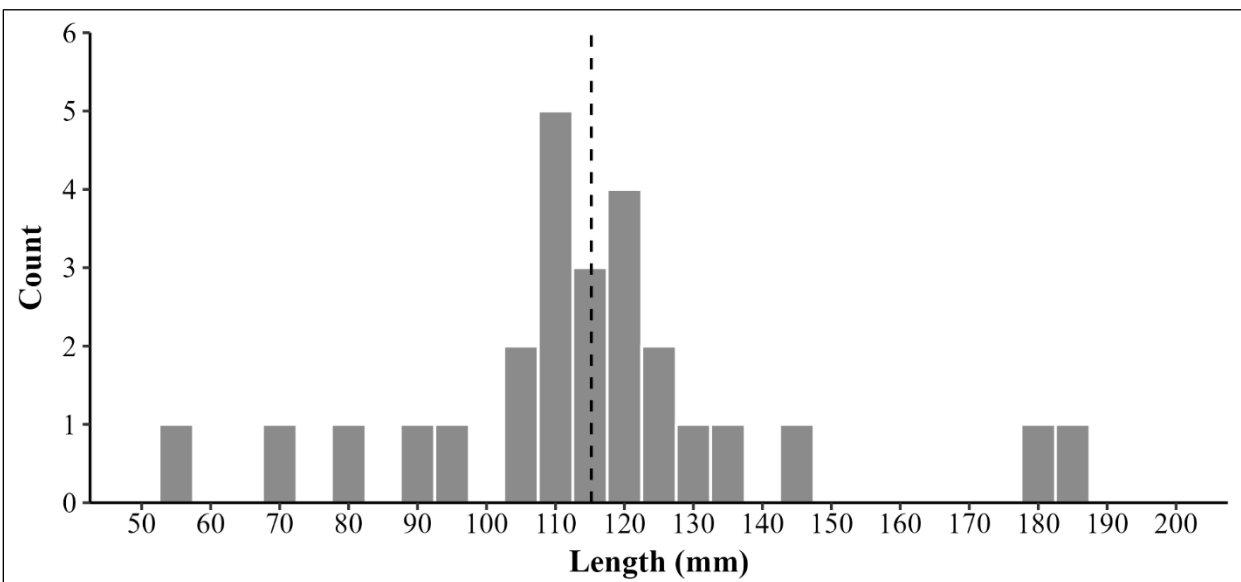


Figure 53.—Dolly Varden length frequency distribution captured in East Fork Ikalukrok Creek, 2000–2002 and 2016–2025. The vertical dashed line represents the sample mean length.

IKALUKROK CREEK UPSTREAM OF GRAYLING JUNIOR CREEK (RDMLE-02)

Water Quality

Ikalukrok Creek upstream of Grayling Junior Creek is somewhat turbid with orange staining on the substrate. This was the first year that in situ water quality was collected at Ikalukrok Creek

upstream of Grayling Junior Creek. In July 2025, in situ water temperature was 14.2°C, pH was 7.46, dissolved oxygen was 8.51 mg/L, turbidity was 4.88 NTU, and specific conductance was 514 $\mu\text{s}/\text{cm}$. In situ water quality data from 2025 are presented in Appendix B.

Periphyton

This was the first year that periphyton samples were collected at Ikalukrok Creek upstream of Grayling Junior Creek. Mean chlorophyll-a concentration was 0.04 mg/m^2 (SD = 0.06). Periphyton data from 2025 are presented in Appendix C.

Benthic Macroinvertebrates

This was the first year that BMI samples were collected at Ikalukrok Creek upstream of Grayling Junior Creek. The mean BMI density was 372 BMI/ m^2 (SD = 229). EPT taxa made up 27.5% while Diptera made up 70% of the samples. Taxa richness was 10 taxa. BMI data from 2025 are presented in Appendix D.

Fish

This was the first year that fish sampling took place at Ikalukrok Creek upstream of Grayling Junior Creek. Dolly Varden CPUE was 3 fish, and fork length ranged from 67 to 82 mm with a mean of 74.7 mm (SD = 7.5; n = 3). Fish capture data from 2025 are presented in Appendix E.

Sediment

Sediment element concentrations in Ikalukrok Creek upstream of Grayling Junior Creek and summary statistics from all 2025 sites are presented in Table 5. Copper, mercury, and selenium concentrations were below the 2025 mean concentrations while cadmium, lead, and zinc were above. Sediment data from 2025 are presented in Appendix F.

Table 5.—Sediment sample element concentrations (mg/kg) in Ikalukrok Creek upstream of Grayling Junior Creek in 2025 and summary statistics. Summary statistics were calculated with all sites (n = 8) sampled in July 2025. Due to non-detections, mercury summary statistics exclude two sites (n = 6).

Element	Ikalukrok u/s Grayling	All 2025 Sample Sites		
	2025	Mean	Minimum	Maximum
Cadmium	5.79	3.6	0.43	7.88
Copper	108	149.88	29.3	544
Lead	61.1	31.61	11.4	61.1
Mercury	0.088	0.15	0.06	0.498
Selenium	2.2	5.23	1.27	16.6
Zinc	1,420	1,170.88	134	4,070

GRAYLING JUNIOR CREEK (STATION 209)

Water Quality

Historically, Grayling Junior Creek has had good water quality with a generally neutral to slightly basic pH and only a small number of water samples from the early 2000s exceeded the EPA aquatic life criteria for aluminum and iron (Weber-Scannell and Ott 2006; EPA 2026). There is a metal rich seep in the headwaters that flows into East Fork Grayling Junior Creek and impacts water quality at the Grayling Junior Creek site. From 2019–2021, the seep influence was visible, creating turbid conditions at the sample site. However, water clarity has improved in recent years and all measured metal concentrations in 2025 were lower than those in 2024 (Yancy and Edwards 2025; Appendix A). In July 2025, in situ water temperature and specific conductance were higher than in previous years while dissolved oxygen and turbidity were lower; pH was similar to previous years (Figure 54). In situ water quality data from 2025 are presented in Appendix B.

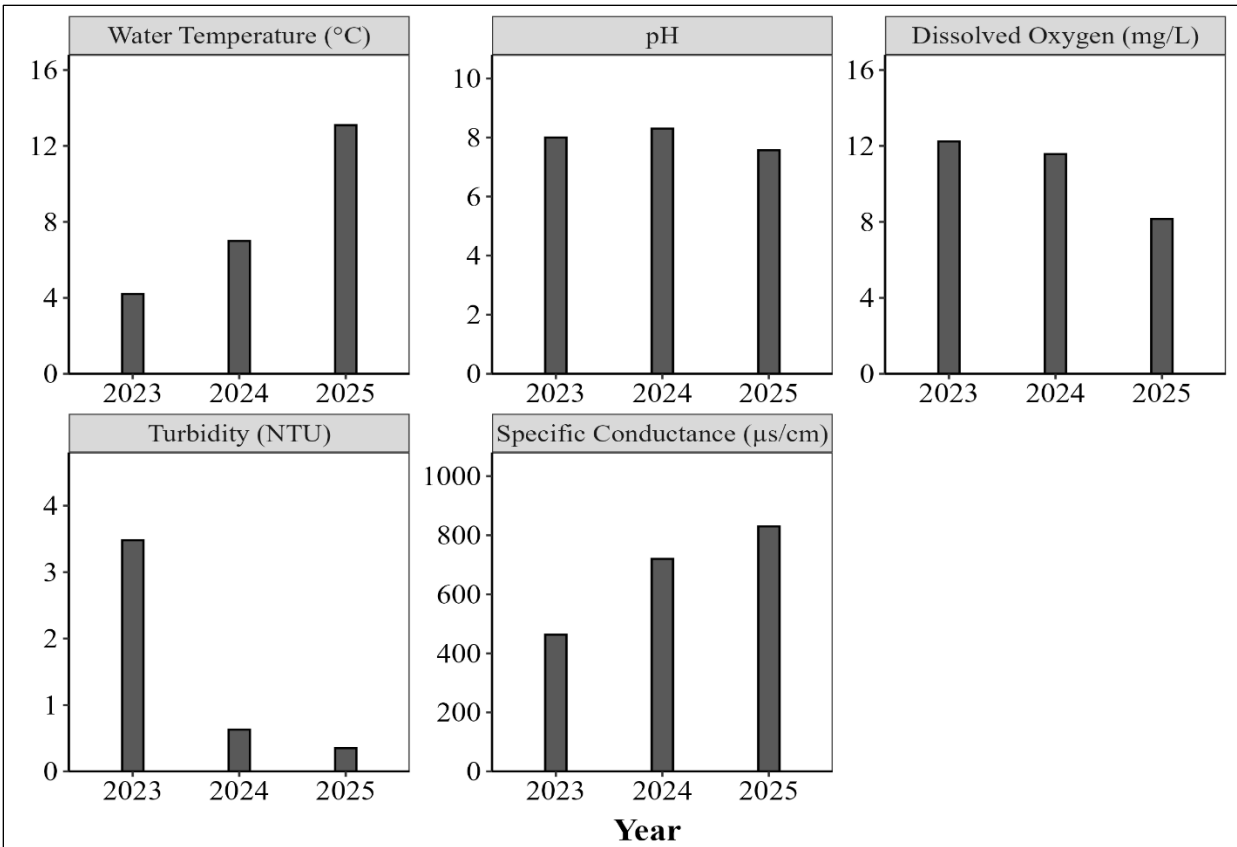


Figure 54.—In situ water quality at Grayling Junior Creek, 2023–2025.

Periphyton

Mean chlorophyll-a concentration in Grayling Junior Creek in 2025 was 0.62 mg/m^2 (SD = 0.48) which is the highest mean on record since 2018. Mean chlorophyll-a concentrations have ranged from a low of 0.02 mg/m^2 in 2020 to a high of 4.63 mg/m^2 in 2002 (Figure 55). Grayling Junior Creek is historically a productive site, although chlorophyll-a has decreased and remained relatively low since 2018. Periphyton data from 2025 are presented in Appendix C.

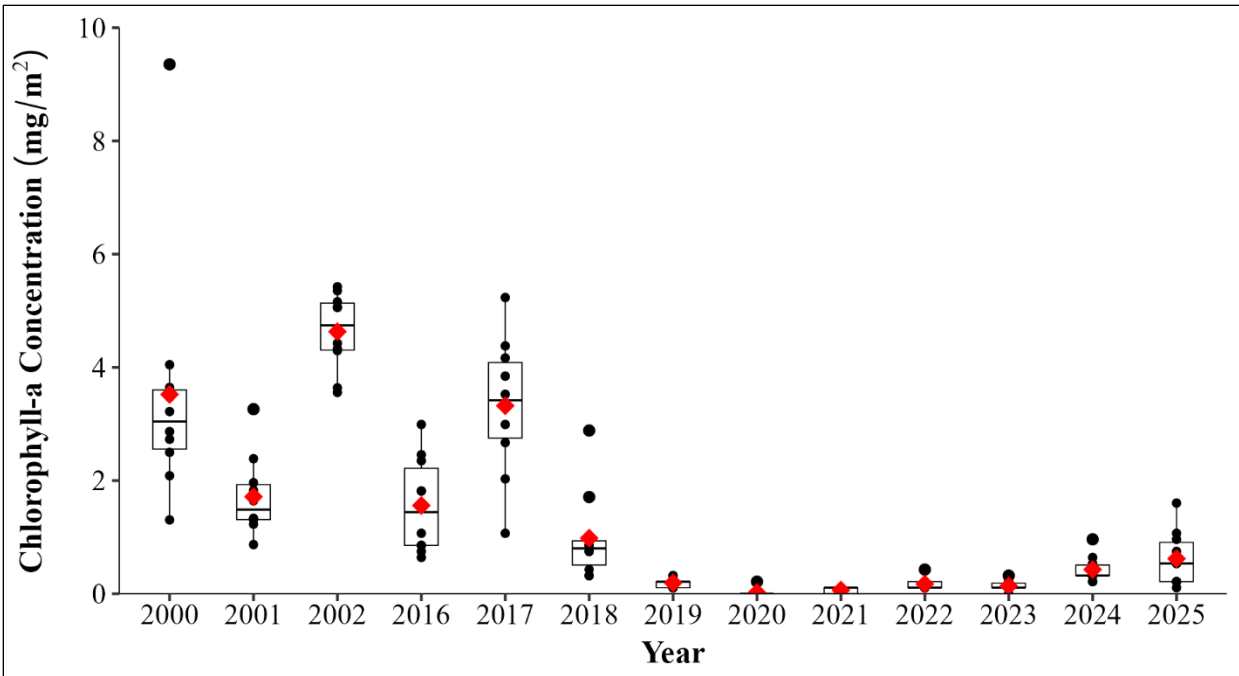


Figure 55.—Chlorophyll-a concentration boxplot by year at Grayling Junior Creek, 2000–2002 and 2016–2025. Raw data are depicted by black dots and mean values are depicted by red diamonds.

Benthic Macroinvertebrates

Mean BMI density in Grayling Junior Creek in 2025 was 421 BMI/m² (SD = 257), continuing an increasing trend since 2022 (Figure 56). Diptera made up 50% or more of the samples in all years and made up 69.6% of the samples in 2025 (Figure 57). EPT taxa made up 29.8% of the samples in 2025, approximately twice the proportion in 2024. Taxa richness in 2025 was 8 taxa, similar to the past three years when Hess samplers were used (Figure 58). BMI data from 2025 are presented in Appendix D.

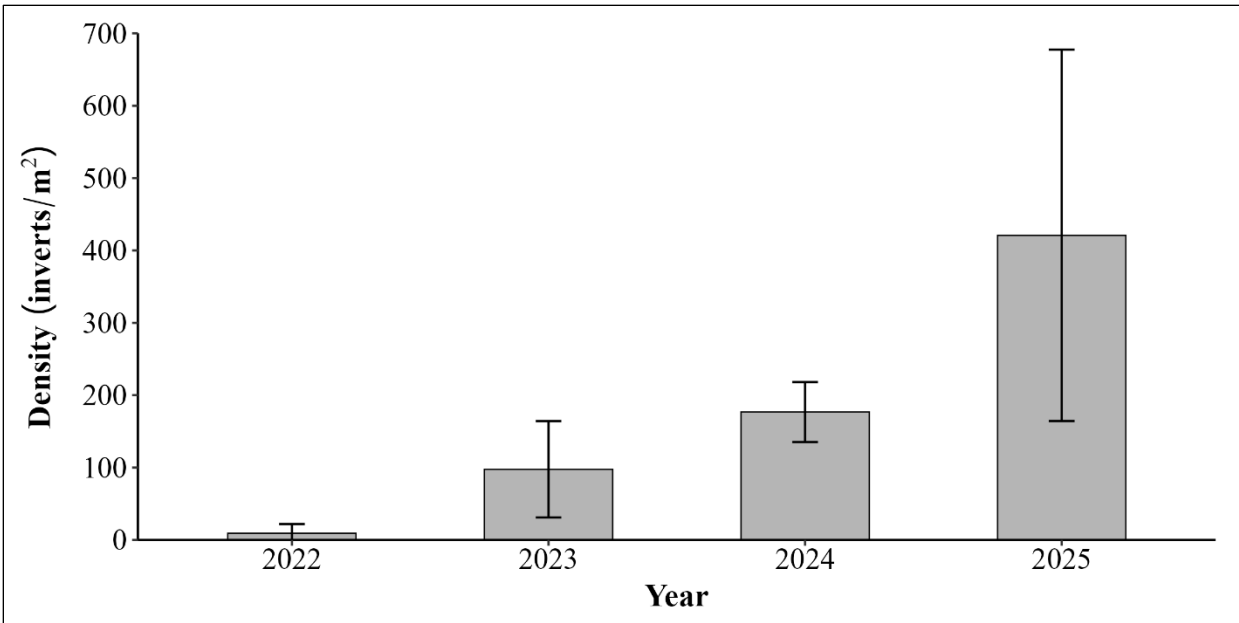


Figure 56.—Mean BMI density (± 1 SD) at Grayling Junior Creek, 2022–2025.

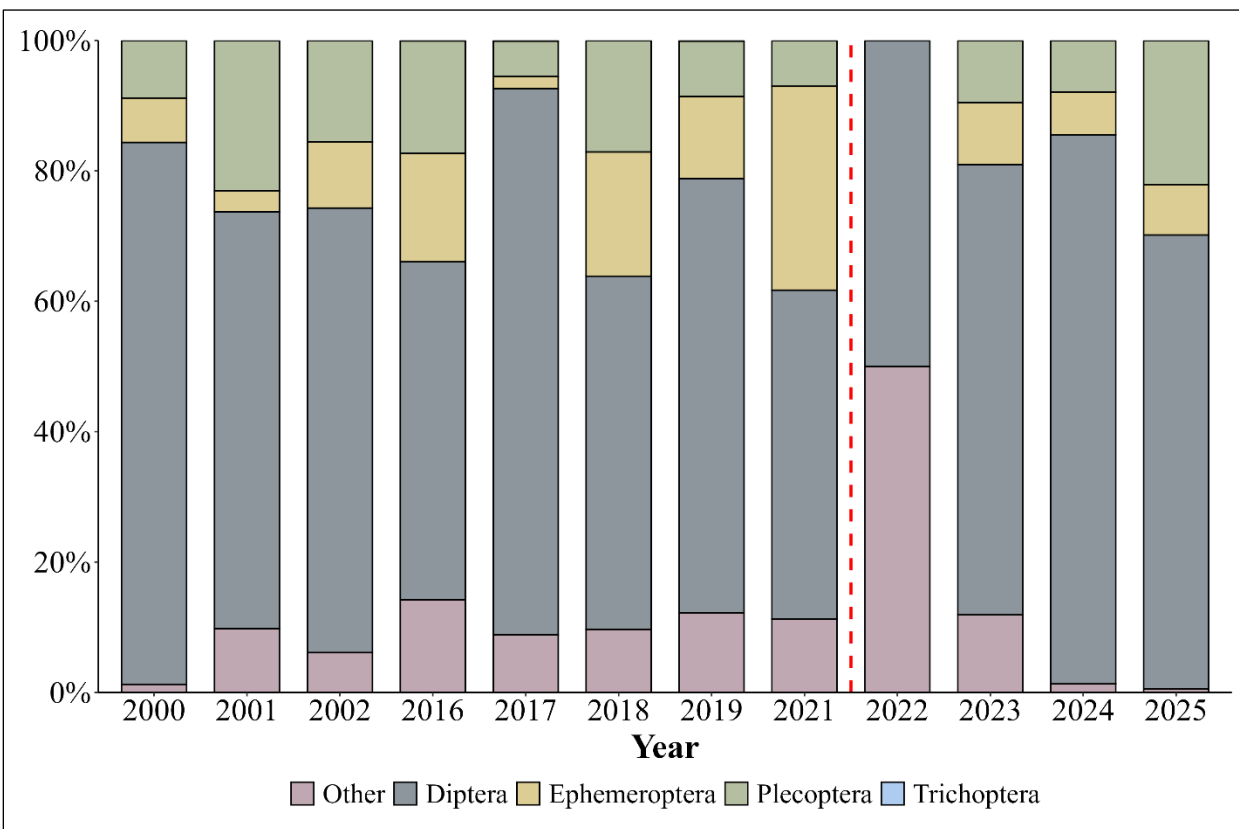


Figure 57.—Mean percent EPT, Diptera, and other taxa in Grayling Junior Creek aquatic invertebrate samples, 2000–2002 and 2016–2025. Sampling method was changed from drift nets to Hess samplers in 2022 as indicated by the red vertical dashed line.

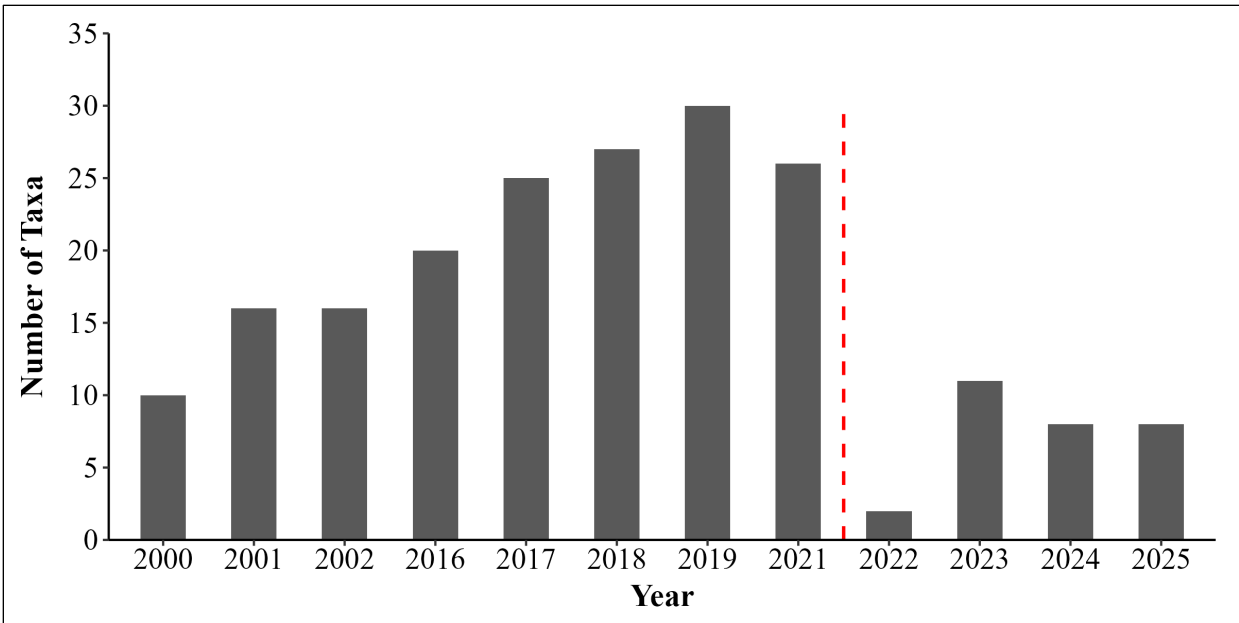


Figure 58.—Taxa richness in Grayling Junior Creek aquatic invertebrate samples, 2000–2002 and 2016–2025. Sampling method was changed from drift nets to Hess samplers in 2022 as indicated by the red vertical dashed line.

Fish

Dolly Varden CPUE in Grayling Junior Creek in 2025 was 9 fish. CPUE has ranged from 0 to 44 fish but has remained below 10 fish since 2016 (Figure 59). Multiple length classes are present in Grayling Junior Creek ranging from 63 to 151 mm among all years with a generally uniform distribution and mean of 94.8 mm (SD = 19; Figure 60). Slimy sculpin were captured in 2000 and 2017–2019 and Arctic grayling were captured in 2000. A large aggregation of adult Arctic grayling were observed at the mouth of Grayling Junior Creek in July 1999 (Ott et al. 2019). Fish capture data from 2025 are presented in Appendix E.

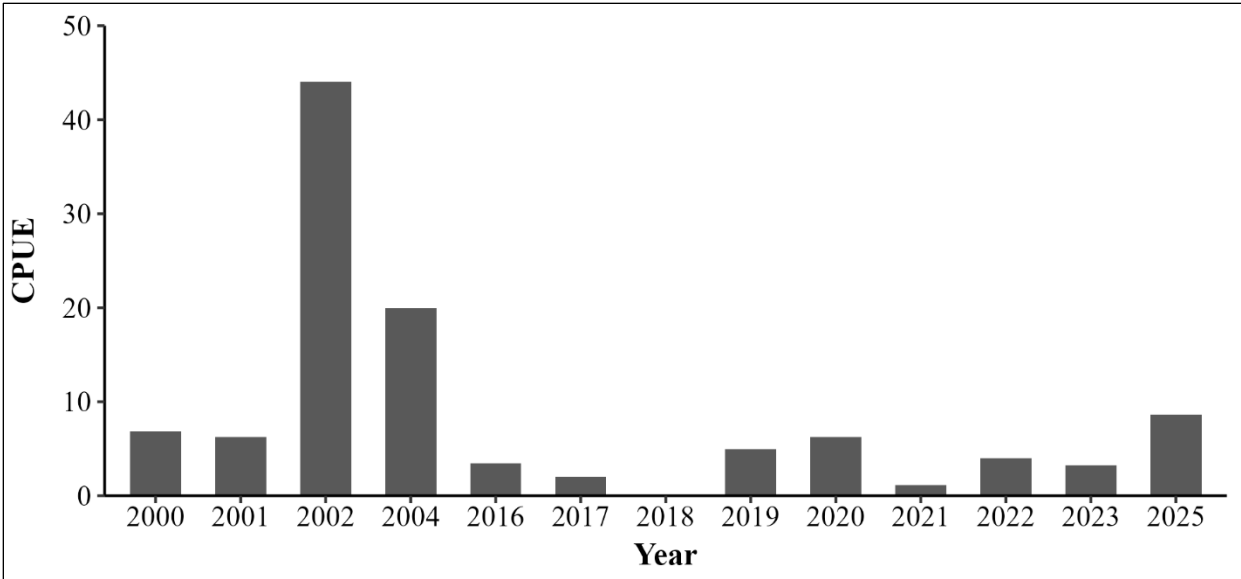


Figure 59.–Dolly Varden catch per unit effort (CPUE) captured in Grayling Junior Creek, 2000–2002, 2004, and 2016–2025.

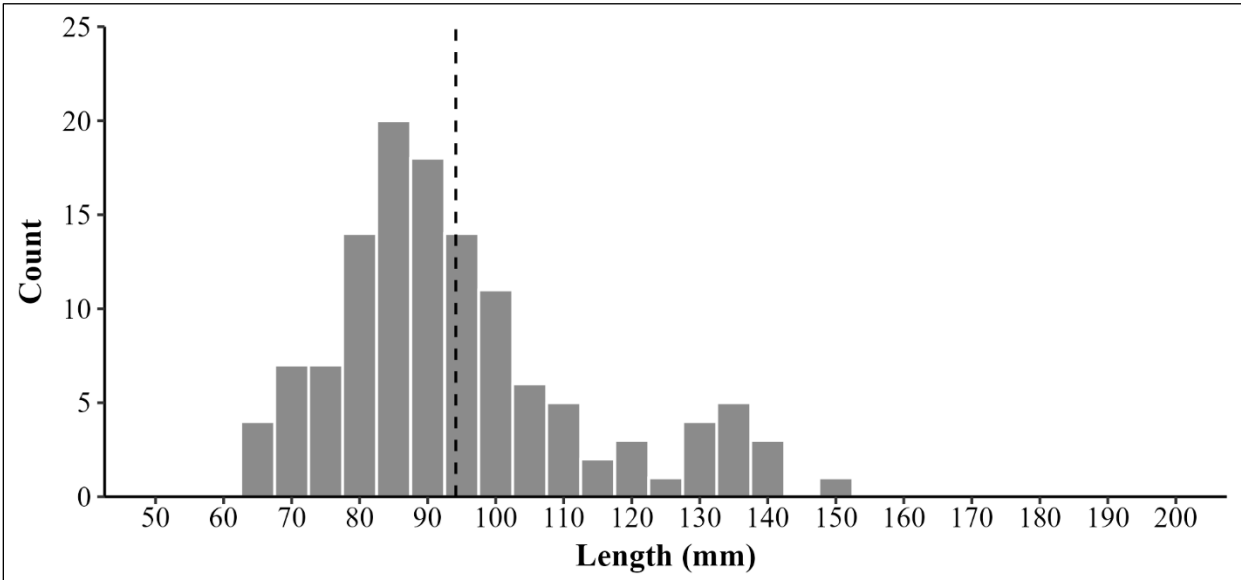


Figure 60.–Dolly Varden length frequency distribution for fish captured in Grayling Junior Creek, 2000–2002, 2004, and 2016–2025. The vertical dashed line represents the sample mean length.

NORTH FORK GRAYLING JUNIOR CREEK

Water Quality

No visual indicators suggest impaired water quality in North Fork Grayling Junior Creek. In July 2025, in situ water temperature was higher than in 2024 while dissolved oxygen was lower. pH,

turbidity, and specific conductance were similar to 2024 (Figure 61). In situ water quality data from 2025 are presented in Appendix B.

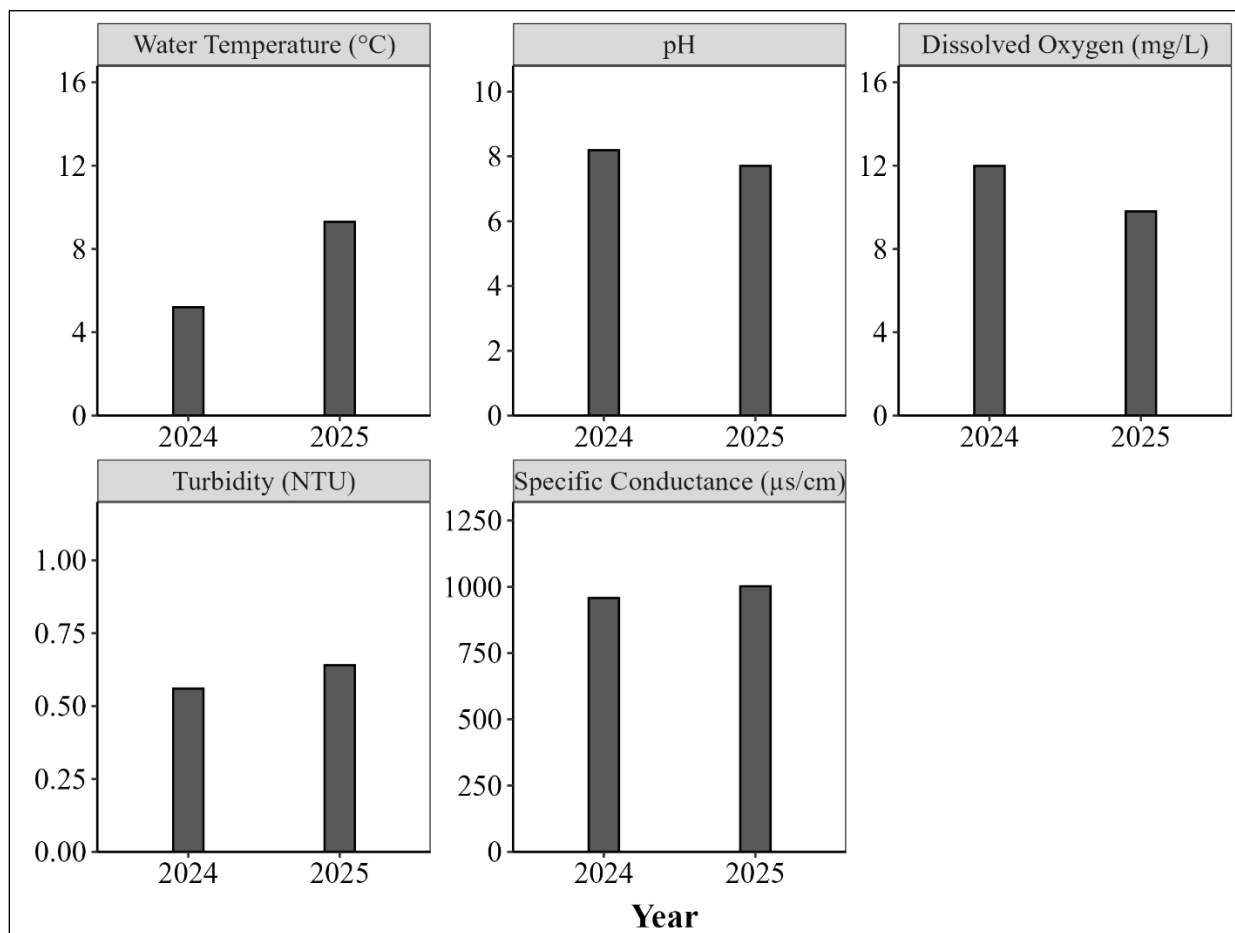


Figure 61.—In situ water quality at North Fork Grayling Junior Creek, 2024 and 2025. No sampling occurred at this site in 2023.

