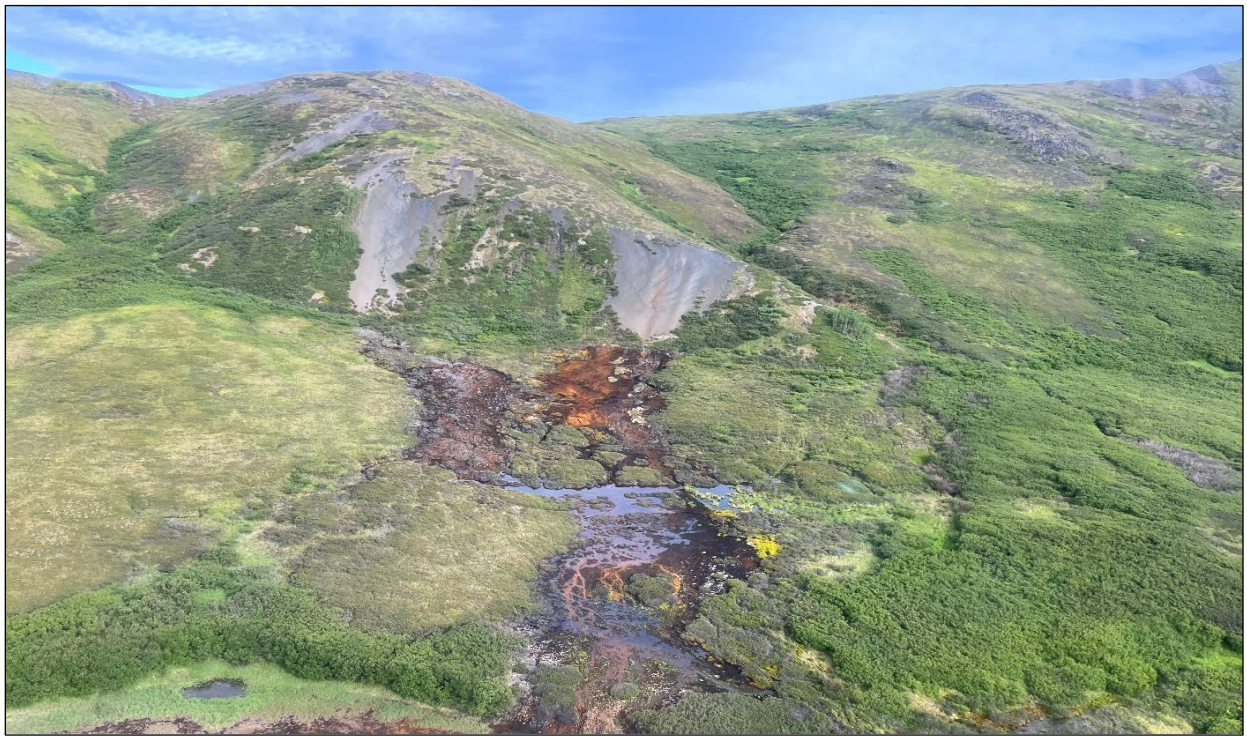
**Technical Report No. 25-11**

# Baseline Aquatic Biomonitoring for the Aktigiruq-Anarraaq Extension Project, 2024

**By**
**Lauren E. Yancy and Olivia N. Edwards**



**July 2025**

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

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**Weights and measures (metric)**

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

**Weights and measures (English)**

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

**Time and temperature**

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

**Physics and chemistry**

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

**General**

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

**Mathematics, statistics**

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

*TECHNICAL REPORT NO. 25-11*

# BASELINE AQUATIC BIOMONITORING FOR THE AKTIGIRUQ-ANARRAAQ EXTENSION PROJECT, 2024

By

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July 2025

Cover photograph: Naturally occurring hillside seep on the north side of the Ikalukrok Creek approximately 1 km northeast of Moil Creek, July 7, 2024. Photograph by Lauren Yancy.

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# ACKNOWLEDGEMENTS

We thank Teck American Incorporated and Teck Alaska Incorporated[1] (collectively referred to as Teck) for their financial and logistical support for aquatic biomonitoring in streams associated with the Aktigiruq-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 and Lauren Yancy participated in field sampling and laboratory work. Olivia Edwards and Lauren Yancy processed all periphyton samples in the ADF&G laboratory in Fairbanks. Nora Foster (NRF Taxonomic Services) was responsible for sorting, identification, and enumeration of aquatic invertebrates.

Chelsea Clawson, Audra Brase, and Dr. Al Ott (ADF&G Habitat) and Heidi Tillquist (Teck) provided constructive reviews of this report.

[1] The aquatic biomonitoring for this report was collected for the Aktigiruq-Anarraaq Extension Project, which is a Teck American Incorporated project. While onsite, Teck Alaska Incorporated staff provided logistical support.

# EXECUTIVE SUMMARY

This report summarizes results of 2024 biomonitoring work conducted in streams in the vicinity of the Aktigiruq-Anarraaq Extension Project (AAEP) located northwest of the Red Dog Mine. Biomonitoring included sampling of water quality, periphyton, benthic macroinvertebrates (BMI), and sediment. No fish sampling occurred in 2024 due to high flows that precluded minnow trapping. One new site was added on Ikalukrok Creek, upstream of the mouth of Noa Creek. Sampling at North Fork Grayling Junior and Upper North Fork Red Dog North Tributary resumed in 2024, but due to weather constraints Lower Competition Creek was not sampled in 2024. Historic biomonitoring data from 2000–2002 are included for comparison (Weber-Scannell and Ott 2006).

Of the comprehensive water samples collected by Teck Alaska in 2024, Noa and Moil creeks consistently had the highest levels of aluminum, cadmium, nickel, and zinc. Based on in-situ water quality measured by ADF&G in July 2024, Moil and Upper Competition creeks had the highest turbidity levels, while the remaining sites had low turbidity (< 1 NTU). Noa and Moil creeks consistently have the lowest pH (< 4.2). Upper Competition, Noa, and Moil creeks had the highest measured specific conductance (> 1,200 µs/cm).

Periphyton standing crop, as estimated by chlorophyll-a concentration, was collected at 16 sites in 2024. Upper North Fork Red Dog (NFRD) North Tributary had the highest chlorophyll-a concentration (mean = 14.3 mg/m$^2$) followed by Upper NFRD South Tributary (mean = 3.6 mg/m$^2$). The remainder of sites had low chlorophyll-a concentrations (range = 0.29–1.45 mg/m$^2$) or had concentrations below the detection limit (0.14 mg/m$^2$).

In 2024, 15 sites were sampled for BMI. East Fork Ikalukrok Creek and Upper NFRD North and South tributaries had the highest BMI densities. Upper Competition Creek had the lowest density, followed by Noa, Moil, and West Fork Ikalukrok creeks. Chironomids were most abundant and found at every site. EPT taxa were present at all sites in 2024 except Upper Competition, Lower Competition, and Noa creeks.

Sediment samples were collected at all sites in 2024. Sediment element concentrations varied among sites; Volcano Creek had considerably high levels of zinc (>2,000 mg/kg) and cadmium (>20 mg/kg). Copper concentration exceeded 600 mg/Kg in East Fork Grayling Junior.

# INTRODUCTION

Teck American has been conducting mineral exploration drilling around the Anarraaq Prospect since the mid-1990's and the Aktigiruq 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). 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 crossing North Fork Red Dog, Grayling Junior, and Ikalukrok creeks. These creeks are anadromous waterbodies that support Dolly Varden, as well as the resident fish species of Arctic grayling and slimy sculpin. Road construction began in winter 2024–2025 with completion of approximately 9 km of road and the bridges across Mainstem Red Dog Creek and Grayling Junior Creek.

The Aktigiruq and/or 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 (ADNR) technical reports summarize water quality, periphyton, benthic macroinvertebrate, and fish data collected in 2000, 2001, and 2002 (Weber-Scannell and Ott 2006).

From 2014–2024, the ADF&G Habitat Section has collected pre-mining baseline aquatic data annually focusing on streams which flow to the west and east from the Aktigiruq and Anarraaq ore bodies. Most sites are spread throughout the Ikalukrok Creek drainage with three sites in the Competition Creek drainage, both tributaries to the Wulik River (Figure 1). Three primary types of data are collected: periphyton, benthic macroinvertebrates (BMI), and fish, including samples for fish whole body element analysis. In-situ water quality and sediment element concentration data have also been collected in recent years.

This report summarizes the 2024 in-situ water quality, periphyton, BMI, and sediment element concentration data collected by ADF&G and water quality data, including element concentrations, in water samples collected by Teck Alaska. No fish were collected in 2024.

## LOCATION AND DESCRIPTION OF MONITORING SITES

Biomonitoring was performed at 16 sites in 2024 (Figure 1; Table 1). High water precluded fish sampling at all sites. A sample site was added on Ikalukrok Creek, upstream of the mouth of Noa Creek. Due to weather constraints, benthic macroinvertebrate samples were not collected from Sourdock Creek, and no sampling occurred at Lower Competition Creek. Sampling at North Fork Grayling Junior and Upper North Fork Red Dog North Tributary resumed in 2024. Distances in the site descriptions below are in river kilometers.

- **Competition Creek**
    - **Upper Competition Creek** is approximately 3 m wide with patches of thick vegetation lining the banks with intermittent eroded rock outcrops (Figure 2). The sample site is approximately 3.5 km upstream of its confluence with the Wulik River. There are multiple heavy metal seeps at the headwaters of Competition Creek, creating orange staining on the cobble substrate.
    - **Sourdock Creek** is characterized by mostly dense willows that form a canopy over the stream except in a few locations, including our sample site (Figure 2). The sample site is approximately 0.1 km upstream of its confluence with Competition Creek. The stream bed is characterized by large boulders.
    - **Lower Competition Creek** is 4–7 m wide with gravel and small cobble substrate. The sample site 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). Lower Competition Creek was not sampled in 2024.
- **Upper Ikalukrok Creek**
    - **West Fork Ikalukrok Creek** is a small, shallow stream with small cobble substrate. The stream runs through eroding banks with some willow colonization in the riparian zone but is dominated by open canopy (Figure 3).

- **Ikalukrok Creek upstream of West Fork Ikalukrok** is approximately 12 m wide with medium to large cobble substrate. There are depositional gravel bars at the sample site as well as established willow vegetation on the island (Figure 3).

- **Ikalukrok Creek downstream of West Fork Ikalukrok** is approximately 0.25 km downstream of the confluence of West Fork and main stem Ikalukrok creeks. Sampling occurs on a run downstream of a deep pool formed by a river bend (Figure 4). Substrate consists of small to medium cobble.

- **Ikalukrok Creek downstream of Cub Creek** 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 where the stream width is approximately 7 m wide (Figure 4). Substrate consists of small to medium cobble.

- **East Fork Ikalukrok Creek** 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 and is approximately 20 m wide (Figure 5). 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** is approximately 2.3 km downstream of the East Fork Ikalukrok confluence with Ikalukrok Creek. The sample site on Grayling Junior Creek 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 5). The stream at the site is approximately 5–7 m wide, with some cobble but predominantly gravel substrate.

  - **North Fork Grayling Junior Creek** is a shallow clearwater tributary that flows into Grayling Junior Creek. The sample site is approximately 2 km upstream of the confluence with East Fork Grayling Junior and is at the base of an eroding cliff face with willows lining the riverbanks (Figure 6). The stream is approximately 6–8 m wide, with small cobble and sparsely distributed boulders.

  - **East Fork Grayling Junior Creek** is a shallow tributary of Grayling Junior that is approximately 7 m wide. The sample site is approximately 2 km upstream of the confluence with the North Fork Grayling Junior Creek and downstream of a small red stained tributary (Figure 6). Substrate consists of small to medium cobble with minimal shrubs on gravel bars and along the riverbank.

- **Lower Ikalukrok Creek and Tributaries**

    - **Noa Creek** is a small tributary of Ikalukrok Creek, approximately 1 m wide with thick overhanging willow canopy (Figure 7). The channel is narrowly constrained with large boulders and has abundant moss growing along the riverbank.

    - **Ikalukrok Creek upstream of Noa Creek** is 29 m wide with shallow riffles across the entire width (Figure 7). The sample site is approximately 0.17 km upstream of the mouth of Noa Creek. The substrate is dominated by boulders with smaller cobbles along the stream edges.

    - **Moil Creek** is a small tributary of Ikalukrok Creek, approximately 3.7 km downstream of Noa Creek. The sample site is approximately 40 m upstream of the mouth of Moil Creek and is 1–3 m wide. There are a variety of substrate sizes, from gravel to boulders, all heavily coated by red precipitate, bonding the substrate in place (Figure 8). There is some vegetation and grass along the bedrock stream banks.

    - **Volcano Creek** is a tributary of Ikalukrok Creek and is approximately 4.15 km downstream of Moil Creek. The creek is 2–4 m wide with dense vegetation shading narrow sections but leaving open canopy over wider sections (Figure 8). The substrate consists of cobble with occasional boulders.

- **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 abundant 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 and is 2–3 m wide. The substrate ranges from gravel to cobble, and dense grasses with moderate willow growth line the banks (Figure 9).

Table 1.–Location of sample sites, parameters collected, and years sampled. Parameters include in situ water quality (W), periphyton (P), benthic macroinvertebrates (B), and sediment (S). Fish sampling occurred in previous years but are not included here since fish sampling did not occur in 2024.

| Stream/Site Name | Station | 2024 Parameters | Years Sampled |
|---|---|---|---|
| Upper Competition | 203 | W, P, B, S | 2000–2002 and 2014–2024 |
| Sourdock | 204 | W, P, S | 2000–2002 and 2014–2024 |
| West Fork Ikalukrok[1] | 205 | W, P, B, S | 2000–2002 and 2015–2024 |
| Ikalukrok upstream of West Fork Ikalukrok[1] | 206 | W, P, B, S | 2000–2002 and 2015–2024 |
| Ikalukrok downstream of WF Ikalukrok | 230 | W, P, B, S | 2021–2024 |
| Ikalukrok downstream of Cub Creek Seep[1] | 207 | W, P, B, S | 1997–1998, 2000–2002, and 2016–2024 |
| East Fork Ikalukrok[1] | 208 | W, P, B, S | 1997–1998, 2000–2002, and 2016–2024 |
| Grayling Junior[1] | 209 | W, P, B, S | 2000–2002 and 2016–2024 |
| NF Grayling Junior | n/a | W, P, B, S | 2021–2024 |
| EF Grayling Junior | n/a | W, P, B, S | 2021–2022 and 2024 |
| Noa | 210 | W, P, B, S | 2000–2002 and 2016–2024 |
| Ikalukrok upstream of Noa | n/a | W, P, B, S | 2024 |
| Moil | 211 | W, P, B, S | 2000–2002 and 2016–2024 |
| Volcano | n/a | W, P, B, S | 2014–2024 |
| Upper NFRD North Trib | n/a | W, P, B, S | 2021–2022 and 2024 |
| Upper NFRD South Trib | n/a | W, P, B, S | 2021–2024 |

[1]Site was not sampled in 2020.

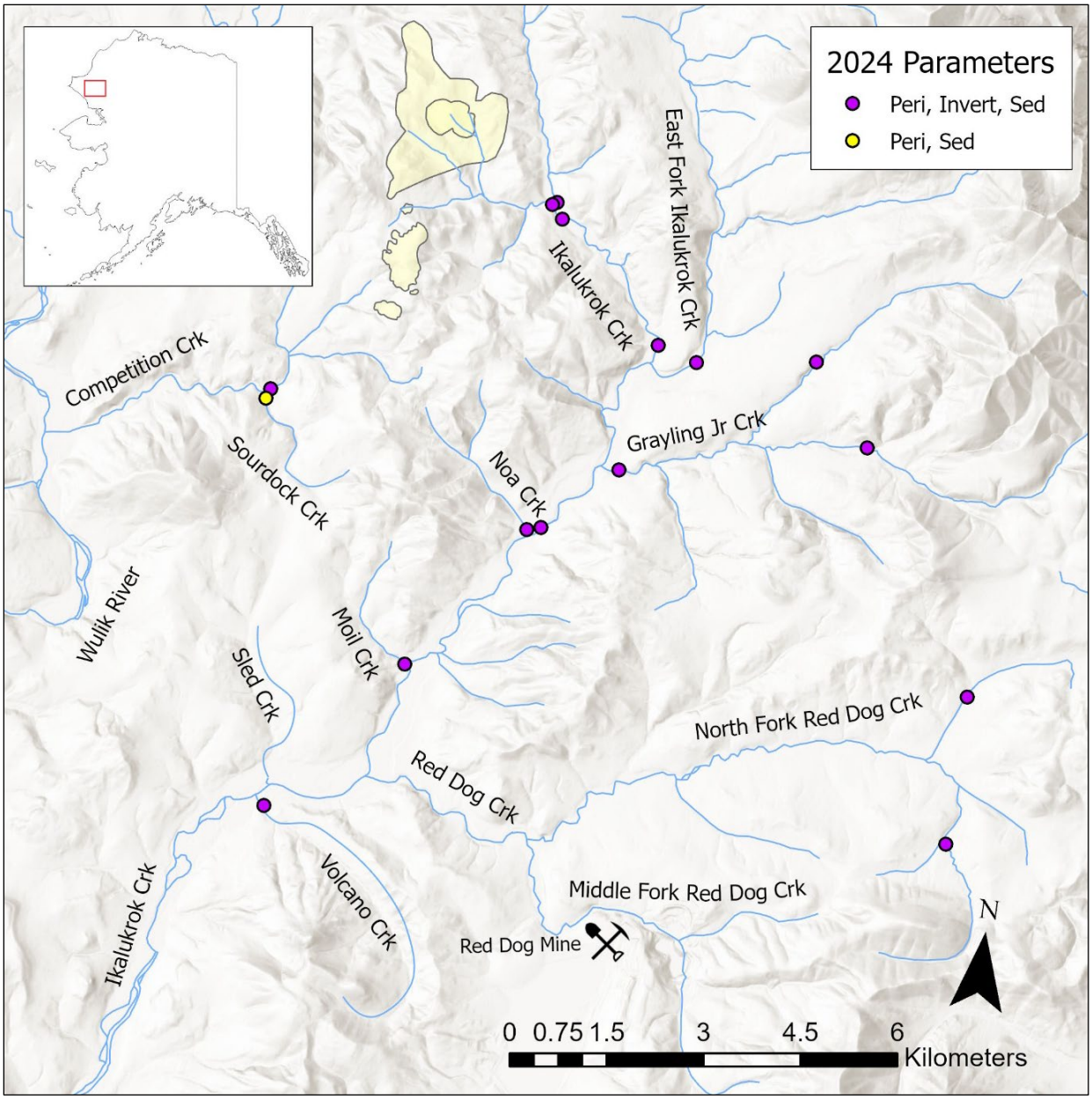


Figure 1.–July 2024 sample sites and associated parameters. The general location of Aktigiruq and Anarraaq deposits are depicted as yellow polygons.

Figure 2.–Sample sites on Lower Competition Creek (left), July 2023, and Sourdock Creek (middle) and Upper Competition Creek (right), July 2024.


Figure 3.–Sample sites on West Fork Ikalukrok Creek (left) and Ikalukrok Creek upstream of West Fork Ikalukrok (right), July 2024.