Periphyton

This was the second year that periphyton samples were collected at North Fork Grayling Junior Creek. Mean chlorophyll-a concentration in 2025 was 0.34 mg/m² (SD = 0.25) which is similar to 2024 (Figure 62). Chlorophyll-a concentrations ranged from 0.11 to 0.75 mg/m² among 2025 samples. Periphyton data from 2025 are presented in Appendix C.

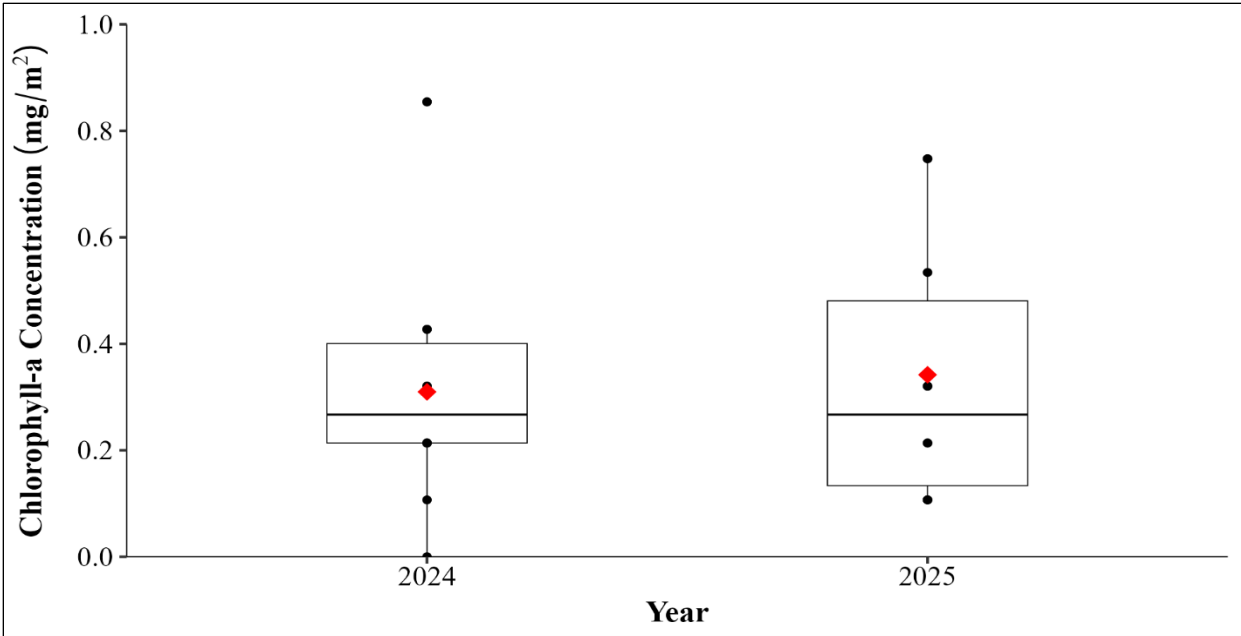


Figure 62.—Chlorophyll-a concentration boxplot by year at North Fork Grayling Junior Creek, 2024 and 2025. Raw data are depicted by black dots and mean values are depicted by red diamonds.

Benthic Macroinvertebrates

Mean BMI density in North Fork Grayling Junior Creek in 2025 was 144 BMI/m² (SD = 101), very similar to 2024 (Figure 63). Diptera made up the majority of the samples in 2025 at 74.2%. EPT taxa made up 16.1% of the samples, well above the proportion in 2024 (Figure 64). Taxa richness in 2025 was 5 taxa, down from 8 taxa in 2024 (Figure 65). BMI data from 2025 are presented in Appendix D.

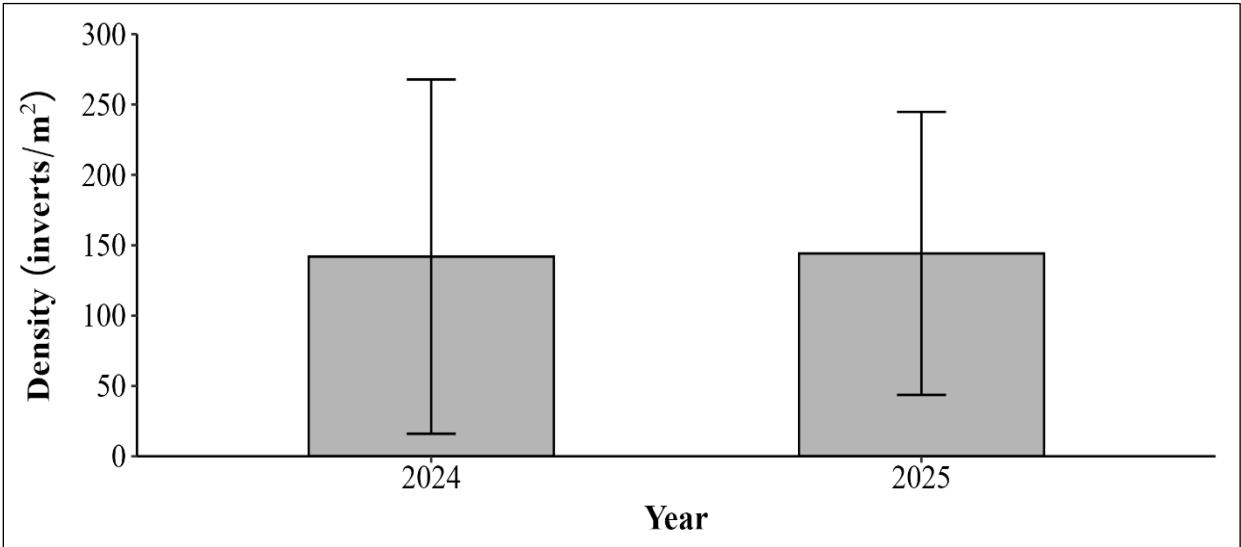


Figure 63.—Mean BMI density (± 1 SD) at North Fork Grayling Junior Creek, 2024 and 2025.

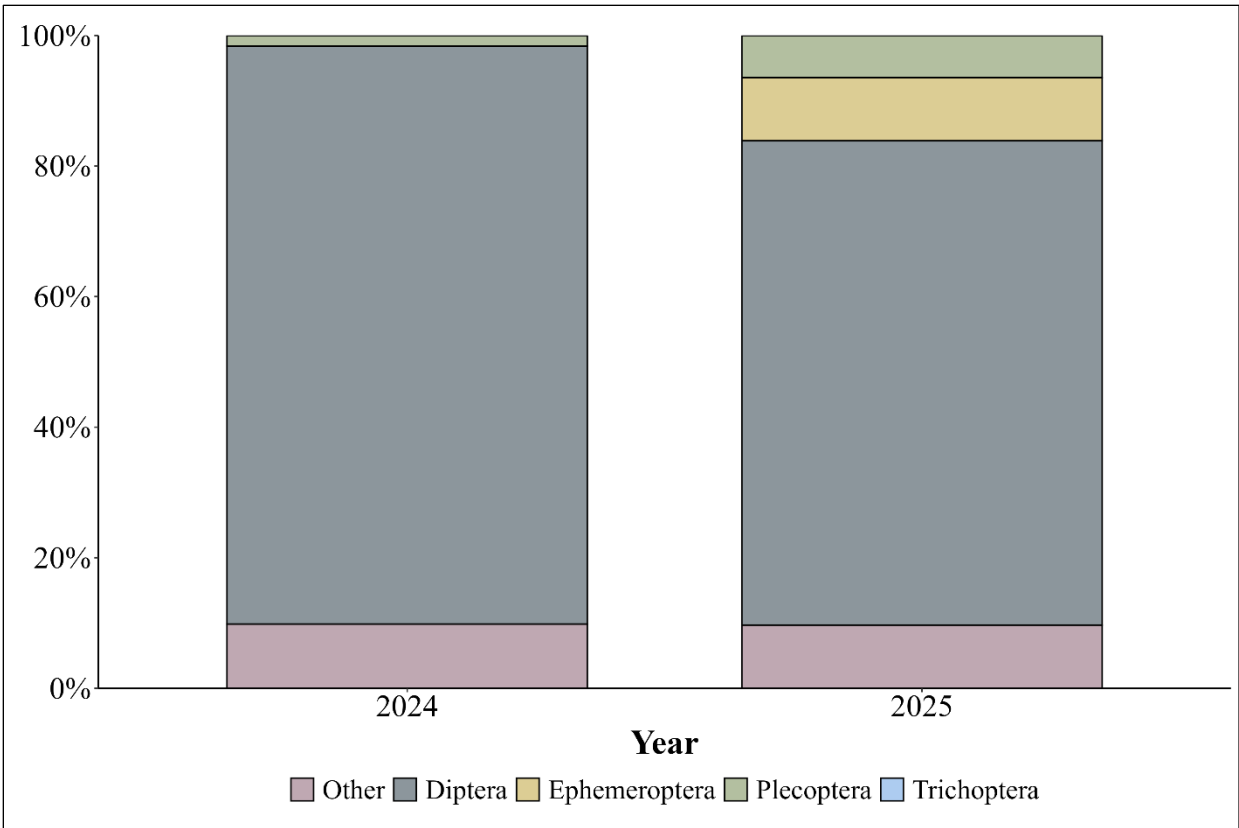


Figure 64.—Mean percent EPT, Diptera, and other taxa in North Fork Grayling Junior Creek aquatic invertebrate samples, 2024 and 2025.

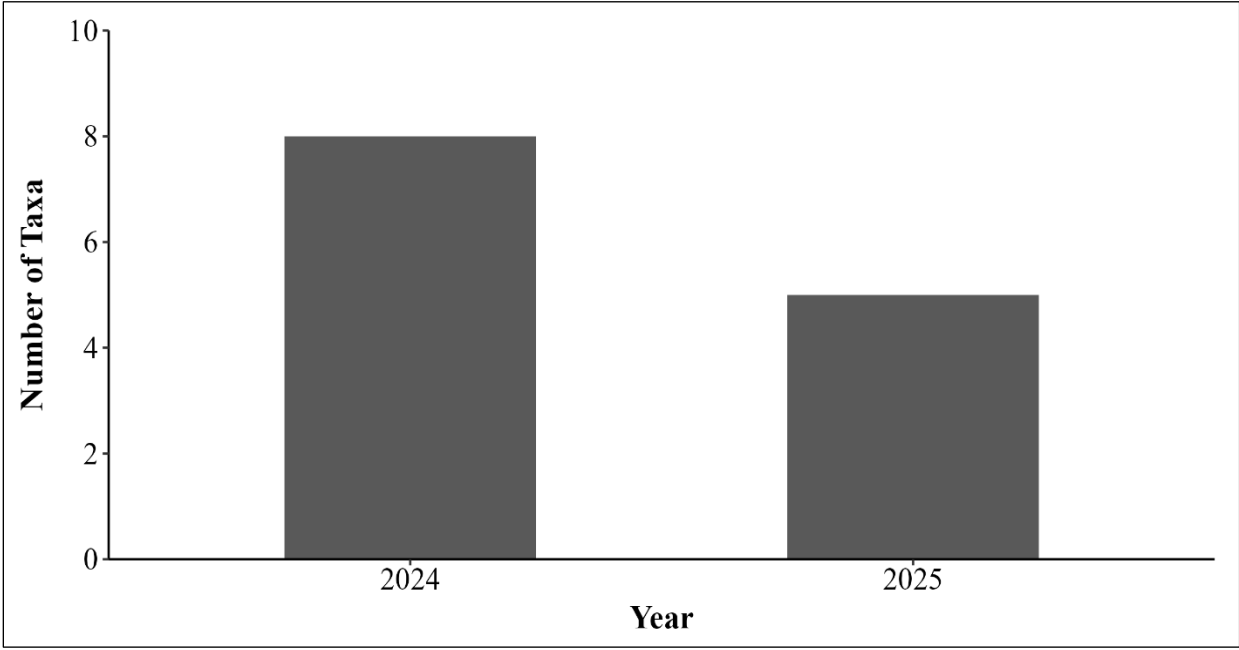


Figure 65.—Taxa richness in North Fork Grayling Junior Creek aquatic invertebrate samples, 2024 and 2025.

Fish

Dolly Varden CPUE in North Fork Grayling Junior Creek in 2025 was 2 fish, the lowest on record (Figure 66). CPUE was 8 fish and 19 fish in 2021 and 2022, respectively. Multiple length classes are present in North Fork Grayling Junior Creek ranging from 61 to 175 mm among all years with a mean of 122.1 mm (SD = 23.1; Figure 67). Fish were not sampled at this site in 2023 and 2024. Fish capture data from 2025 are presented in Appendix E.

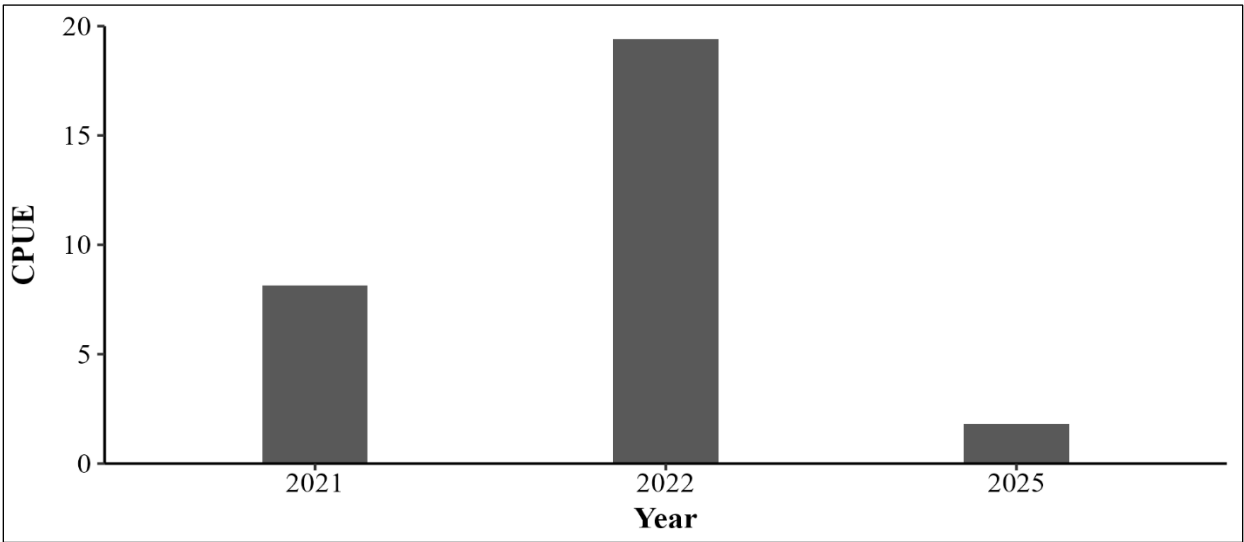


Figure 66.—Dolly Varden catch per unit effort (CPUE) captured in North Fork Grayling Junior Creek, 2021, 2022, and 2025.

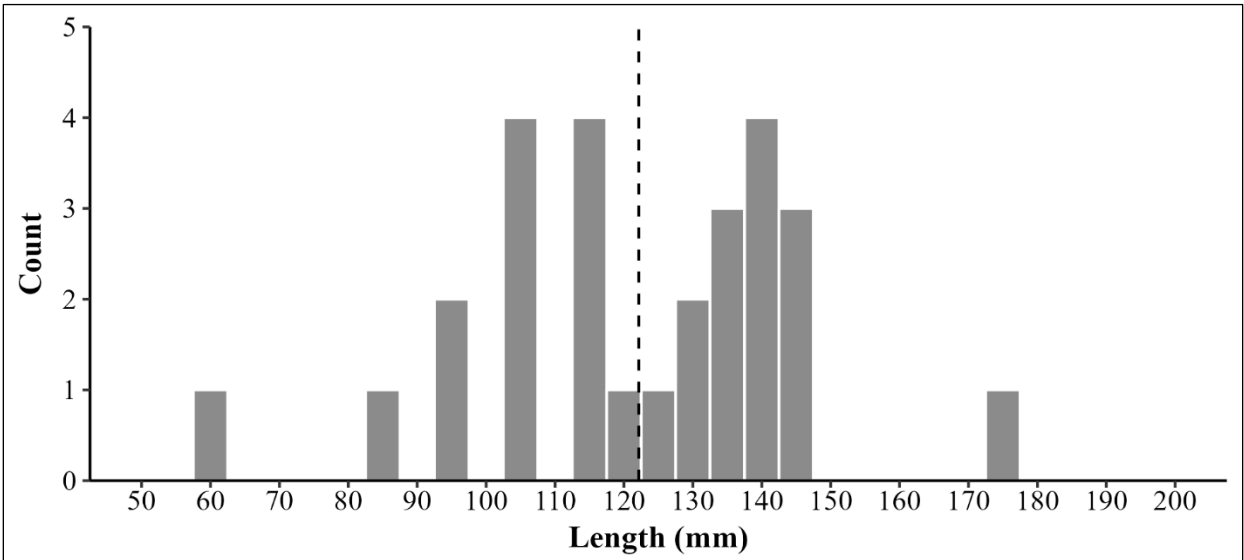


Figure 67.—Dolly Varden length frequency distribution for fish captured in North Fork Grayling Junior Creek, 2021, 2022, and 2025. The vertical dashed line represents the sample mean length.

EAST FORK GRAYLING JUNIOR CREEK

Water Quality

Teck collected seasonal water quality samples from East Fork Grayling Junior Creek (referred to as Grayling Junior South in Teck's dataset) for the first time in 2025. All element concentrations were notably higher than the Grayling Junior Creek sample site reflecting the proximity of the site to the active metal rich seep in the drainage (Appendix A). ADF&G sampling has occurred in slightly different areas of East Fork Grayling Junior Creek over the years. In 2022, the July periphyton and BMI sampling occurred upstream of the orange-stained tributary while the August minnow trapping occurred at and below the confluence. All 2023 sampling occurred just upstream of the orange-stained tributary, while 2024 sampling occurred downstream. Going forward all sampling will take place downstream of the confluence of the orange-stained tributary. In July 2025, in situ water temperature, turbidity, and specific conductance were higher than in 2024 while pH and dissolved oxygen were lower (Figure 68). In situ water quality data from 2025 are presented in Appendix B.

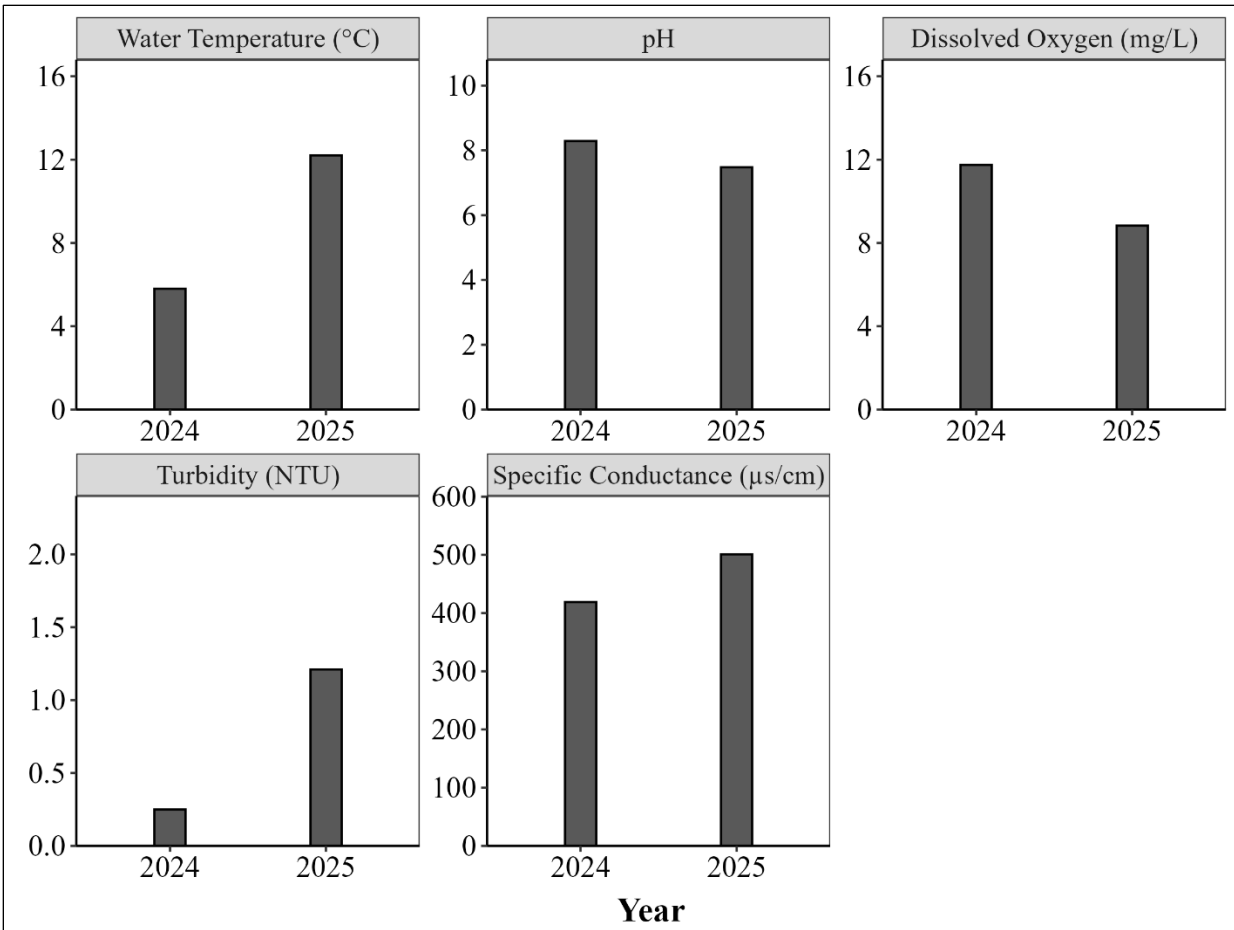


Figure 68.—In situ water quality at East Fork Grayling Junior Creek, 2024 and 2025. Water quality data was not collected at this site in 2023.

Periphyton

Mean chlorophyll-a concentration in East Fork Grayling Junior Creek in 2025 was 0.66 mg/m² (SD = 0.30). Mean chlorophyll-a concentrations have ranged from a low of 0.29 mg/m² in 2024 to a high of 1.02 mg/m² in 2022 (Figure 69). It should be noted that sampling occurred upstream of an orange-stained tributary at the site in 2022 and 2023 but has occurred downstream of it since 2024. Periphyton data from 2025 are presented in Appendix C.

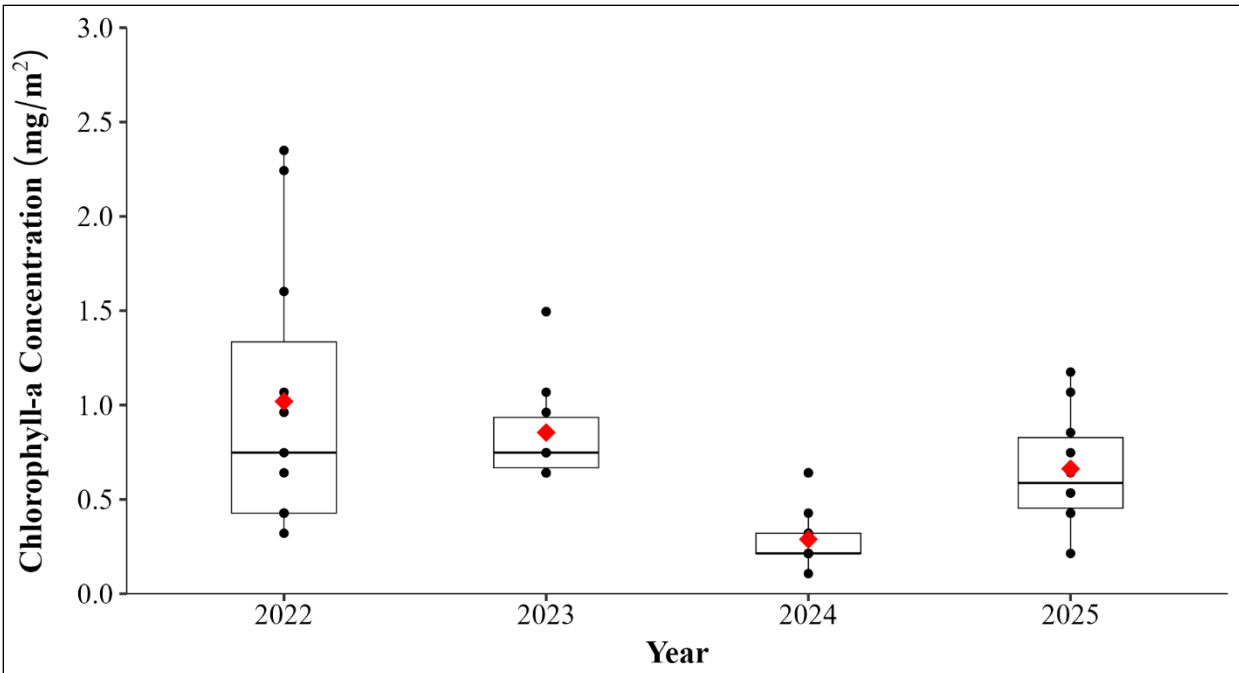


Figure 69.–Chlorophyll-a concentration boxplot by year at East Fork Grayling Junior Creek, 2022–2025. Raw data are depicted by black dots and mean values are depicted by red diamonds.

Benthic Macroinvertebrates

Mean BMI density in East Fork Grayling Junior Creek in 2025 was 270 BMI/m² (SD = 243; Figure 70). EPT taxa made up 22.4% of the sample in 2025, the lowest proportion on record. Conversely, Diptera made up 67.2% of the sample, the highest proportion on record (Figure 71). Taxa richness was 9 taxa (Figure 72). It should be noted that sampling occurred upstream of an orange-stained tributary in 2022 and 2023 but has occurred downstream of it since 2024. BMI data from 2025 are presented in Appendix D.

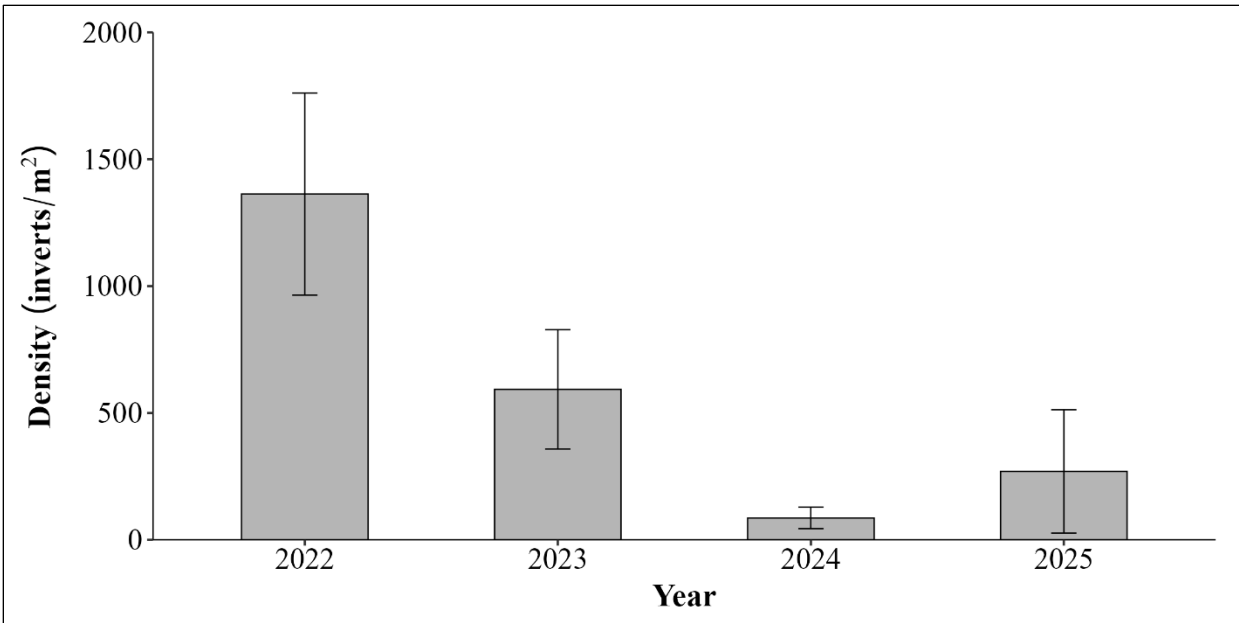


Figure 70.—Mean BMI density (± 1 SD) at East Fork Grayling Junior Creek, 2022–2025.

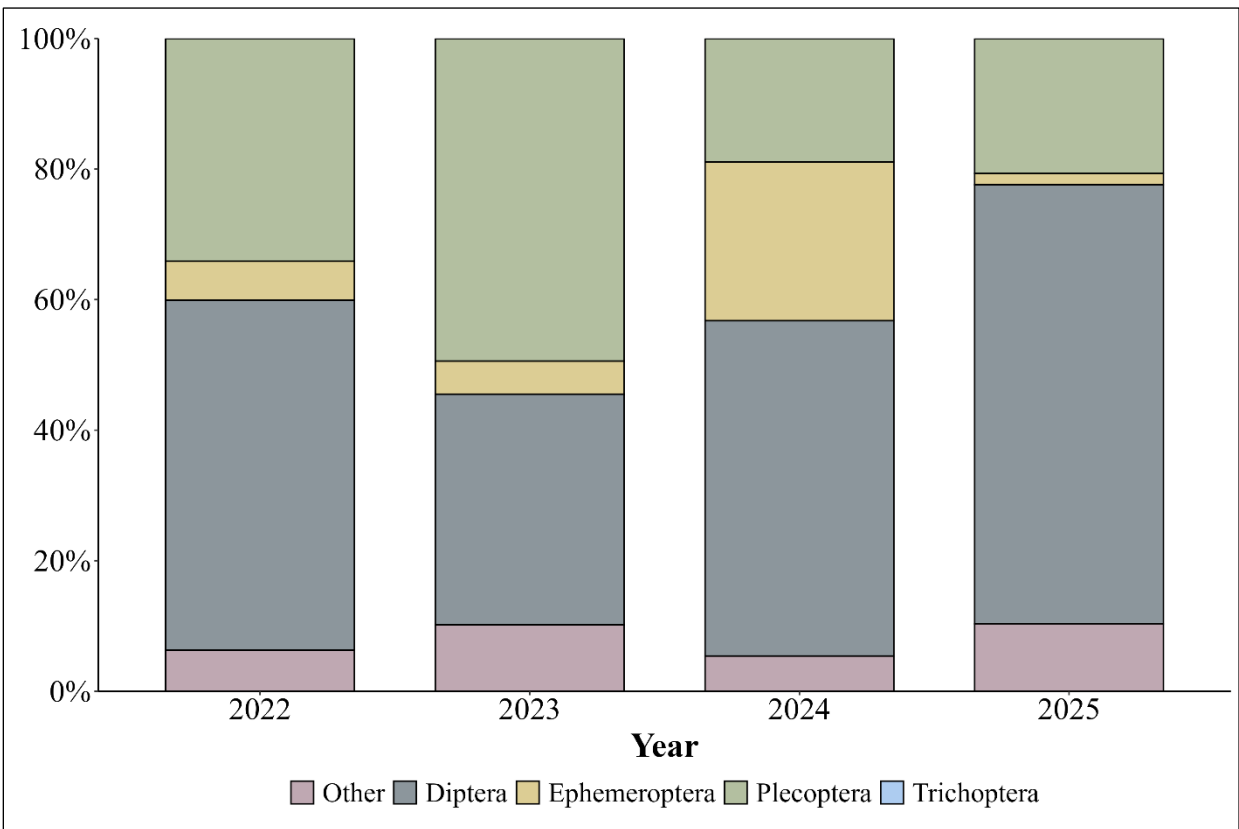


Figure 71.—Mean percent EPT, Diptera, and other taxa in East Fork Grayling Junior Creek aquatic invertebrate samples, 2022–2025.