Figure 4.–Sample sites on Ikalukrok Creek downstream of West Fork Ikalukrok (left) and Ikalukrok Creek downstream of Cub Creek (right), July 2024.

Figure 5.–Sample sites on East Fork Ikalukrok Creek (left) and Grayling Junior Creek (right), July 2024.

Figure 6.–Sample sites on North Fork Grayling Junior Creek (left), July 2024 and East Fork Grayling Junior Creek looking downstream of the confluence with the red stained tributary (right), July 2022.

Figure 7.–Sample sites on Noa Creek (left) and Ikalukrok Creek upstream of Noa Creek (right), July 2024.

Figure 8.–Sample sites on Moil Creek (left) and Volcano Creek (right), July 2024.

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 2024.

# METHODS

## SAMPLING OVERVIEW

The objective of the AAEP 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 2024 there was one sampling event which took place from July 2–9. At each location in situ water quality parameters were recorded and replicate samples of benthic macroinvertebrates and periphyton were collected. One in-stream sediment sample from each site was also collected (Table 1).

Beginning in 2022, BMI were collected with Hess samplers rather than drift nets to identify and quantify the in-situ BMI community (Edwards 2023). 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. This provides a more accurate baseline for evaluating changes at each sampling location.

# WATER QUALITY

Teck Alaska performed water quality sampling throughout the 2024 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 $cm^2$ were collected from submerged areas at each site. A 5 cm x 5 cm square of high-density flexible foam was placed on the rock. All the material around the foam was scrubbed off with a toothbrush and rinsed back into the stream. The foam square was then removed from the rock, and that section of the rock was brushed and rinsed onto a 0.45 µm glass fiber filter receptacle attached to a hand vacuum pump. Material from the toothbrush was also rinsed onto the filter. The water was extracted from the periphyton covered filter using a hand vacuum pump. Just before all the water was pumped through the filter, one to two drops of magnesium carbonate ($MgCO_3$) were added to the water to prevent acidification and additional conversion of chlorophyll-a to phaeophytin.

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

## Laboratory Methods

In the lab, periphyton samples were removed from the freezer, the glass fiber filters were cut into small pieces and placed in individual 15 ml centrifuge tubes with 10 ml of 90% spectrophotometric grade acetone. The centrifuge tubes were secured in a vial rack covered with aluminum foil to reduce light exposure and stored in a dark refrigerator overnight. On the following day (~18–24 hours after preparation), sample tubes were placed in a centrifuge and spun at 1,600 rpm for 20 minutes. Samples were then decanted individually into cuvettes and absorption values at 750 nm, 664 nm, 647 nm, and 630 nm were recorded on a split beam spectrophotometer. Each sample was treated with 80 µL of 0.1 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 for can be found in ADF&G Technical Report 17-09 *Methods for Aquatic Life Monitoring at the Red Dog Mine Site* (Bradley 2017).

# BENTHIC MACROINVERTEBRATES

## Field Methods

At each sample site, five replicates were collected using a Hess sampler (Table 1). The Hess stream bottom sampler has a 0.086 $m^2$ sample area and material is captured in a 200 mL cod end, both constructed with 300 μm mesh net. Rocks within the sample area were scoured by hand, and gravel, sand, and silt were disturbed to about 10 cm depth to dislodge macroinvertebrates occupying the benthos into the net. The cod end contents were then removed and placed in individual pre-labeled Nalgene bottles with denatured ethyl alcohol to preserve the macroinvertebrates.

## Laboratory Methods

Samples were sorted and invertebrates identified by a private aquatic invertebrate lab in Fairbanks. Insects of the orders Ephemeroptera, Plecoptera, Trichoptera were identified to genus. Insects of the order Diptera were identified to genus, except the nonbiting midges of the family Chironomidae. Copepoda, Collembola, and Coleoptera were identified to genus. Oligochaeta, Ostracoda, Platyhelminthes, and Nematoda were identified to class level. Because invertebrates belonging to the orders Ephemeroptera (mayflies), Plecoptera (stoneflies), and Trichoptera (caddisflies) (EPT) are more sensitive to water quality, the total number of individual specimens of EPT was calculated and compared to groups of other invertebrates, which are less sensitive. The BMI density was calculated for each sample by dividing the number of invertebrates by 0.086 $m^2$, the Hess sampling area. Mean density was estimated for each site by calculating the mean density among the five samples. Density data is only reported for the years Hess samplers have been used since this method is not directly comparable to the previously used drift nets and the units differ. Taxa richness is reported as the number of taxonomic groups identified to the lowest practical level. Terrestrial organisms were excluded from all calculations.

## SEDIMENT

In-stream sediment samples were collected at all sites in 2024 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 AND DISCUSSION

## UPPER COMPETITION CREEK (STATION 203)

### Water Quality

Upper Competition Creek water samples had moderately low pH and elevated concentrations of aluminum, cadmium, nickel, and zinc in the early 2000's (Weber-Scannell and Ott 2006). In July 2024 in situ pH was 6.03, specific conductance was 1,416 µs/cm, water temperature was 1.3°C, dissolved oxygen was 13.1 mg/L, and turbidity was the highest recorded of 2024 sites at 26.1 NTU (Appendix B). The substrate had a grayish-yellow precipitate in the early 2000's, but the precipitate in 2014–2024 has varied from white to orange. The water in Upper Competition Creek varies among years from opaque white to orange in color and typically has elevated turbidity.

### Periphyton

In 2024, the mean chlorophyll-a concentration in Upper Competition Creek was 0.03 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 10). Mean chlorophyll-a concentrations have been consistently lower in Upper Competition Creek during the more recent sampling period (2014–2024) compared to the early 2000's. Notably, only 10 out of 100 raw data points have been above the annual estimated detection limit since 2014. Periphyton data from 2024 are presented in Appendix C.

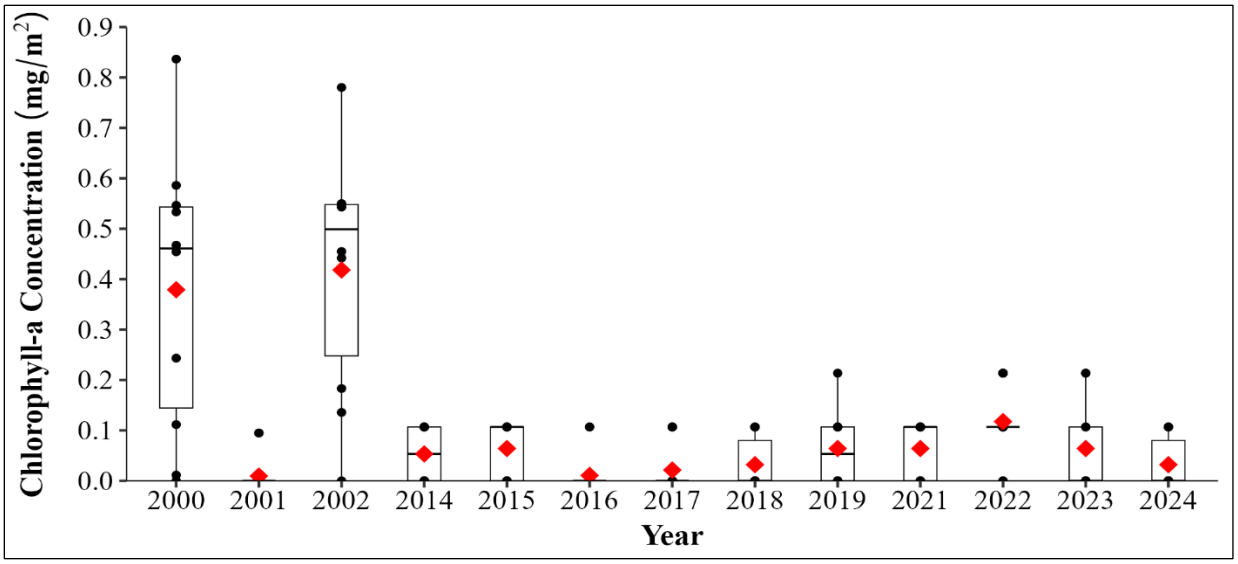


Figure 10.–Chlorophyll-a concentration boxplot by year at Upper Competition Creek, 2000–2002 and 2014–2024. Raw data are depicted by black dots and mean values are depicted in red.

## Benthic Macroinvertebrates

The mean BMI density in Upper Competition Creek in 2024 was 14/m$^2$ (SD = 19). This is similar to the mean in 2022, but well below the mean in 2023 (Figure 11). EPT taxa are not consistently present in Upper Competition Creek BMI samples. EPT taxa were not present in the samples in 2024, while Diptera and "other" taxa each made up 50% of the sample (Figure 12). Taxa richness in 2024 remained relatively low at 3 taxa. Prior to 2022, taxa richness ranged from 12–22 (Figure 13). The contrast with previous results may be due in part to the change in sampling methods from drift nets to Hess samplers beginning in 2022. BMI data from 2024 are presented in Appendix D.

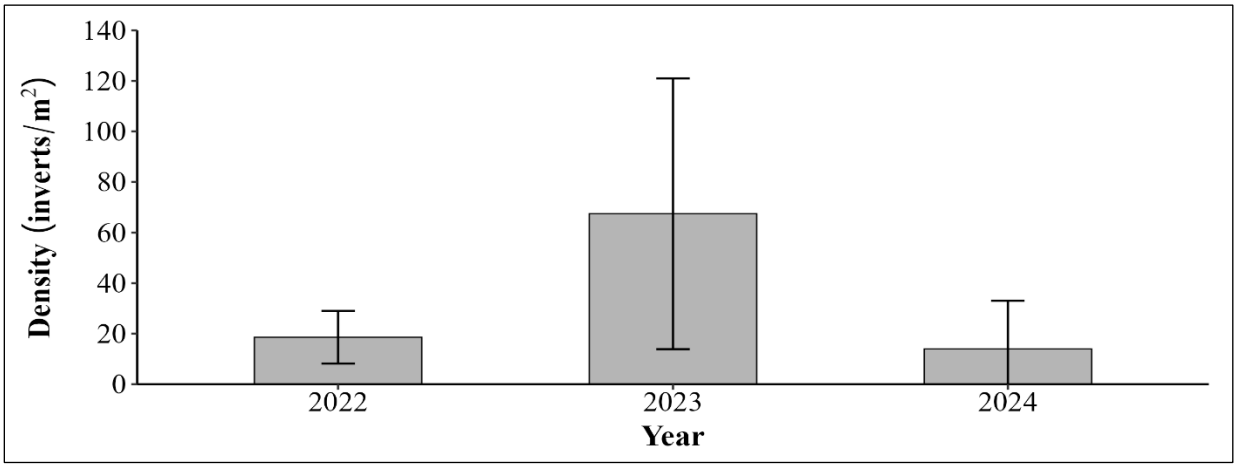


Figure 11.–Mean BMI density (± 1 SD) at Upper Competition Creek, 2022–2024.

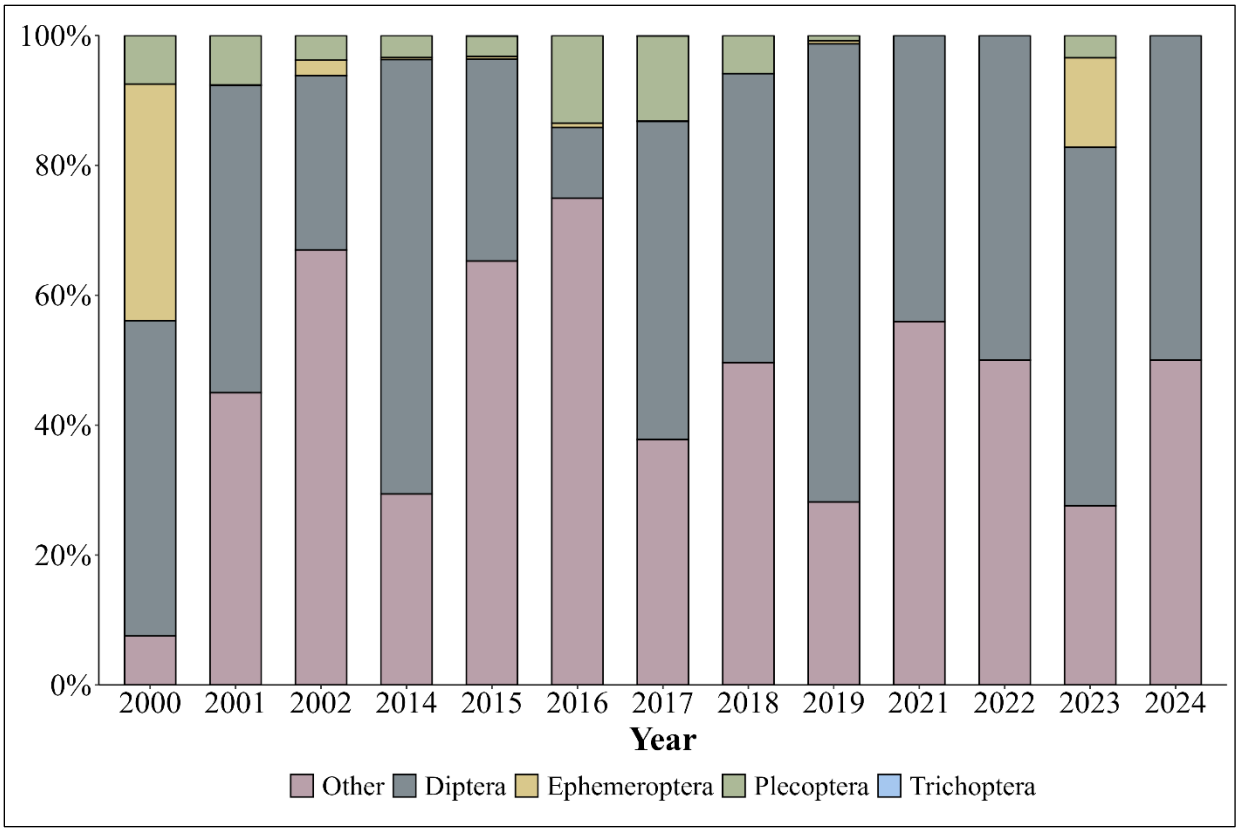


Figure 12.–Mean percent EPT, Diptera, and other taxa in Upper Competition Creek BMI samples, 2000–2002 and 2014–2024.

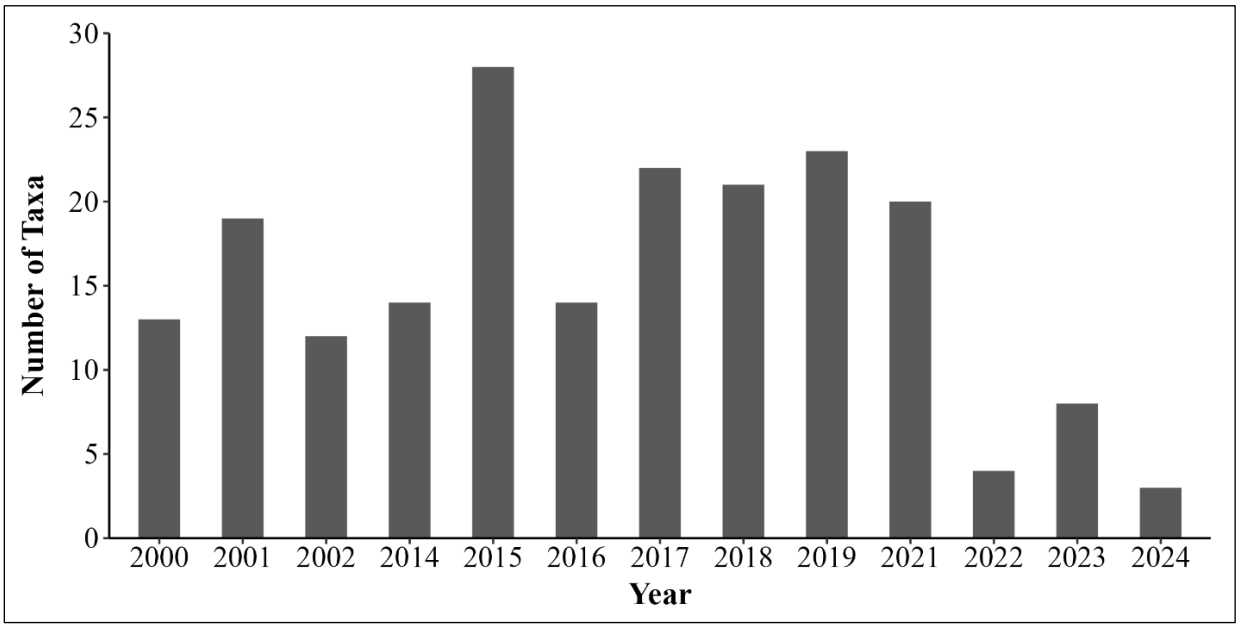


Figure 13.–Taxa richness in Upper Competition Creek BMI samples, 2000–2002 and 2014–2024. Sampling method was changed from drift nets to Hess samplers in 2022.

### Sediment

Sediment element concentrations from Upper Competition Creek and summary statistics from all 2024 sites are presented in Table 2. All elements excluding copper were below the mean concentration of 2024 samples. Copper was slightly above the mean, but well below the maximum concentration. Concentrations of copper and lead were notably lower in the 2024 sample compared to the 2022 sample.

Table 2.–Sediment sample element concentrations (mg/kg) in Upper Competition Creek in 2022 and 2024 and summary statistics for all sites in 2024. Summary statistics were calculated with all sites (n = 16) sampled in July 2024. Mercury summary statistics exclude two sites that had no detection (n = 14).

| Element | Upper Competition | | All 2024 Sample Sites | | |
|---|---|---|---|---|---|
| | 2022 | 2024 | Mean | Minimum | Maximum |
| Cadmium | 1.93 | 3.56 | 4.59 | 0.10 | 26.80 |
| Copper | 250.0 | 126.0 | 117.1 | 22.5 | 649.0 |
| Lead | 79.70 | 50.40 | 22.72 | 5.36 | 84.30 |
| Mercury | 0.083 | 0.069 | 0.054 | 0.024 | 0.084 |
| Selenium | 5.50 | 3.26 | 2.10 | 1.22 | 3.26 |
| Zinc | 493.0 | 403.0 | 603.0 | 50.8 | 2,030.0 |

## SOURDOCK CREEK (STATION 204)

### Water Quality

In the early 2000's, Sourdock Creek water samples had moderate alkalinity (as $CaCO_3$), and the pH was neutral with slightly elevated concentrations of aluminum, cadmium, and zinc (Weber-Scannell and Ott 2006). In July 2024 in situ pH was 7.9, specific conductance was 779 µs/cm, water temperature was 1.2°C, dissolved oxygen was 13.2 mg/L, and turbidity was relatively elevated at 7.96 NTU (Appendix B). 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.

### Periphyton

In 2024, the mean chlorophyll-a concentration in Sourdock Creek was 0.15 mg/m$^2$ (SD = 0.12) which is similar to the means in 2022 and 2023 (Figure 14). The highest mean chlorophyll-a concentration observed in Sourdock Creek was 12.44 mg/m$^2$ in 2002 (Figure 14). Historically, chlorophyll-a concentrations were considerably higher in Sourdock Creek than in Upper

Competition Creek, but since 2022 both have been very low. These two creeks merge just downstream of the sample sites into Competition Creek. Periphyton data from 2024 are presented in Appendix C.