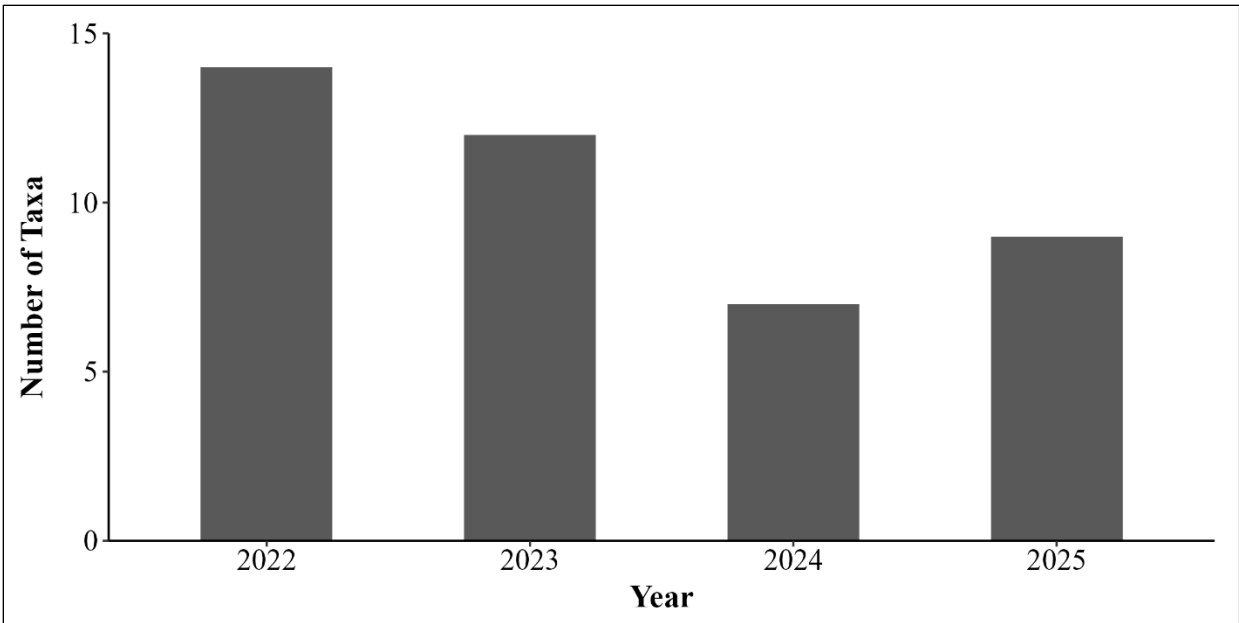


Figure 72.—Taxa richness in East Fork Grayling Junior Creek aquatic invertebrate samples, 2022–2025.

Fish

Dolly Varden CPUE in East Fork Grayling Junior Creek in 2025 was 2 fish. CPUE has been 2 fish or less in all years (Figure 73). Both fish captured in 2025 were 71 mm, while the two captured previously were 152 and 159 mm. Mean length among all years was 113.3 mm (SD = 48.9). Fish were not sampled at this site in 2024. Fish capture data from 2025 are presented in Appendix E.

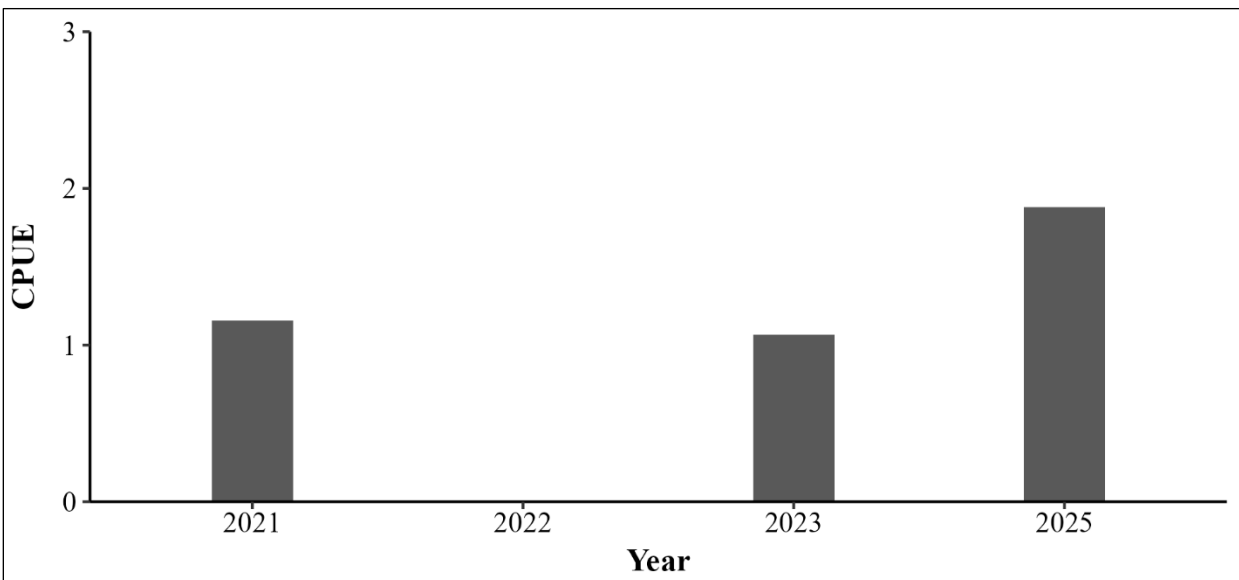


Figure 73.—Dolly Varden catch per unit effort (CPUE) for fish captured in East Fork Grayling Junior Creek, 2021–2023 and 2025.

NOA CREEK (STATION 210)

Water Quality

Noa Creek has naturally degraded water quality with orange-stained rocks and white precipitate at the confluence with Ikalukrok Creek. In the early 2000s, 95% of water samples exceeded the EPA chronic aquatic life criteria for aluminum and cadmium, 90% exceeded the nickel and zinc criteria, and 76% had a pH below the criterion (Weber-Scannell and Ott, 2006; EPA 2026). Noa Creek had the highest concentration for aluminum, cadmium, nickel, and zinc compared to other sites sampled in 2025 (Appendix A). In July 2025, in situ water temperature was much higher than in previous years. Specific conductance was also higher than in previous years while pH, dissolved oxygen, and turbidity were lower (Figure 74). In situ water quality data from 2025 are presented in Appendix B.

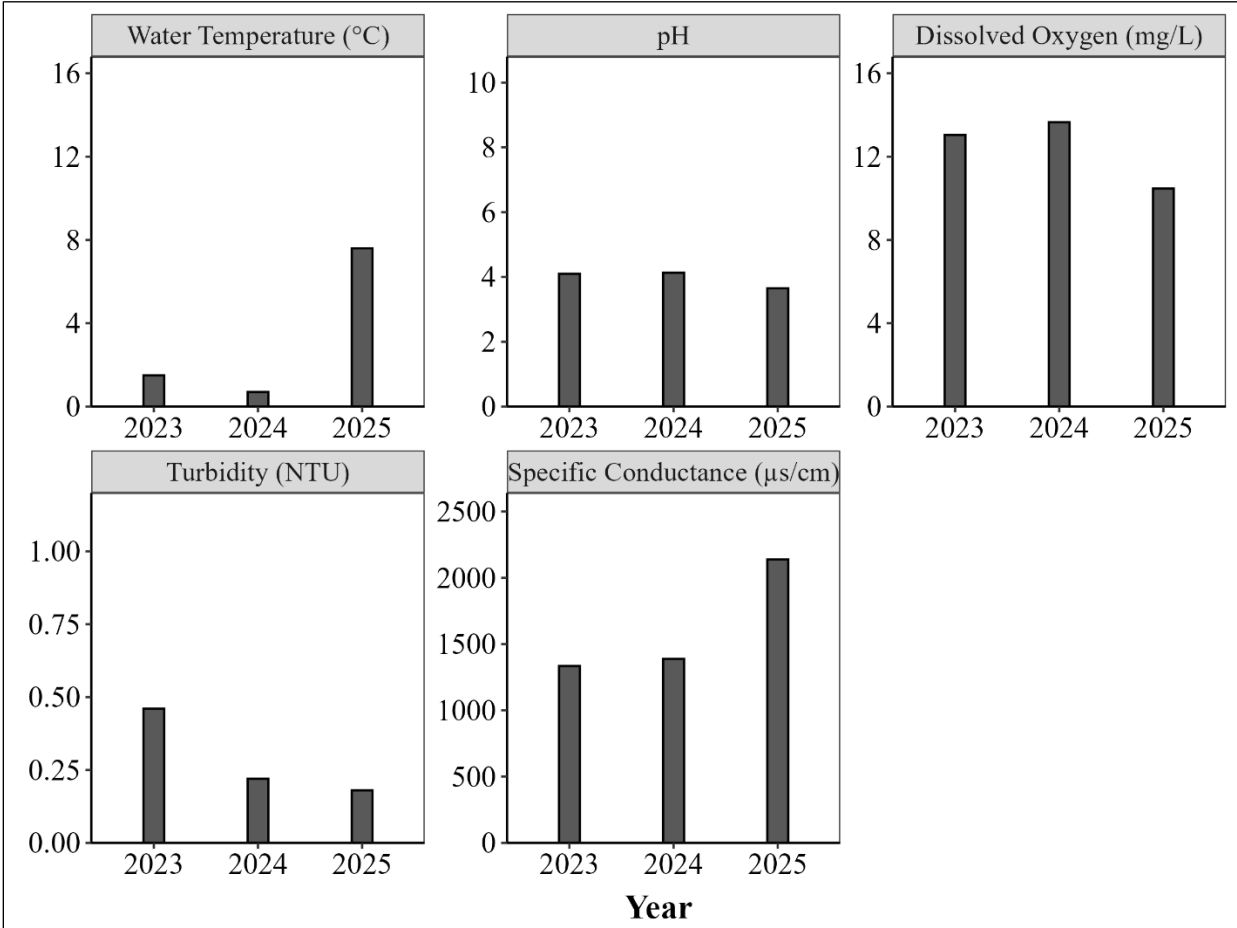


Figure 74.—In situ water quality at Noa Creek, 2023–2025.

Periphyton

The mean chlorophyll-a concentration in Noa Creek in 2025 was 5.16 mg/m² (SD = 4.28), the highest mean on record (Figure 75). Prior to 2020, the mean chlorophyll-a concentrations in Noa Creek were consistently low, ranging from 0.07 mg/m² in 2019 to 0.32 mg/m² in 2000. Periphyton data from 2025 are presented in Appendix C.

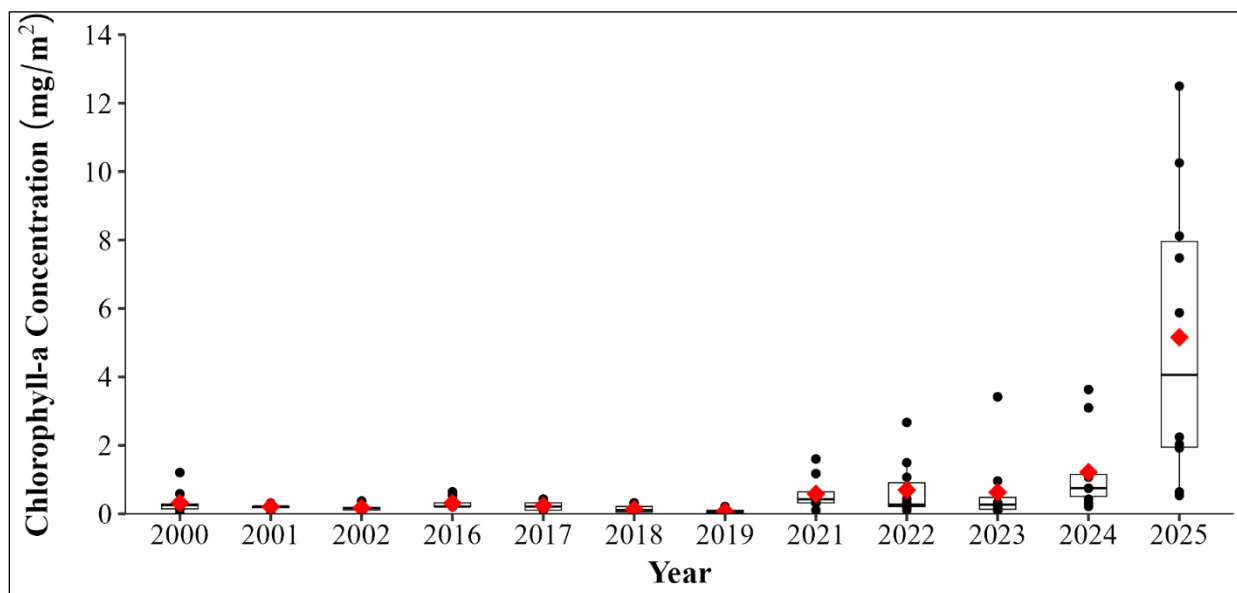


Figure 75.—Chlorophyll-a concentration boxplot by year at Noa Creek, 2000–2002 and 2016–2025. Raw data are depicted by black dots and mean values are depicted by red diamonds.

Benthic Macroinvertebrates

Mean BMI density in Noa Creek in 2025 was the same as 2024 at 21 BMI/m² (SD = 15). Mean density has ranged from 14 to 37 BMI/m² among years (Figure 76). EPT taxa have made up 0 to 1.5% of the samples among years except in 2022 when a single Trichoptera made up 16.7% of the samples (Figure 77). No EPT taxa were present in 2025 samples, Diptera made up 11.1%, and “other” taxa made up the remaining 88.9% of the sample. Taxa richness was 4 taxa, similar to the previous three years of Hess data. Taxa richness ranged from 14 to 23 taxa prior to 2022 when drift nets were used (Figure 78). BMI data from 2025 are presented in Appendix D.

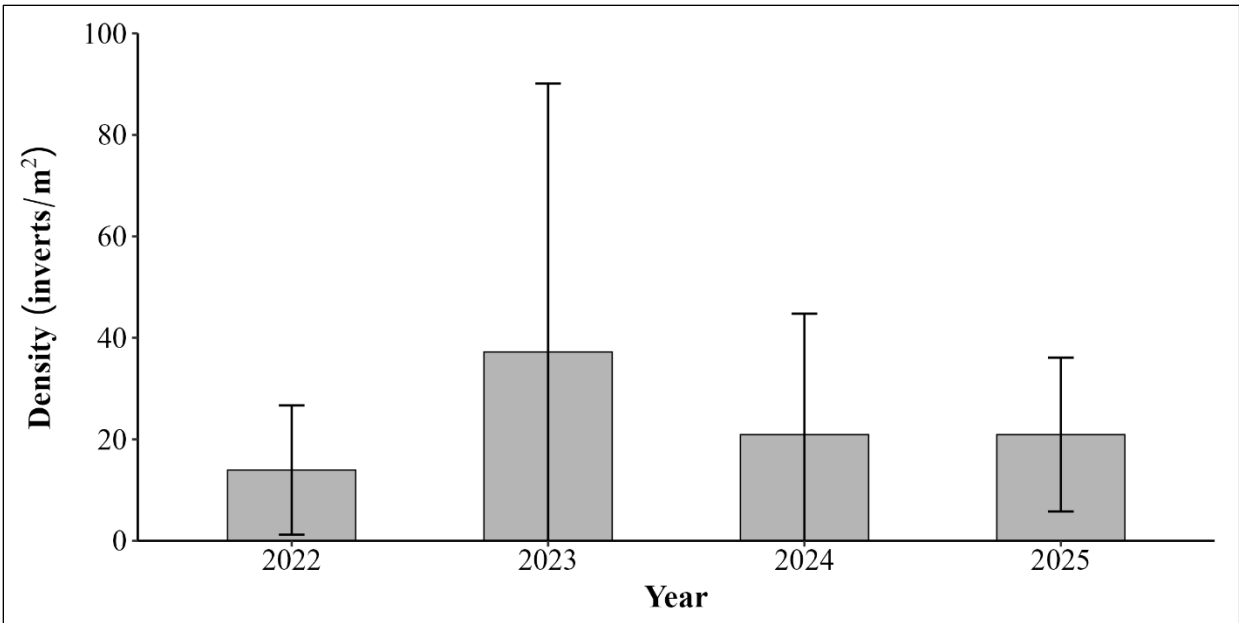


Figure 76.—Mean BMI density (± 1 SD) at Noa Creek, 2022–2025.

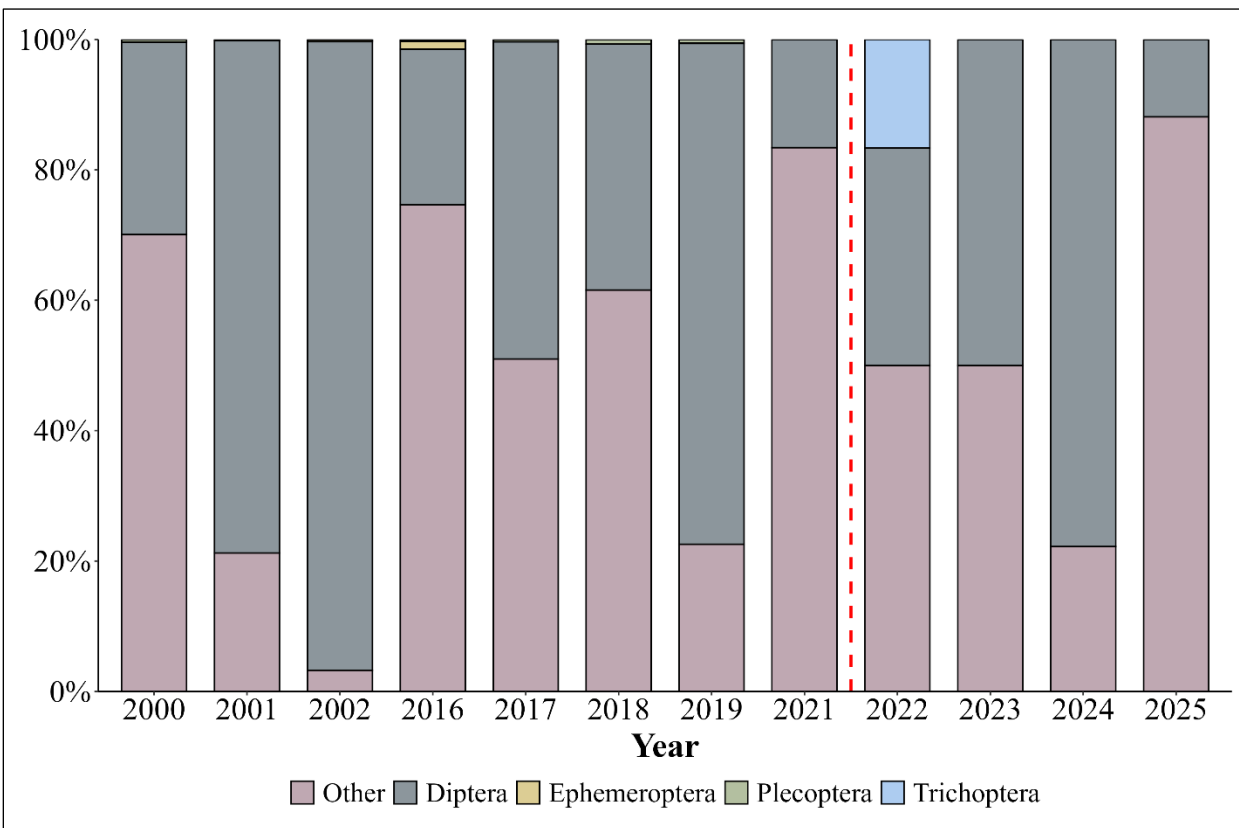


Figure 77.—Mean percent EPT, Diptera, and other taxa in Noa Creek aquatic invertebrate samples, 2000–2002 and 2016–2025. Sampling method was changed from drift nets to Hess samplers in 2022 as indicated by the red vertical dashed line.

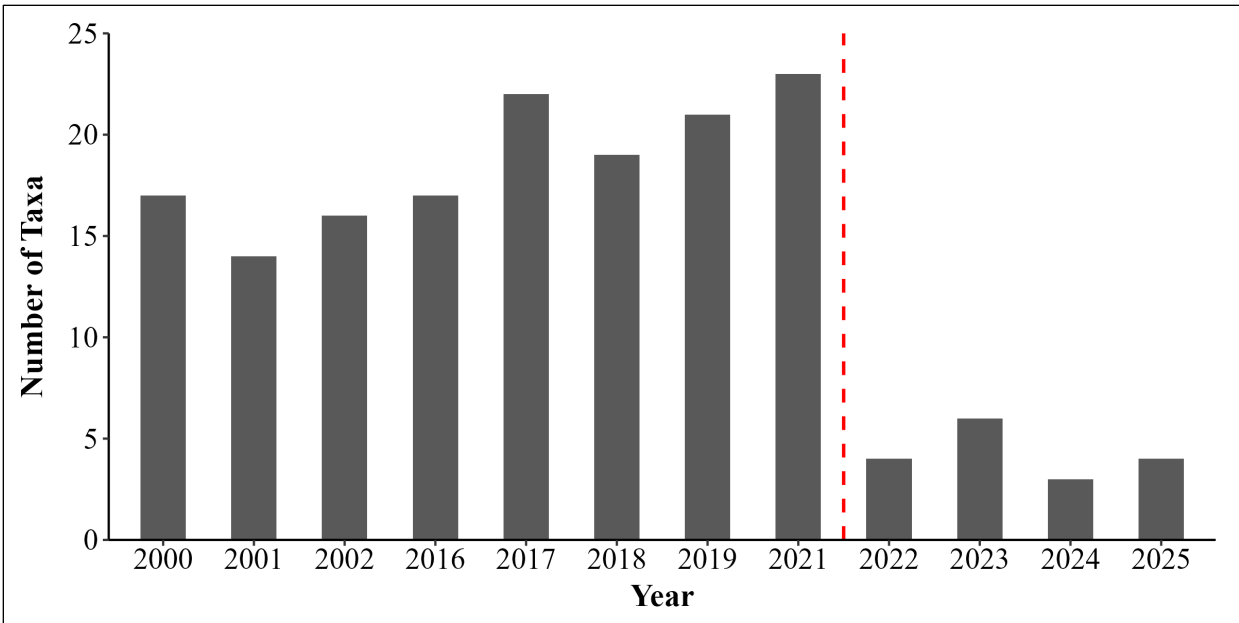


Figure 78.—Taxa richness in Noa Creek aquatic invertebrate samples, 2000–2002 and 2016–2025. Sampling method was changed from drift nets to Hess samplers in 2022 as indicated by the red vertical dashed line.

Fish

Fish sampling in Noa Creek has not occurred since the early 2000’s when no fish were captured or visually observed (Weber-Scannell and Ott, 2006). Noa Creek is connected by surface flow to Ikalukrok Creek, so fish do have access to the stream during the ice-free months, but impaired water quality likely deters fish from entering the stream.

IKALUKROK CREEK UPSTREAM OF NOA CREEK (RDMLE-03)

Water Quality

Ikalukrok Creek upstream of Noa Creek has clear water with orange staining on the substrate. This was the second year that sampling was performed at Ikalukrok Creek upstream of Noa Creek. In July 2025, in situ water temperature, turbidity, and specific conductance were higher than in 2024 while pH and dissolved oxygen were lower (Figure 79). In situ water quality data from 2025 are presented in Appendix B.

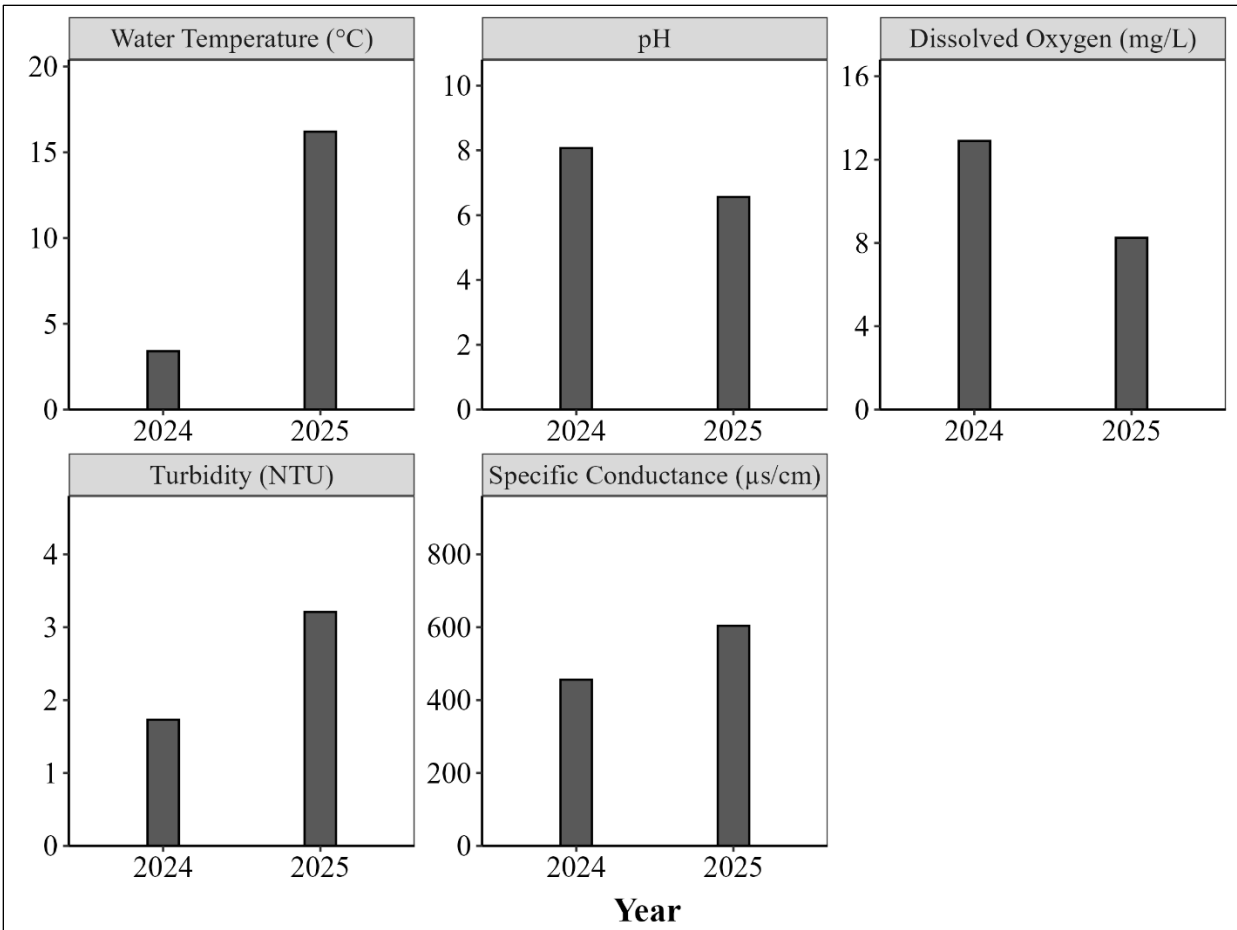


Figure 79.–In situ water quality at Ikalukrok Creek upstream of Noa Creek, 2024 and 2025.

Periphyton

This was the second year that periphyton samples were collected at Ikalukrok Creek upstream of Noa Creek. Mean chlorophyll-a concentration in 2025 was 0.09 mg/m^2 (SD = 0.08) which is approximately one third the mean in 2024 (Figure 80). Periphyton data from 2025 are presented in Appendix C.

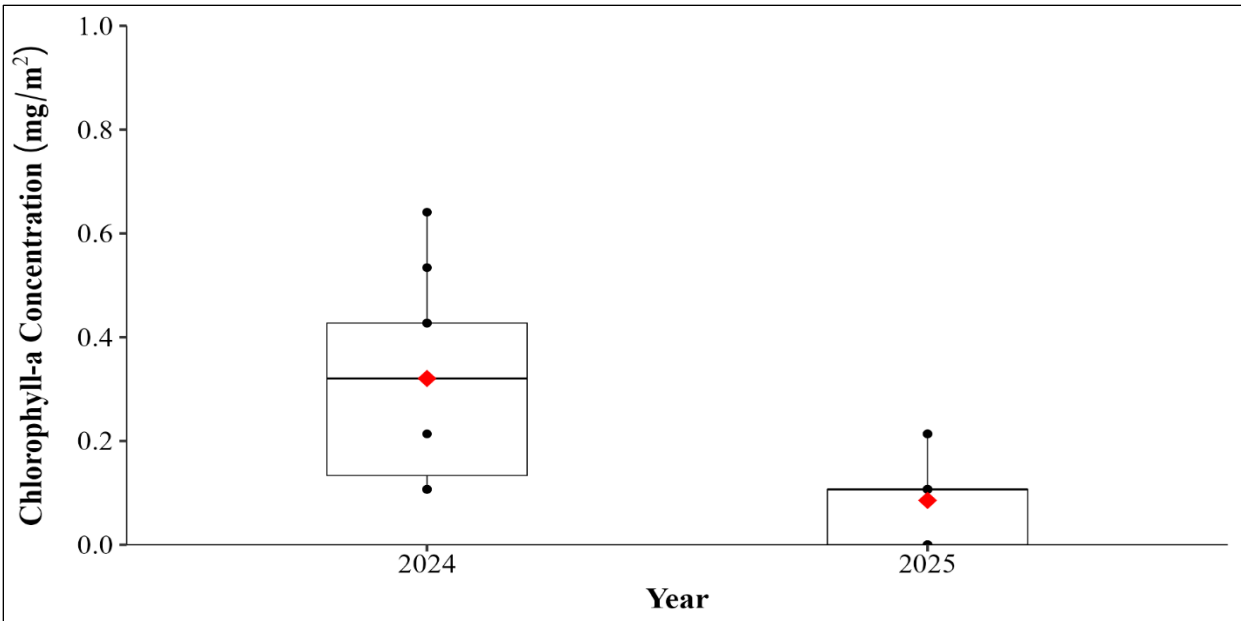


Figure 80.—Chlorophyll-a concentration boxplot by year at at Ikalukrok Creek upstream of Noa Creek, 2024 and 2025. Raw data are depicted by black dots and mean values are depicted by red diamonds.

Benthic Macroinvertebrates

This was the second year that BMI were collected at Ikalukrok Creek upstream of Noa Creek. Mean BMI density in 2025 was 344 BMI/m² (SD = 122; Figure 81). EPT taxa in 2025 made up 41.5% of the samples, which was nearly twice the proportion of EPT in 2024 samples (Figure 82). Taxa richness was 13 taxa in 2025, similar to 2024 (Figure 83). BMI data from 2025 are presented in Appendix D.