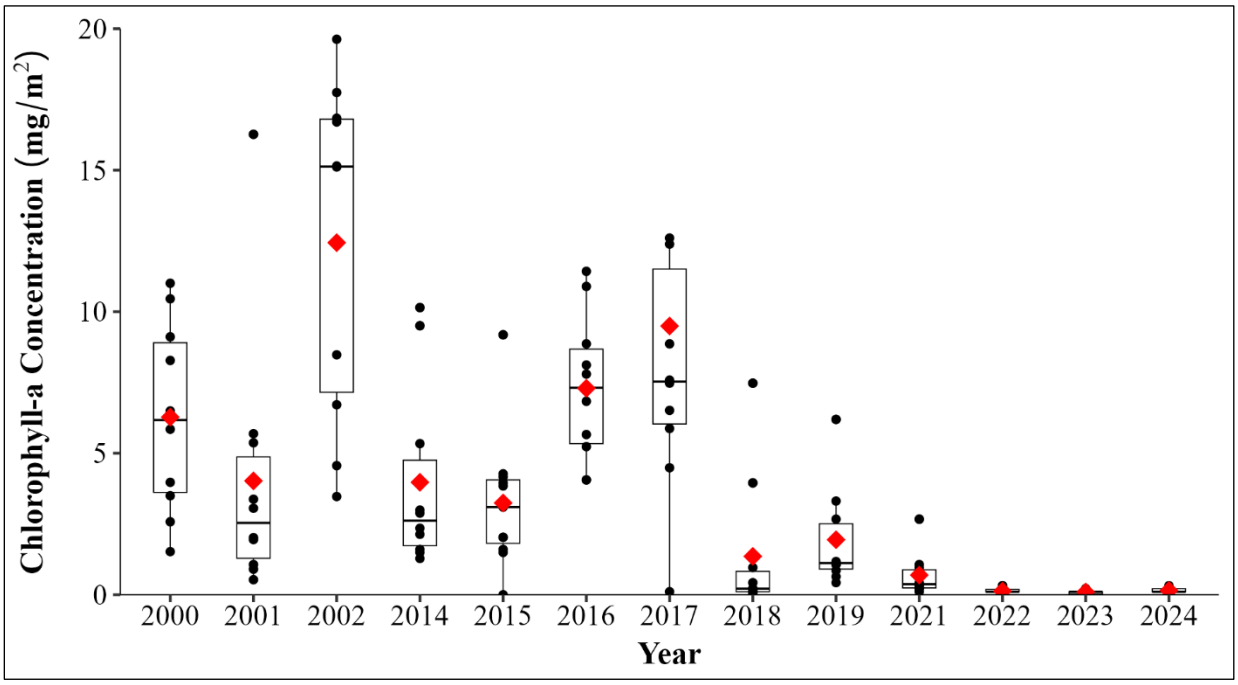


Figure 14.–Chlorophyll-a concentration boxplot by year at Sourdock Creek, 2000–2002 and 2014–2024. Raw data are depicted by black dots and mean values are depicted in red.

## Benthic Macroinvertebrates

Benthic macroinvertebrates were not collected in 2024 at Sourdock Creek due to weather constraints.

## Sediment

Sediment element concentrations from Sourdock Creek and summary statistics from all 2024 sites are presented in Table 3. Mercury and selenium concentrations were similar to the maximum observed concentration in 2024. Cadmium and zinc were slightly higher but comparable to the 2024 mean concentrations. The 2022 and 2024 samples had similar concentrations of cadmium, copper, and lead with increased concentrations of mercury and selenium in 2024.

Table 3.–Sediment sample element concentrations (mg/kg) in Sourdock Creek in 2022 and 2024 and summary statistics for all sites in 2024. Summary statistics were calculated with all sites (n = 16) sampled in July 2024. Mercury summary statistics exclude two sites that had no detection (n = 14).

| Element | Sourdock Creek | | All 2024 Sample Site | | |
|---|---|---|---|---|---|
| | 2022 | 2024 | Mean | Minimum | Maximum |
| Cadmium | 5.85 | 5.34 | 4.59 | 0.10 | 26.80 |
| Copper | 72.0 | 69.8 | 117.1 | 22.5 | 649.0 |
| Lead | 15.10 | 14.30 | 22.72 | 5.36 | 84.30 |
| Mercury | 0.028 | 0.082 | 0.054 | 0.024 | 0.084 |
| Selenium | 2.09 | 3.20 | 2.10 | 1.22 | 3.26 |
| Zinc | 996.0 | 785.0 | 603.0 | 50.8 | 2,030.0 |

# WEST FORK IKALUKROK CREEK (STATION 205)

## Water Quality

In the early 2000's, water hardness and sulfate concentrations in West Fork Ikalukrok Creek were relatively high while alkalinity was low. The pH was also low ranging from 4.3–6.8 (Weber-Scannell and Ott 2006). Water samples had high concentrations of most elements analyzed in the early 2000's, especially aluminum, cadmium, copper, nickel, and zinc (Weber-Scannell and Ott 2006). In 2024, water quality data were collected by Teck at Station 231 approximately one river km upstream of Station 205. Element concentration data from these samples were consistent with early 2000's data (Appendix A). In July 2024 in situ pH was acidic at 4.5, water temperature was 3.5°C, dissolved oxygen was 12.7 mg/L, specific conductance was 890 µs/cm, and turbidity was 0.32 NTU (Appendix B). Since sampling began in the area, a white precipitate has been observed at the mouth of the creek where the water converges with mainstem Ikalukrok Creek.

## Periphyton

Mean chlorophyll-a concentration in West Fork Ikalukrok Creek in 2024 was 0.32 mg/m$^2$ (SD = 0.19). 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 15). The mean chlorophyll-a concentrations in West Fork Ikalukrok Creek from 2015–2024 were generally lower than those from 2000–2002 and have remained below 1 mg/m$^2$ since 2020 (Figure 15). Periphyton data from 2024 are presented in Appendix C.

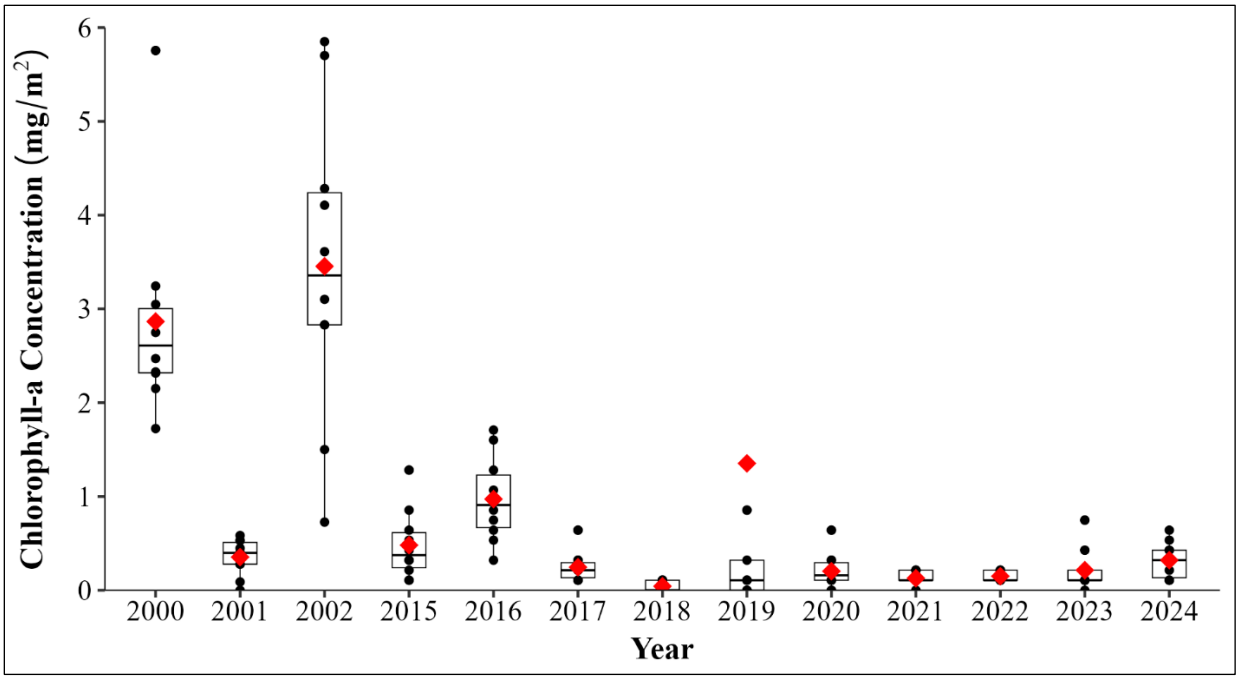


Figure 15.–Chlorophyll-a concentration boxplot by year at West Fork Ikalukrok Creek, 2000–2002 and 2015–2024. Raw data are depicted by black dots and mean values are depicted in red. Note that the raw data point of 10.68 mg/m$^2$ in 2019 is excluded from this plot but not from statistical analyses.

## Benthic Macroinvertebrates

Mean BMI density in West Fork Ikalukrok Creek in 2024 was 44/m$^2$ (SD = 44). This is approximately halfway between the mean densities in 2022 and 2023 (Figure 16). EPT taxa were not present in 2024 samples for only the second time among all years of data (Figure 17). Diptera made up 47.4% of the samples and "other" taxa made up the remaining percentage. Taxa richness in 2024 was 5, which is similar to 2022 and 2023 (Figure 18). The contrast with previous results may be due in part to the change in sampling methods from drift nets to Hess samplers beginning in 2022. BMI data from 2024 are presented in Appendix D.

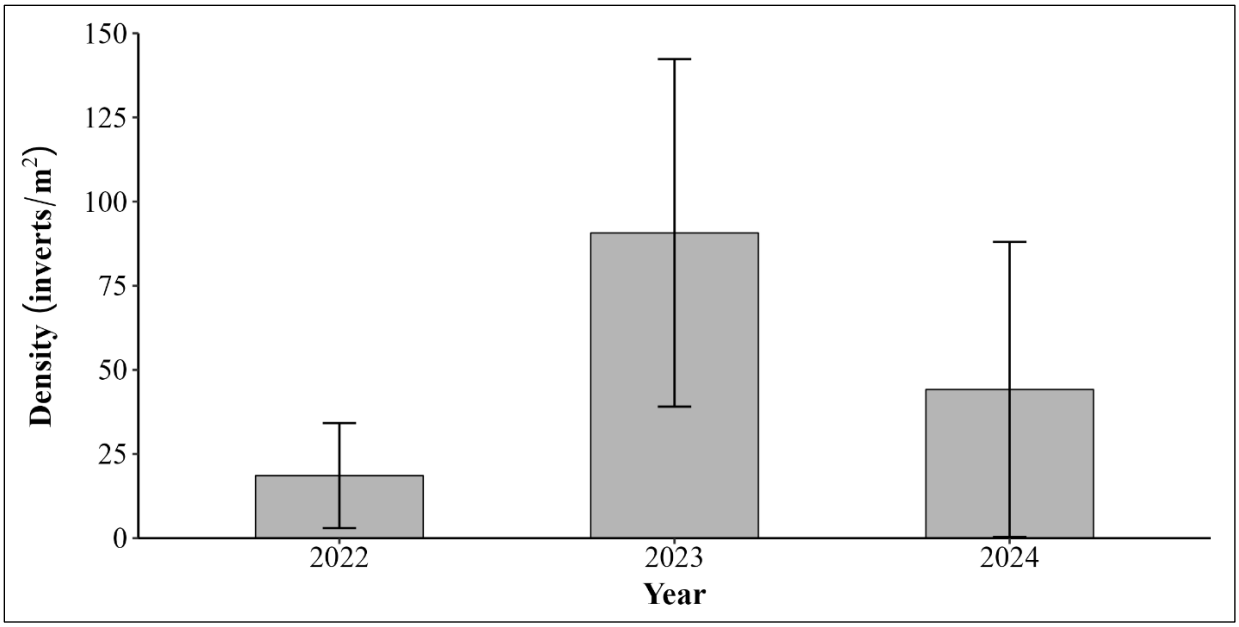


Figure 16.–Mean BMI density (± 1 SD) at West Fork Ikalukrok Creek, 2022–2024.

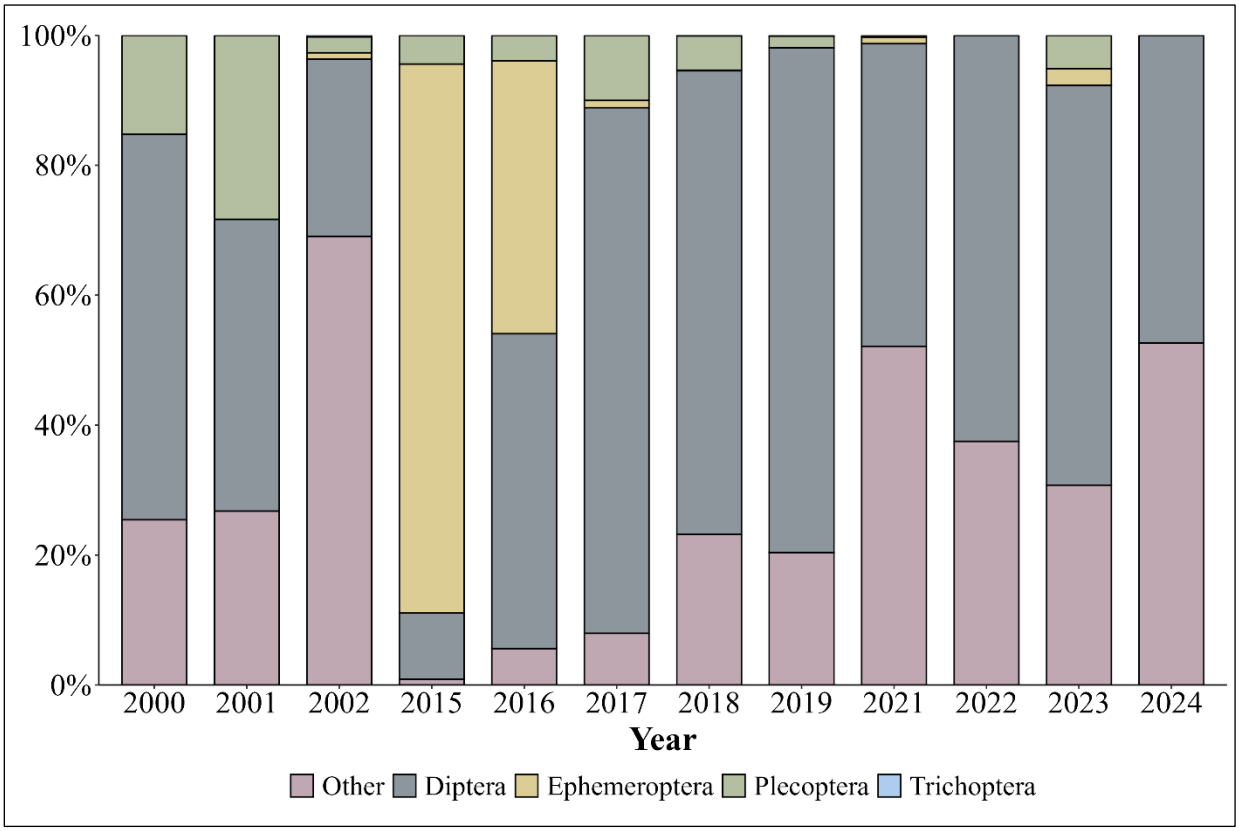


Figure 17.–Mean percent EPT, Diptera, and other taxa in West Fork Ikalukrok Creek BMI samples, 2000–2002 and 2015–2024.

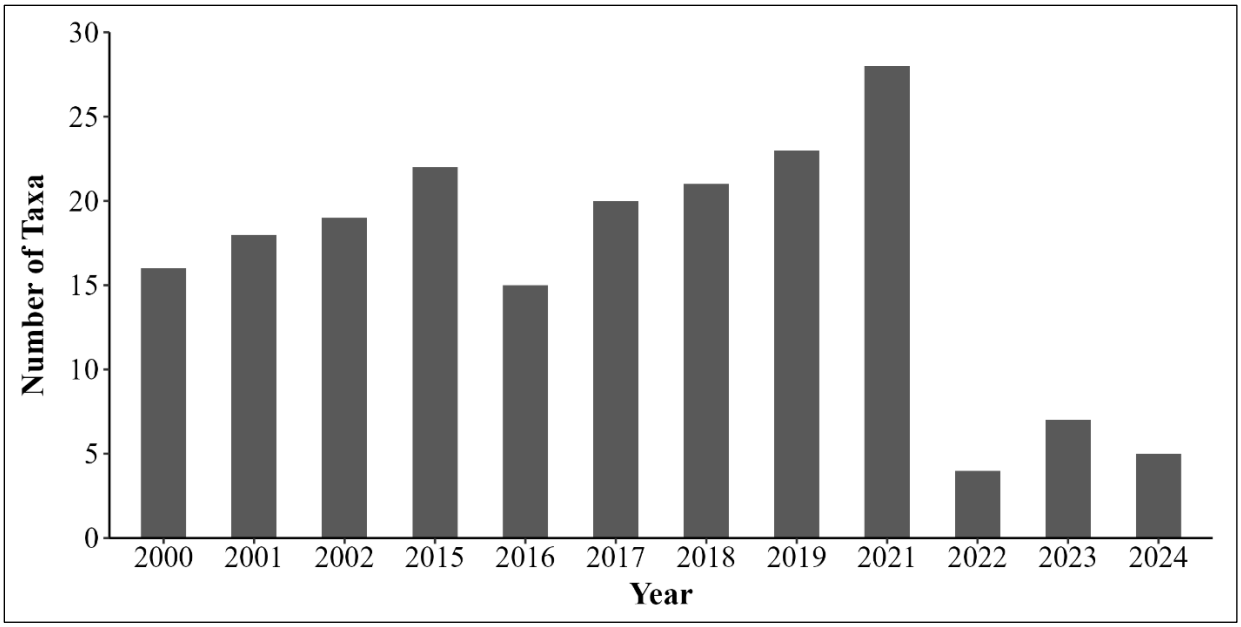


Figure 18.–Taxa richness in West Fork Ikalukrok Creek BMI samples, 2000–2002 and 2015–2024. Sampling method was changed from drift nets to Hess samplers in 2022.

## Sediment

Sediment element concentrations from West Fork Ikalukrok and summary statistics from all 2024 sites are presented in Table 4. All elements excluding copper were well below the 2024 mean concentrations. Zinc concentration at West Fork Ikalukrok was lower than most other monitored AAEP sites. Compared to the 2022 sediment sample, element concentrations in 2024 were marginally lower but values remain comparable.