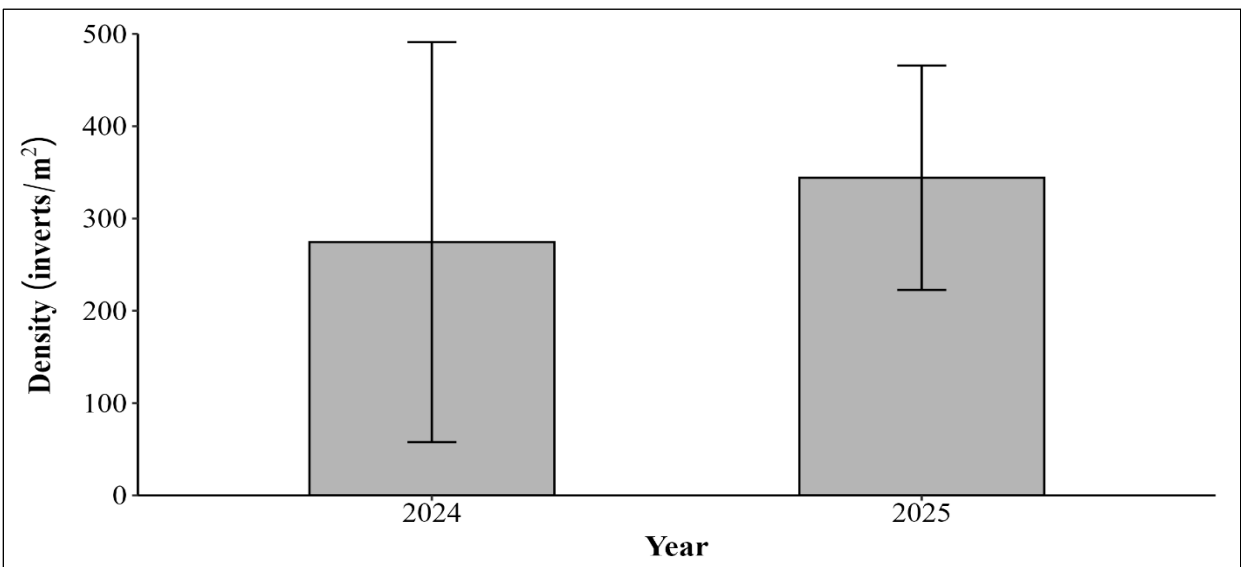


Figure 81.—Mean BMI density (± 1 SD) at Ikalukrok upstream of Noa Creek, 2024 and 2025.

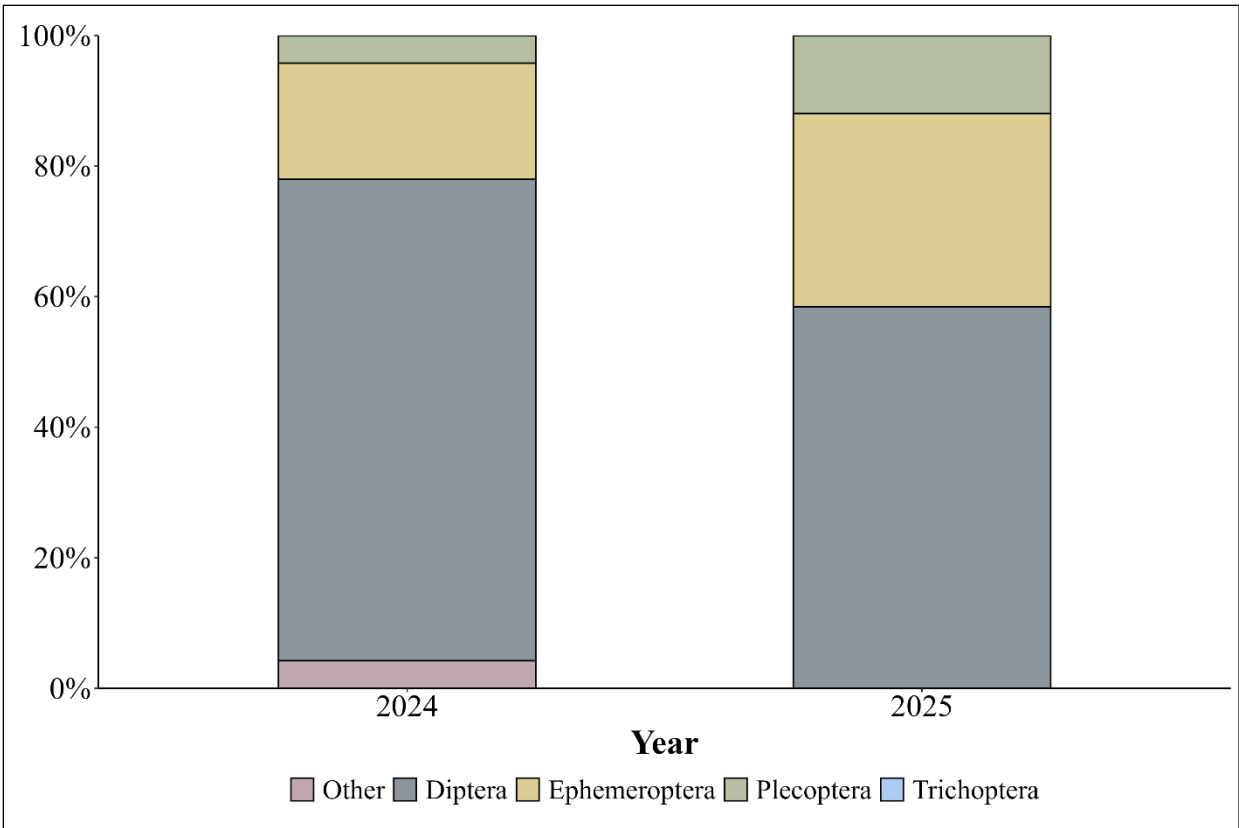


Figure 82.—Mean percent EPT, Diptera, and other taxa in Ikalukrok Creek upstream of Noa Creek aquatic invertebrate samples, 2024 and 2025.

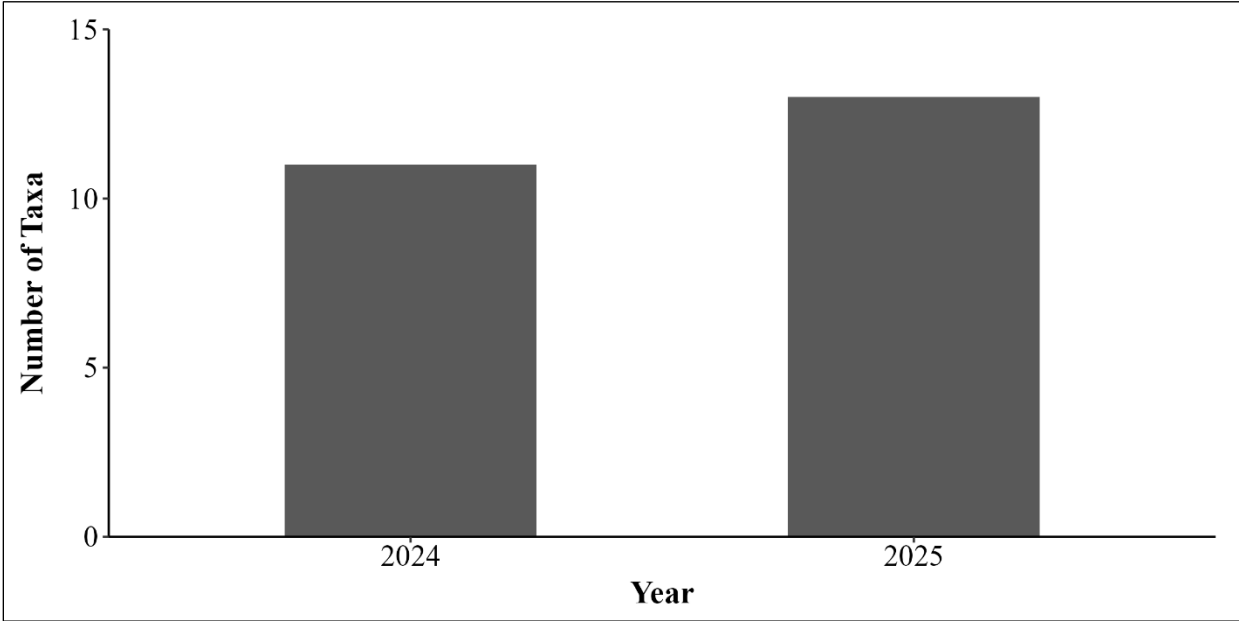


Figure 83.—Taxa richness in Ikalukrok Creek upstream of Noa Creek aquatic invertebrate samples, 2024 and 2025.

Fish

This was the first year that fish sampling took place at Ikalukrok Creek upstream of Noa Creek. Dolly Varden CPUE was 5 fish, and fork length ranged from 65 to 154 mm with a mean of 89.5 mm (SD = 28.3; Figure 84). Two slimy sculpin were also captured at this site in 2025. Fish capture data from 2025 are presented in Appendix E.

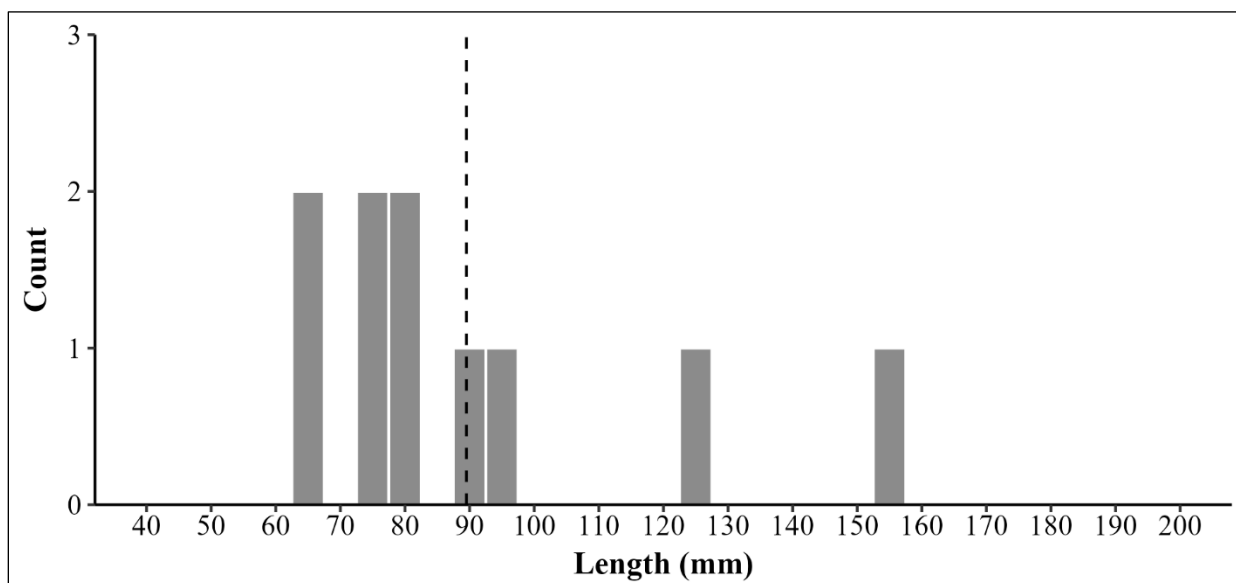


Figure 84.—Dolly Varden length frequency distribution captured in Ikalukrok Creek upstream of Noa Creek, 2025. The vertical dashed line represents the sample mean length.

UPPER NORTH FORK RED DOG CREEK NORTH TRIBUTARY

Water Quality

Upper North Fork Red Dog Creek North Tributary has darker water, likely due to the presence of tannins and/or dense algae and moss on the streambed. There are no visual indicators to suggest that water quality is impaired. This was the second year that in situ water quality data were collected at Upper North Fork Red Dog Creek North Tributary. In July 2025, in situ water temperature was notably higher than in 2024, while pH, dissolved oxygen, and turbidity were lower than 2024 measurements (Figure 85). In situ water quality data from 2025 are presented in Appendix B.

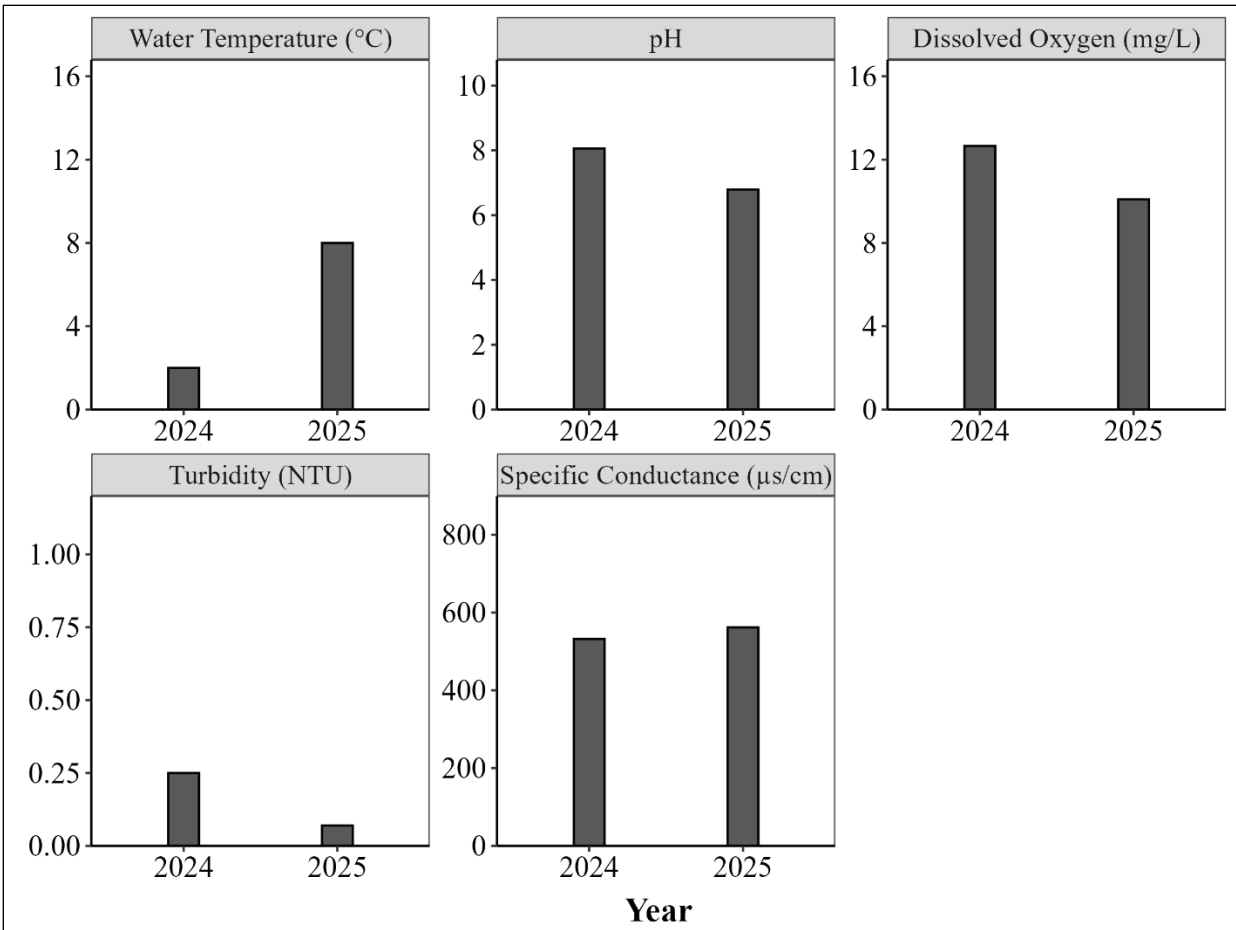


Figure 85.—In situ water quality at Upper North Fork Red Dog Creek North Tributary, 2024 and 2025.

Periphyton

This was the second year that periphyton samples were collected at Upper North Fork Red Dog Creek North Tributary. The mean chlorophyll-a concentration in 2025 was 4.51 mg/m^2 (SD = 4.06) which is approximately one third the mean in 2024 (Figure 86). Periphyton data from 2025 are presented in Appendix C.

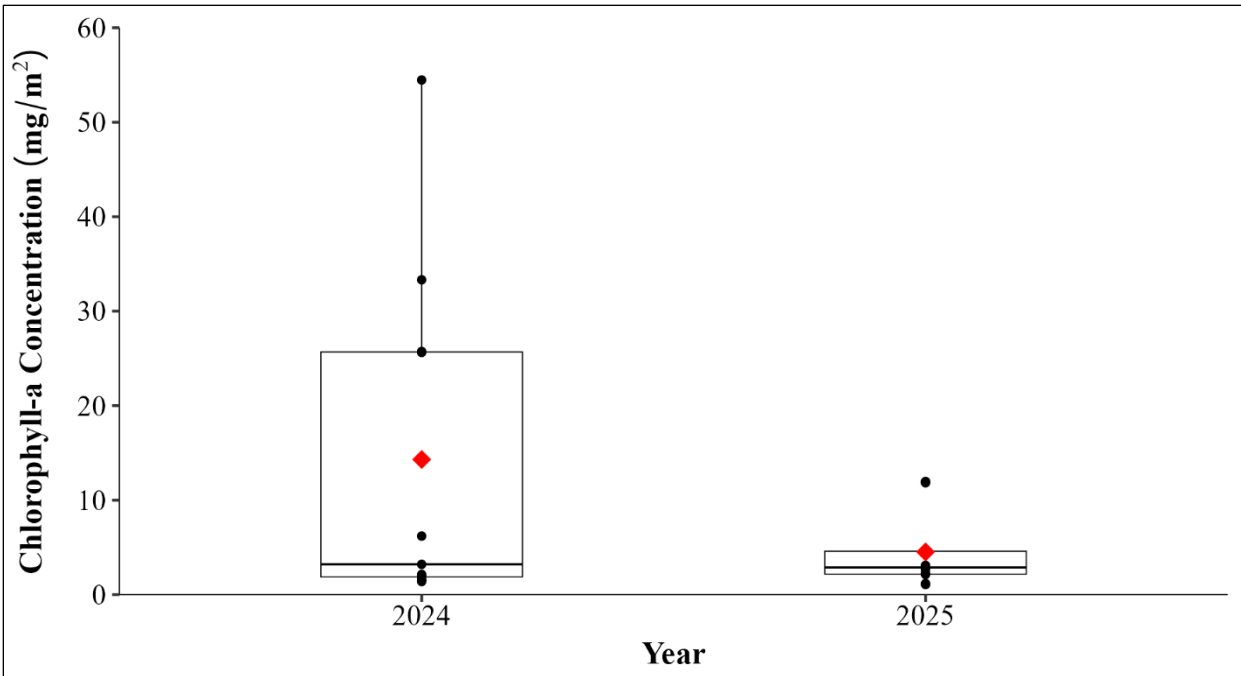


Figure 86.—Chlorophyll-a concentration boxplot by year at Upper North Fork Red Dog Creek North Tributary, 2024 and 2025. Raw data are depicted by black dots and mean values are depicted by red diamonds.

Benthic Macroinvertebrates

This was the second year that BMI were collected at Upper North Fork Red Dog Creek North Tributary. Mean BMI density in 2025 was 31,256 BMI/m² (SD = 9,232; Figure 87). This is an order of magnitude higher than any other site sampled in 2025. EPT taxa in 2025 made up 5.7% of the samples which is approximately twice the proportion in 2024 samples (Figure 88). In both years, Diptera made up over 85% of the samples. Taxa richness in 2025 was 19 taxa (Figure 89). BMI data from 2025 are presented in Appendix D.

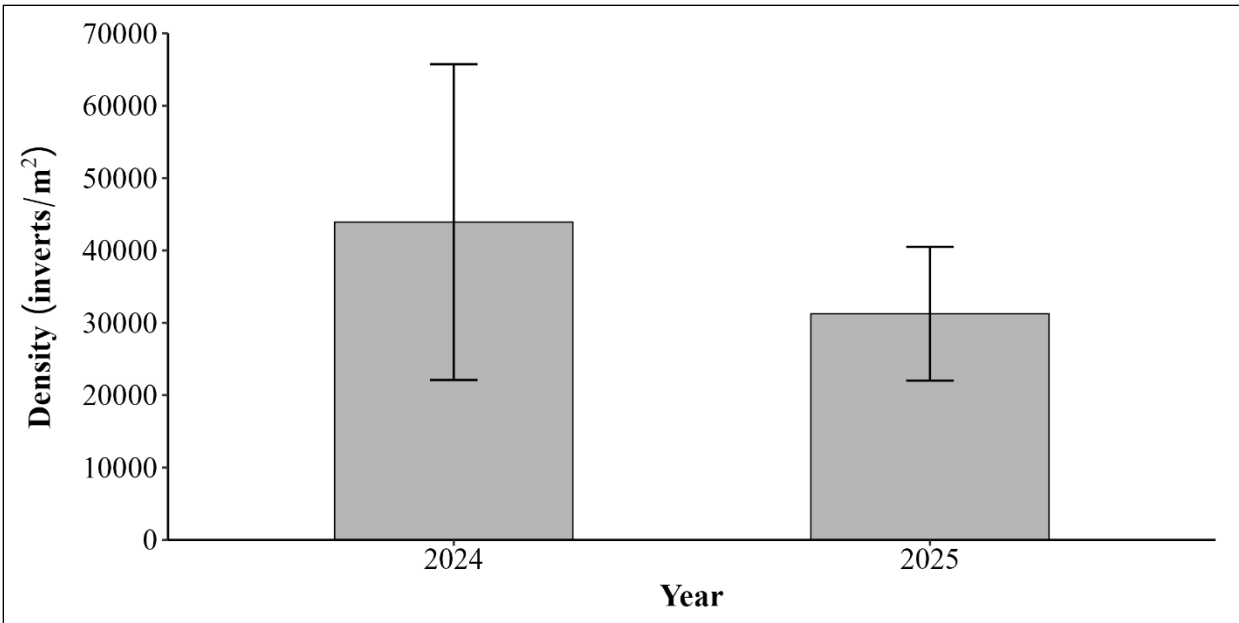


Figure 87.—Mean BMI density (± 1 SD) at Upper North Fork Red Dog Creek North Tributary, 2024 and 2025.



Figure 88.—Mean percent EPT, Diptera, and other taxa in Upper North Fork Red Dog Creek North Tributary aquatic invertebrate samples, 2024 and 2025.

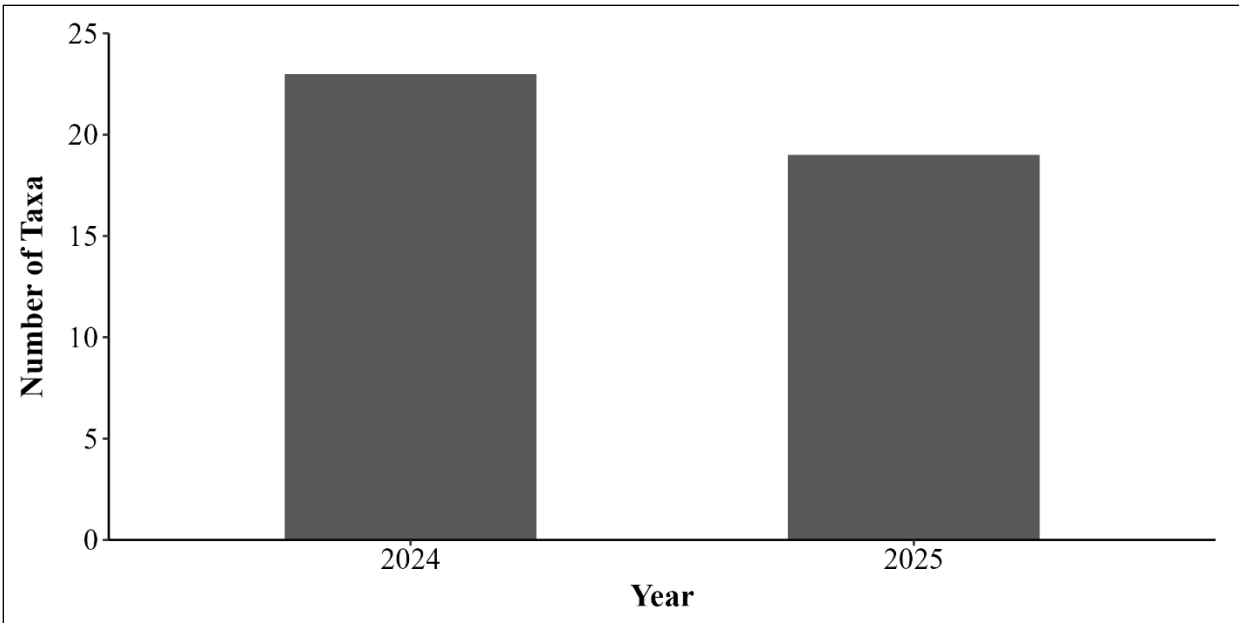


Figure 89.–Taxa richness in Upper North Fork Red Dog Creek North Tributary aquatic invertebrate samples, 2024 and 2025.

Fish

This was the first year that fish were captured in Upper North Fork Red Dog Creek North Tributary despite the site having been sampled in 2021 and 2022. Dolly Varden CPUE was 1 fish with fork lengths of 160 and 170 mm for the two individuals captured. Fish capture data from 2025 are presented in Appendix E.

UPPER NORTH FORK RED DOG CREEK SOUTH TRIBUTARY

Water Quality

Upper North Fork Red Dog Creek South Tributary is below a large beaver dam and has clear water. There are no visual indicators to suggest that water quality is impaired. In July 2025, in situ water temperature, turbidity, and specific conductance were notably higher than in 2024 while pH and dissolved oxygen were lower (Figure 90). In situ water quality data from 2025 are presented in Appendix B.

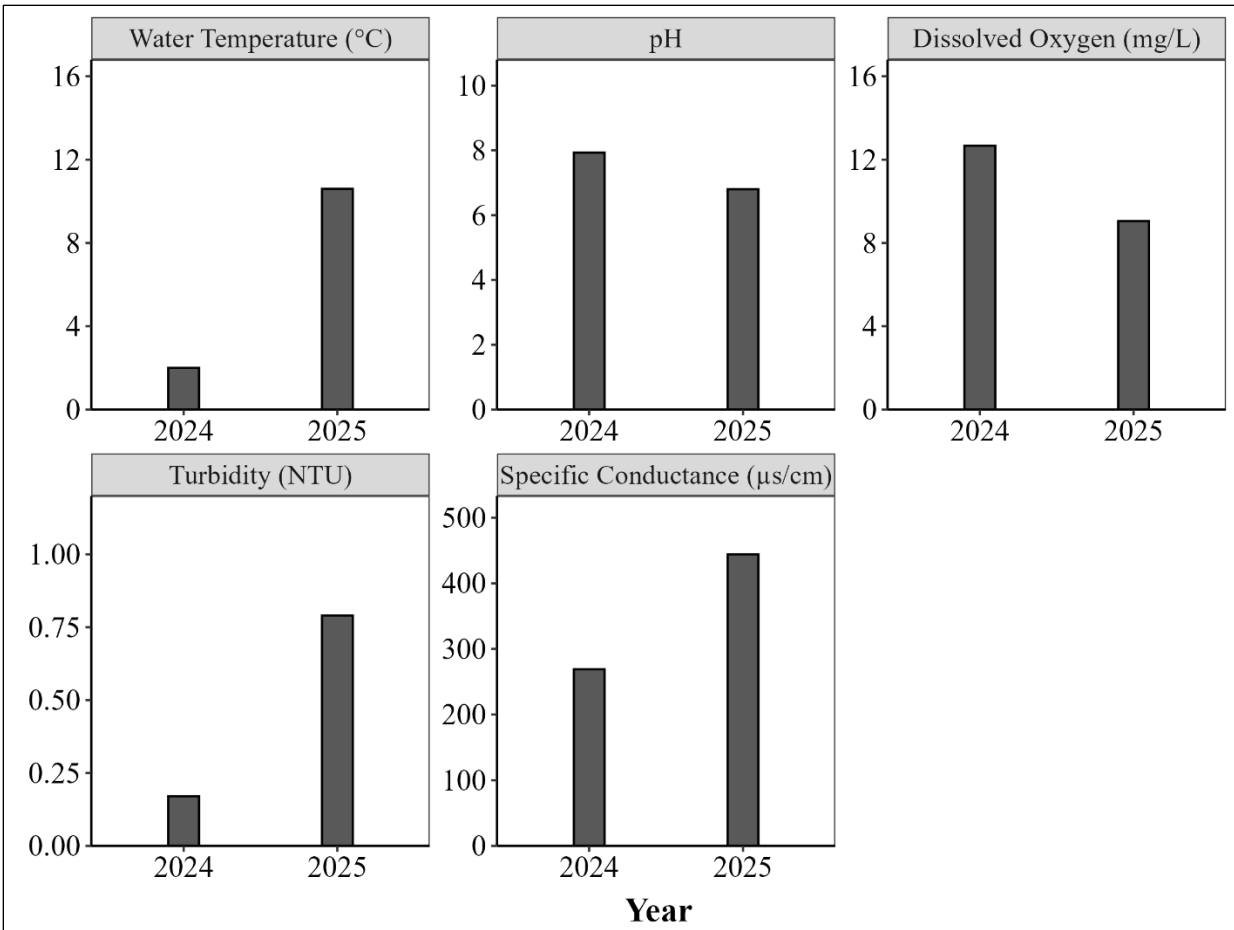


Figure 90.—In situ water quality at Upper North Fork Red Dog Creek South Tributary, 2024 and 2025.

Periphyton

Periphyton sampling first occurred at Upper North Fork Red Dog Creek South Tributary in 2022, resumed in 2024, and continued in 2025. The mean chlorophyll-a concentration in Upper North Fork Red Dog Creek South Tributary in 2025 was 4.62 mg/m² (SD = 1.73). Mean chlorophyll-a concentrations have steadily increased at this site since sampling began (Figure 91). Periphyton data from 2025 are presented in Appendix C.

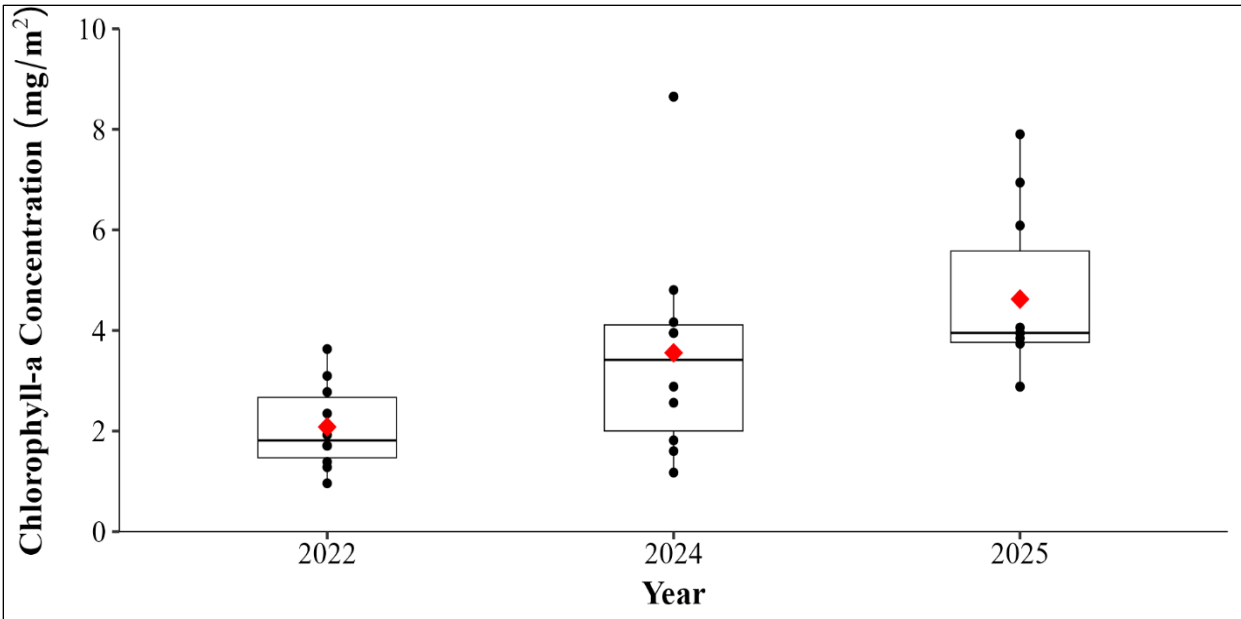


Figure 91.—Chlorophyll-a concentration boxplot by year at Upper North Fork Red Dog Creek South Tributary, 2022, 2024, and 2025. Raw data are depicted by black dots and mean values are depicted by red diamonds.

Benthic Macroinvertebrates

BMI sampling first occurred at Upper North Fork Red Dog Creek South Tributary in 2022 and resumed in 2024. Mean BMI density was the highest on record in 2025 at 8,307 BMI/m² (SD = 1,969; Figure 92). EPT taxa made up 9.6% of the samples in 2025, the lowest on record. Diptera have made up well over 50% of the samples in all years (Figure 93). Taxa richness in 2025 was similar to previous years at 19 taxa (Figure 94). BMI data from 2025 are presented in Appendix D.

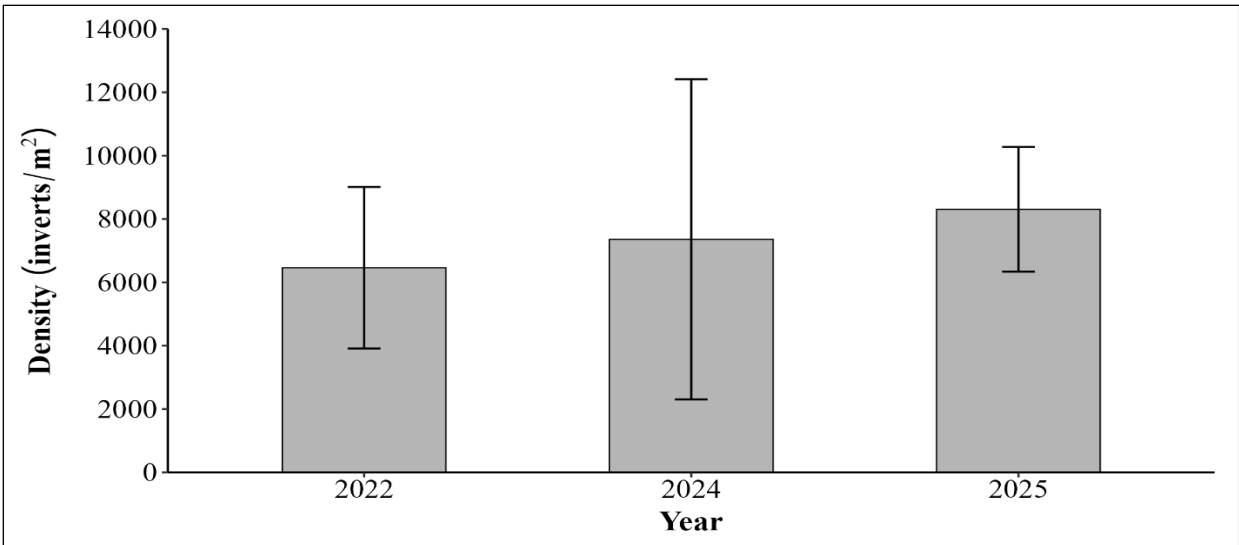


Figure 92.—Mean BMI density (± 1 SD) at Upper North Fork Red Dog Creek South Tributary, 2022, 2024, and 2025.

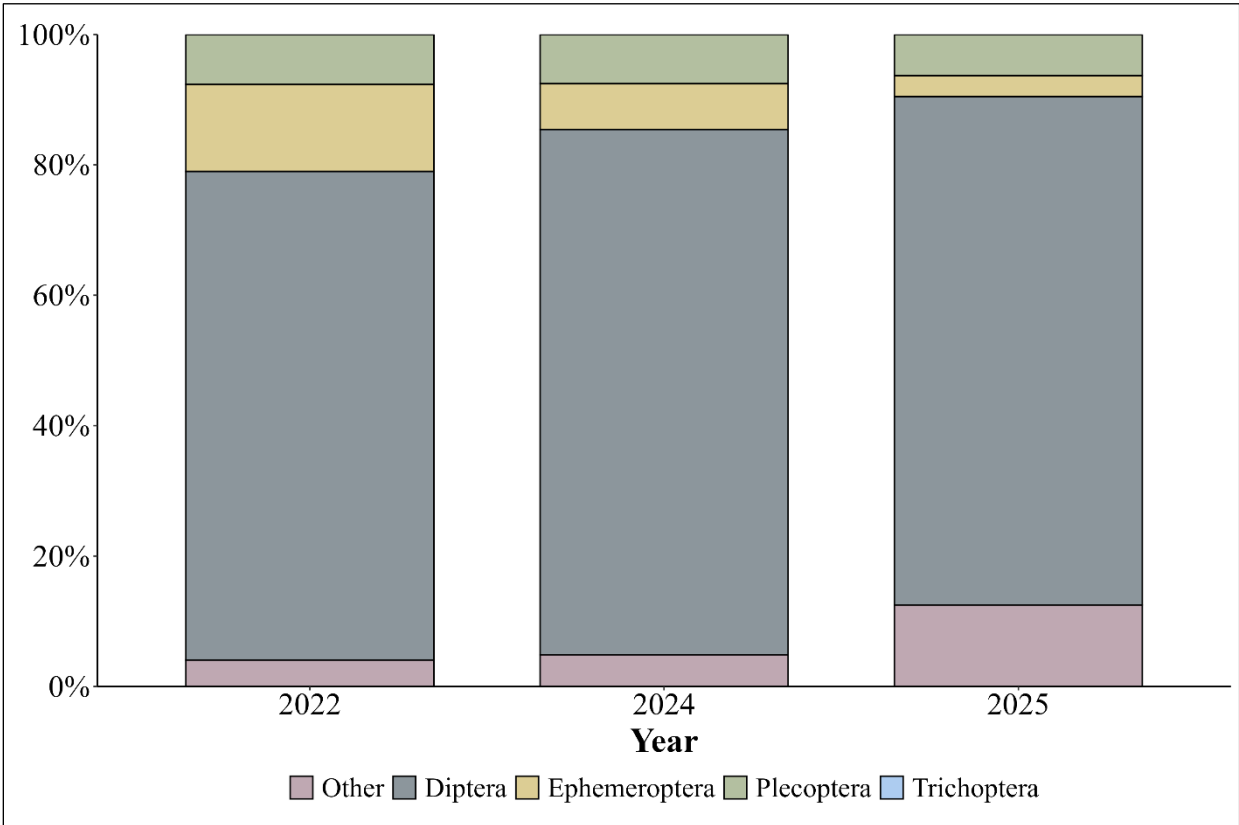


Figure 93.—Mean percent EPT, Diptera, and other taxa in Upper North Fork Red Dog Creek South Tributary aquatic invertebrate samples, 2022, 2024, and 2025.

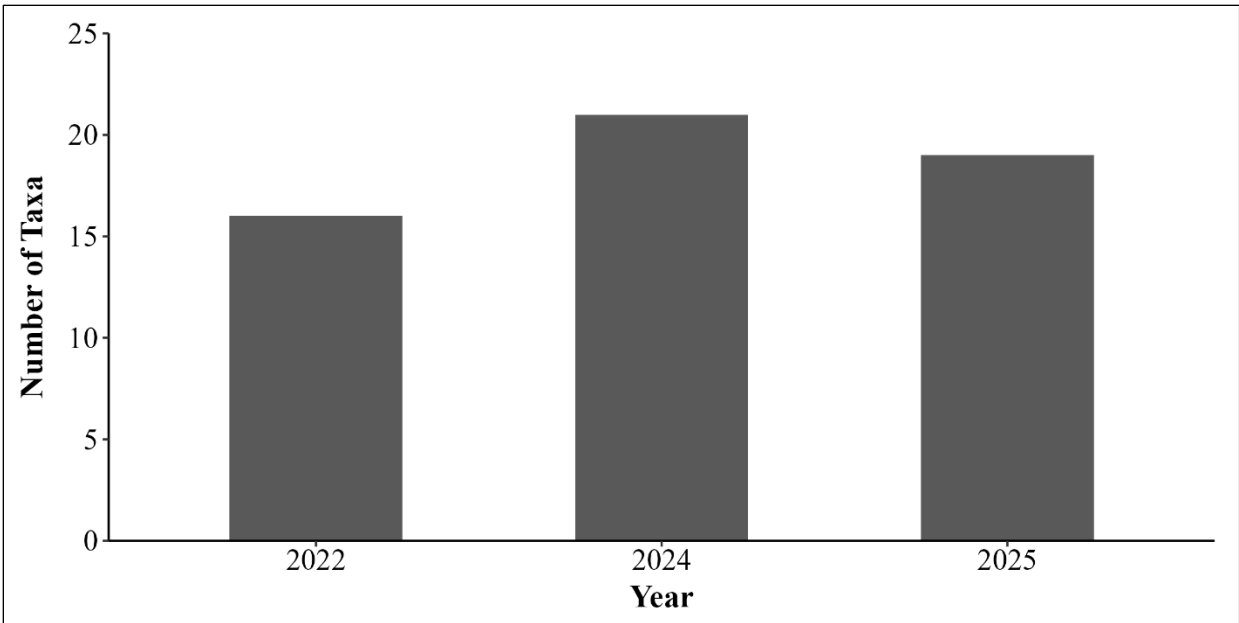


Figure 94.–Taxa richness in Upper North Fork Red Dog Creek South Tributary aquatic invertebrate samples, 2022–2025.

Fish

Dolly Varden CPUE in Upper North Fork Red Dog Creek South Tributary in 2025 was 5 fish, the highest on record (Figure 95). Fork lengths have ranged from 121 to 165 mm among all years with a mean of 144.4 mm (SD = 13.7; Figure 96). Fish capture data from 2025 are presented in Appendix E.

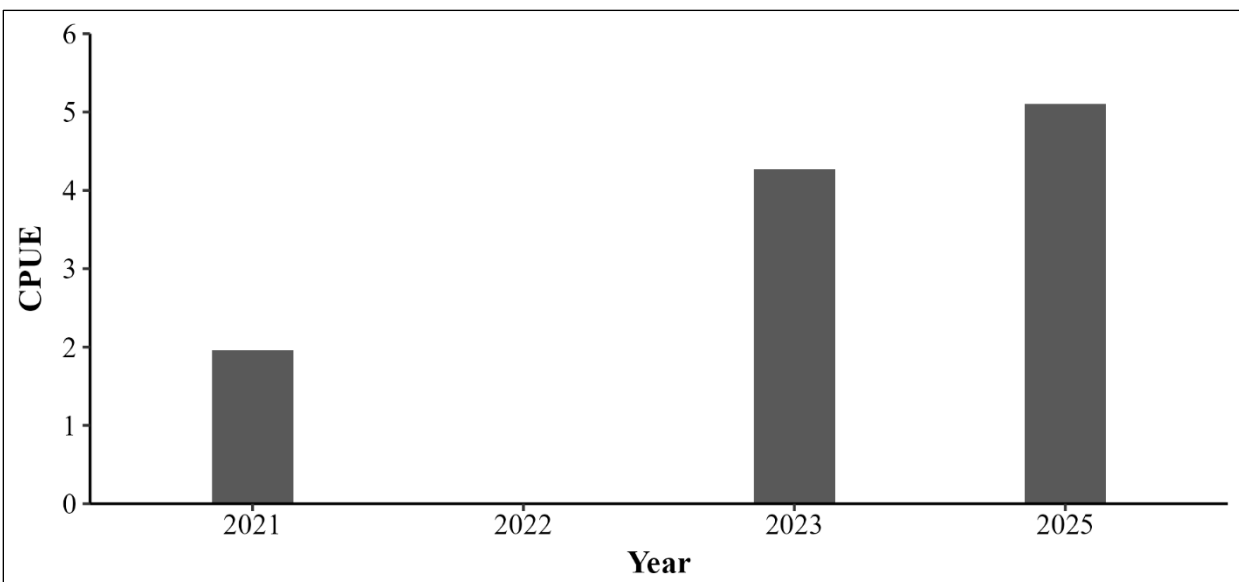


Figure 95.–Dolly Varden catch per unit effort (CPUE) captured in Upper North Fork Red Dog Creek South Tributary, 2021–2023 and 2025.

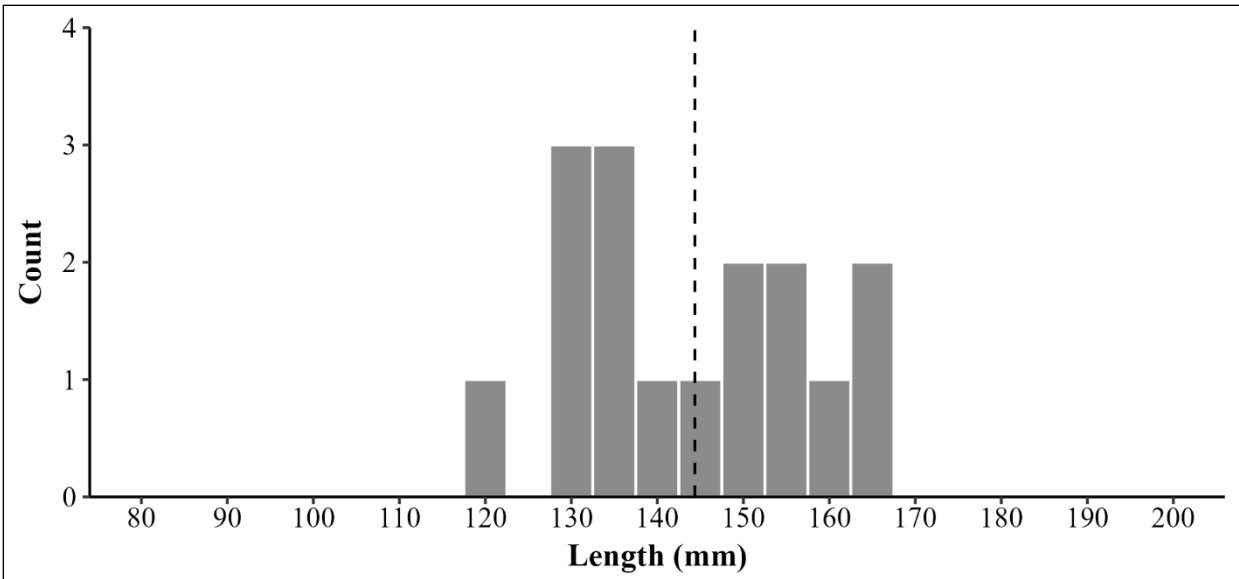


Figure 96.—Dolly Varden length frequency distribution captured in Upper North Fork Red Dog Creek South Tributary, 2021–2023 and 2025. The vertical dashed line represents the sample mean length.

OAK CREEK (STATION 216)

Water Quality

Oak Creek is a tributary to the Wulik River with orange-stained substrate and orange turbid water. In 2001 and 2002, the stream was noted to flow over heavy mineralized formations, evident by orange staining on the streambed (Weber-Scannell and Ott 2006). Median conductivity in the early 2000s was 279.5 $\mu\text{s}/\text{cm}$ and median pH was 7.8. Concentrations of metals in water samples were mostly low except for iron, of which 67% of samples exceeded the chronic aquatic life criterion (EPA 2026; Weber-Scannell and Ott 2006). In July 2025, in situ water temperature was 13.6°C, pH was 6.9, dissolved oxygen was 8.57 mg/L, turbidity was 20.9 NTU, and specific conductance was 730 $\mu\text{s}/\text{cm}$. In situ water quality data from 2025 are presented in Appendix B.

Periphyton

This was the first year that periphyton samples were collected at Oak Creek since 2002. Mean chlorophyll-a concentration in Oak Creek was notably lower in 2025 than in 2002 at 0.44 mg/m² (SD = 1.31; Figure 97). Periphyton data from 2025 are presented in Appendix C.

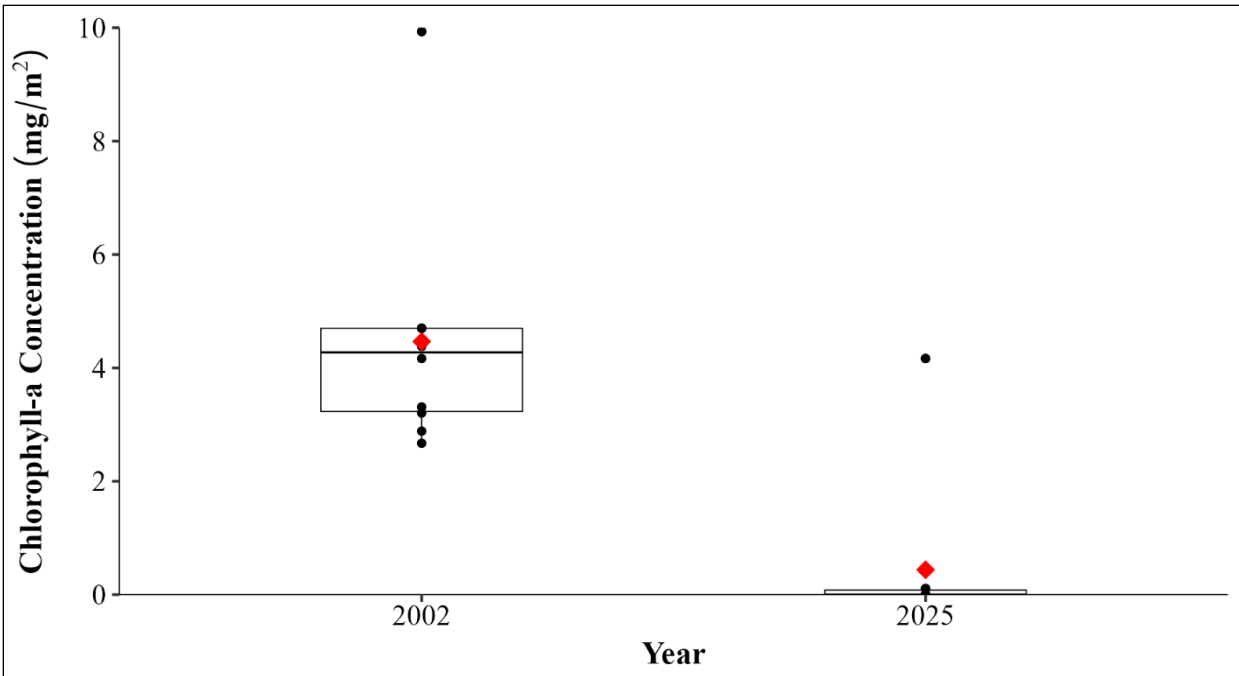


Figure 97.—Chlorophyll-a concentration boxplot by year at Oak Creek, 2002 and 2025. Raw data are depicted by black dots and mean values are depicted by red diamonds.

Benthic Macroinvertebrates

This was the first year that BMI samples were collected at Oak Creek since 2002 when samples were collected with drift nets instead of Hess samplers. The mean BMI density in Oak Creek in 2025 was 86 BMI/m² (SD = 42). EPT taxa were present in Oak Creek BMI samples in 2025 at similar proportions to samples in 2001 and 2002 (Figure 98). Diptera made up 73%, EPT taxa made up 18.9%, and “other” taxa made up the remaining proportion of the sample. Taxa richness in 2025 was 8 taxa, which is less than half the richness in 2001 and 2002 when drift nets were used (Figure 99). BMI data from 2025 are presented in Appendix D.

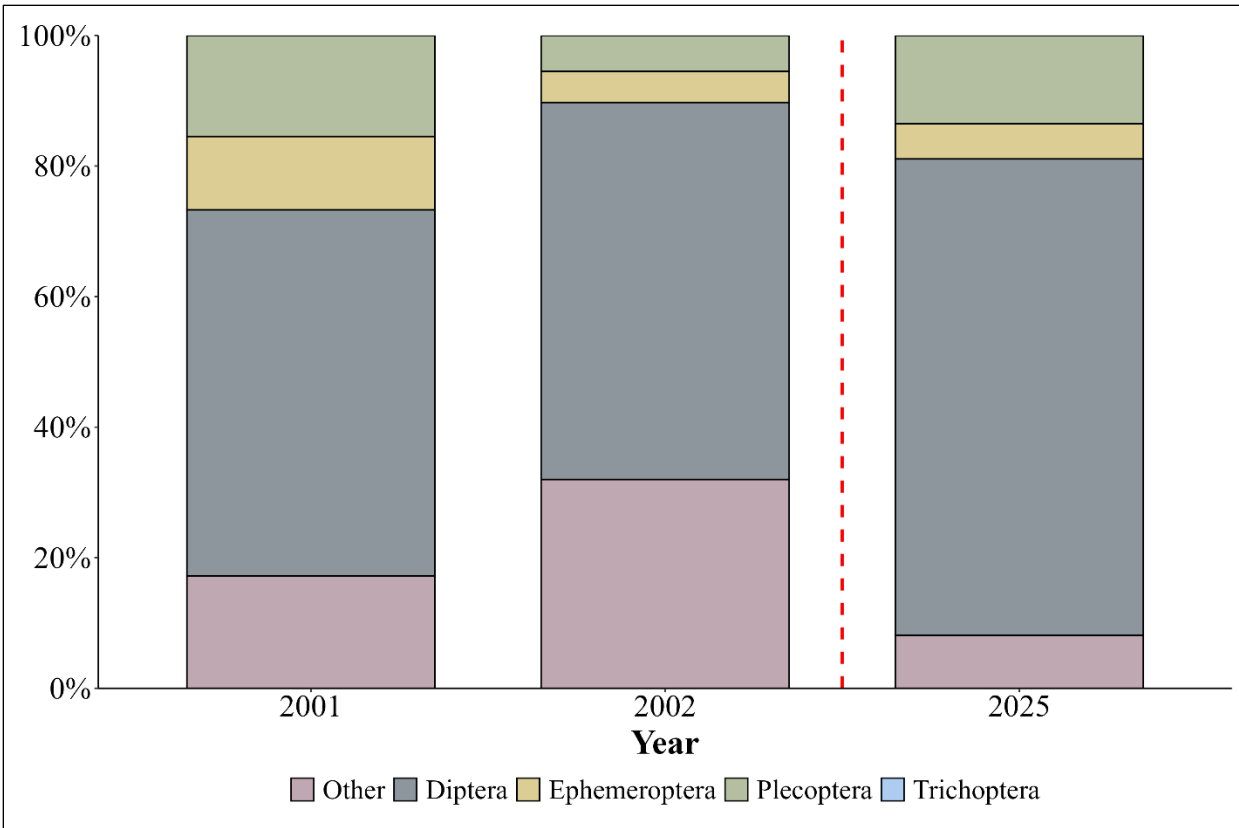


Figure 98.—Mean percent EPT, Diptera, and other taxa in Oak Creek aquatic invertebrate samples, 2001, 2002, and 2025. Hess samplers were used in 2025 as indicated by the red vertical dashed line.

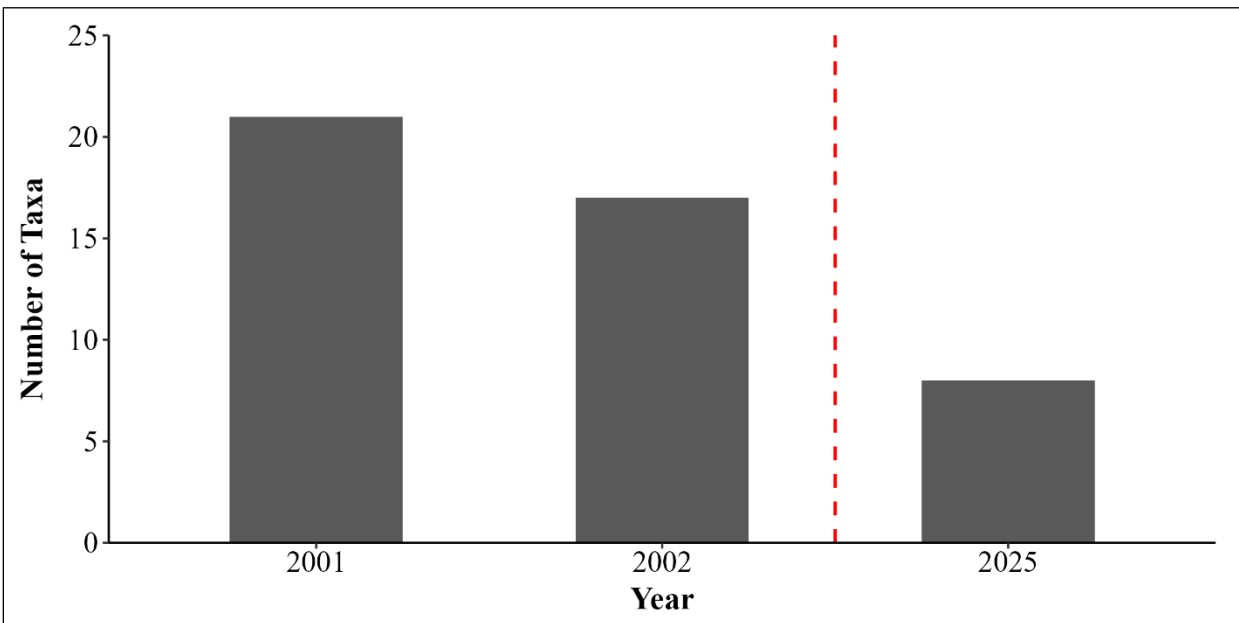


Figure 99.—Taxa richness in Oak Creek aquatic invertebrate samples, 2001, 2002, and 2025. Hess samplers were used in 2025 as indicated by the red vertical dashed line.

Sediment

Sediment element concentrations in Oak Creek and summary statistics from all 2025 sites are presented in Table 6. Cadmium and zinc at Oak Creek were more than double the mean concentration of all 2025 samples. The remaining elements were below the mean concentration. Sediment data from 2025 are presented in Appendix F.

Table 6.–Sediment sample element concentrations (mg/kg) in Oak Creek in 2025 and summary statistics. Summary statistics were calculated with all sites (n = 8) sampled in July 2025. Due to non-detections, mercury summary statistics exclude two sites (n = 6).

Element	Oak	All 2025 Sample Sites		
	2025	Mean	Minimum	Maximum
Cadmium	7.88	3.6	0.43	7.88
Copper	116	149.88	29.3	544
Lead	23.1	31.61	11.4	61.1
Mercury	ND	0.15	0.06	0.498
Selenium	4.4	5.23	1.27	16.6
Zinc	4,070	1,170.88	134	4,070

SUNDAY CREEK (STATION 215)

Water Quality

Sunday Creek is a tributary to the Wulik River that has an orange metal seep midway up the drainage. In 2001 and 2002, Sunday Creek was noted to have exceptionally good water quality with low concentrations of metals (Weber-Scannell and Ott 2006). In July 2025, in situ water temperature was 13.3°C, pH was 7.47, dissolved oxygen was 8.53 mg/L, turbidity was 24.16 NTU, and specific conductance was 575 µs/cm. In situ water quality data from 2025 are presented in Appendix B.

Periphyton

This was the first year that periphyton samples were collected at Sunday Creek since 2002. Mean chlorophyll-a concentration in Sunday Creek was notably lower in 2025 than in the early 2000s at 0.07 mg/m² (SD = 0.05; Figure 100). Periphyton data from 2025 are presented in Appendix C.

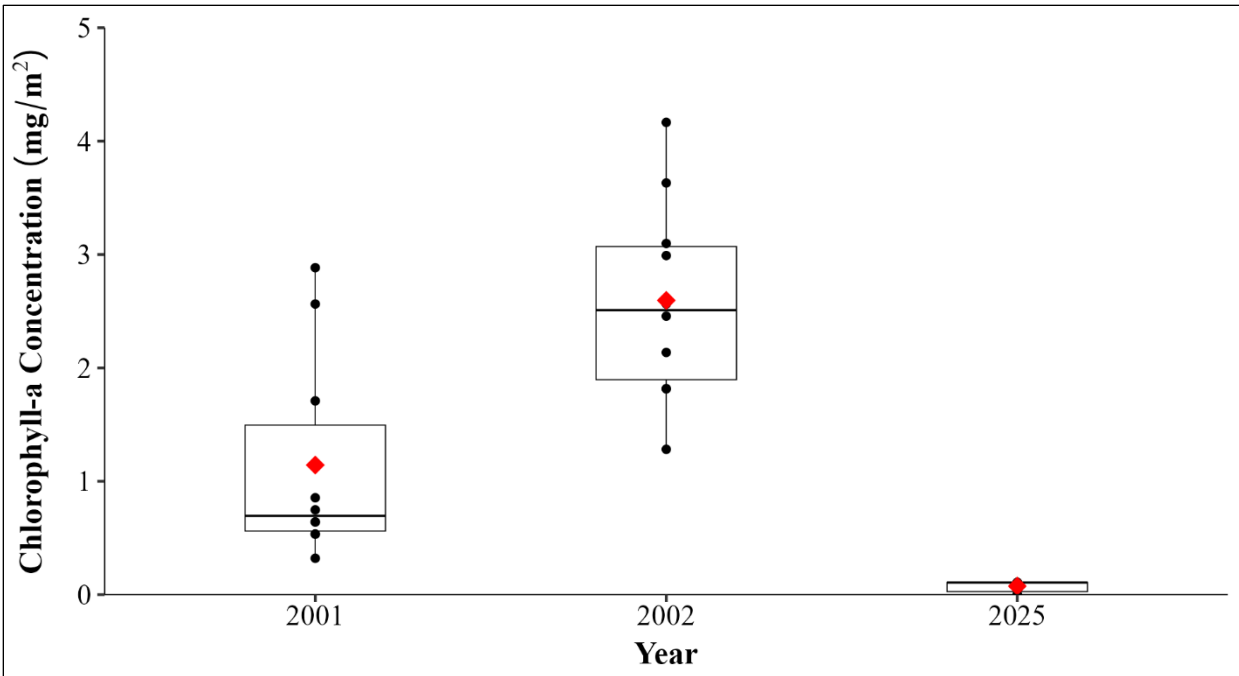


Figure 100.—Chlorophyll-a concentration boxplot by year at Sunday Creek, 2001, 2002, and 2025. Raw data are depicted by black dots and mean values are depicted by red diamonds.

Benthic Macroinvertebrates

This was the first year that BMI samples were collected at Sunday Creek since 2002 when samples were collected with drift nets instead of Hess samplers. The mean BMI density in Sunday Creek in 2025 was 253 BMI/m² (SD = 149). The proportion of EPT taxa present in BMI samples was the lowest on record in 2025 at 20.1% (Figure 101). Diptera made up 75.2% of the sample and “other” taxa made up the remaining proportion. Taxa richness in 2025 was 15 taxa, which is less than the richness in 2001 and 2002 (Figure 102). BMI data from 2025 are presented in Appendix D.

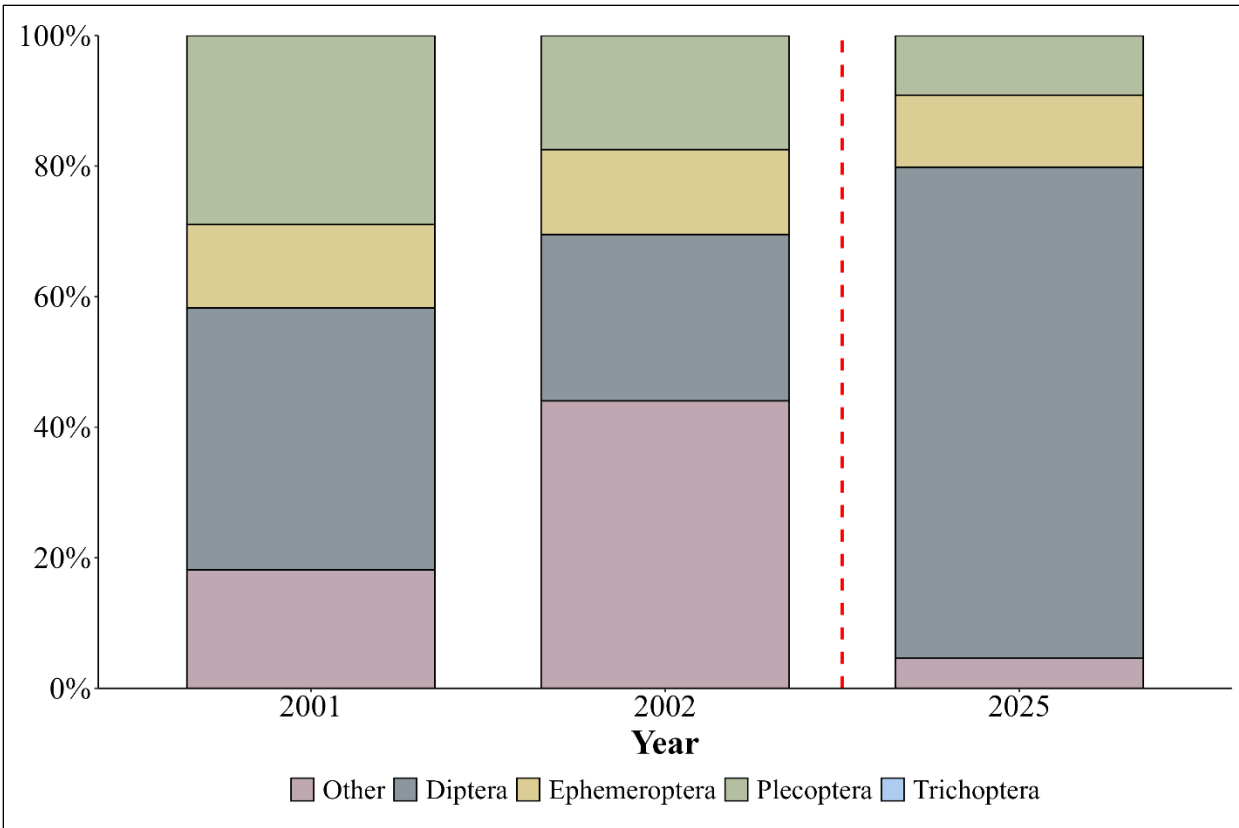


Figure 101.—Mean percent EPT, Diptera, and other taxa in Sunday Creek aquatic invertebrate samples, 2001, 2002, and 2025. Hess samplers were used in 2025 as indicated by the red vertical dashed line.