Table 4.–Sediment sample element concentrations (mg/kg) in West Fork Ikalukrok Creek in 2022 and 2024 and summary statistics for all sites in 2024. Summary statistics were calculated with all sites (n = 16) sampled in July 2024. Mercury summary statistics exclude two sites that had no detection (n = 14).

| Element | West Fork Ikalukrok Creek | | All 2024 Sample Sites | | |
|---|---|---|---|---|---|
| | 2022 | 2024 | Mean | Minimum | Maximum |
| Cadmium | 0.62 | 0.41 | 4.59 | 0.10 | 26.80 |
| Copper | 159.0 | 120.0 | 117.1 | 22.5 | 649.0 |
| Lead | 18.00 | 13.40 | 22.72 | 5.36 | 84.30 |
| Mercury | 0.029 | 0.038 | 0.054 | 0.024 | 0.084 |
| Selenium | 2.45 | 1.77 | 2.10 | 1.22 | 3.26 |
| Zinc | 179.0 | 102.0 | 603.0 | 50.8 | 2,030.0 |

# 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 2000's, concentrations of all elements in Ikalukrok Creek upstream West Fork water samples 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 6.5–8.1 (Weber-Scannell and Ott 2006). In July 2024 in situ pH was 7.38, water temperature was 5.5°C, dissolved oxygen was 11.9 mg/L, specific conductance was 444 µs/cm, and turbidity was 0.81 NTU (Appendix B). The water at this site is generally clear, although in 2020 it was milky with white and orange staining on the rocks.

## Periphyton

Mean chlorophyll-a concentration in Ikalukrok Creek upstream of West Fork Ikalukrok in 2024 was 0.07 mg/m$^2$ (SD = 0.07). This is approximately one third of the mean in 2023 but similar to the annual means from 2019–2022 (Figure 19). Mean chlorophyll-a concentrations have ranged from 0.03 mg/m$^2$ in 2020 to 3.48 mg/m$^2$ in 2002 (Figure 19). Chlorophyll-a concentrations have remained notably low since 2019. Periphyton data from 2024 are presented in Appendix C.

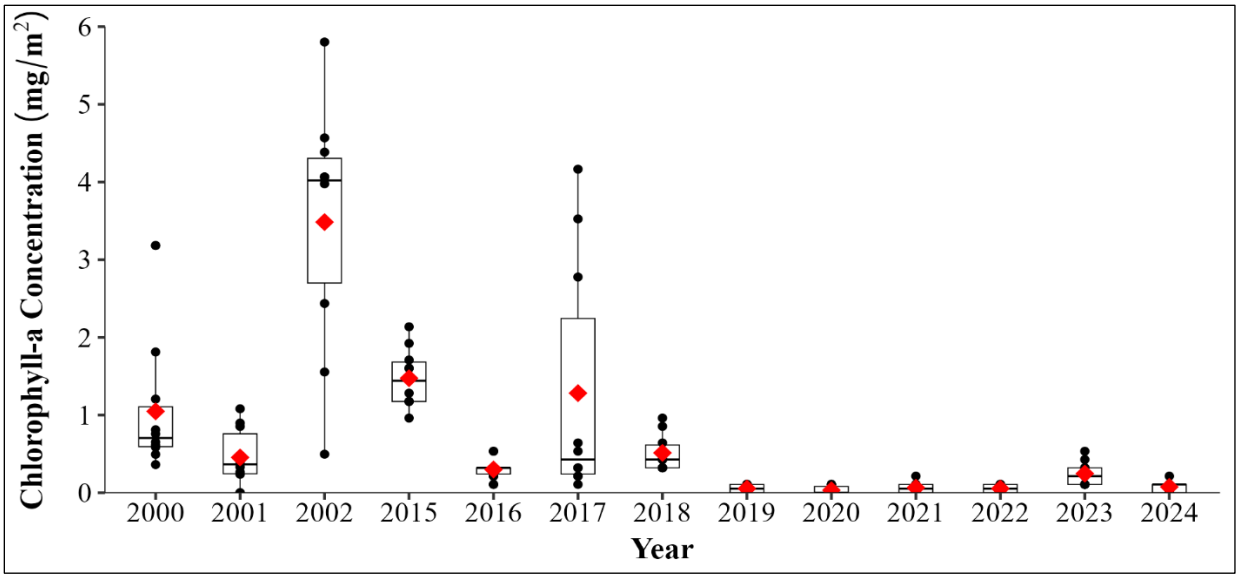


Figure 19.–Chlorophyll-a concentration boxplot by year at Ikalukrok Creek upstream of West Fork Ikalukrok Creek, 2000–2002 and 2015–2024. Raw data are depicted by black dots and mean values are depicted in red.

## Benthic Macroinvertebrates

Mean BMI density in Ikalukrok Creek upstream of West Fork Ikalukrok Creek in 2024 was similar to the previous two years at 265/$m^2$ (SD = 115; Figure 20). EPT taxa presence has been highly variable among years ranging from 3.1% in 2019 to 98% in 2016. For the fifth year in a row Diptera made up the majority of the samples in 2024 at 92.1% while EPT made up 7.0% (Figure 21). Taxa richness in 2024 was 6 which is less than half the richness in 2023 but the same as the 2022 taxa richness (Figure 22). The contrast with previous results may be due in part to the change in sampling methods from drift nets to Hess samplers beginning in 2022. BMI data from 2024 are presented in Appendix D.

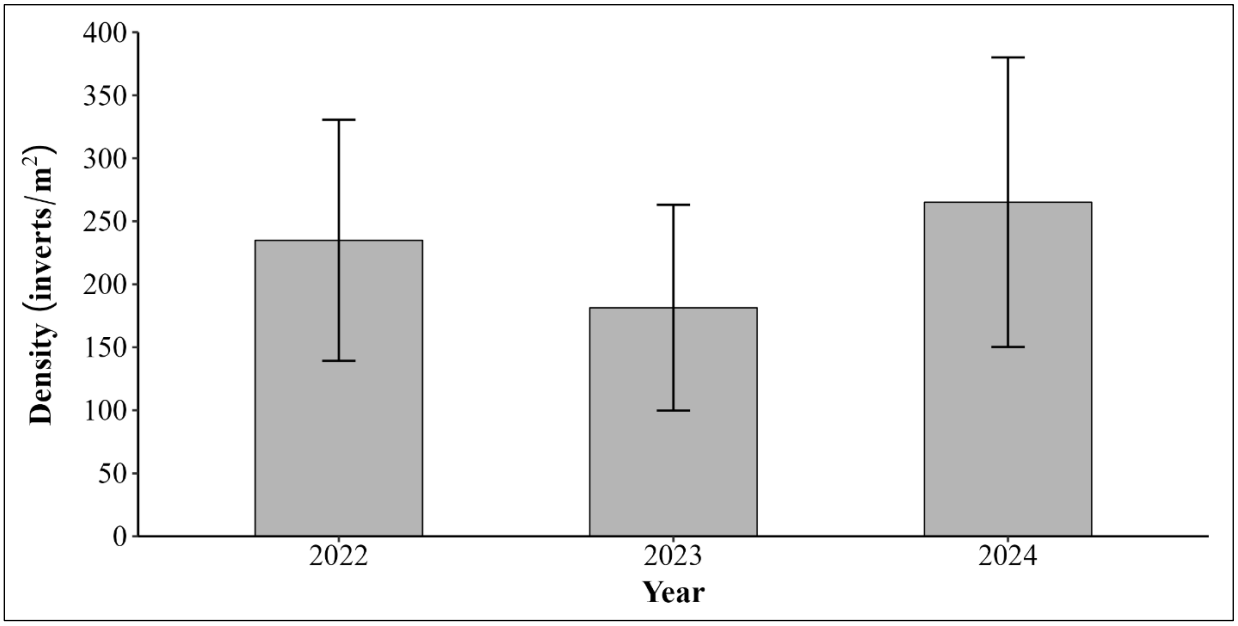


Figure 20.–Mean BMI density (± 1 SD) at Ikalukrok Creek upstream of West Fork Ikalukrok Creek, 2022–2024.

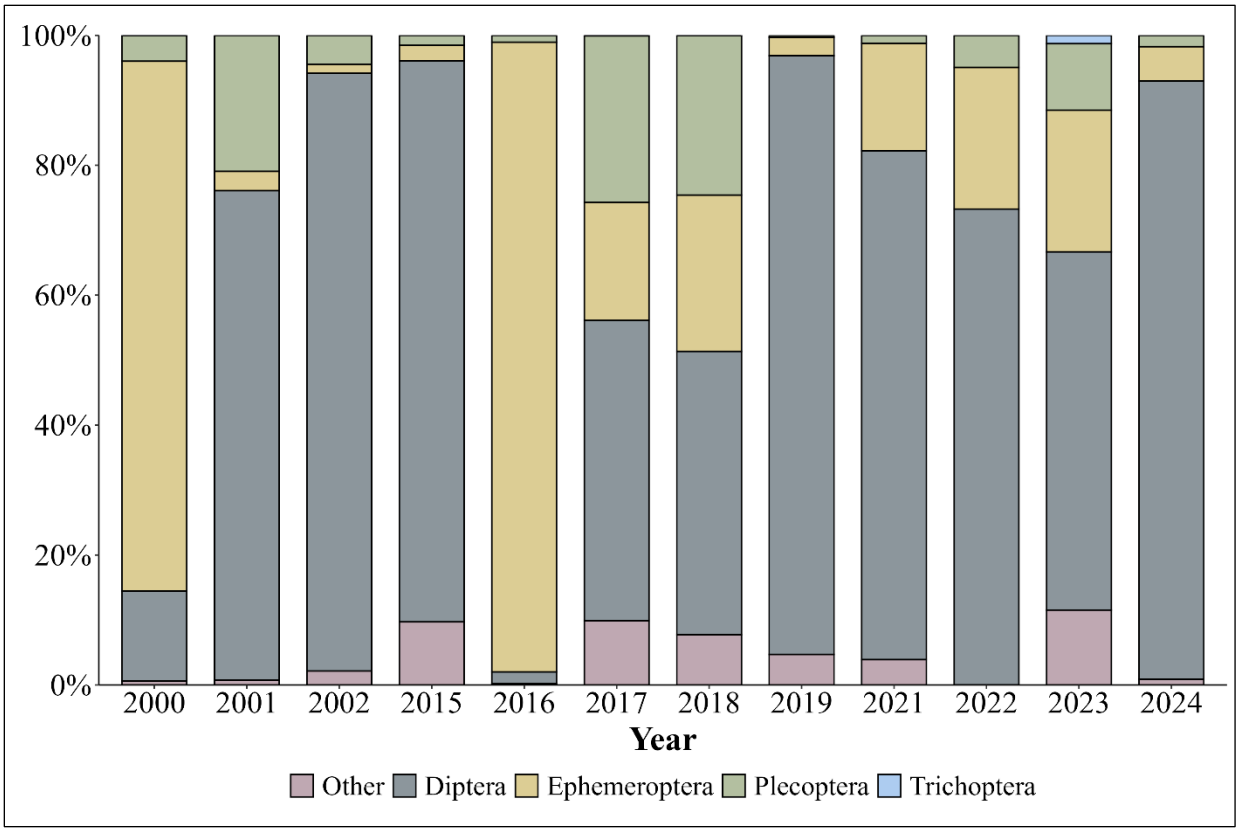


Figure 21.–Mean percent EPT, Diptera, and other taxa in Ikalukrok Creek upstream of West Fork Ikalukrok Creek BMI samples, 2000–2002 and 2015–2024.

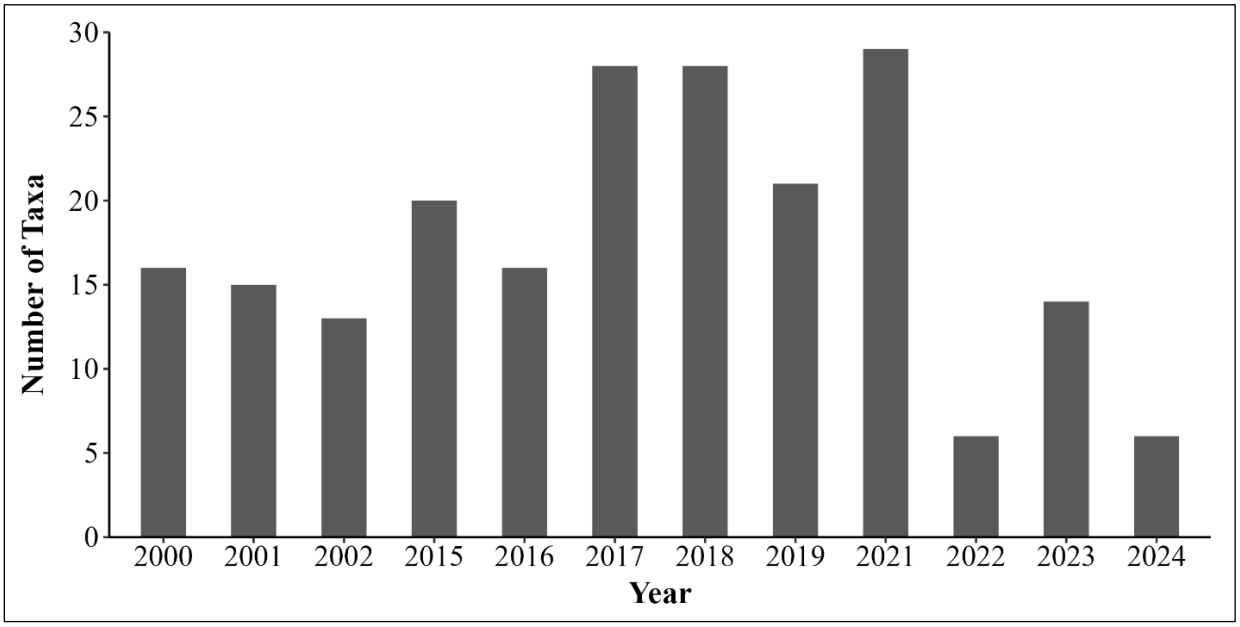


Figure 22.–Taxa richness in Ikalukrok Creek upstream of West Fork Ikalukrok Creek BMI samples, 2000–2002 and 2015–2024. Sampling method was changed from drift nets to Hess samplers in 2022.

### Sediment

Sediment element concentrations in Ikalukrok Creek, upstream of West Fork Ikalukrok Creek, and summary statistics from all 2024 sites are presented in Table 5. All elements excluding copper were well below the mean concentrations, similar to the West Fork Ikalukrok sample. Copper was higher than the mean but well below the maximum concentration. Compared to the 2022 sample, 2024 element concentrations were all marginally lower and remain broadly comparable.

Table 5.–Sediment sample element concentrations (mg/kg) in Ikalukrok upstream West Fork Ikalukrok Creek in 2022 and 2024 and summary statistics for all sites in 2024. Summary statistics were calculated with all sites (n = 16) sampled in July 2024. Mercury summary statistics exclude two sites that had no detection (n = 14).

| Element | Ikalukrok above West Fork | | All 2024 Sample Sites | | |
|---|---|---|---|---|---|
| | 2022 | 2024 | Mean | Minimum | Maximum |
| Cadmium | 3.25 | 2.41 | 4.59 | 0.10 | 26.80 |
| Copper | 201.0 | 155.0 | 117.1 | 22.5 | 649.0 |
| Lead | 13.40 | 12.50 | 22.72 | 5.36 | 84.30 |
| Mercury | 0.038 | 0.035 | 0.054 | 0.024 | 0.084 |
| Selenium | 1.50 | 1.40 | 2.10 | 1.22 | 3.26 |
| Zinc | 595.0 | 475.0 | 603.0 | 50.8 | 2,030.0 |

## IKALUKROK CREEK DOWNSTREAM OF WEST FORK IKALUKROK CREEK (STATION 230)

### Water Quality

Ikalukrok Creek downstream of West Fork Ikalukrok Creek has clear water, but occasional white staining has been observed. In July 2024 in situ pH was 7.7, water temperature was 6.3°C, dissolved oxygen was 12.1 mg/L, specific conductance was 552 µs/cm, and turbidity was 1.04 NTU (Appendix B). Comprehensive element concentrations measured in Ikalukrok Creek downstream of West Fork Ikalukrok were higher than East Fork Ikalukrok Creek, but lower than concentrations at sites heavily impacted by rusting seeps, including Ikalukrok Creek downstream of Cub Creek (Appendix A).

### Periphyton

Mean chlorophyll-a concentration in Ikalukrok Creek downstream of West Fork Ikalukrok Creek in 2024 was the same as in 2023 at 0.02 mg/m$^2$ (SD = 0.04), down from 0.05 mg/m$^2$ (SD = 0.06)

in 2021 and 2022 (Figure 23). In 2023 and 2024 only two data points were above 0. All chlorophyll-a concentration individual data points from Ikalukrok Creek downstream of West Fork Ikalukrok Creek have been below the annual detection limits. Periphyton data from 2024 are presented in Appendix C.

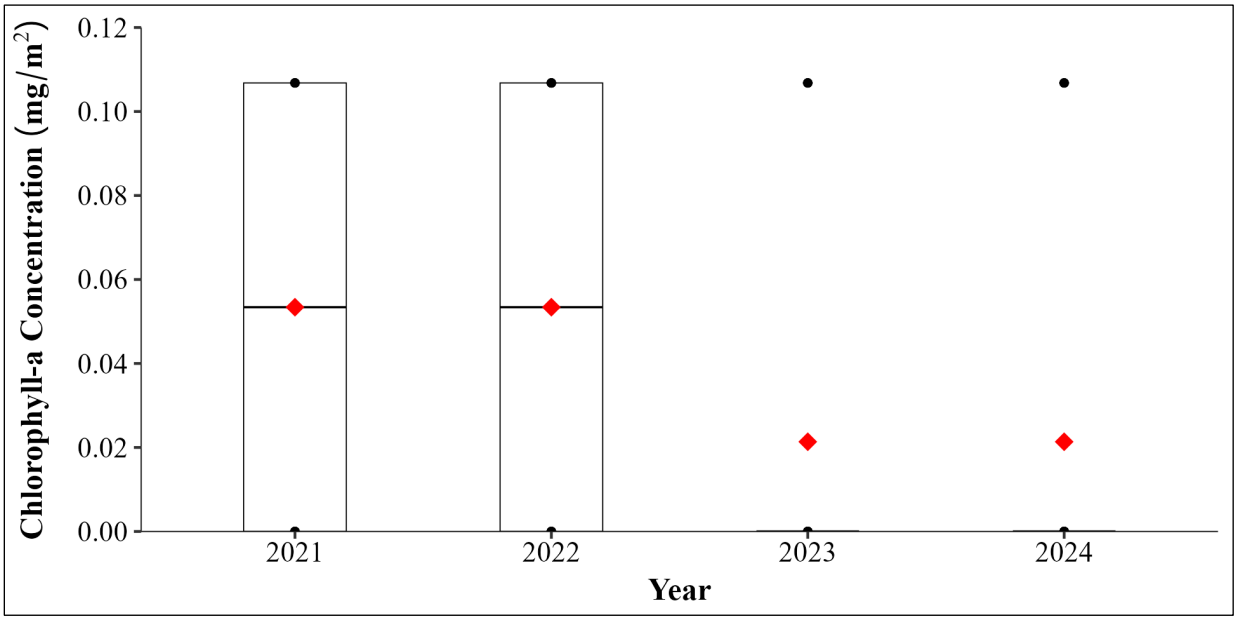


Figure 23.–Chlorophyll-a concentration boxplot by year at Ikalukrok Creek downstream of West Fork Ikalukrok Creek, 2021–2024. Raw data are depicted by black dots and mean values are depicted in red.