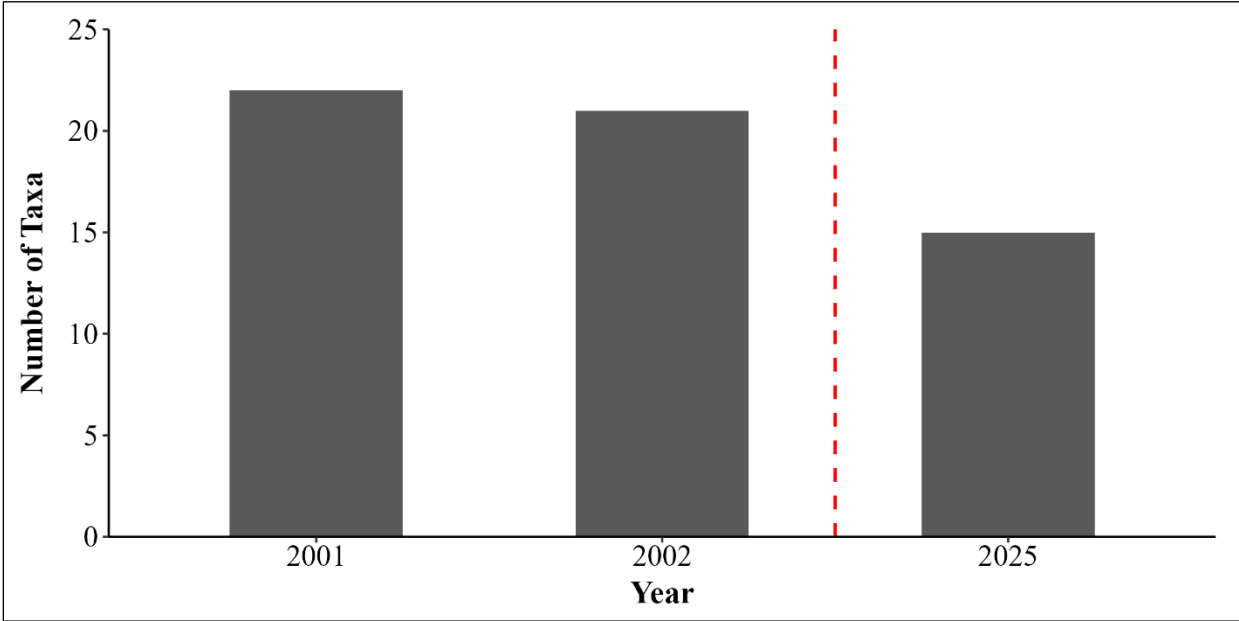


Figure 102.—Taxa richness in Sunday Creek aquatic invertebrate samples, 2001, 2002, and 2025. Hess samplers were used in 2025 as indicated by the red vertical dashed line.

Sediment

Sediment element concentrations in Sunday Creek and summary statistics from all 2025 sites are presented in Table 7. Most elements in Sunday Creek were below the mean concentration of 2025 samples except for cadmium and zinc. Sediment data from 2025 are presented in Appendix F.

Table 7.—Sediment sample element concentrations (mg/kg) in Sunday Creek in 2025 and summary statistics. Summary statistics were calculated with all sites (n = 8) sampled in July 2025. Due to non-detections, mercury summary statistics exclude two sites (n = 6).

Element	Sunday	All 2025 Sample Sites		
	2025	Mean	Minimum	Maximum
Cadmium	4.87	3.6	0.43	7.88
Copper	105	149.88	29.3	544
Lead	11.4	31.61	11.4	61.1
Mercury	0.06	0.15	0.06	0.498
Selenium	4.1	5.23	1.27	16.6
Zinc	1,470	1,170.88	134	4,070

SQUARE CREEK (STATION 214)

Water Quality

Square Creek is a tributary to the Wulik River with no visual indicators of impaired water quality. In 2001 and 2002, Square Creek was reported to have exceptionally good water quality with low concentrations of metals (Weber-Scannell and Ott 2006). In July 2025, in situ water temperature was 10.1°C, pH was 7.46, dissolved oxygen was 9.53 mg/L, turbidity was 0.1 NTU, and specific conductance was 636 µs/cm. In situ water quality data from 2025 are presented in Appendix B.

Periphyton

This was the first year that periphyton samples were collected at Square Creek since 2002. Mean chlorophyll-a concentration in Square Creek in 2025 was slightly lower than in the early 2000s at 1.13 mg/m² (SD = 0.94; Figure 103). Periphyton data from 2025 are presented in Appendix C.

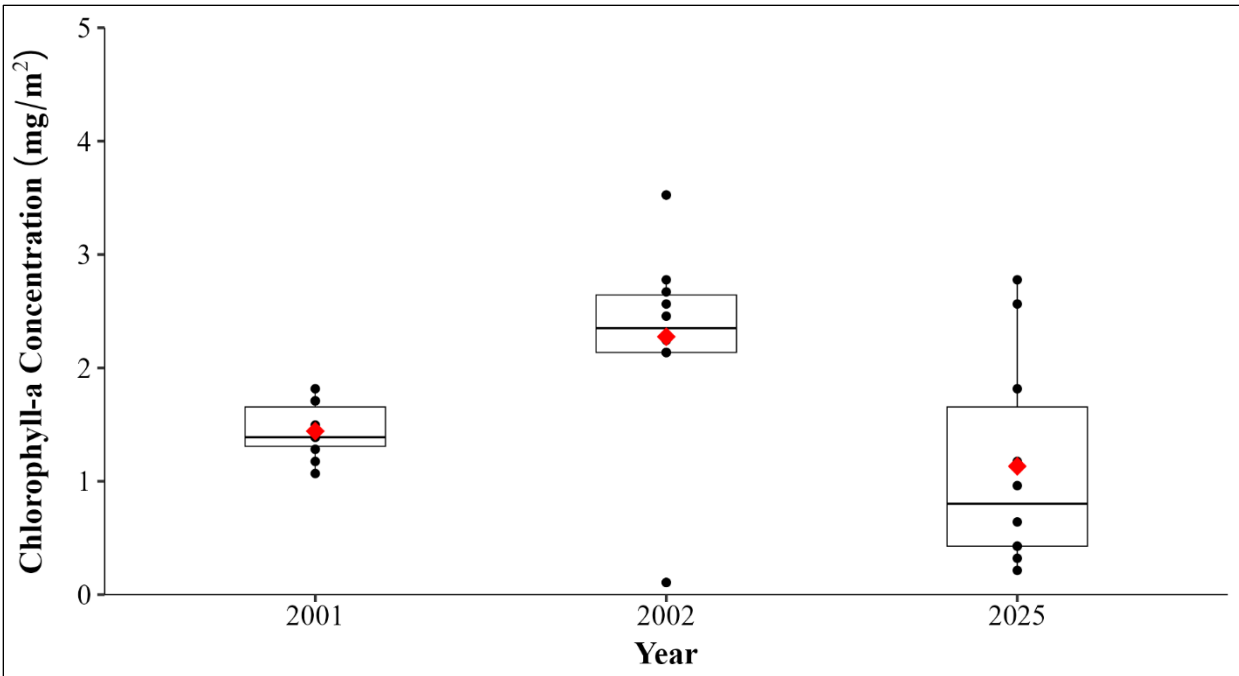


Figure 103.—Chlorophyll-a concentration boxplot by year at Square Creek, 2001, 2002, and 2025. Raw data are depicted by black dots and mean values are depicted by red diamonds.

Benthic Macroinvertebrates

This was the first year that BMI samples were collected at Square Creek since 2002 when samples were collected with drift nets instead of Hess samplers. The mean BMI density in Square Creek in 2025 was 4,249 BMI/m² (SD = 1,986). The proportion of EPT taxa present in BMI samples in 2025 was within the range observed in the early 2000s at 26.4% (Figure 104). Taxa richness in 2025 was 16 taxa, which is similar to the richness in 2002 (Figure 105). BMI data from 2025 are presented in Appendix D.

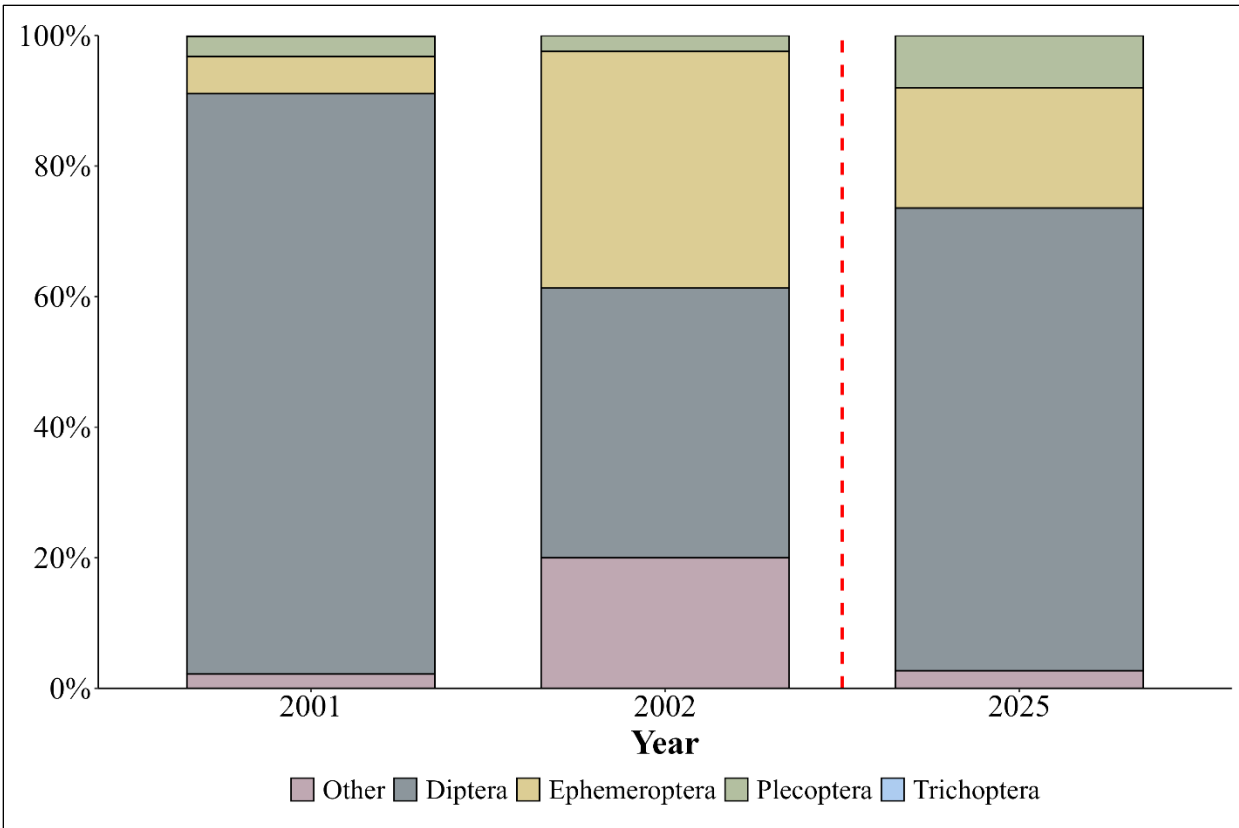


Figure 104.—Mean percent EPT, Diptera, and other taxa in Square Creek aquatic invertebrate samples, 2001, 2002, and 2025. Hess samplers were used in 2025 as indicated by the red vertical dashed line.

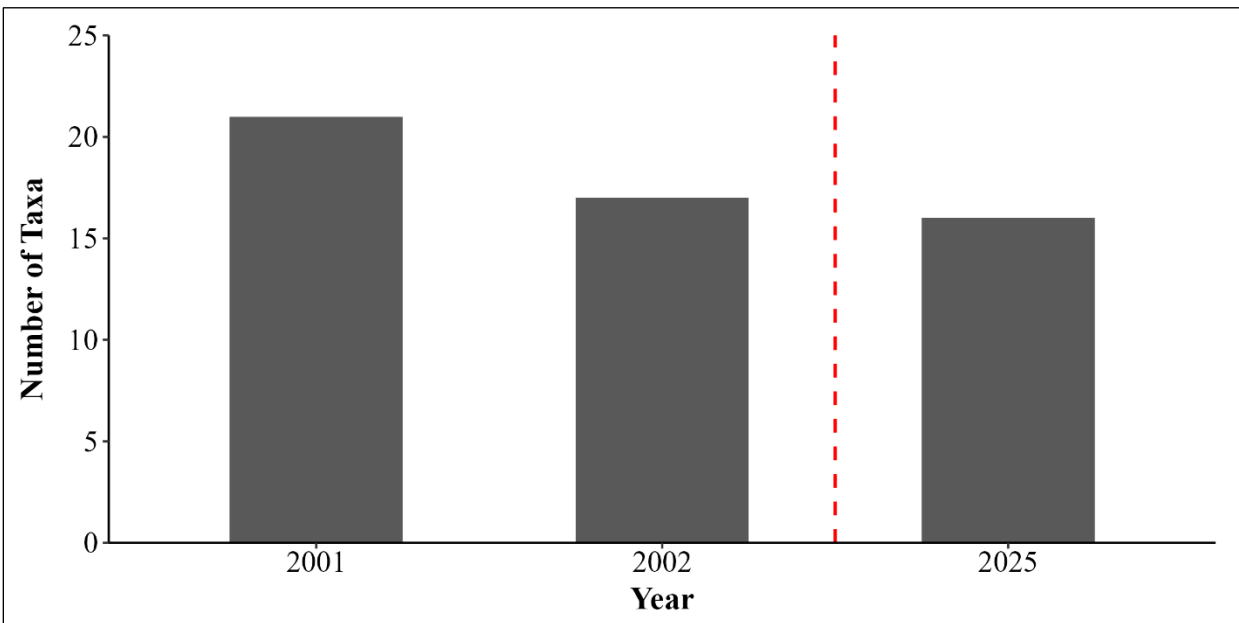


Figure 105.—Taxa richness in Square Creek aquatic invertebrate samples, 2001, 2002, and 2025. Hess samplers were used in 2025 as indicated by the red vertical dashed line.

Sediment

Sediment element concentrations in Square Creek and summary statistics from all 2025 sites are presented in Table 8. All elements were below the mean concentration of 2025 samples except for lead. Sediment data from 2025 are presented in Appendix F.

Table 8.—Sediment sample element concentrations (mg/kg) in Square Creek in 2025 and summary statistics. Summary statistics were calculated with all sites (n = 8) sampled in July 2025. Due to non-detections, mercury summary statistics exclude two sites (n = 6).

Element	Square	All 2025 Sample Sites		
	2025	Mean	Minimum	Maximum
Cadmium	1.24	3.6	0.43	7.88
Copper	29.3	149.88	29.3	544
Lead	46.4	31.61	11.4	61.1
Mercury	0.075	0.15	0.06	0.498
Selenium	2.7	5.23	1.27	16.6
Zinc	640	1,170.88	134	4,070

FERRIC CREEK (STATION 213)

Water Quality

Ferric Creek is a tributary to the Wulik River with orange-stained substrate. This staining was also noted during sampling in the early 2000s. In 2000–2002, concentrations of aluminum and iron were elevated, and pH ranged from 6.6 to 8.1 with a median of 7.6 (Weber-Scannell and Ott 2006). In July 2025, in situ water temperature was 5.3°C, pH was 5.56, dissolved oxygen was 11.74 mg/L, turbidity was 1.54 NTU, and specific conductance was 582 $\mu\text{S}/\text{cm}$. In situ water quality data from 2025 are presented in Appendix B.

Periphyton

This was the first year that periphyton samples were collected at Ferric Creek since 2002. In July 2025, mean chlorophyll-a concentration was higher than in the early 2000s at 14.19 mg/m^2 (SD = 8.32; Figure 106). Chlorophyll-a concentrations ranged from 3.52 to 32.89 mg/m^2 among 2025 samples. Periphyton data from 2025 are presented in Appendix C.

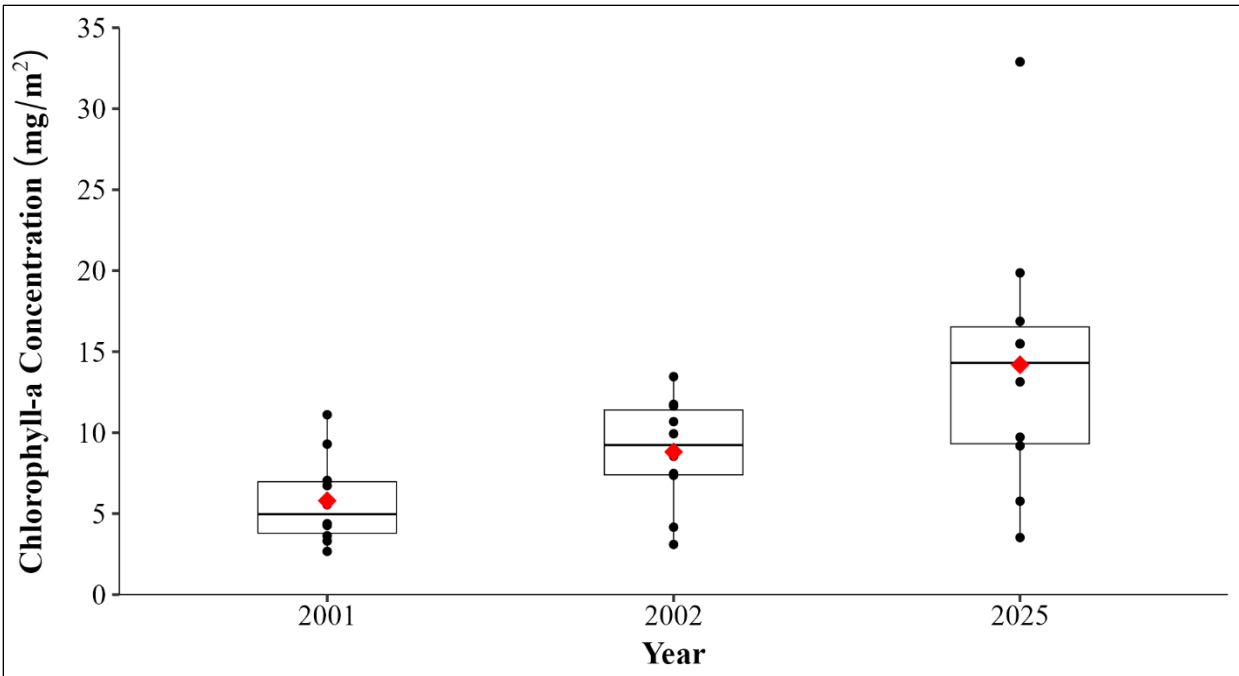


Figure 106.—Chlorophyll-a concentration boxplot by year at Ferric Creek, 2001, 2002, and 2025. Raw data are depicted by black dots and mean values are depicted by red diamonds.

Benthic Macroinvertebrates

This was the first year that BMI samples were collected at Ferric Creek since 2002 when samples were collected with drift nets instead of Hess samplers. The mean BMI density in Ferric Creek in 2025 was 749 BMI/m² (SD = 217). The proportion of EPT taxa present in BMI samples in 2025 was greater than the proportion observed in the early 2000s at 4.7% (Figure 107). Diptera made up 75.8% of the sample and “other” taxa made up the remaining proportion. Taxa richness in 2025 was 16 taxa, which is similar to the richness in 2001 and 2002 (Figure 108). BMI data from 2025 are presented in Appendix D.

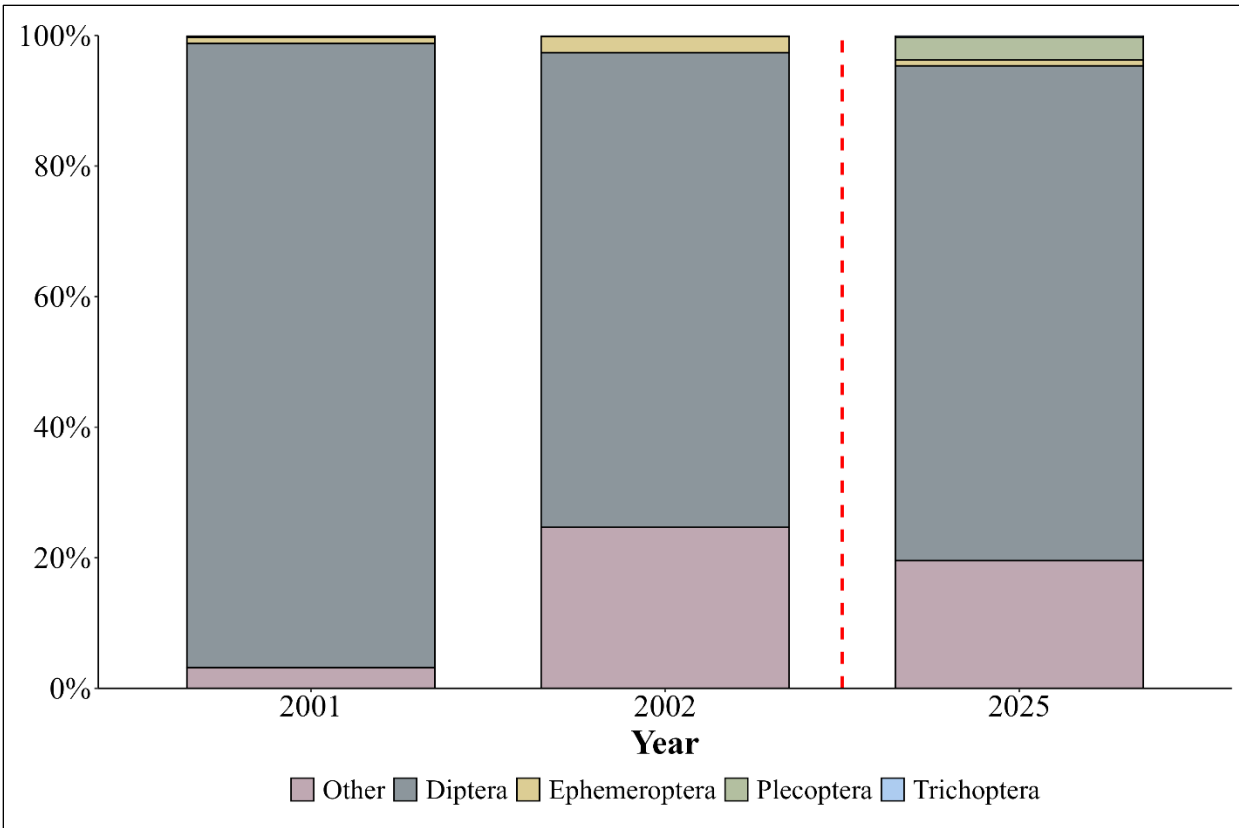


Figure 107.—Mean percent EPT, Diptera, and other taxa in Ferric Creek aquatic invertebrate samples, 2001, 2002, and 2025. Note: one Trichoptera (0.31% of the sample) was present in 2025. Hess samplers were used in 2025 as indicated by the red vertical dashed line.

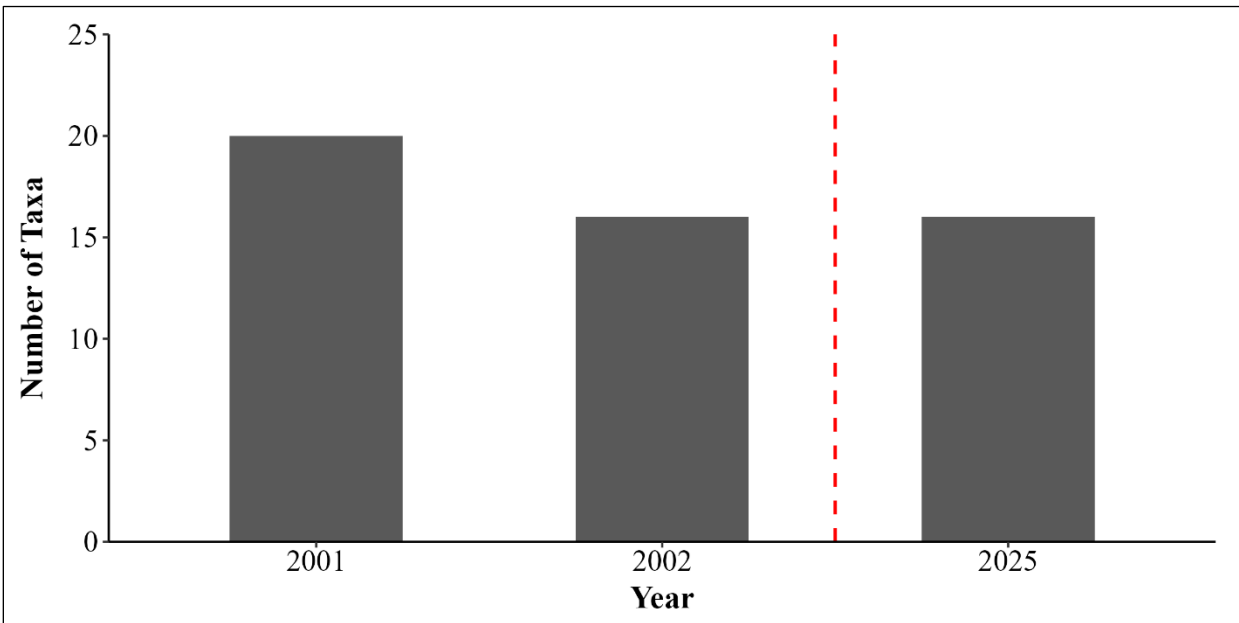


Figure 108.—Taxa richness in Ferric Creek aquatic invertebrate samples, 2001, 2002, and 2025. Hess samplers were used in 2025 as indicated by the red vertical dashed line.

Fish

This was the first year that fish sampling took place at Ferric Creek since 2002. In 2001, age-0 Dolly Varden were captured in drift samples, indicating spawning in the creek (Weber-Scannell and Ott 2006). Dolly Varden CPUE has ranged from 1 fish in 2001 to 53 fish in 2025 (Figure 109). Six of the Dolly Varden captured in 2025 had orange sediment particles on their gills and two had eroded opercula. Dolly Varden fork length ranged from 53 to 149 mm with a generally normal distribution and mean of 87.58 mm (SD = 11.4; Figure 110). All fish with FL 110 mm or greater were captured in 1999 and 2002. One slimy sculpin was also captured at this site in 2025. Fish capture data from 2025 are presented in Appendix E.

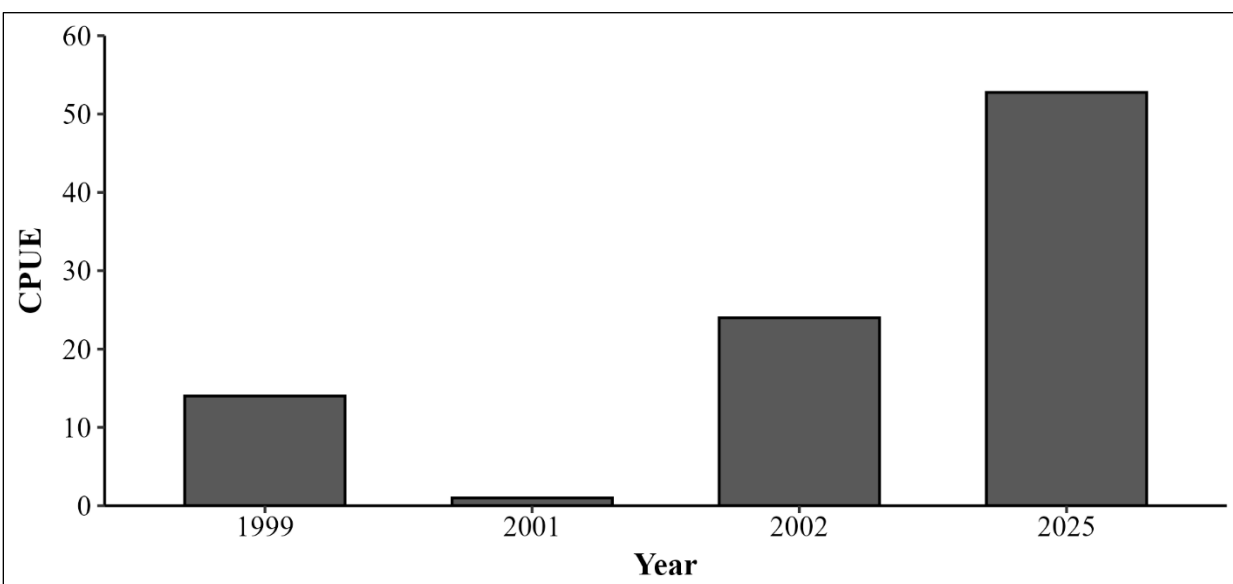


Figure 109.—Dolly Varden catch per unit effort (CPUE) captured in Ferric Creek, 1999, 2001, 2002, and 2025. Note that sampling took place upstream of the mineral seep in 1999 and downstream of it in all other years.

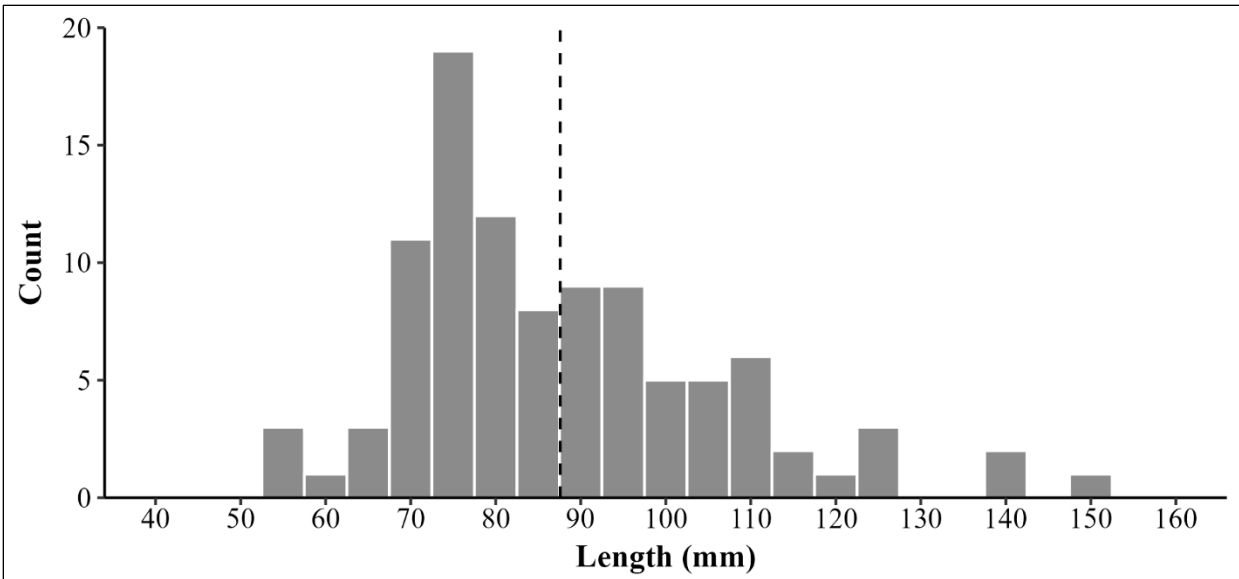


Figure 110.—Dolly Varden length frequency distribution for fish captured in Ferric Creek, 1999, 2001, 2002, and 2025. The vertical dashed line represents the sample mean length.

Sediment

Sediment element concentrations in Ferric Creek and summary statistics from all 2025 sites are presented in Table 9. Additional samples at a white seep near the main sample site were collected (Figure 111). Lead, mercury, and selenium were above the mean concentration of 2025 samples while the other elements were below the mean. All element concentrations at the white seep were well below the concentrations at the main sample site with non-detections for mercury and selenium. Sediment data from 2025 are presented in Appendix F.

Table 9.—Sediment sample element concentrations (mg/kg) in Ferric Creek and a nearby white seep in 2025 and summary statistics. Summary statistics were calculated with all sites (excluding the white seep; n = 8) sampled in July 2025. Due to non-detections, mercury summary statistics exclude two sites (n = 6).

Element	Ferric		All 2025 Sample Sites		
	2025	2025 White Seep	Mean	Minimum	Maximum
Cadmium	2.44	0.099	3.6	0.43	7.88
Copper	62.7	4.06	149.88	29.3	544
Lead	34.9	1.04	31.61	11.4	61.1
Mercury	0.498	ND	0.15	0.06	0.498
Selenium	16.6	ND	5.23	1.27	16.6
Zinc	279	12.3	1,170.88	134	4,070



Figure 111.–White seep entering Ferric Creek from river right near the sample site, August 2025.

CONCLUSION

In 2025, the weather during the August sampling period was clear and mild except for one day of low-lying fog. In contrast, weather conditions during the July sampling period were notably hot and dry. In situ water temperature was greater than 12°C at 8 out of the 21 sites sampled in July with a maximum of 16.2°C at Ikalukrok Creek upstream of Noa Creek. In previous years when in situ data was collected (2023 and 2024) the highest water temperature recorded was 7°C at Grayling Junior Creek in July 2024. In situ measurements of dissolved oxygen at all sample sites were within ranges considered suitable for supporting aquatic life (EPA 2026). However, six sites had dissolved oxygen levels less than 9 mg/L and nearing the 8 mg/L one day minimum aquatic life criteria. These results reflect the reduced solubility of oxygen as water temperature increases.

In situ pH values were below the lower limit of the EPA aquatic life criteria in freshwater (6.5 to 9) at nine sites in July 2025 (EPA 2025). Specific conductance ranged from 351 to 2,155 $\mu\text{S}/\text{cm}$ among sites which is generally elevated when compared to other freshwater Arctic rivers (Koch et al. 2024). Streams with higher specific conductance typically exhibited elevated concentrations of total recoverable metals. These higher conductance levels are consistent with water chemistry observations from streams influenced by rusting seeps in the Kobuk Valley National Park and Noatak National Preserve (Koch et al. 2023).

Mean chlorophyll-a concentrations in 2025 ranged from 0 mg/m^2 at Ikalukrok Creek downstream of Cub Creek to 14.2 mg/m^2 at Ferric Creek. Concentrations within all sites remained similar to recent years in 2025 except for Noa Creek where the mean chlorophyll-a concentration was the highest on record and over four times the second highest mean on record. The pH at this site was

3.65 indicating the potential presence of acid-tolerant algae species. The mean chlorophyll-a concentrations observed at RDMLE sites are similar to other streams monitored annually for the Red Dog Mine (Clawson 2025). Fourteen of the RDMLE sites fell within the range of values (0.12 to 28.88 mg/m²) observed in streams in the vicinity of the Arctic-Bornite exploratory mining prospects in 2024 (Edwards 2025b). The remaining seven sites fell below this range.

Despite having the second highest mean chlorophyll-a concentration among sites in 2025, Noa Creek (pH 3.65) had the second lowest mean BMI density, no EPT taxa, and the second lowest BMI taxa richness. In contrast, Ferric Creek (pH 5.56) had the highest mean chlorophyll-a concentration, the second highest mean BMI density, and EPT taxa were present. EPT taxa were not present in samples from Sourdock, Upper West Fork Ikalukrok, and West Fork Ikalukrok creeks. Taxa richness ranged from 2 at Sourdock Creek to 19 at Upper North Fork Red Dog North Tributary. The mean BMI density at Upper North Fork Red Dog North Tributary was highest among all sites for the second year in a row and over three times the second highest value. This mean BMI density of 31,256 BMI/m² is higher than the maximum observed densities in streams in the vicinity of the Arctic-Bornite exploratory mining prospects and similar to the highest densities on record in streams in the vicinity of the historic Illinois Creek mine (Edwards 2025a; Edwards 2025b).

Dolly Varden CPUE was highest at Ferric Creek (CPUE = 53 fish) where pH measured 5.56, below the EPA minimum aquatic life criterion of 6.5. Clearwater refugia sites with potentially more neutral pH exist upstream of the sample site and in a nearby tributary downstream of the sample site. At other sites with similar or lower pH zero fish were captured, including Lower and Upper Competition, Sourdock, West Fork Ikalukrok, and Ikalukrok upstream of West Fork Ikalukrok Creeks. The CPUE at the remaining sites ranged from 1 to 9 fish. Three slimy sculpin were captured in 2025, 2 at Ikalukrok Creek upstream of Noa Creek and 1 at Ferric Creek.

The RDMLE biomonitoring program has established a valuable continuous multi-year baseline data set and led to the identification of physical and biological changes in several streams in the vicinity of the RDMLE. Documented declines in chlorophyll-a concentrations in Sourdock, Lower Competition, and Grayling Junior creeks are likely due to an increased prevalence of natural mineral seeps. Resampling the legacy sites that were first sampled in the early 2000s

provides a coarse comparison on how streams within the Wulik River drainage are changing, as metal rich seeps are increasing in frequency across the Brooks Range in recent years (O'Donnell et al. 2024; Sullivan et al. 2025). In addition, the general variability in biological data observed among and within sample sites over the years illustrates the importance of continued aquatic biomonitoring to capture the magnitude of natural variability at these sites prior to development and to better assess conditions post-development. ADF&G recommends continuing the annual aquatic biomonitoring program including in situ water quality, periphyton, BMI, fish, and sediment sampling.

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APPENDIX A. WATER QUALITY AND ELEMENT CONCENTRATION DATA FROM LOCATIONS NEAR THE RED DOG MINE LIFE EXTENSION PROJECT, 2025.

Samples were collected by Teck and analyzed by external labs.

Site	Station	Parameter	Units	Seasonal Mean	Minimum	Maximum	n
Upper Competition	203	Aluminum	ug/L	8045	2670	20000	4
Upper Competition	203	Cadmium	ug/L	17.525	6.07	36	4
Upper Competition	203	Conductivity, Field	uS/cm	763.4	424.6	1124	4
Upper Competition	203	Lead	ug/L	1.8225	1.15	3.03	4
Upper Competition	203	Nickel	ug/L	1419.25	584	3250	4
Upper Competition	203	Temperature, Field	°C	2.2	0	6.8	4
Upper Competition	203	Total Dissolved Solids	mg/L	1196	570	2040	4
Upper Competition	203	Turbidity, Field	NTU	69.02	8.38	159	4
Upper Competition	203	Zinc	ug/L	4727.5	1700	9650	4
Upper Competition	203	pH, Field	pH Units	5.7525	4.61	7.13	4
Sourdock	204	Aluminum	ug/L	4876.75	867	12300	4
Sourdock	204	Cadmium	ug/L	12.7775	4.25	27.9	4
Sourdock	204	Conductivity, Field	uS/cm	711.875	354.5	1399	4
Sourdock	204	Lead	ug/L	1.235	0.25	2.39	4
Sourdock	204	Nickel	ug/L	945.25	462	1740	4
Sourdock	204	Temperature, Field	°C	2.7	0	8.8	4
Sourdock	204	Total Dissolved Solids	mg/L	1016	506	1890	4
Sourdock	204	Turbidity, Field	NTU	47.025	30.9	69.4	4
Sourdock	204	Zinc	ug/L	3852.5	1120	9500	4
Sourdock	204	pH, Field	pH Units	6.0325	4.85	7.02	4
West Fork Ikalukrok	231	Aluminum	ug/L	3775	2870	5090	4
West Fork Ikalukrok	231	Cadmium	ug/L	17.425	12.6	27.3	4
West Fork Ikalukrok	231	Conductivity, Field	uS/cm	816	548	1346	4
West Fork Ikalukrok	231	Lead	ug/L	0.46	0.13	0.79	2
West Fork Ikalukrok	231	Nickel	ug/L	1002.5	531	1570	4
West Fork Ikalukrok	231	Temperature, Field	°C	2.125	0	5.1	4
West Fork Ikalukrok	231	Total Dissolved Solids	mg/L	1190	826	1950	4
West Fork Ikalukrok	231	Turbidity, Field	NTU	1.355	0.49	2.62	4
West Fork Ikalukrok	231	Zinc	ug/L	2762.5	1990	4220	4
West Fork Ikalukrok	231	pH, Field	pH Units	3.875	3.62	4.26	4
Ikalukrok d/s Cub	207	Aluminum	ug/L	2612.5	1390	5380	4
Ikalukrok d/s Cub	207	Cadmium	ug/L	16.83	8.8	31.5	4
Ikalukrok d/s Cub	207	Conductivity, Field	uS/cm	513.575	350.6	794	4
Ikalukrok d/s Cub	207	Lead	ug/L	5.54	3.46	7.41	4
Ikalukrok d/s Cub	207	Nickel	ug/L	470.25	299	652	4
Ikalukrok d/s Cub	207	Temperature, Field	°C	4.175	0	11.5	4
Ikalukrok d/s Cub	207	Total Dissolved Solids	mg/L	652	466	838	4
Ikalukrok d/s Cub	207	Turbidity, Field	NTU	13.115	7.19	24.4	4
Ikalukrok d/s Cub	207	Zinc	ug/L	4270	2160	8660	4
Ikalukrok d/s Cub	207	pH, Field	pH Units	5.365	4.67	6.08	4

Site	Station	Parameter	Units	Seasonal Mean	Minimum	Maximum	n
East Fork Ikalukrok	208	Aluminum	ug/L	36.98	15.5	58.9	5
East Fork Ikalukrok	208	Cadmium	ug/L	0.086	0.066	0.175	6
East Fork Ikalukrok	208	Conductivity, Field	uS/cm	251.425	180.4	322.1	4
East Fork Ikalukrok	208	Lead	ug/L	1.04	0.29	1.79	2
East Fork Ikalukrok	208	Nickel	ug/L	6.04	3.18	10.3	5
East Fork Ikalukrok	208	Temperature, Field	°C	4.45	0	11	4
East Fork Ikalukrok	208	Total Dissolved Solids	mg/L	250	186	296	6
East Fork Ikalukrok	208	Turbidity, Field	NTU	0.8375	0.39	1.16	4
East Fork Ikalukrok	208	Zinc	ug/L	18.7714	6.4	43.6	7
East Fork Ikalukrok	208	pH, Field	pH Units	7.1875	5.78	8.06	4
Grayling Jr	209	Aluminum	ug/L	140.6	53.4	213	4
Grayling Jr	209	Cadmium	ug/L	0.5228	0.267	0.735	4
Grayling Jr	209	Conductivity, Field	uS/cm	584.75	393	805	4
Grayling Jr	209	Nickel	ug/L	41.425	22.1	53.5	4
Grayling Jr	209	Temperature, Field	°C	5.125	0	11.8	4
Grayling Jr	209	Total Dissolved Solids	mg/L	727	486	956	4
Grayling Jr	209	Turbidity, Field	NTU	2.49	0.71	5.04	4
Grayling Jr	209	Zinc	ug/L	76.025	36.9	97.5	4
Grayling Jr	209	pH, Field	pH Units	7.0925	6.45	7.89	4
EF Grayling Jr	n/a	Aluminum	ug/L	532.75	324	1030	4
EF Grayling Jr	n/a	Cadmium	ug/L	1.7925	1.39	2.45	4
EF Grayling Jr	n/a	Conductivity, Field	uS/cm	553.775	413.8	708	4
EF Grayling Jr	n/a	Lead	ug/L	0.29	0.29	0.29	1
EF Grayling Jr	n/a	Nickel	ug/L	99.5	81.1	115	4
EF Grayling Jr	n/a	Temperature, Field	°C	4.35	0	11.8	4
EF Grayling Jr	n/a	Total Dissolved Solids	mg/L	702.5	552	1020	4
EF Grayling Jr	n/a	Turbidity, Field	NTU	8.855	1.49	19.9	4
EF Grayling Jr	n/a	Zinc	ug/L	266.75	232	317	4
EF Grayling Jr	n/a	pH, Field	pH Units	7.125	6.34	7.84	4
Noa	210	Aluminum	ug/L	16375	12000	22900	4
Noa	210	Cadmium	ug/L	19.25	14.5	24.6	4
Noa	210	Conductivity, Field	uS/cm	1084.25	759	1609	4
Noa	210	Lead	ug/L	1.155	0.34	1.97	2
Noa	210	Nickel	ug/L	4247.5	2540	6130	4
Noa	210	Temperature, Field	°C	2.775	0	6.5	4
Noa	210	Total Dissolved Solids	mg/L	1780	1190	2430	4
Noa	210	Turbidity, Field	NTU	3.745	0.71	10.2	4
Noa	210	Zinc	ug/L	7177.5	4640	10800	4
Noa	210	pH, Field	pH Units	3.5325	3.32	3.69	4

APPENDIX B. IN SITU WATER QUALITY DATA FROM LOCATIONS NEAR THE RED DOG MINE LIFE EXTENSION PROJECT, 2025.

Site	Station	Date	Time	Water Temp (°C)	Dissolved Oxygen (mg/L)	pH	Specific Conductivity (µs/cm)	Turbidity (NTU)
Upper Competition	203	7/4/25	1100	5.9	10.2	3.94	2155	50.6
Sourdock	204	7/4/25	1150	5.1	10.88	6.13	1013	21.4
Lower Competition	202	7/4/25	1330	10.9	9.49	5.12	1499	17.72
Warf	233	7/2/25	1000	5.6	10.6	7.87	461	0.25
Upper WF Ikalukrok	231	7/2/25	1115	4.9	10.48	3.66	1703	0.21
WF Ikalukrok	205	7/2/25	1215	7.1	10.51	3.59	1347	0.44
Ikalukrok u/s WF	206	7/2/25	1255	10.2	9.35	5.96	621	0.45
Ikalukrok d/s Cub	207	7/2/25	1410	12.5	9.15	5.8	786	7.87
Ikalukrok u/s Grayling	RDMLE-02	7/3/25	1430	14.2	8.51	7.46	514	4.88
EF Ikalukrok	208	7/2/25	1510	12.3	9.45	7.12	350.5	0.06
Grayling Jr	209	7/3/25	1305	13.1	8.15	7.57	830	0.35
NF Grayling Jr		7/3/25	1100	9.3	9.8	7.71	1002	0.64
EF Grayling Jr		7/3/25	1200	12.2	8.83	7.48	501	1.21
Noa	210	7/3/25	1530	7.6	10.47	3.65	2138	0.18
Ikalukrok u/s Noa	RDMLE-03	7/3/25	1620	16.2	8.25	6.56	604	3.21
Upper NFRD North Trib		7/4/25	1515	8	10.09	6.79	562	0.07
Upper NFRD South Trib		7/4/25	1630	10.6	9.05	6.8	444.2	0.79
Oak	216	7/5/25	1245	13.6	8.57	6.9	730	20.9
Sunday	215	7/5/25	1155	13.3	8.53	7.47	575	24.16
Square	214	7/5/25	1100	10.1	9.53	7.46	636	0.1
Ferric	213	7/5/25	930	5.3	11.74	5.56	582	1.54

APPENDIX C. CHLOROPHYLL DATA FROM LOCATIONS NEAR THE RED DOG MINE LIFE EXTENSION PROJECT, 2025.

The values reported and analyzed in this report are in the phaeo-corrected chlorophyll-a value 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			
					Phaeo Corrected			
Daily Vial #	Site (Station)	Date	Vial	Chl a	Chl a	664/665	Chl b	Chl c
		Analyzed	Chl a	mg/m2	mg/m2	Ratio	mg/m2	mg/m2
32	Upper Competition (203)	10/2/2025	0.00	0.00	0		0.00	0.00
33	Upper Competition (203)	10/2/2025	0.00	0.00	0		0.00	0.00
34	Upper Competition (203)	10/2/2025	0.01	0.05	0.1068		0.00	0.09
35	Upper Competition (203)	10/2/2025	0.00	0.00	0		0.00	0.10
36	Upper Competition (203)	10/2/2025	0.01	0.04	0.1068		0.05	0.06
37	Upper Competition (203)	10/2/2025	0.00	0.00	0		0.00	0.00
38	Upper Competition (203)	10/2/2025	0.01	0.04	0.1068		0.05	0.06
39	Upper Competition (203)	10/2/2025	0.00	0.00	0		0.00	0.00
40	Upper Competition (203)	10/2/2025	0.01	0.04	0.1068		0.05	0.06
41	Upper Competition (203)	10/2/2025	0.01	0.04	0.1068		0.05	0.06
52	Sourdock (204)	10/1/2025	0.01	0.04	0		0.0518	0.061
53	Sourdock (204)	10/1/2025	0.02	0.08	0.2136		0	0
54	Sourdock (204)	10/1/2025	0.02	0.09	0.2136		0	0
55	Sourdock (204)	10/1/2025	0.02	0.09	0.2136		0	0
56	Sourdock (204)	10/1/2025	0.03	0.14	0.1068		0	0
57	Sourdock (204)	10/1/2025	0.03	0.14	0.1068		0.0518	0.061
58	Sourdock (204)	10/1/2025	0.01	0.05	0.1068		0	0
59	Sourdock (204)	10/1/2025	0.01	0.05	0.1068		0	0
60	Sourdock (204)	10/1/2025	0.01	0.04	0.1068		0	0
61	Sourdock (204)	10/1/2025	0.00	0.00	0		0	0
12	Lower Competition (202)	9/26/2025	0.00	0.00	0		0.00	0.00
13	Lower Competition (202)	9/26/2025	0.00	0.00	0		0.00	0.00
14	Lower Competition (202)	9/26/2025	0.01	0.04	0.1068		0.05	0.06
15	Lower Competition (202)	9/26/2025	0.00	0.00	0		0.00	0.00
16	Lower Competition (202)	9/26/2025	0.00	0.00	0		0.00	0.00
17	Lower Competition (202)	9/26/2025	0.00	0.00	0		0.00	0.00
18	Lower Competition (202)	9/26/2025	0.00	0.00	0		0.00	0.00
19	Lower Competition (202)	9/26/2025	0.00	0.00	0		0.00	0.00
20	Lower Competition (202)	9/26/2025	0.00	0.00	0		0.00	0.00
21	Lower Competition (202)	9/26/2025	0.00	0.00	0		0.00	0.00
12	Warf (233)	9/30/2025	0.04	0.18	0.2136		2	0.07
13	Warf (233)	9/30/2025	0.01	0.04	0.1068		0.05	0.06
14	Warf (233)	9/30/2025	0.01	0.05	0.1068		0.00	0.00
15	Warf (233)	9/30/2025	0.03	0.14	0.2136		3	0.01
16	Warf (233)	9/30/2025	0.02	0.09	0.1068		2	0.03
17	Warf (233)	9/30/2025	0.04	0.18	0.3204		4	0.07
18	Warf (233)	9/30/2025	0.00	0.00	0		0.00	0.00
19	Warf (233)	9/30/2025	0.01	0.04	0.1068		0.05	0.06
20	Warf (233)	9/30/2025	0.06	0.22	0.3204	2.5	0.05	0.00
21	Warf (233)	9/30/2025	0.04	0.18	0.2136		2	0.07

IDL = 0.08 mg/m ² EDL = 0.41 mg/m ²					Linear Check Maximum = 73.89 mg/m ²			
					Phaeo Corrected			
Daily Vial #	Site	Date Analyzed	Vial Chl a	Chl a mg/m2	Chl a mg/m2	664/665 Ratio	Chl b mg/m2	Chl c mg/m2
42	Upper WF Ikalukrok (231)	10/2/2025	0.45	1.81	1.7088	1.6667	0.2131	0.1899
43	Upper WF Ikalukrok (231)	10/2/2025	0.28	1.13	1.068	1.6667	0.1502	0.1479
44	Upper WF Ikalukrok (231)	10/2/2025	0.08	0.32	0.2136	1.4000	0.0000	0.0886
45	Upper WF Ikalukrok (231)	10/2/2025	0.09	0.36	0.3204	1.6000	0.0573	0.0515
46	Upper WF Ikalukrok (231)	10/2/2025	0.01	0.05	0.1068	0.0000	0.0000	0.0000
47	Upper WF Ikalukrok (231)	10/2/2025	0.03	0.14	0.1068	1.5000	0.0083	0.0476
48	Upper WF Ikalukrok (231)	10/2/2025	0.11	0.45	0.3204	1.4286	0.0032	0.1362
49	Upper WF Ikalukrok (231)	10/2/2025	0.10	0.41	0.4272	1.8000	0.0356	0.0448
50	Upper WF Ikalukrok (231)	10/2/2025	0.03	0.14	0.3204	0.0000	0.0083	0.0476
51	Upper WF Ikalukrok (231)	10/2/2025	0.09	0.36	0.3204	1.6000	0.0467	0.1496
2	WF Ikalukrok (205)	9/26/2025	0.01	0.05	0.1068	0	0.00	0.00
3	WF Ikalukrok (205)	9/26/2025	0.01	0.05	0.1068	0	0.00	0.09
4	WF Ikalukrok (205)	9/26/2025	0.01	0.05	0.1068	0	0.00	0.00
5	WF Ikalukrok (205)	9/26/2025	0.02	0.09	0.2136	0	0.03	0.05
6	WF Ikalukrok (205)	9/26/2025	0.01	0.04	0.1068	0	0.05	0.06
7	WF Ikalukrok (205)	9/26/2025	0.01	0.05	0.1068	0	0.00	0.00
8	WF Ikalukrok (205)	9/26/2025	0.01	0.05	0.1068	0	0.00	0.00
9	WF Ikalukrok (205)	9/26/2025	0.01	0.05	0.1068	0	0.00	0.00
10	WF Ikalukrok (205)	9/26/2025	0.01	0.05	0.1068	0	0.00	0.00
11	WF Ikalukrok (205)	9/26/2025	0.01	0.04	0.1068	0	0.05	0.06
22	Ikalukrok u/s WF Ikalukrok (206)	10/2/2025	0.01	0.04	0.1068	0	0.05	0.06
23	Ikalukrok u/s WF Ikalukrok (206)	10/2/2025	0.01	0.04	0.1068	0	0.05	0.06
24	Ikalukrok u/s WF Ikalukrok (206)	10/2/2025	0.00	0.00	0	0	0.00	0.00
25	Ikalukrok u/s WF Ikalukrok (206)	10/2/2025	0.01	0.04	0.1068	0	0.05	0.06
26	Ikalukrok u/s WF Ikalukrok (206)	10/2/2025	0.01	0.04	0.1068	0	0.05	0.06
27	Ikalukrok u/s WF Ikalukrok (206)	10/2/2025	0.01	0.05	0.1068	0	0.00	0.09
28	Ikalukrok u/s WF Ikalukrok (206)	10/2/2025	0.01	0.04	0.1068	0	0.05	0.06
29	Ikalukrok u/s WF Ikalukrok (206)	10/2/2025	0.01	0.04	0.1068	0	0.05	0.06
30	Ikalukrok u/s WF Ikalukrok (206)	10/2/2025	0.01	0.05	0.1068	0	0.00	0.09
31	Ikalukrok u/s WF Ikalukrok (206)	10/2/2025	0.00	0.00	0	0	0.00	0.00
2	Ikalukrok d/s Cub (207)	10/1/2025	0.00	0.00	0	0	0.00	0.00
3	Ikalukrok d/s Cub (207)	10/1/2025	0.00	0.00	0	0	0.00	0.10
4	Ikalukrok d/s Cub (207)	10/1/2025	0.00	0.00	0	0	0.07	0.07
5	Ikalukrok d/s Cub (207)	10/1/2025	0.00	0.00	0	0	0.00	0.00
6	Ikalukrok d/s Cub (207)	10/1/2025	0.00	0.00	0	0	0.00	0.00
7	Ikalukrok d/s Cub (207)	10/1/2025	0.00	0.00	0	0	0.00	0.00
8	Ikalukrok d/s Cub (207)	10/1/2025	0.00	0.00	0	0	0.00	0.00
9	Ikalukrok d/s Cub (207)	10/1/2025	0.00	0.00	0	0	0.00	0.10
10	Ikalukrok d/s Cub (207)	10/1/2025	0.00	0.00	0	0	0.00	0.00
11	Ikalukrok d/s Cub (207)	10/1/2025	0.00	0.00	0	0	0.00	0.00
22	Ikalukrok u/s Grayling (RDMLE-02)	10/1/2025	0.00	0.00	0	0	0.00	0.00
23	Ikalukrok u/s Grayling (RDMLE-02)	10/1/2025	0.01	0.05	0.1068	0	0.00	0.09
24	Ikalukrok u/s Grayling (RDMLE-02)	10/1/2025	0.01	0.04	0.1068	0	0.05	0.06
25	Ikalukrok u/s Grayling (RDMLE-02)	10/1/2025	0.01	0.04	0.1068	0	0.05	0.06
26	Ikalukrok u/s Grayling (RDMLE-02)	10/1/2025	0.00	0.00	0	0	0.00	0.10
27	Ikalukrok u/s Grayling (RDMLE-02)	10/1/2025	0.00	0.00	0	0	0.00	0.00
28	Ikalukrok u/s Grayling (RDMLE-02)	10/1/2025	0.01	0.04	0.1068	0	0.05	0.06
29	Ikalukrok u/s Grayling (RDMLE-02)	10/1/2025	0.00	0.00	0	0	0.00	0.00
30	Ikalukrok u/s Grayling (RDMLE-02)	10/1/2025	0.00	0.00	0	0	0.00	0.00
31	Ikalukrok u/s Grayling (RDMLE-02)	10/1/2025	0.00	0.00	0	0	0.00	0.00

IDL = 0.08 mg/m ² EDL = 0.41 mg/m ²					Linear Check Maximum = 73.89 mg/m ²			
					Phaeo Corrected			
Daily Vial #	Site	Date	Vial	Chl a	Chl a	664/665	Chl b	Chl c
		Analyzed	Chl a	mg/m2	mg/m2	Ratio	mg/m2	mg/m2
42	EF Ikalukrok (208)	10/1/2025	0.35	1.41	1.3884	1.72	0.02	0.11
43	EF Ikalukrok (208)	10/1/2025	0.48	1.90	1.8156	1.68	0.15	0.37
44	EF Ikalukrok (208)	10/1/2025	0.40	1.59	1.4952	1.67	0.07	0.31
45	EF Ikalukrok (208)	10/1/2025	0.40	1.59	1.3884	1.59	0.00	0.25
46	EF Ikalukrok (208)	10/1/2025	0.40	1.58	1.3884	1.59	0.15	0.28
47	EF Ikalukrok (208)	10/1/2025	0.52	2.09	1.9224	1.64	0.07	0.25
48	EF Ikalukrok (208)	10/1/2025	0.64	2.55	2.4564	1.70	0.08	0.38
49	EF Ikalukrok (208)	10/1/2025	0.28	1.13	0.9612	1.56	0.13	0.34
50	EF Ikalukrok (208)	10/1/2025	0.31	1.23	1.1748	1.69	0.02	0.16
51	EF Ikalukrok (208)	10/1/2025	0.25	1.00	1.068	1.83	0.00	0.16
32	Grayling Jr (209)	9/30/2025	0.07	0.27	0.2136	1.5000	0.0273	0.0000
33	Grayling Jr (209)	9/30/2025	0.03	0.14	0.1068	1.5000	0.0083	0.0476
34	Grayling Jr (209)	9/30/2025	0.42	1.69	1.602	1.6818	0.0000	0.2335
35	Grayling Jr (209)	9/30/2025	0.14	0.54	0.534	1.7143	0.0439	0.0925
36	Grayling Jr (209)	9/30/2025	0.25	1.00	0.9612	1.6923	0.0000	0.0630
37	Grayling Jr (209)	9/30/2025	0.16	0.64	0.534	1.5556	0.0005	0.0791
38	Grayling Jr (209)	9/30/2025	0.05	0.18	0.2136	2.0000	0.0000	0.0410
39	Grayling Jr (209)	9/30/2025	0.25	1.00	1.068	1.8333	0.0000	0.0630
40	Grayling Jr (209)	9/30/2025	0.05	0.18	0.2136	2.0000	0.0000	0.0410
41	Grayling Jr (209)	9/30/2025	0.17	0.69	0.7476	1.8750	0.0000	0.0724
12	NF Grayling Jr	10/1/2025	0.03	0.14	0.1068	1.5000	0.0083	0.0476
13	NF Grayling Jr	10/1/2025	0.07	0.27	0.3204	2.0000	0.0166	0.0953
14	NF Grayling Jr	10/1/2025	0.03	0.13	0.1068	1.5000	0.0818	0.1153
15	NF Grayling Jr	10/1/2025	0.15	0.59	0.534	1.6250	0.0222	0.0858
16	NF Grayling Jr	10/1/2025	0.07	0.27	0.2136	1.5000	0.1008	0.0649
17	NF Grayling Jr	10/1/2025	0.19	0.77	0.7476	1.7000	0.0194	0.0287
18	NF Grayling Jr	10/1/2025	0.06	0.22	0.2136	1.6667	0.0490	0.0039
19	NF Grayling Jr	10/1/2025	0.09	0.36	0.3204	1.6000	0.0573	0.0515
20	NF Grayling Jr	10/1/2025	0.03	0.14	0.1068	1.5000	0.0083	0.0476
21	NF Grayling Jr	10/1/2025	0.21	0.82	0.7476	1.6364	0.0000	0.0220
22	EF Grayling Jr	9/29/2025	0.12	0.50	0.4272	1.5714	0.0550	0.1972
23	EF Grayling Jr	9/29/2025	0.07	0.27	0.2136	1.5000	0.0273	0.0000
24	EF Grayling Jr	9/29/2025	0.31	1.23	1.1748	1.6875	0.0227	0.1649
25	EF Grayling Jr	9/29/2025	0.24	0.96	0.8544	1.6154	0.0000	0.1677
26	EF Grayling Jr	9/29/2025	0.17	0.68	0.6408	1.6667	0.0522	0.1401
27	EF Grayling Jr	9/29/2025	0.14	0.55	0.534	1.7143	0.0000	0.1229
28	EF Grayling Jr	9/29/2025	0.11	0.45	0.4272	1.6667	0.0139	0.0382
29	EF Grayling Jr	9/29/2025	0.14	0.55	0.534	1.7143	0.0000	0.1229
30	EF Grayling Jr	9/29/2025	0.20	0.81	0.7476	1.6364	0.0606	0.1878
31	EF Grayling Jr	9/29/2025	0.31	1.23	1.068	1.5882	0.0227	0.1649