## Benthic Macroinvertebrates

Mean BMI density in Ikalukrok Creek downstream of West Fork Ikalukrok Creek in 2024 was 365/m$^2$ (SD = 172), which is greater than the mean density in 2023 but less than the mean density in 2022 (Figure 24). Diptera made up the majority of the samples in 2024 for the fourth year in a row at 87.3%. Conversely, EPT was the lowest on record at 10.8% but Trichoptera were present in the samples for the first time since 2021 (Figure 25). Taxa richness in 2024 was the same as 2023 at 10 taxa. Taxa richness has ranged from 7–25 among all years (Figure 26). BMI data from 2024 are presented in Appendix D.

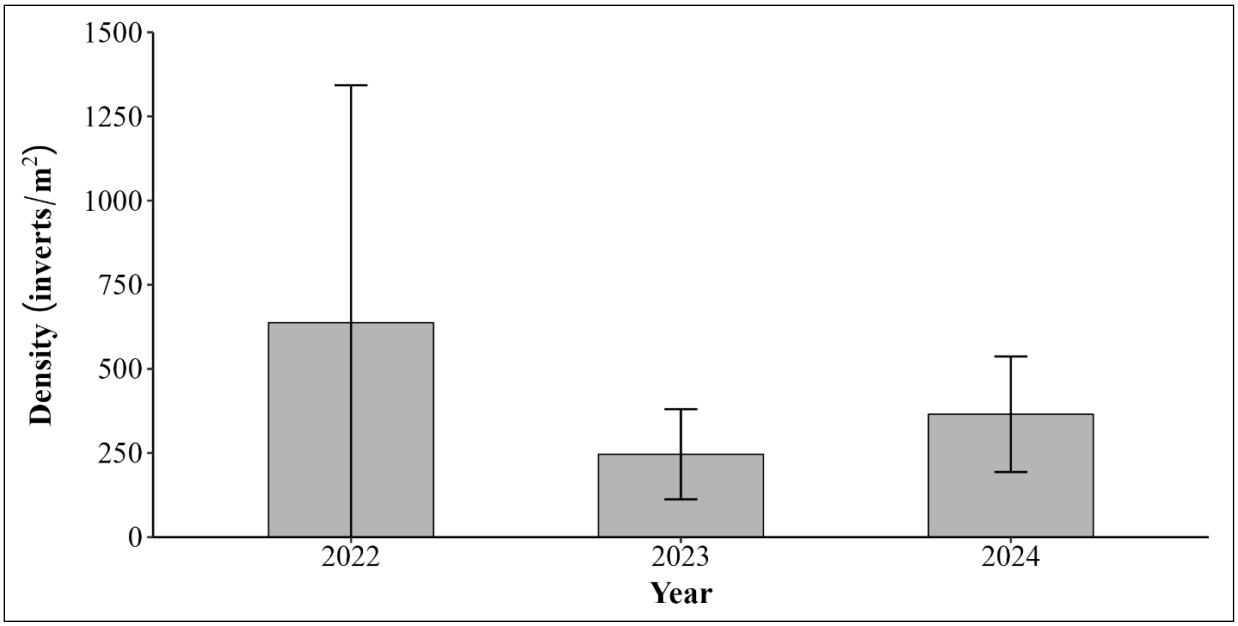


Figure 24.–Mean BMI density (± 1 SD) at Ikalukrok Creek downstream of West Fork Ikalukrok Creek, 2022–2024.

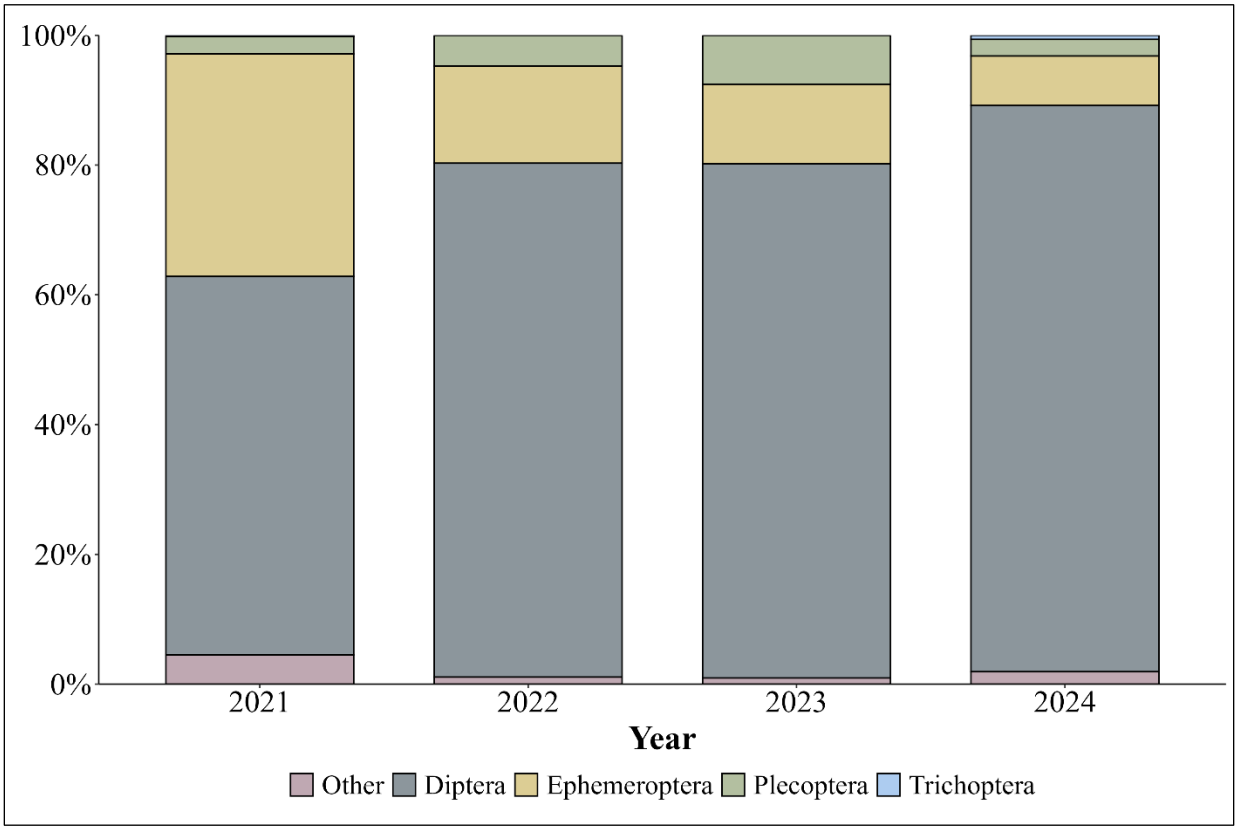


Figure 25.–Mean percent EPT, Diptera, and other taxa in Ikalukrok Creek downstream of West Fork Ikalukrok Creek BMI samples, 2021–2024.

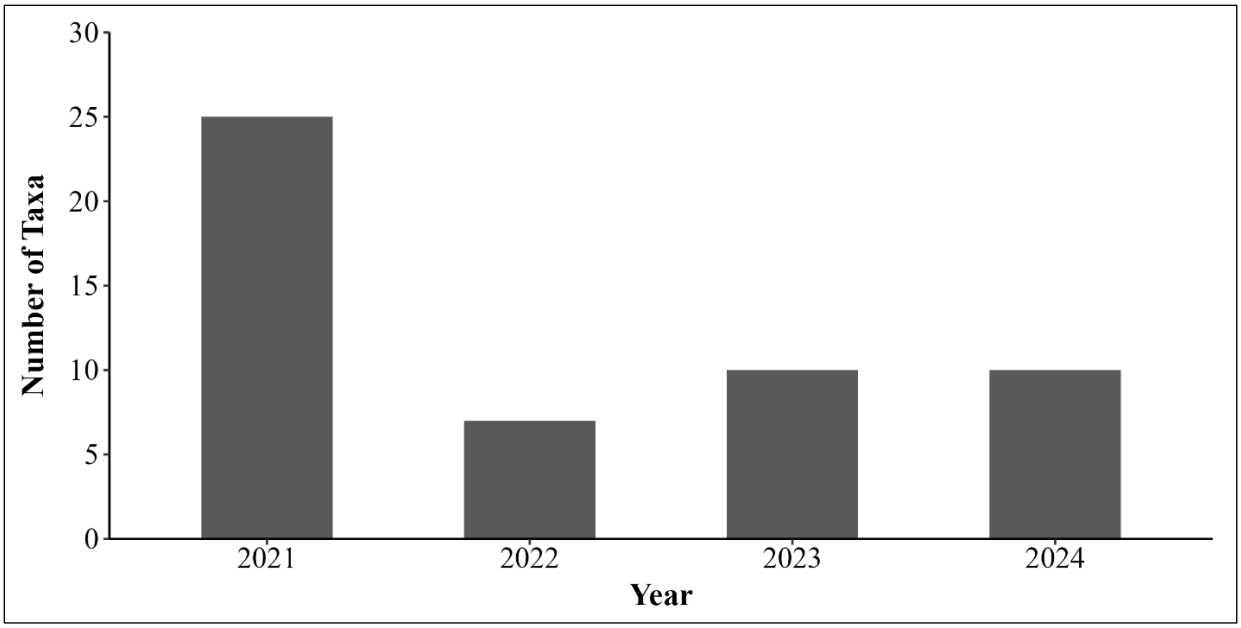


Figure 26.–Taxa richness in Ikalukrok Creek downstream of West Fork Ikalukrok Creek BMI samples, 2021–2024. Sampling method was changed from drift nets to Hess samplers in 2022.

## Sediment

Sediment element concentrations from Ikalukrok Creek downstream of West Fork Ikalukrok Creek, and summary statistics from all 2024 sites are presented in Table 6. No sediment samples were collected in 2022. Element concentrations were very similar or slightly elevated compared to concentrations at Ikalukrok Creek upstream of West Fork Ikalukrok Creek (Table 5). The copper concentration is the second highest concentration for all AAEP site, but well below the maximum observed at Upper Grayling Junior South Tributary.

Table 6.–Sediment sample element concentrations (mg/kg) in Ikalukrok Creek downstream of West Fork Ikalukrok Creek in 2024 and summary statistics for all sites in 2024. Summary statistics were calculated with all sites (n = 16) sampled in July 2024. Mercury summary statistics exclude two sites that had no detection (n = 14).

| Element | Ikalukrok below West Fork | All 2024 Sample Sites | | |
|---|---|---|---|---|
| | 2024 | Mean | Minimum | Maximum |
| Cadmium | 2.87 | 4.59 | 0.10 | 26.80 |
| Copper | 178.0 | 117.1 | 22.5 | 649.0 |
| Lead | 12.90 | 22.72 | 5.36 | 84.30 |
| Mercury | 0.033 | 0.054 | 0.024 | 0.084 |
| Selenium | 1.70 | 2.10 | 1.22 | 3.26 |
| Zinc | 545.0 | 603.0 | 50.8 | 2,030.0 |

# IKALUKROK CREEK DOWNSTREAM OF CUB CREEK (STATION 207)

## Water Quality

Ikalukrok Creek downstream of Cub Creek is influenced by several heavy metal 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 2000's and often exceeded the EPA chronic aquatic life criteria (Weber-Scannell and Ott 2006; EPA 2024). In 2024, 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 2023 and 2024, higher than average summer discharge diluted and mobilized the settled precipitate resulting in turbid water, but minimal precipitate and staining compared to previous years. In July 2024 in situ pH was 7.16, water temperature was 5.9°C, dissolved oxygen was 11.8 mg/L, specific conductance was 573 µs/cm, and turbidity was 2.46 NTU (Appendix B).

## Periphyton

Mean chlorophyll-a concentration in Ikalukrok Creek downstream of Cub Creek in 2024 was 0.01 $mg/m^2$ (SD = 0.03). Chlorophyll-a concentrations have been consistently low since sampling began. Mean chlorophyll-a concentration in 2021 was the highest on record at 0.11 $mg/m^2$ (Figure 27). From 2016–2024 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 2024 are presented in Appendix C.

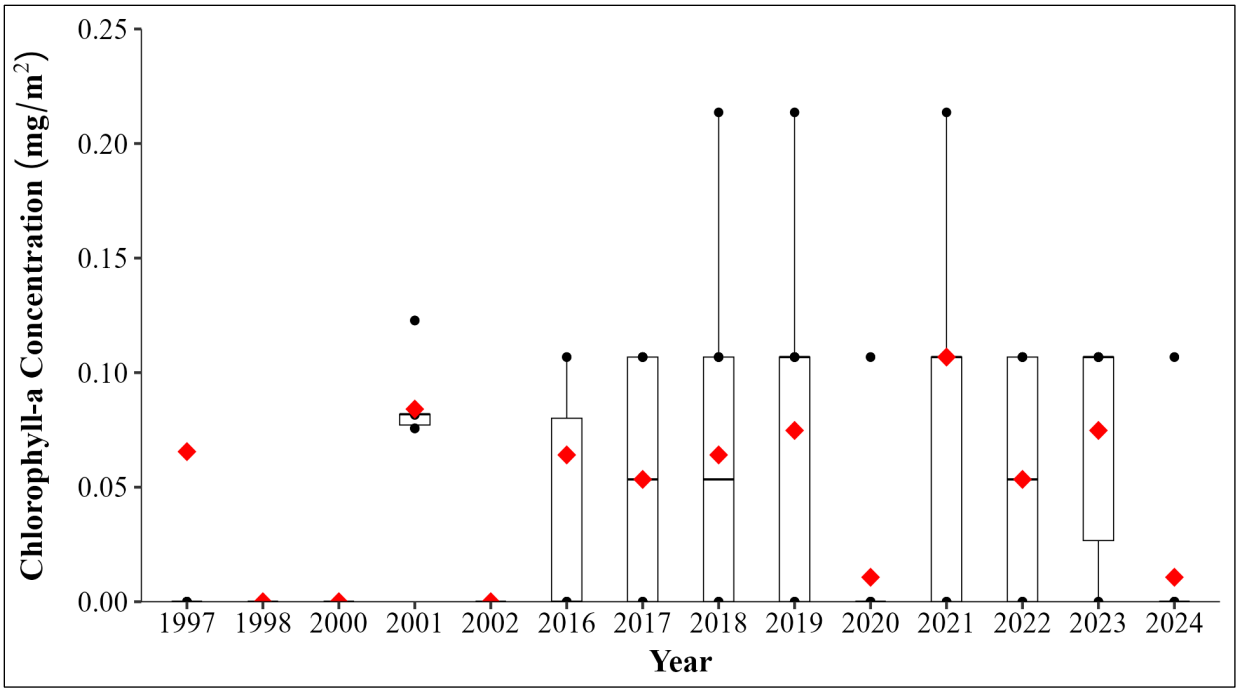


Figure 27.–Chlorophyll-a concentration boxplot by year at Ikalukrok Creek downstream of Cub Creek, 1997, 1998, 2000–2002, and 2016–2024. Raw data are depicted by black dots and mean values are depicted in red. Note that raw data points of 0.66 in 1997, 0.43 in 2016, and 0.43 in 2021 are excluded from this plot but not from statistical analyses.

## Benthic Macroinvertebrates

Mean BMI density in Ikalukrok Creek downstream of Cub Creek in 2024 was 258/m$^2$ (SD = 98), which is similar to 2022 and 2023 (Figure 28). Sample composition has varied among years, with Diptera making up more than 50% of the samples in 6 out of 10 years of data (Figure 29). EPT taxa made up 9.9% of the samples in 2024, which is the lowest on record since 2019. Taxa richness was the lowest on record at 7 taxa and has ranged from 7–29 among all years of data (Figure 30). The contrast with previous results may be due in part to the change in sampling methods from drift nets to Hess samplers beginning in 2022. BMI data from 2024 are presented in Appendix D.

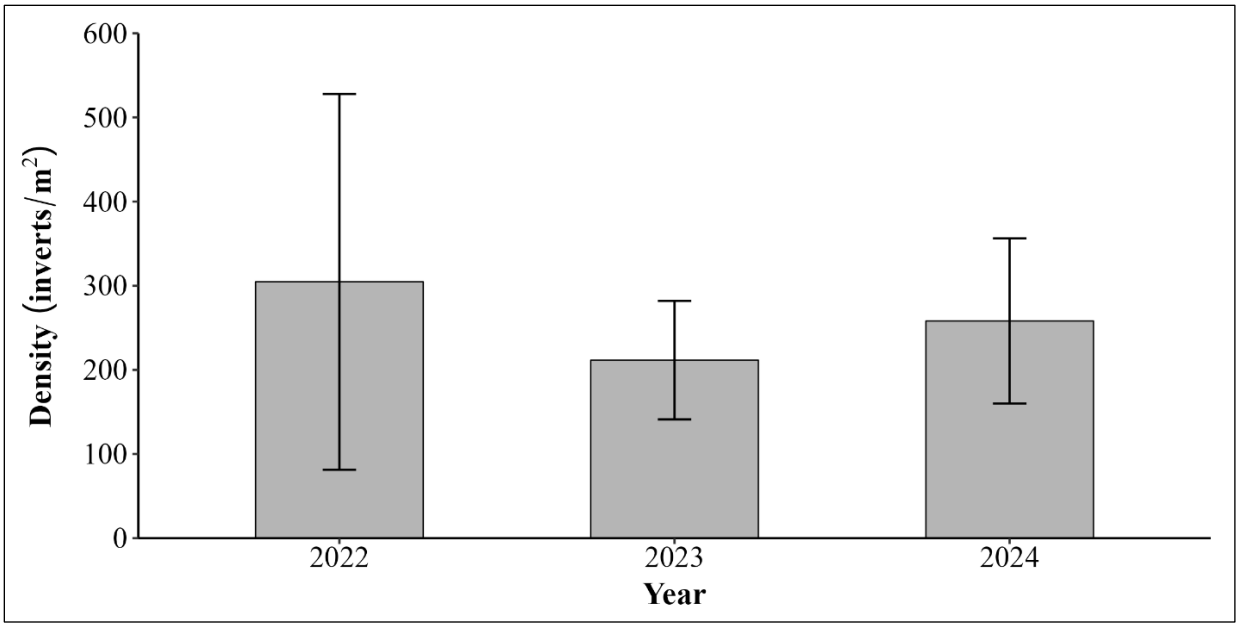


Figure 28.–Mean BMI density (± 1 SD) at Ikalukrok Creek downstream of Cub, 2022–2024.

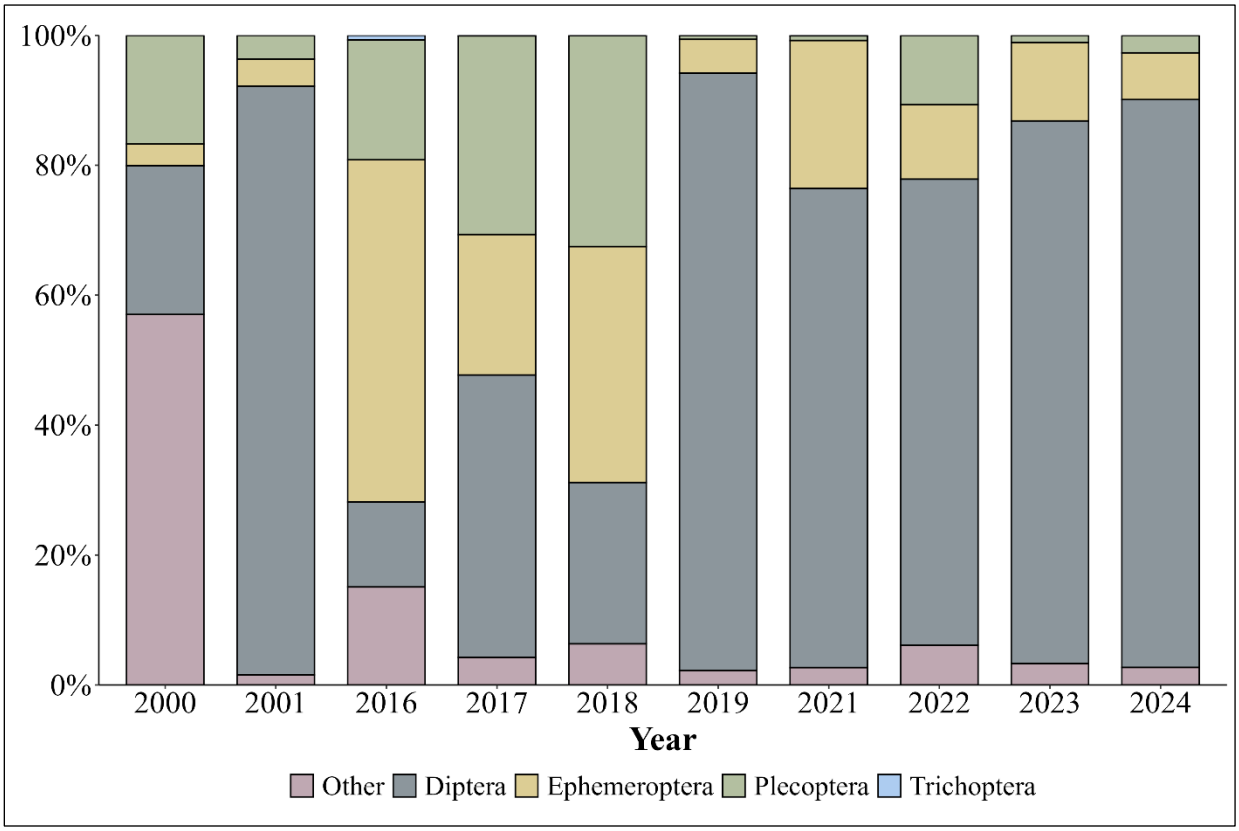


Figure 29.–Mean percent EPT, Diptera, and other taxa in Ikalukrok Creek downstream of Cub Creek BMI samples, 2000–2001 and 2016–2024.

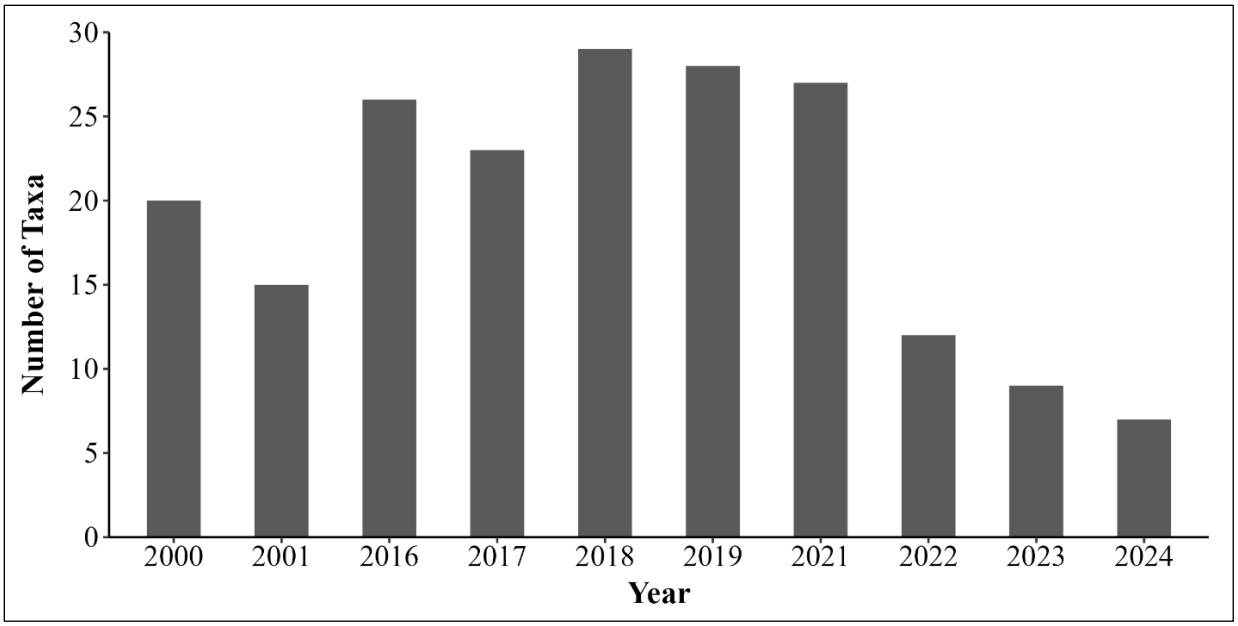


Figure 30.–Taxa richness in Ikalukrok Creek downstream of Cub Creek BMI samples, 2000–2001 and 2016–2024. Sampling method was changed from drift nets to Hess samplers in 2022.

## Sediment

Sediment element concentrations in Ikalukrok Creek downstream of Cub Creek, and summary statistics from all 2024 sites are presented in Table 7. Cadmium, selenium, and zinc concentrations were all well below the mean concentration. The copper and mercury concentrations were similar to the mean concentration, and the lead concentration was the highest observed concentration of all AAEP sites. All 2024 concentrations were lower than those from 2022, except for mercury which was slightly higher in 2024.

Table 7.–Sediment sample element concentrations (mg/kg) in Ikalukrok Creek downstream of Cub Creek in 2022 and 2024 and summary statistics for all sites in 2024. Summary statistics were calculated with all sites (n = 16) sampled in July 2024. Mercury summary statistics exclude two sites that had no detection (n = 14).

| Element | Ikalukrok below Cub Creek | | All 2024 Sample Sites | | |
|---|---|---|---|---|---|
| | 2022 | 2024 | Mean | Minimum | Maximum |
| Cadmium | 3.36 | 1.91 | 4.59 | 0.10 | 26.80 |
| Copper | 190.0 | 113.0 | 117.1 | 22.5 | 649.0 |
| Lead | 102.00 | 84.30 | 22.72 | 5.36 | 84.30 |
| Mercury | 0.049 | 0.065 | 0.054 | 0.024 | 0.084 |
| Selenium | 2.00 | 1.76 | 2.10 | 1.22 | 3.26 |
| Zinc | 754.0 | 444.0 | 603.0 | 50.8 | 2,030.0 |

## EAST FORK IKALUKROK CREEK (STATION 208)

### Water Quality

In the early 2000's, only one water sample exceeded the EPA aquatic life criteria for cadmium, lead, and zinc (Weber-Scannell and Ott 2006). In 2024, East Fork Ikalukrok Creek had clear water with lower concentrations of aluminum, cadmium, and nickel compared to other sites where water sample element concentration data were collected (Appendix A). In July 2024 in situ pH was 8.48, water temperature was 5.5°C, dissolved oxygen was 12.23 mg/L, specific conductance was 309 µs/cm, and turbidity was 0.21 NTU (Appendix B).

### Periphyton

Mean chlorophyll-a concentration in East Fork Ikalukrok Creek in 2024 was 1.45 mg/m$^2$ (SD = 1.19) down from 4.2 mg/m$^2$ (SD = 5.33) in 2023. 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/m$^2$ in 2002 (Figure 31). Periphyton data from 2024 are presented in Appendix C.

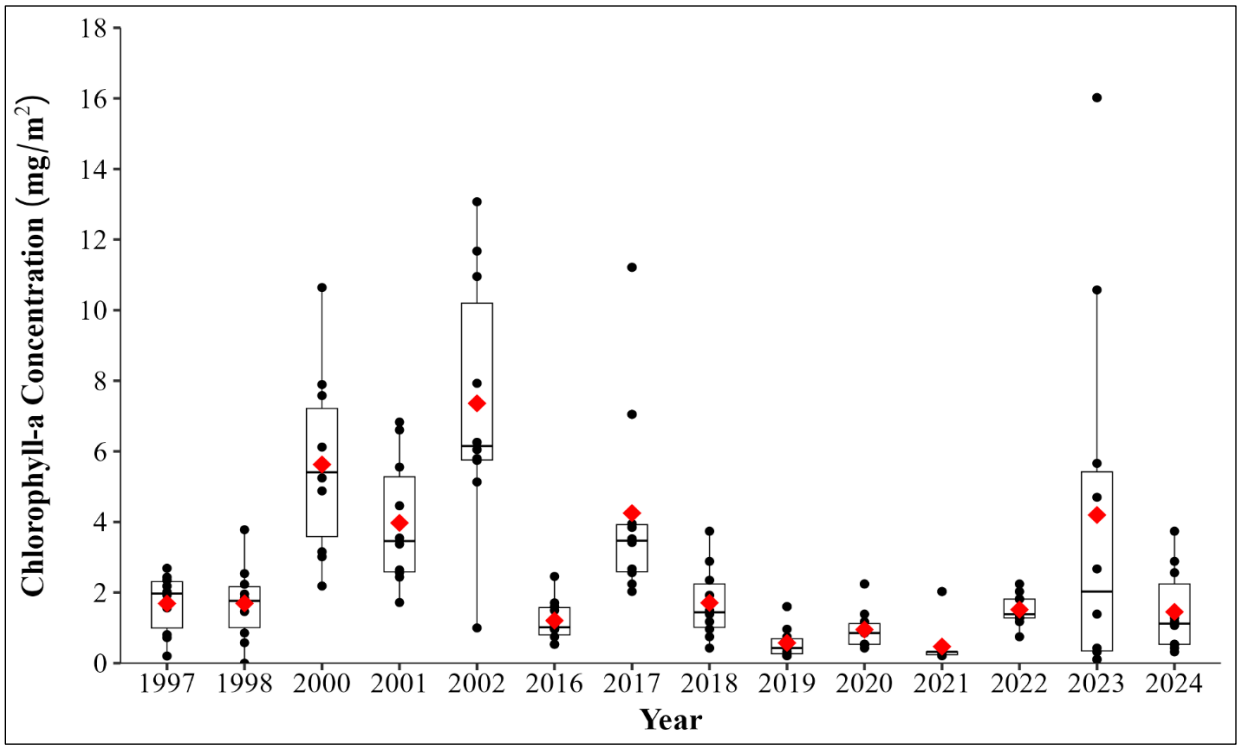


Figure 31.–Chlorophyll-a concentration boxplot by year at East Fork Ikalukrok Creek, 1997, 1998, 2000–2002, and 2016–2024. Raw data are depicted by black dots and mean values are depicted in red.

## Benthic Macroinvertebrates

The mean BMI density in East Fork Ikalukrok Creek in 2024 was 5,891/$m^2$ (SD = 2,009). This is similar to the densities in 2022 and 2023 (Figure 32). Sample composition has varied among years, but Diptera have made up over 50% of the samples in 7 out of 11 years of data, including 2024 (Figure 33). EPT taxa made up 23.9% of the samples in 2024. Taxa richness in 2024 was the lowest on record at 5 taxa which is less than one fourth of the richness in 2023. Taxa richness has ranged from 5–27 among all years of data (Figure 34). The contrast with previous results may be due in part to the change in sampling methods from drift nets to Hess samplers beginning in 2022. BMI data from 2024 are presented in Appendix D.

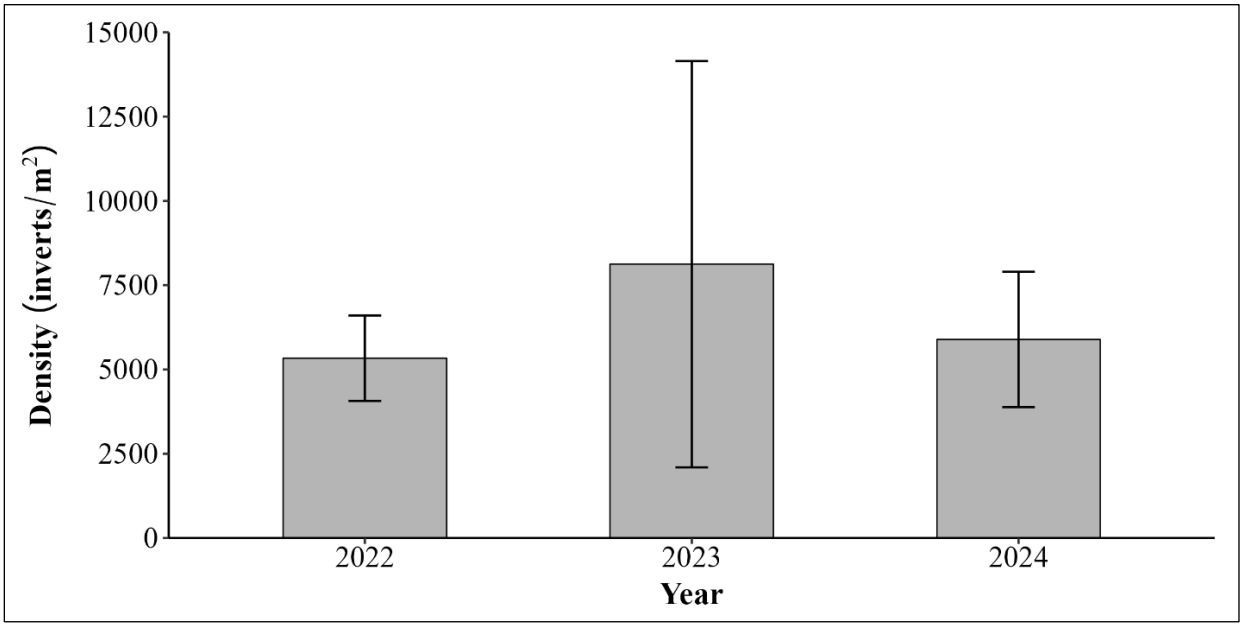


Figure 32.–Mean BMI density (± 1 SD) at East Fork Ikalukrok Creek, 2022–2024.

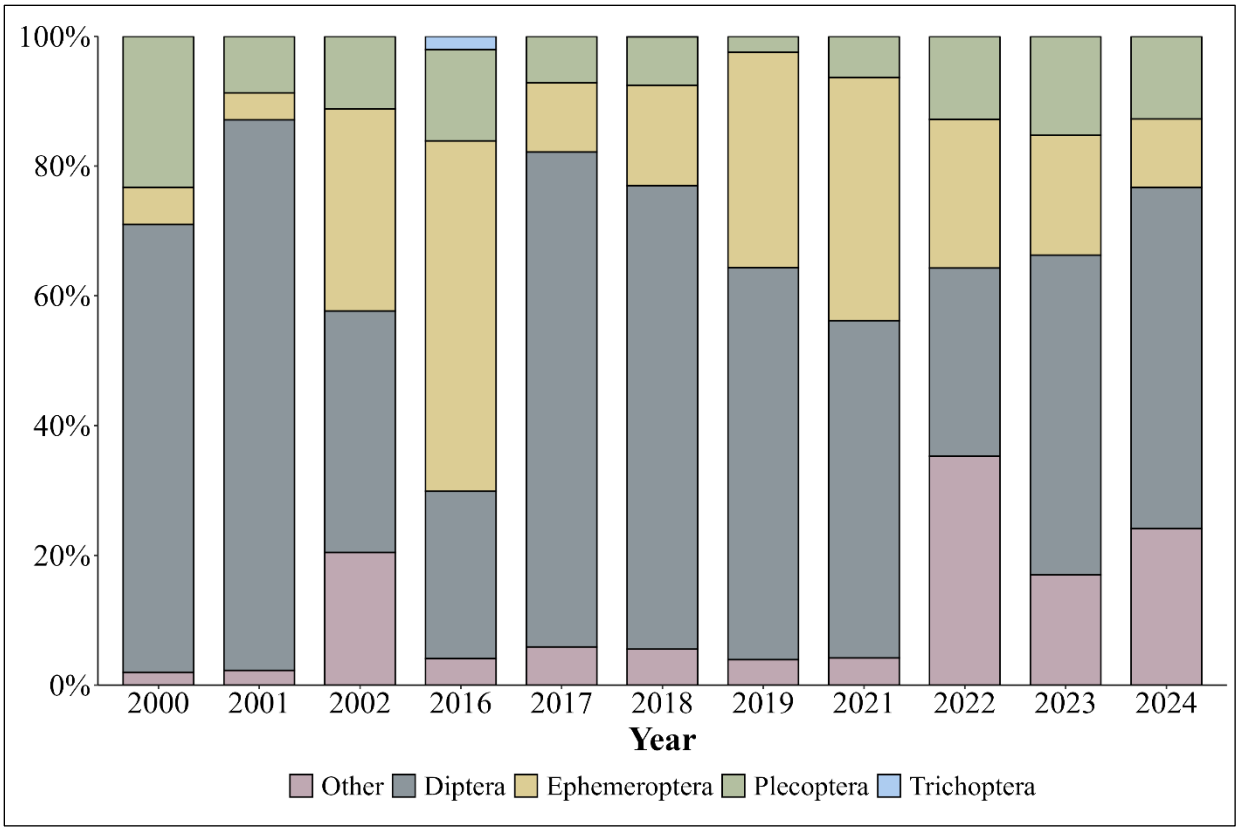


Figure 33.–Mean percent EPT, Diptera, and other taxa in East Fork Ikalukrok Creek BMI samples, 2000–2002 and 2016–2024.