IDL = 0.08 mg/m ² EDL = 0.41 mg/m ²					Linear Check Maximum = 73.89 mg/m ²			
					Phaeo Corrected			
Daily Vial #	Site	Date	Vial	Chl a	Chl a	664/665	Chl b	Chl c
		Analyzed	Chl a	mg/m2	mg/m2	Ratio	mg/m2	mg/m2
12	Noa (210)	10/2/2025	0.52	2.10	2.0292	1.7037	0.0000	0.2783
13	Noa (210)	10/2/2025	0.59	2.37	2.2428	1.6774	0.0000	0.4040
14	Noa (210)	10/2/2025	0.17	0.69	0.6408	1.6667	0.0000	0.1705
15	Noa (210)	10/2/2025	0.55	2.19	1.9224	1.6000	0.0000	0.2650
16	Noa (210)	10/2/2025	2.18	8.71	8.1168	1.6609	0.0000	1.0361
17	Noa (210)	10/2/2025	3.32	13.29	12.4956	1.6724	0.0000	1.7355
18	Noa (210)	10/2/2025	2.75	11.00	10.2528	1.6621	0.0000	1.1896
19	Noa (210)	10/2/2025	1.55	6.21	5.874	1.6790	0.0000	0.8110
20	Noa (210)	10/2/2025	0.14	0.55	0.534	1.7143	0.0000	0.1229
21	Noa (210)	10/2/2025	2.06	8.22	7.476	1.6364	0.0000	1.0654
12	Ikalukrok u/s Noa (RDMLE-03)	9/29/2025	0.00	0.00	0	0	0.00	0.00
13	Ikalukrok u/s Noa (RDMLE-03)	9/29/2025	0.00	0.00	0	0	0.00	0.00
14	Ikalukrok u/s Noa (RDMLE-03)	9/29/2025	0.00	0.00	0	0	0.00	0.00
15	Ikalukrok u/s Noa (RDMLE-03)	9/29/2025	0.02	0.09	0.2136	0	0.00	0.00
16	Ikalukrok u/s Noa (RDMLE-03)	9/29/2025	0.00	0.00	0	0	0.00	0.00
17	Ikalukrok u/s Noa (RDMLE-03)	9/29/2025	0.01	0.04	0.1068	0	0.05	0.06
18	Ikalukrok u/s Noa (RDMLE-03)	9/29/2025	0.01	0.04	0.1068	0	0.05	0.06
19	Ikalukrok u/s Noa (RDMLE-03)	9/29/2025	0.01	0.04	0.1068	0	0.05	0.06
20	Ikalukrok u/s Noa (RDMLE-03)	9/29/2025	0.02	0.09	0.2136	0	0.03	0.05
21	Ikalukrok u/s Noa (RDMLE-03)	9/29/2025	0.01	0.05	0.1068	0	0.00	0.09
32	Upper NFRD North Trib	10/1/2025	0.57	2.27	2.136	1.6667	0.0588	0.2889
33	Upper NFRD North Trib	10/1/2025	0.62	2.46	2.2428	1.6364	0.0000	0.3602
34	Upper NFRD North Trib	10/1/2025	0.25	1.00	1.068	1.8333	0.0578	0.1306
35	Upper NFRD North Trib	10/1/2025	1.22	4.87	4.6992	1.6984	0.0496	0.5006
36	Upper NFRD North Trib	10/1/2025	0.32	1.28	1.1748	1.6471	0.0010	0.1582
37	Upper NFRD North Trib	10/1/2025	0.81	3.22	3.0972	1.6905	0.1383	0.4262
38	Upper NFRD North Trib	10/1/2025	0.69	2.78	2.67	1.6944	0.0616	0.2223
39	Upper NFRD North Trib	10/1/2025	1.13	4.50	4.272	1.6780	0.1499	0.4864
40	Upper NFRD North Trib	10/1/2025	3.17	12.68	11.8548	1.6529	1.6703	0.9677
40	Upper NFRD North Trib	10/1/2025	3.19	12.77	11.9616	1.6550	1.7738	1.0897
22	Upper NFRD South Trib	9/26/2025	1.06	4.25	4.0584	1.6909	0.0000	0.4146
23	Upper NFRD South Trib	9/26/2025	0.99	3.98	3.8448	1.7059	0.0000	0.4851
24	Upper NFRD South Trib	9/26/2025	0.99	3.98	3.9516	1.7400	0.0000	0.4851
25	Upper NFRD South Trib	9/26/2025	0.97	3.89	3.738	1.7000	0.0000	0.3327
26	Upper NFRD South Trib	9/26/2025	0.77	3.06	2.8836	1.6750	0.0000	0.2803
27	Upper NFRD South Trib	9/26/2025	1.58	6.32	6.0876	1.7037	0.0000	0.2700
28	Upper NFRD South Trib	9/26/2025	1.83	7.32	6.942	1.6842	0.0000	0.1368
29	Upper NFRD South Trib	9/26/2025	1.05	4.20	3.9516	1.6727	0.0000	0.4890
30	Upper NFRD South Trib	9/26/2025	2.05	8.18	7.9032	1.7048	0.0000	0.8083
31	Upper NFRD South Trib	9/26/2025	0.75	3.01	2.8836	1.6923	0.0000	0.3850

IDL = 0.08 mg/m ² EDL = 0.41 mg/m ²					Linear Check Maximum = 73.89 mg/m ²			
					Phaeo Corrected			
Daily Vial #	Site	Date Analyzed	Vial Chl a	Chl a mg/m2	Chl a mg/m2	664/665 Ratio	Chl b mg/m2	Chl c mg/m2
2	Oak (216)	9/29/2025	0.00	0.00	0	0.0000	0.0000	0.0000
3	Oak (216)	9/29/2025	0.01	0.05	0.1068	0.0000	0.0000	0.0000
4	Oak (216)	9/29/2025	0.00	0.00	0	0.0000	0.0000	0.0000
5	Oak (216)	9/29/2025	0.00	0.00	0	0.0000	0.0000	0.0000
6	Oak (216)	9/29/2025	0.00	0.00	0	0.0000	0.0000	0.0981
7	Oak (216)	9/29/2025	0.00	0.00	0	0.0000	0.0000	0.0000
8	Oak (216)	9/29/2025	1.05	4.21	4.1652	1.7091	1.0262	0.1481
9	Oak (216)	9/29/2025	0.01	0.04	0.1068	0.0000	0.0518	0.0610
10	Oak (216)	9/29/2025	0.00	0.00	0	0.0000	0.0000	0.0981
11	Oak (216)	9/29/2025	0.00	0.00	0	0.0000	0.0000	0.0000
2	Sunday (215)	9/30/2025	0.01	0.04	0.1068	0.0000	0.0518	0.0610
3	Sunday (215)	9/30/2025	0.00	0.00	0	0.0000	0.0000	0.0000
4	Sunday (215)	9/30/2025	0.01	0.04	0.1068	0.0000	0.0518	0.0610
5	Sunday (215)	9/30/2025	0.00	0.00	0	0.0000	0.0000	0.0981
6	Sunday (215)	9/30/2025	0.01	0.04	0.1068	0.0000	0.0518	0.0610
7	Sunday (215)	9/30/2025	0.00	0.00	0	0.0000	0.0000	0.0000
8	Sunday (215)	9/30/2025	0.01	0.04	0.1068	0.0000	0.0518	0.0610
9	Sunday (215)	9/30/2025	0.01	0.05	0.1068	0.0000	0.0000	0.0000
10	Sunday (215)	9/30/2025	0.01	0.05	0.1068	0.0000	0.0000	0.0914
11	Sunday (215)	9/30/2025	0.01	0.05	0.1068	0.0000	0.0000	0.0000
52	Square (214)	10/2/2025	0.27	1.09	0.9612	1.6000	0.0144	0.1173
53	Square (214)	10/2/2025	0.48	1.91	1.8156	1.6800	0.0121	0.1393
54	Square (214)	10/2/2025	0.72	2.88	2.7768	1.7027	0.0000	0.0432
55	Square (214)	10/2/2025	0.68	2.73	2.5632	1.6667	0.0833	0.2290
56	Square (214)	10/2/2025	0.32	1.28	1.1748	1.6471	0.0000	0.1886
57	Square (214)	10/2/2025	0.03	0.14	0.2136	3.0000	0.0083	0.0476
58	Square (214)	10/2/2025	0.14	0.54	0.4272	1.5000	0.0439	0.0925
59	Square (214)	10/2/2025	0.08	0.31	0.4272	2.3333	0.0790	0.0582
60	Square (214)	10/2/2025	0.17	0.69	0.6408	1.6667	0.0000	0.0724
61	Square (214)	10/2/2025	0.10	0.41	0.3204	1.5000	0.0356	0.0448
22	Ferric (213)	9/30/2025	8.80	35.21	32.8944	1.6652	0.0000	2.1292
23	Ferric (213)	9/30/2025	4.04	16.17	15.486	1.6938	0.0000	1.2206
24	Ferric (213)	9/30/2025	2.55	10.18	9.7188	1.6894	0.0000	0.8734
25	Ferric (213)	9/30/2025	3.42	13.70	13.1364	1.6949	0.0000	1.1918
26	Ferric (213)	9/30/2025	2.41	9.62	9.1848	1.6880	0.0000	0.9163
27	Ferric (213)	9/30/2025	0.92	3.69	3.5244	1.6875	0.0000	0.4271
28	Ferric (213)	9/30/2025	3.99	15.98	15.486	1.7073	0.0000	1.2169
29	Ferric (213)	9/30/2025	5.30	21.20	19.8648	1.6691	0.0000	1.8296
30	Ferric (213)	9/30/2025	1.54	6.16	5.7672	1.6667	0.0000	0.5912
31	Ferric (213)	9/30/2025	4.41	17.63	16.8744	1.6930	0.0000	1.5178

APPENDIX D. BENTHIC MACROINVERTEBRATES IDENTIFIED IN SAMPLES FROM LOCATIONS NEAR THE RED DOG MINE LIFE EXTENSION PROJECT, 2025.

Year	Order	Family	Genus	Upper Competition	Sourdock	Lower Competition	Warf
2025	Acari	Acarina	spp	3	0	0	1
2025	Coleoptera	Dytiscidae	spp	2	0	0	0
2025	Coleoptera	Staphylinidae	spp	0	0	0	0
2025	Coleoptera	spp	spp	1	0	0	0
2025	Collembola	Entomobryidae	spp	1	0	1	2
2025	Collembola	Isotomidae	spp	3	0	1	0
2025	Collembola	Sminthuridae	Dicyrtoma	0	0	0	1
2025	Collembola	spp	spp	0	0	0	0
2025	Copepoda	Harpacticoida	spp	0	0	0	0
2025	Copepoda	Cyclopoida	spp	0	0	0	0
2025	Diptera	Chironomidae	spp	19	6	11	29
2025	Diptera	Empididae	Clinocera	0	0	0	0
2025	Diptera	Simuliidae	Simulium	0	0	0	6
2025	Diptera	spp	spp	0	0	0	0
2025	Diptera	Empididae	Chelifera	0	0	0	1
2025	Diptera	Tipulidae	Tipula	0	0	0	0
2025	Diptera	Tipulidae	Dicranota	0	0	0	0
2025	Diptera	Empididae	spp	0	0	1	0
2025	Ephemeroptera	Heptageniidae	Cinygmula	0	0	0	0
2025	Ephemeroptera	Ameletidae	Ameletus	0	0	0	0
2025	Ephemeroptera	Baetidae	Baetis	0	0	0	0
2025	Ephemeroptera	Heptageniidae	Epeorus	0	0	0	0
2025	Ephemeroptera	Heptageniidae	spp	0	0	0	0
2025	Ephemeroptera	Epeorus	spp	1	0	0	0
2025	Ephemeroptera	spp	spp	0	0	0	0
2025	Lepidoptera	Crambidae	spp	1	1	0	0
2025	Nematoda	spp	spp	0	0	0	0
2025	Oligochaeta	spp	spp	0	0	0	0
2025	Ostracoda	spp	spp	0	0	0	0
2025	Platyhelminthes	spp	spp	0	0	0	0
2025	Plecoptera	Capniidae	Capnia	0	0	1	0
2025	Plecoptera	Nemouridae	Prostoia	0	0	0	0
2025	Plecoptera	Chloroperlidae	Suwallia	0	0	0	0
2025	Plecoptera	Nemouridae	Podmosta	0	0	0	0
2025	Plecoptera	spp	spp	0	0	0	1
2025	Plecoptera	Chloroperlidae	spp	0	0	0	0
2025	Plecoptera	Nemouridae	Zapada	0	0	0	0
2025	Plecoptera	Perlodidae	spp	0	0	0	0
2025	Plecoptera	Capniidae	spp	0	0	0	0
2025	Plecoptera	Leuctridae	Despaxia	0	0	0	0
2025	Plecoptera	Chloroperlidae	Kathroperla	0	0	0	0
2025	Trichoptera	Limnephilidae	Ecclisocosmoecus	0	0	0	0

Year	Order	Family	Genus	Upper WF Ik	WF Ik	Ik u/s WF Ik	Ik d/s Cub
2025	Acari	Acarina	spp	2	1	3	1
2025	Coleoptera	Dytiscidae	spp	0	0	0	0
2025	Coleoptera	Staphylinidae	spp	0	0	0	0
2025	Coleoptera	spp	spp	0	0	0	0
2025	Collembola	Entomobryidae	spp	3	9	0	0
2025	Collembola	Isotomidae	spp	2	2	0	1
2025	Collembola	Sminthuridae	Dicyrtoma	0	1	0	0
2025	Collembola	spp	spp	0	1	0	0
2025	Copepoda	Harpacticoida	spp	0	0	0	0
2025	Copepoda	Cyclopoida	spp	0	0	0	0
2025	Diptera	Chironomidae	spp	256	15	229	279
2025	Diptera	Empididae	Clinocera	0	0	0	0
2025	Diptera	Simuliidae	Simulium	0	0	4	0
2025	Diptera	spp	spp	0	0	0	0
2025	Diptera	Empididae	Chelifera	0	0	0	1
2025	Diptera	Tipulidae	Tipula	0	0	0	0
2025	Diptera	Tipulidae	Dicranota	0	0	0	1
2025	Diptera	Empididae	spp	0	0	0	0
2025	Ephemeroptera	Heptageniidae	Cinygmula	0	0	25	42
2025	Ephemeroptera	Ameletidae	Ameletus	0	0	0	0
2025	Ephemeroptera	Baetidae	Baetis	0	0	0	0
2025	Ephemeroptera	Heptageniidae	Epeorus	0	0	0	0
2025	Ephemeroptera	Heptageniidae	spp	0	0	5	0
2025	Ephemeroptera	Epeorus	spp	0	0	0	0
2025	Ephemeroptera	spp	spp	0	0	0	0
2025	Lepidoptera	Crambidae	spp	1	0	0	0
2025	Nematoda	spp	spp	0	0	0	0
2025	Oligochaeta	spp	spp	0	1	0	0
2025	Ostracoda	spp	spp	0	0	0	0
2025	Platyhelminthes	spp	spp	0	0	0	0
2025	Plecoptera	Capniidae	Capnia	0	0	12	11
2025	Plecoptera	Nemouridae	Prostoia	0	0	0	0
2025	Plecoptera	Chloroperlidae	Suwalia	0	0	0	0
2025	Plecoptera	Nemouridae	Podmosta	0	0	0	0
2025	Plecoptera	spp	spp	0	0	0	0
2025	Plecoptera	Chloroperlidae	spp	0	0	0	0
2025	Plecoptera	Nemouridae	Zapada	0	0	0	0
2025	Plecoptera	Perlodidae	spp	0	0	0	0
2025	Plecoptera	Capniidae	spp	0	0	0	0
2025	Plecoptera	Leuctridae	Despaxia	0	0	0	0
2025	Plecoptera	Chloroperlidae	Kathroperla	0	0	0	0
2025	Trichoptera	Limnephilidae	Ecclisocosmoecus	0	0	0	0

Year	Order	Family	Genus	lk u/s Grayling	EF lk	Grayling Jr	NF Grayling Jr
2025	Acari	Acarina	spp	1	2	0	0
2025	Coleoptera	Dytiscidae	spp	0	0	0	0
2025	Coleoptera	Staphylinidae	spp	0	0	0	0
2025	Coleoptera	spp	spp	0	0	0	0
2025	Collembola	Entomobryidae	spp	1	0	1	0
2025	Collembola	Isotomidae	spp	0	0	0	0
2025	Collembola	Sminthuridae	Dicyrtoma	0	0	0	0
2025	Collembola	spp	spp	0	0	0	0
2025	Copepoda	Harpacticoida	spp	0	2	0	0
2025	Copepoda	Cyclopoida	spp	0	0	0	6
2025	Diptera	Chironomidae	spp	111	1526	123	44
2025	Diptera	Empididae	Clinocera	0	0	0	0
2025	Diptera	Simuliidae	Simulium	1	255	2	2
2025	Diptera	spp	spp	0	0	0	0
2025	Diptera	Empididae	Chelifera	0	2	0	0
2025	Diptera	Tipulidae	Tipula	0	12	1	0
2025	Diptera	Tipulidae	Dicranota	0	0	0	0
2025	Diptera	Empididae	spp	0	0	0	0
2025	Ephemeroptera	Heptageniidae	Cinygmula	21	356	13	2
2025	Ephemeroptera	Ameletidae	Ameletus	0	5	0	0
2025	Ephemeroptera	Baetidae	Baetis	0	26	0	0
2025	Ephemeroptera	Heptageniidae	Epeorus	0	6	0	0
2025	Ephemeroptera	Heptageniidae	spp	6	0	1	4
2025	Ephemeroptera	Epeorus	spp	0	0	0	0
2025	Ephemeroptera	spp	spp	0	0	0	0
2025	Lepidoptera	Crambidae	spp	0	0	0	0
2025	Nematoda	spp	spp	0	12	0	0
2025	Oligochaeta	spp	spp	0	636	0	0
2025	Ostracoda	spp	spp	1	0	0	0
2025	Platyhelminthes	spp	spp	1	11	0	0
2025	Plecoptera	Capniidae	Capnia	9	291	37	4
2025	Plecoptera	Nemouridae	Prostoia	2	11	0	0
2025	Plecoptera	Chloroperlidae	Suwallia	0	3	0	0
2025	Plecoptera	Nemouridae	Podmosta	0	5	1	0
2025	Plecoptera	spp	spp	1	5	0	0
2025	Plecoptera	Chloroperlidae	spp	0	0	0	0
2025	Plecoptera	Nemouridae	Zapada	0	0	0	0
2025	Plecoptera	Perlodidae	spp	2	0	2	0
2025	Plecoptera	Capniidae	spp	2	0	0	0
2025	Plecoptera	Leuctridae	Despaxia	1	0	0	0
2025	Plecoptera	Chloroperlidae	Kathroperla	0	0	0	0
2025	Trichoptera	Limnephilidae	Ecclisocosmoecus	0	0	0	0

Year	Order	Family	Genus	EF Grayling Jr	Noa	lk u/s Noa	Upr NFRD North
2025	Acari	Acarina	spp	4	2	0	415
2025	Coleoptera	Dytiscidae	spp	0	0	0	5
2025	Coleoptera	Staphylinidae	spp	0	0	0	0
2025	Coleoptera	spp	spp	0	0	0	0
2025	Collembola	Entomobryidae	spp	6	1	1	0
2025	Collembola	Isotomidae	spp	0	5	0	5
2025	Collembola	Sminthuridae	Dicyrtoma	0	0	0	0
2025	Collembola	spp	spp	0	0	0	0
2025	Copepoda	Harpacticoida	spp	0	0	2	0
2025	Copepoda	Cyclopoida	spp	0	0	0	5
2025	Diptera	Chironomidae	spp	68	1	77	11425
2025	Diptera	Empididae	Clinocera	2	0	0	0
2025	Diptera	Simuliidae	Simulium	2	0	2	135
2025	Diptera	spp	spp	6	0	0	0
2025	Diptera	Empididae	Chelifera	0	0	1	0
2025	Diptera	Tipulidae	Tipula	0	0	1	0
2025	Diptera	Tipulidae	Dicranota	0	0	2	0
2025	Diptera	Empididae	spp	0	0	0	0
2025	Ephemeroptera	Heptageniidae	Cinygmula	2	0	42	20
2025	Ephemeroptera	Ameletidae	Ameletus	0	0	0	15
2025	Ephemeroptera	Baetidae	Baetis	0	0	0	20
2025	Ephemeroptera	Heptageniidae	Epeorus	0	0	0	0
2025	Ephemeroptera	Heptageniidae	spp	0	0	0	0
2025	Ephemeroptera	Epeorus	spp	0	0	0	0
2025	Ephemeroptera	spp	spp	0	0	0	0
2025	Lepidoptera	Crambidae	spp	0	0	0	0
2025	Nematoda	spp	spp	0	0	0	25
2025	Oligochaeta	spp	spp	2	0	1	625
2025	Ostracoda	spp	spp	0	0	2	30
2025	Platyhelminthes	spp	spp	0	0	0	0
2025	Plecoptera	Capniidae	Capnia	16	0	13	320
2025	Plecoptera	Nemouridae	Prostoia	8	0	2	70
2025	Plecoptera	Chloroperlidae	Suwalia	0	0	0	10
2025	Plecoptera	Nemouridae	Podmosta	0	0	0	55
2025	Plecoptera	spp	spp	0	0	1	10
2025	Plecoptera	Chloroperlidae	spp	0	0	0	5
2025	Plecoptera	Nemouridae	Zapada	0	0	0	180
2025	Plecoptera	Perlodidae	spp	0	0	1	65
2025	Plecoptera	Capniidae	spp	0	0	0	0
2025	Plecoptera	Leuctridae	Despaxia	0	0	0	0
2025	Plecoptera	Chloroperlidae	Kathroperla	0	0	0	0
2025	Trichoptera	Limnephilidae	Ecclisocosmoecus	0	0	0	0

Year	Order	Family	Genus	Upr NFRD South	Oak	Sunday	Square	Ferric
2025	Acari	Acarina	spp	14	0	1	2	1
2025	Coleoptera	Dytiscidae	spp	2	1	1	0	0
2025	Coleoptera	Staphylinidae	spp	0	0	0	1	0
2025	Coleoptera	spp	spp	0	0	0	0	0
2025	Collembola	Entomobryidae	spp	0	0	0	0	1
2025	Collembola	Isotomidae	spp	0	0	0	0	1
2025	Collembola	Sminthuridae	Dicyrtoma	0	0	0	0	0
2025	Collembola	spp	spp	0	0	0	0	0
2025	Copepoda	Harpacticoida	spp	0	0	0	0	0
2025	Copepoda	Cyclopoida	spp	1	0	0	0	4
2025	Diptera	Chironomidae	spp	2694	26	55	745	237
2025	Diptera	Empididae	Clinocera	0	0	0	0	0
2025	Diptera	Simuliidae	Simulium	82	1	26	549	7
2025	Diptera	spp	spp	0	0	0	0	0
2025	Diptera	Empididae	Chelifera	0	0	0	0	0
2025	Diptera	Tipulidae	Tipula	3	0	1	1	0
2025	Diptera	Tipulidae	Dicranota	3	0	0	0	0
2025	Diptera	Empididae	spp	0	0	0	0	0
2025	Ephemeroptera	Heptageniidae	Cinygmula	75	2	5	63	2
2025	Ephemeroptera	Ameletidae	Ameletus	14	0	2	0	0
2025	Ephemeroptera	Baetidae	Baetis	3	0	2	56	0
2025	Ephemeroptera	Heptageniidae	Epeorus	0	0	2	202	1
2025	Ephemeroptera	Heptageniidae	spp	18	0	1	16	0
2025	Ephemeroptera	Epeorus	spp	0	0	0	0	0
2025	Ephemeroptera	spp	spp	5	0	0	0	0
2025	Lepidoptera	Crambidae	spp	0	1	1	0	0
2025	Nematoda	spp	spp	0	0	0	0	0
2025	Oligochaeta	spp	spp	421	0	2	44	56
2025	Ostracoda	spp	spp	2	0	0	0	0
2025	Platyhelminthes	spp	spp	9	1	0	2	0
2025	Plecoptera	Capniidae	Capnia	177	2	2	65	3
2025	Plecoptera	Nemouridae	Prostoia	3	3	1	2	3
2025	Plecoptera	Chloroperlidae	Suwallia	10	0	2	44	1
2025	Plecoptera	Nemouridae	Podmosta	2	0	0	0	0
2025	Plecoptera	spp	spp	15	0	2	4	0
2025	Plecoptera	Chloroperlidae	spp	0	0	0	6	1
2025	Plecoptera	Nemouridae	Zapada	2	0	0	5	1
2025	Plecoptera	Perlodidae	spp	15	0	3	11	2
2025	Plecoptera	Capniidae	spp	0	0	0	1	0
2025	Plecoptera	Leuctridae	Despaxia	0	0	0	6	0
2025	Plecoptera	Chloroperlidae	Kathroperla	3	0	0	2	0
2025	Trichoptera	Limnephilidae	Ecclisocosmoecus	0	0	0	0	1

APPENDIX E. FISH CAPTURE DATA FROM LOCATIONS NEAR THE RED DOG MINE LIFE EXTENSION PROJECT, 2025.

High effort hours were due to fog and low clouds that delayed minnow trap retrieval by a day.

Year	Site	Station	Sample Date	Effort (hours)	Dolly Varden	Slimy Sculpin	Dolly Varden CPUE
2025	Upper Competition	203	8/1/2025	27.5	0	0	0
2025	Sourdock	204	8/1/2025	28	0	0	0
2025	Lower Competition	202	8/1/2025	27.75	0	0	0
2025	WF Ikalukrok	205	8/1/2025	24	0	0	0
2025	Ikalukrok u/s WF	206	8/1/2025	24	0	0	0
2025	Ikalukrok u/s Grayling	RDMLE-02	7/31/2025	25.25	3	0	2.85
2025	EF Ikalukrok	208	8/1/2025	27.75	2	0	1.73
2025	Grayling	209	8/1/2025	41.75	15	0	8.62
2025	NF Grayling		7/31/2025	26.25	2	0	1.83
2025	EF Grayling		7/31/2025	25.5	2	0	1.88
2025	Ikalukrok u/s Noa	RDMLE-03	8/5/2025	46	10	2	5.22
2025	Upper NFRD North Trib		8/5/2025	47.75	2	0	1.01
2025	Upper NFRD South Trib		8/5/2025	47	10	0	5.11
2025	Ferric	213	8/2/2025	27.75	61	1	52.76

APPENDIX F. SEDIMENT SAMPLE DATA FROM LOCATIONS NEAR THE RED DOG MINE LIFE EXTENSION PROJECT, 2025.

Year	Site (Station)	Sample Date	Units	Component	Result
2025	Lower Competition (203)	7/4/2025	mg/Kg	Cadmium	5.37
2025	Lower Competition (203)	7/4/2025	mg/Kg	Copper	544
2025	Lower Competition (203)	7/4/2025	mg/Kg	Lead	52.8
2025	Lower Competition (203)	7/4/2025	mg/Kg	Mercury	0.094
2025	Lower Competition (203)	7/4/2025	mg/Kg	Selenium	6.7
2025	Lower Competition (203)	7/4/2025	mg/Kg	Zinc	1210
2025	Lower Competition (203)	7/4/2025	%	Solids	60.3
2025	Warf (233)	7/2/2025	mg/Kg	Cadmium	0.433
2025	Warf (233)	7/2/2025	mg/Kg	Copper	127
2025	Warf (233)	7/2/2025	mg/Kg	Lead	11.4
2025	Warf (233)	7/2/2025	mg/Kg	Mercury	0.065
2025	Warf (233)	7/2/2025	mg/Kg	Selenium	3.9
2025	Warf (233)	7/2/2025	mg/Kg	Zinc	144
2025	Warf (233)	7/2/2025	%	Solids	79
2025	Upper WF Ikalukrok (231)	7/2/2025	mg/Kg	Cadmium	0.752
2025	Upper WF Ikalukrok (231)	7/2/2025	mg/Kg	Copper	107
2025	Upper WF Ikalukrok (231)	7/2/2025	mg/Kg	Lead	11.8
2025	Upper WF Ikalukrok (231)	7/2/2025	mg/Kg	Mercury	ND
2025	Upper WF Ikalukrok (231)	7/2/2025	mg/Kg	Selenium	1.27
2025	Upper WF Ikalukrok (231)	7/2/2025	mg/Kg	Zinc	134
2025	Upper WF Ikalukrok (231)	7/2/2025	%	Solids	82
2025	Ikalukrok u/s Grayling (RDMLE-02)	7/3/2025	mg/Kg	Cadmium	5.79
2025	Ikalukrok u/s Grayling (RDMLE-02)	7/3/2025	mg/Kg	Copper	108
2025	Ikalukrok u/s Grayling (RDMLE-02)	7/3/2025	mg/Kg	Lead	61.1
2025	Ikalukrok u/s Grayling (RDMLE-02)	7/3/2025	mg/Kg	Mercury	0.088
2025	Ikalukrok u/s Grayling (RDMLE-02)	7/3/2025	mg/Kg	Selenium	2.2
2025	Ikalukrok u/s Grayling (RDMLE-02)	7/3/2025	mg/Kg	Zinc	1420
2025	Ikalukrok u/s Grayling (RDMLE-02)	7/3/2025	%	Solids	73.7

Year	Site (Station)	Sample Date	Units	Component	Result
2025	Oak (216)	7/5/2025	mg/Kg	Cadmium	7.88
2025	Oak (216)	7/5/2025	mg/Kg	Copper	116
2025	Oak (216)	7/5/2025	mg/Kg	Lead	23.1
2025	Oak (216)	7/5/2025	mg/Kg	Mercury	ND
2025	Oak (216)	7/5/2025	mg/Kg	Selenium	4.4
2025	Oak (216)	7/5/2025	mg/Kg	Zinc	4070
2025	Oak (216)	7/5/2025	%	Solids	26.8
2025	Sunday (215)	7/5/2025	mg/Kg	Cadmium	4.87
2025	Sunday (215)	7/5/2025	mg/Kg	Copper	105
2025	Sunday (215)	7/5/2025	mg/Kg	Lead	11.4
2025	Sunday (215)	7/5/2025	mg/Kg	Mercury	0.06
2025	Sunday (215)	7/5/2025	mg/Kg	Selenium	4.1
2025	Sunday (215)	7/5/2025	mg/Kg	Zinc	1470
2025	Sunday (215)	7/5/2025	%	Solids	59.2
2025	Square (214)	7/5/2025	mg/Kg	Cadmium	1.24
2025	Square (214)	7/5/2025	mg/Kg	Copper	29.3
2025	Square (214)	7/5/2025	mg/Kg	Lead	46.4
2025	Square (214)	7/5/2025	mg/Kg	Mercury	0.075
2025	Square (214)	7/5/2025	mg/Kg	Selenium	2.7
2025	Square (214)	7/5/2025	mg/Kg	Zinc	640
2025	Square (214)	7/5/2025	%	Solids	75.3
2025	Ferric (213)	8/1/2025	mg/Kg	Cadmium	2.44
2025	Ferric (213)	8/1/2025	mg/Kg	Copper	62.7
2025	Ferric (213)	8/1/2025	mg/Kg	Lead	34.9
2025	Ferric (213)	8/1/2025	mg/Kg	Mercury	0.498
2025	Ferric (213)	8/1/2025	mg/Kg	Selenium	16.6
2025	Ferric (213)	8/1/2025	mg/Kg	Zinc	279
2025	Ferric (213)	8/1/2025	%	Solids	61.1
2025	Ferric White Seep	8/1/2025	mg/Kg	Cadmium	0.099
2025	Ferric White Seep	8/1/2025	mg/Kg	Copper	4.06
2025	Ferric White Seep	8/1/2025	mg/Kg	Lead	1.04
2025	Ferric White Seep	8/1/2025	mg/Kg	Mercury	ND
2025	Ferric White Seep	8/1/2025	mg/Kg	Selenium	ND
2025	Ferric White Seep	8/1/2025	mg/Kg	Zinc	12.3
2025	Ferric White Seep	8/1/2025	%	Solids	46.1