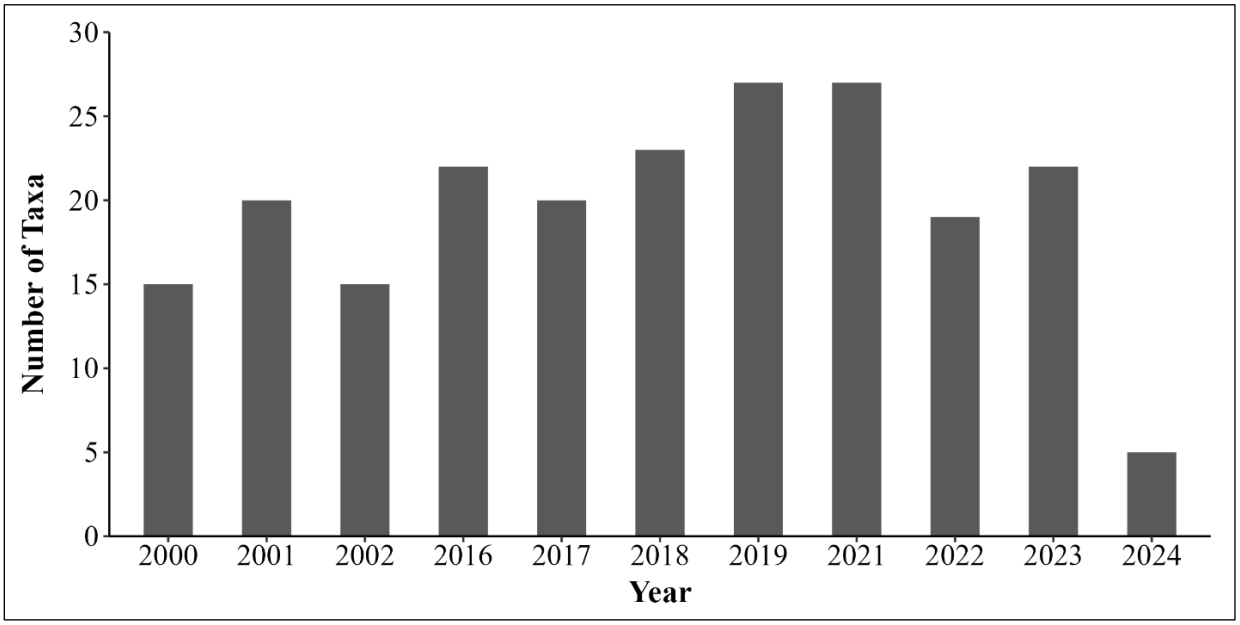


Figure 34.–Taxa richness in East Fork Ikalukrok Creek BMI samples, 2000–2001 and 2016–2024. Sampling method was changed from drift nets to Hess samplers in 2022.

### Sediment

Sediment element concentrations in East Fork Ikalukrok Creek and summary statistics from all 2024 sites are presented in Table 8. All concentrations were below the mean. Overall, all concentrations for East Fork Ikalukrok were on the low end compared to other sites, with mercury and selenium the lowest observed concentrations of all 2024 samples. Element concentrations in 2024 were all marginally lower than those measured in 2022.

Table 8.–Sediment sample element concentrations (mg/kg) in East Fork Ikalukrok Creek in 2022 and 2024 and summary statistics for all sites in 2024. Summary statistics were calculated with all sites (n = 16) sampled in July 2024. Mercury summary statistics exclude two sites that had no detection (n = 14).

| Element | East Fork Ikalukrok | | All 2024 Sample Sites | | |
|---|---|---|---|---|---|
| | 2022 | 2024 | Mean | Minimum | Maximum |
| Cadmium | 1.19 | 1.07 | 4.59 | 0.10 | 26.80 |
| Copper | 52.0 | 41.4 | 117.1 | 22.5 | 649.0 |
| Lead | 35.80 | 15.70 | 22.72 | 5.36 | 84.30 |
| Mercury | 0.089 | 0.024 | 0.054 | 0.024 | 0.084 |
| Selenium | 2.02 | 1.22 | 2.10 | 1.22 | 3.26 |
| Zinc | 211.0 | 143.0 | 603.0 | 50.8 | 2,030.0 |

## 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 2000's exceeding the EPA aquatic life criteria for aluminum and iron (Weber-Scannell and Ott 2006; EPA 2024). There is a seep in the headwaters of Grayling Junior Creek that flows into East Fork Grayling Junior Creek and impacts water quality at the Grayling Junior site. In recent years (2019–2021), the seep discharge was visible, creating cloudy conditions at the site; however, the water clarity has improved since 2022. Zinc concentrations were the lowest of the monitored sites while lead was the highest (Appendix A). In July 2024 in situ pH was 8.3, water temperature was 7.0°C, dissolved oxygen was 11.5 mg/L, specific conductance was 720 µs/cm, and turbidity was 0.63 NTU (Appendix B).

## Periphyton

Mean chlorophyll-a concentration in Grayling Junior Creek in 2024 was 0.43 mg/m$^2$ (SD = 0.23) which is the highest mean since 2018. Chlorophyll-a concentrations in Grayling Junior Creek ranged from a low of 0.02 mg/m$^2$ in 2020 to a high of 4.63 mg/m$^2$ in 2002 (Figure 35). Grayling Junior Creek is historically a productive site, although chlorophyll-a has decreased and remained relatively low since 2018. Periphyton data from 2024 are presented in Appendix C.

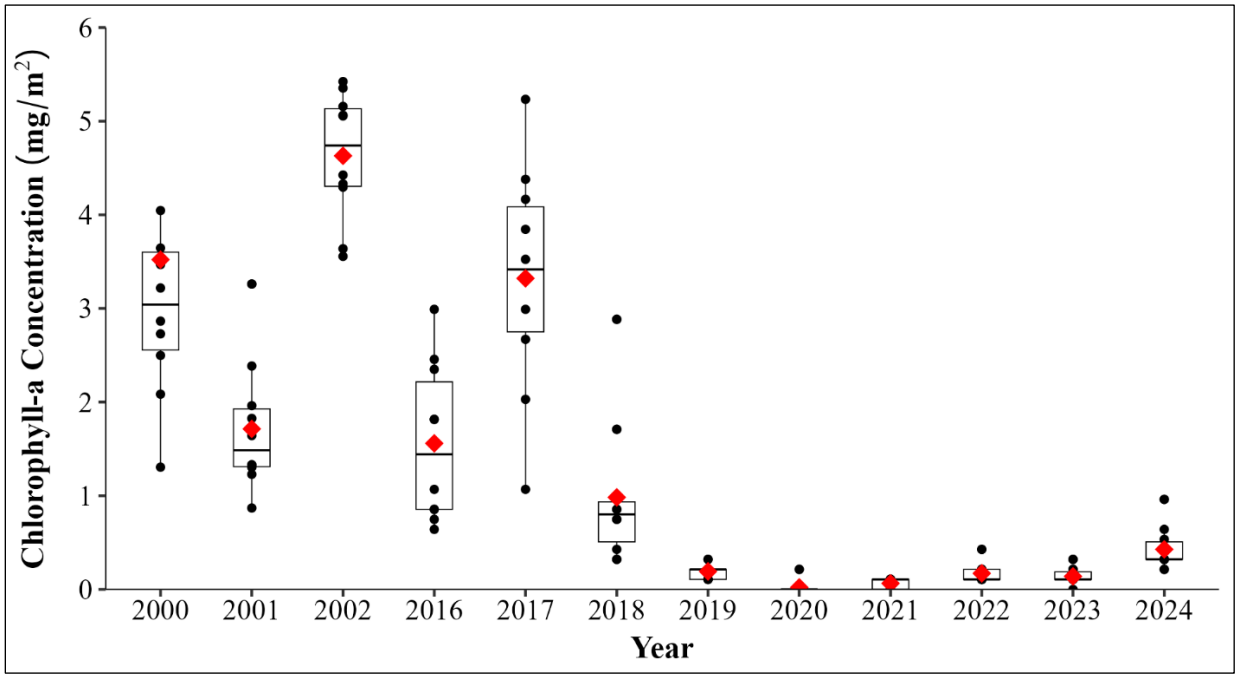


Figure 35.–Chlorophyll-a concentration boxplot by year at Grayling Junior Creek, 2000–2002 and 2016–2024. Raw data are depicted by black dots and mean values are depicted in red. Note that raw data point of 9.35 in 2000 is excluded from this plot but not from statistical analyses.

## Benthic Macroinvertebrates

Mean BMI density in Grayling Junior Creek in 2024 was 177/m$^2$ (SD = 41). This is approximately twice the density in 2023 and twenty times the density in 2022 (Figure 36). Diptera made up 50% or more of the samples in all years and was highest on record at 84.2% in 2024 (Figure 37). EPT taxa made up 14.5% of the samples in 2024 which is within the historical range of 0–38.3%. Taxa richness in 2024 was on the low end of the historical range of 2–30 at 8 taxa (Figure 38). The contrast with previous results may be due in part to the change in sampling methods from drift nets to Hess samplers beginning in 2022. BMI data from 2024 are presented in Appendix D.

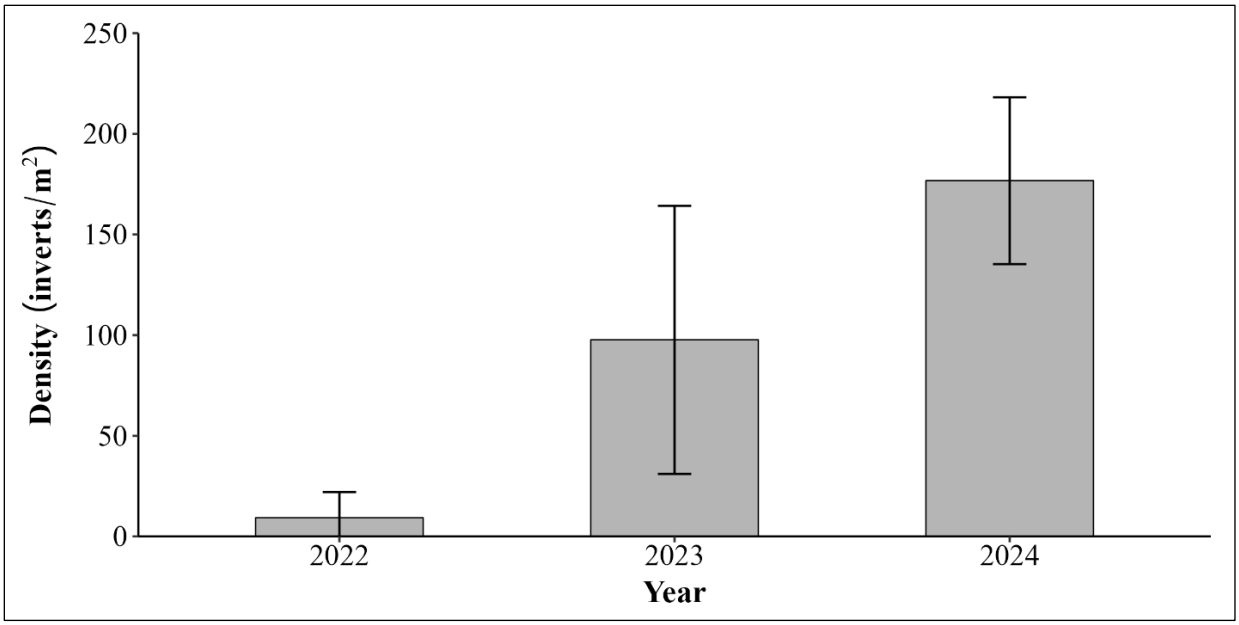


Figure 36.–Mean BMI density (± 1 SD) at Grayling Junior Creek, 2022–2024.

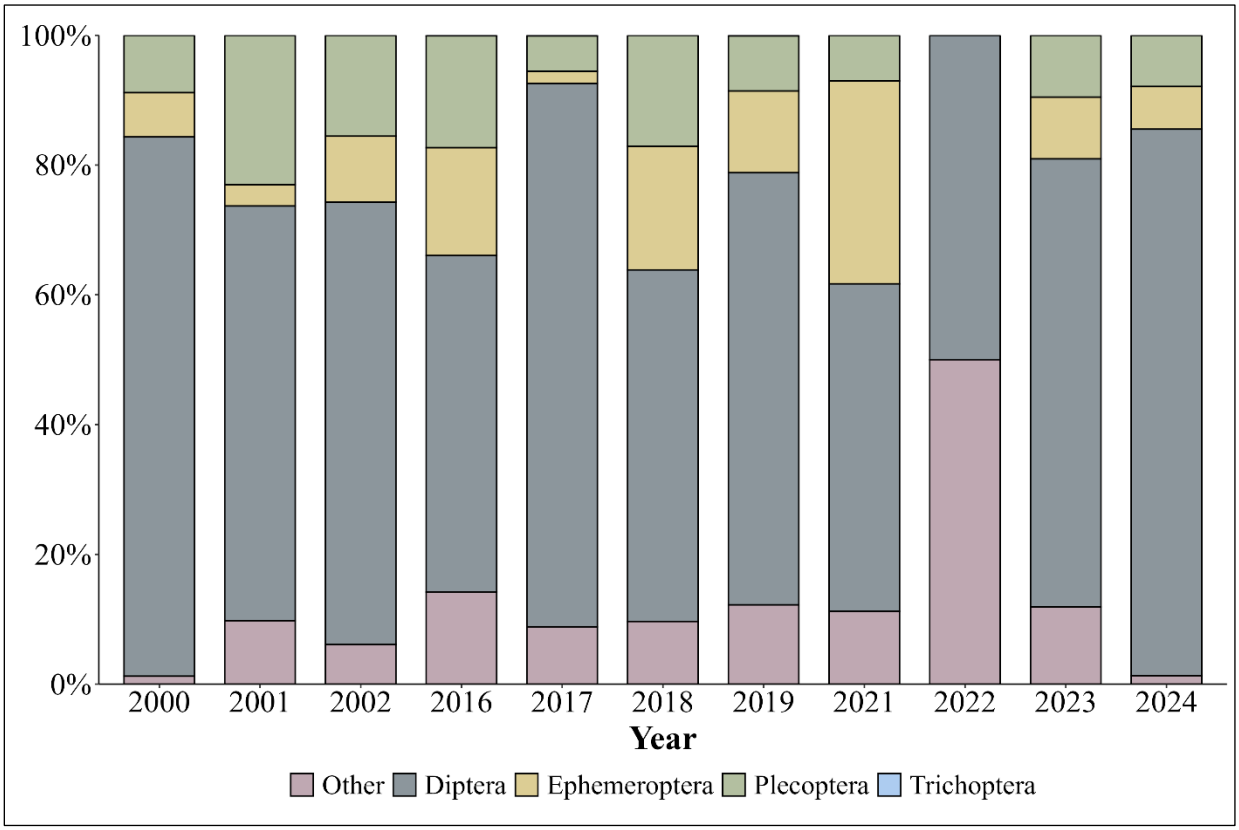


Figure 37.–Mean percent EPT, Diptera, and other taxa in Grayling Junior Creek BMI samples, 2000–2002 and 2016–2024.

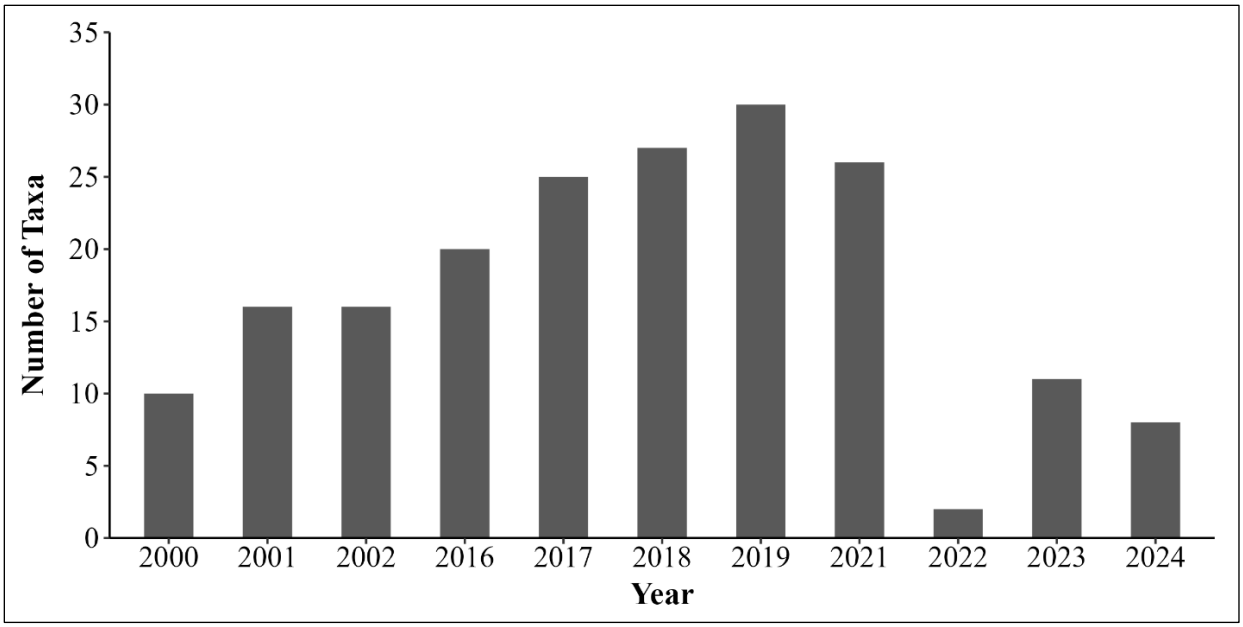


Figure 38.–Taxa richness in Grayling Junior Creek BMI samples, 2000–2001 and 2016–2024. Sampling method was changed from drift nets to Hess samplers in 2022.

## Sediment

Sediment element concentrations in Grayling Junior Creek and summary statistics from all 2024 sites are presented in Table 9. Cadmium and mercury were slightly elevated compared to the 2024 mean, while copper, lead, and selenium were below the mean concentrations. The zinc concentration in Grayling Junior was above the mean but well below the maximum concentration. All element concentrations were lower in 2024 samples compared with 2022.

Table 9.– Sediment sample element concentrations (mg/kg) in Grayling Junior Creek in 2022 and 2024 and summary statistics for all sites in 2024. Summary statistics were calculated with all sites (n = 16) sampled in July 2024. Mercury summary statistics exclude two sites that had no detection (n = 14).

| Element | Grayling Junior Creek | | All 2024 Sample Sites | | |
|---|---|---|---|---|---|
| | 2022 | 2024 | Mean | Minimum | Maximum |
| Cadmium | 9.74 | 6.41 | 4.59 | 0.10 | 26.80 |
| Copper | 116.0 | 77.8 | 117.1 | 22.5 | 649.0 |
| Lead | 17.10 | 9.09 | 22.72 | 5.36 | 84.30 |
| Mercury | 0.083 | 0.064 | 0.054 | 0.024 | 0.084 |
| Selenium | 3.60 | 1.99 | 2.10 | 1.22 | 3.26 |
| Zinc | 1640.0 | 1030.0 | 603.0 | 50.8 | 2,030.0 |

# NORTH FORK GRAYLING JUNIOR CREEK

## Water Quality

No visual indicators suggest impaired water quality in North Fork Grayling Junior Creek. In July 2024 in situ pH was 8.19, water temperature was 5.2°C, dissolved oxygen was 11.99 mg/L, specific conductance was 958 µs/cm, and turbidity was 0.56 NTU (Appendix B).

## Periphyton

This was the first year that periphyton samples were collected at North Fork Grayling Junior Creek. Mean chlorophyll-a concentration in North Fork Grayling Junior Creek in 2024 was 0.31 $mg/m^2$ (SD = 0.23). Chlorophyll-a concentrations ranged from 0–0.85 $mg/m^2$ among samples. Periphyton data from 2024 are presented in Appendix C.

## Benthic Macroinvertebrates

This was the first year that BMI were collected at North Fork Grayling Junior Creek. Mean BMI density was 142 (SD = 126) and taxa richness was 8. EPT taxa made up just 1.6% of the samples while Diptera made up 88.5% of the samples. BMI data from 2024 are presented in Appendix D.

## Sediment

Sediment element concentrations from North Fork Grayling Junior Creek and summary statistics from all 2024 sites are presented in Table 10. North Fork Grayling Junior had relatively low copper, lead, mercury, and selenium concentrations, all well below the mean concentration. Cadmium concentration was comparable to the mean, while the zinc concentration was higher than the mean and was the third highest concentration for all AAEP sites. No sediment samples were collected in 2022.

Table 10.–Sediment sample element concentrations (mg/kg) in North Fork Grayling Junior Creek in 2024 and summary statistics for all sites in 2024. Summary statistics were calculated with all sites (n = 16) sampled in July 2024. Mercury summary statistics exclude two sites that had no detection (n = 14).

| Element | North Fork Grayling Junior | All 2024 Sample Sites | | |
|---|---|---|---|---|
| | 2024 | Mean | Minimum | Maximum |
| Cadmium | 4.74 | 4.59 | 0.10 | 26.80 |
| Copper | 49.4 | 117.1 | 22.5 | 649.0 |
| Lead | 8.39 | 22.72 | 5.36 | 84.30 |
| Mercury | 0.040 | 0.054 | 0.024 | 0.084 |
| Selenium | 1.72 | 2.10 | 1.22 | 3.26 |
| Zinc | 1,170.0 | 603.0 | 50.8 | 2,030.0 |

# EAST FORK GRAYLING JUNIOR CREEK

## Water Quality

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 below the confluence of the orange-stained tributary. In July 2024 in situ pH was 8.29, water temperature was 5.8°C, dissolved oxygen was 11.7 mg/L, specific conductance was 419 µs/cm, and turbidity was 0.25 NTU (Appendix B).

## Periphyton

Mean chlorophyll-a concentration in East Fork Grayling Junior Creek in 2024 was the lowest on record at 0.29 mg/m$^2$ (SD = 0.15). This is approximately one third of the means recorded in 2022 and 2023 (Figure 39). Periphyton data from 2024 are presented in Appendix C.

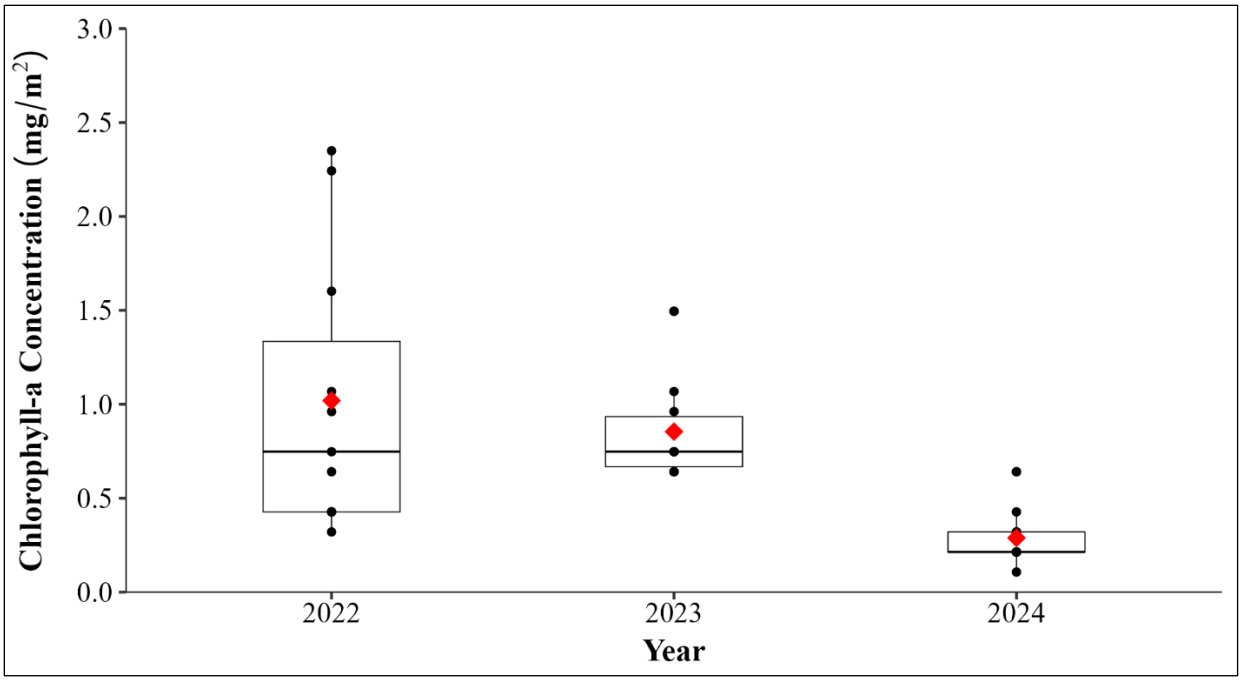


Figure 39.–Chlorophyll-a concentration boxplot by year at East Fork Grayling Junior Creek, 2022–2024. Raw data are depicted by black dots and mean values are depicted in red.

## Benthic Macroinvertebrates

Mean BMI density in East Fork Grayling Junior Creek in 2024 was the lowest on record at 86/$m^2$ (SD = 42). This is approximately one seventh the density in 2023 and one sixteenth the density in 2022 (Figure 40). Sample composition was similar to previous years with Diptera making up 51.3% and EPT taxa making up 43.2% of the samples (Figure 41). Taxa richness was the lowest on record at 7 taxa, which is half the richness recorded in 2022 (Figure 42). BMI data from 2024 are presented in Appendix D.

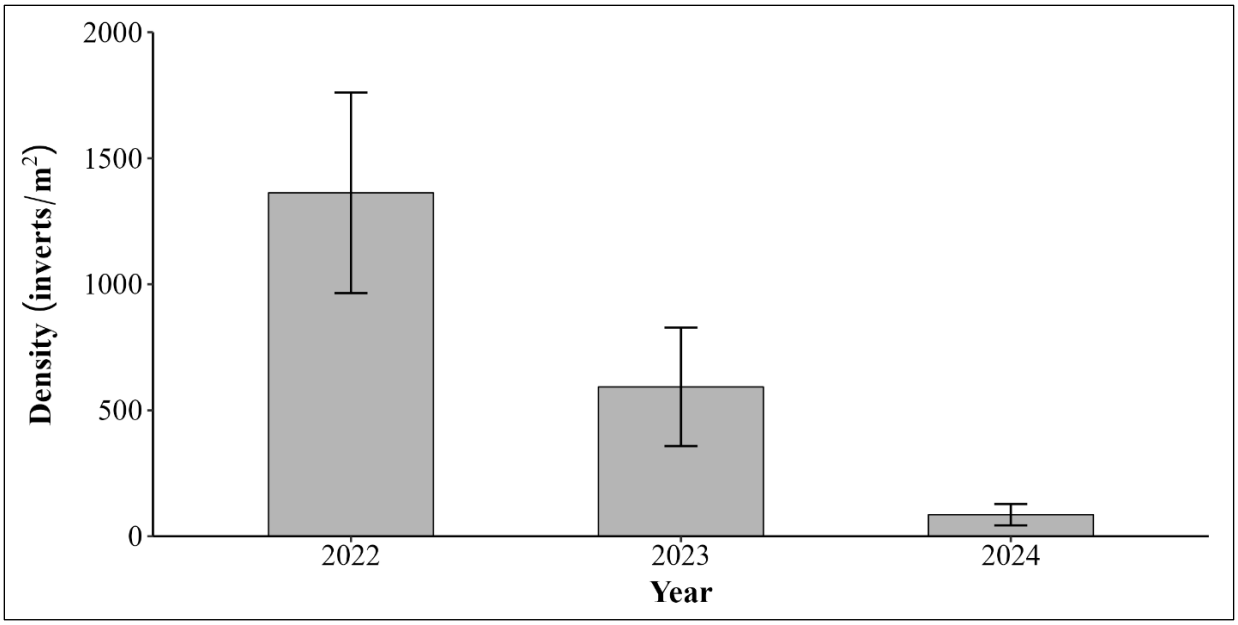


Figure 40.–Mean BMI density (± 1 SD) at East Fork Grayling Junior Creek, 2022–2024.

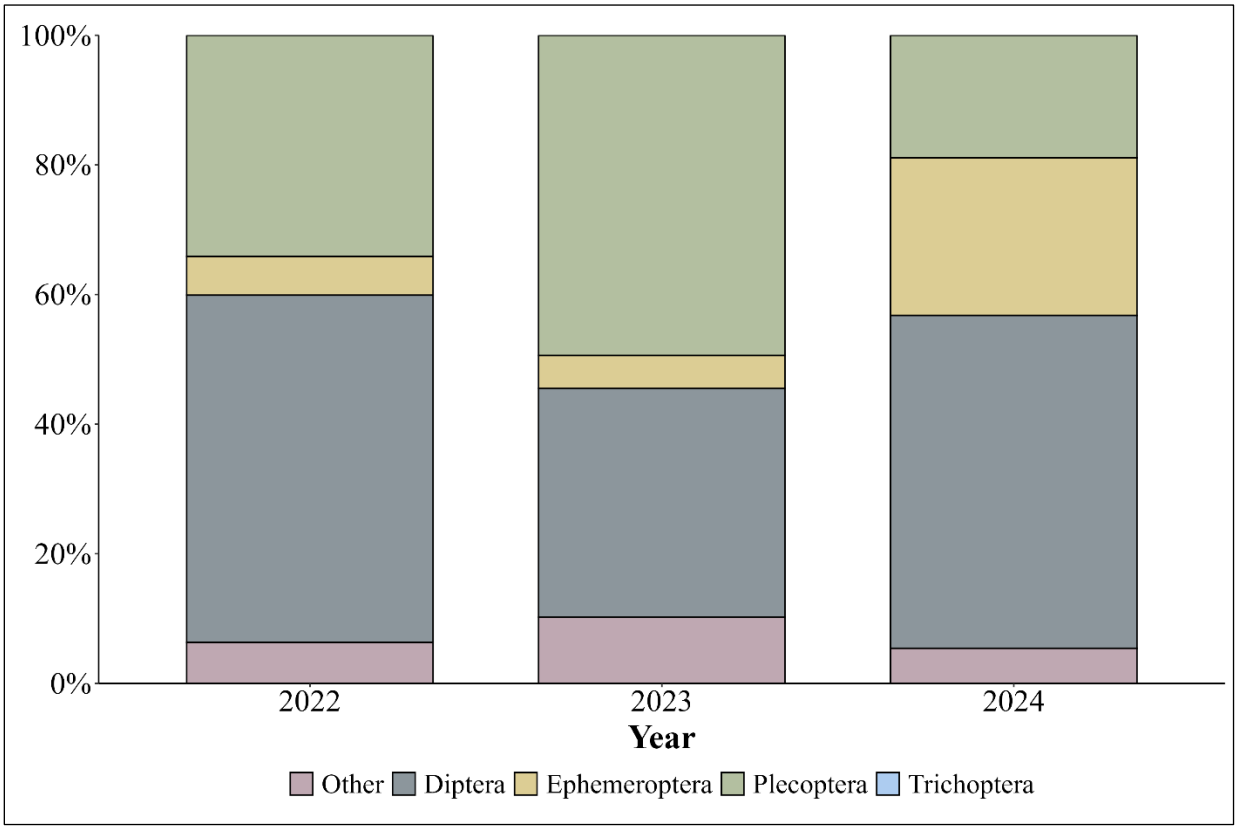


Figure 41.–Mean percent EPT, Diptera, and other taxa in East Fork Grayling Junior Creek BMI samples, 2022–2024.

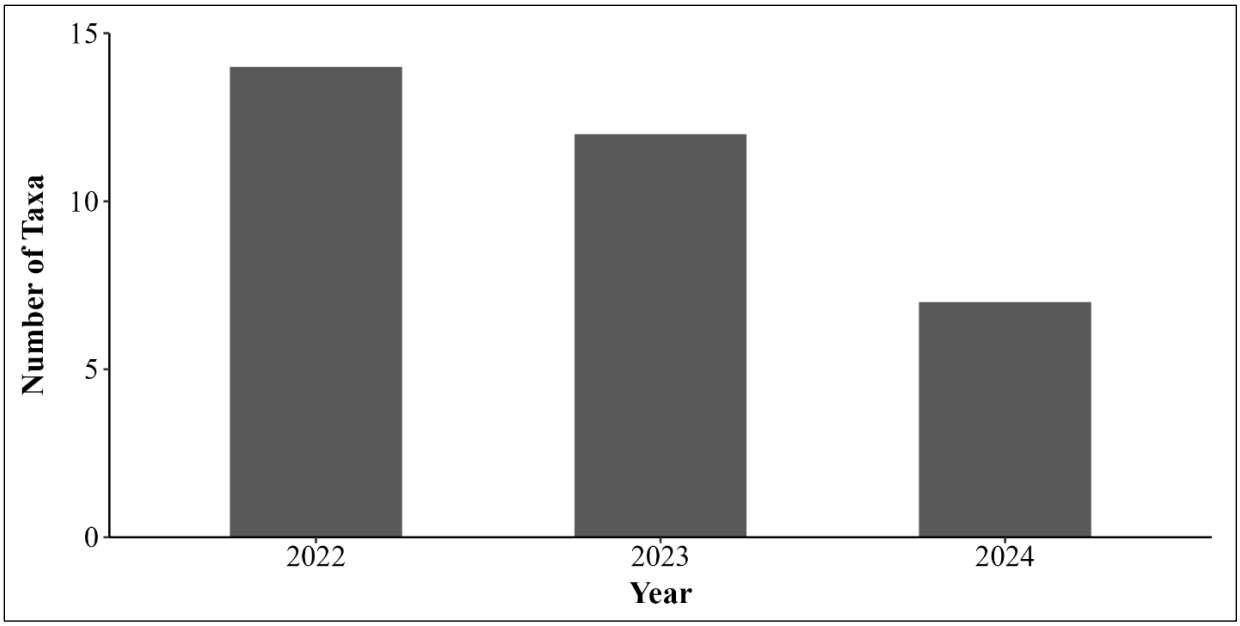


Figure 42.–Taxa richness in East Fork Grayling Junior Creek BMI samples, 2022–2024.

## Sediment

Sediment element concentrations from East Fork Grayling Junior Creek and summary statistics from all 2024 sites are presented in Table 11. Mercury was not detected in the sediment sample. Cadmium, selenium, and zinc concentrations were all below the means. East Fork Grayling Junior had the second lowest observed lead concentration and the highest observed copper concentration. A sediment sample was not collected in 2022.

Table 11.–Sediment sample element concentrations (mg/kg) in East Fork Grayling Junior Creek in 2024 and summary statistics for all sites in 2024. Summary statistics were calculated with all sites (n = 16) sampled in July 2024. Mercury summary statistics exclude two sites that had no detection (ND; n = 14).

| Element | East Fork Grayling Junior | All 2024 Sample Sites | | |
|---|---|---|---|---|
| | 2024 | Mean | Minimum | Maximum |
| Cadmium | 3.51 | 4.59 | 0.10 | 26.80 |
| Copper | 649.0 | 117.1 | 22.5 | 649.0 |
| Lead | 5.38 | 22.72 | 5.36 | 84.30 |
| Mercury | ND | 0.054 | 0.024 | 0.084 |
| Selenium | 1.99 | 2.10 | 1.22 | 3.26 |
| Zinc | 505.0 | 603.0 | 50.8 | 2,030.0 |

## 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 2000's, 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 criteria (Weber-Scannell and Ott, 2006; EPA 2024). In 2024, Noa Creek had concentrations on the higher end for zinc, aluminum, cadmium, and the highest concentration for nickel compared to other sites sampled in 2024 (Appendix A). In July 2024 in situ pH was 4.13, water temperature was 0.7°, dissolved oxygen was 13.6 mg/L, specific conductance was 1,338 µs/cm, and turbidity was 0.22 NTU (Appendix B).

### Periphyton

The mean chlorophyll-a concentration in Noa Creek in 2024 was 1.22 mg/m$^2$ (SD = 1.18). This is the highest mean on record. Prior to 2020, the mean chlorophyll-a concentrations in Noa Creek were consistently low, ranging from 0.07 mg/m$^2$ in 2019 to 0.32 mg/m$^2$ in 2000 (Figure 43). Mean chlorophyll-a concentrations since 2021 have been higher than previous years, but these values are still relatively low compared to other streams in the area. Periphyton data from 2024 are presented in Appendix C.

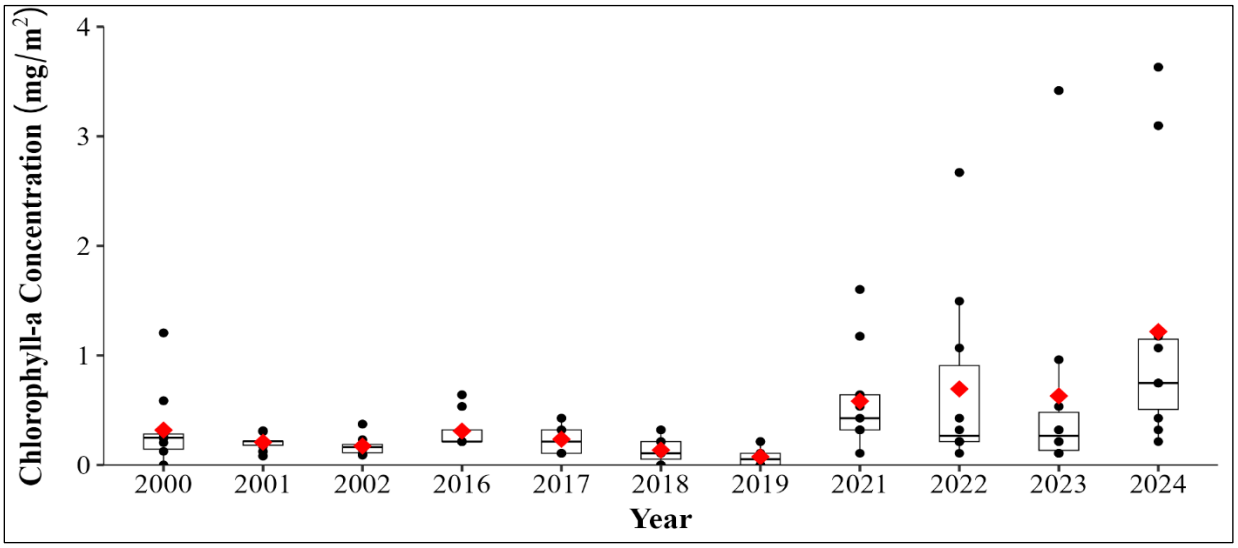


Figure 43.–Chlorophyll-a concentration boxplot by year at Noa Creek, 2000–2002 and 2016–2024. Raw data are depicted by black dots and mean values are depicted in red.

## Benthic Macroinvertebrates

Mean BMI density in Noa Creek in 2024 was 21/$m^2$ (SD = 24) which is similar to the previous years (Figure 44). EPT taxa have made up just 0–1.5% of the samples among years except in 2022 when Trichoptera made up 16.7% of the samples (Figure 45). No EPT taxa were present in 2024 samples. Diptera made up 77.8% and "other" taxa made up 22.2% of the samples in 2024. Taxa richness was the lowest on record in 2024 at 3 taxa. The range among previous years was 4–23 taxa (Figure 46). The contrast with previous results may be due in part to the change in sampling methods from drift nets to Hess samplers beginning in 2022. BMI data from 2024 are presented in Appendix D.

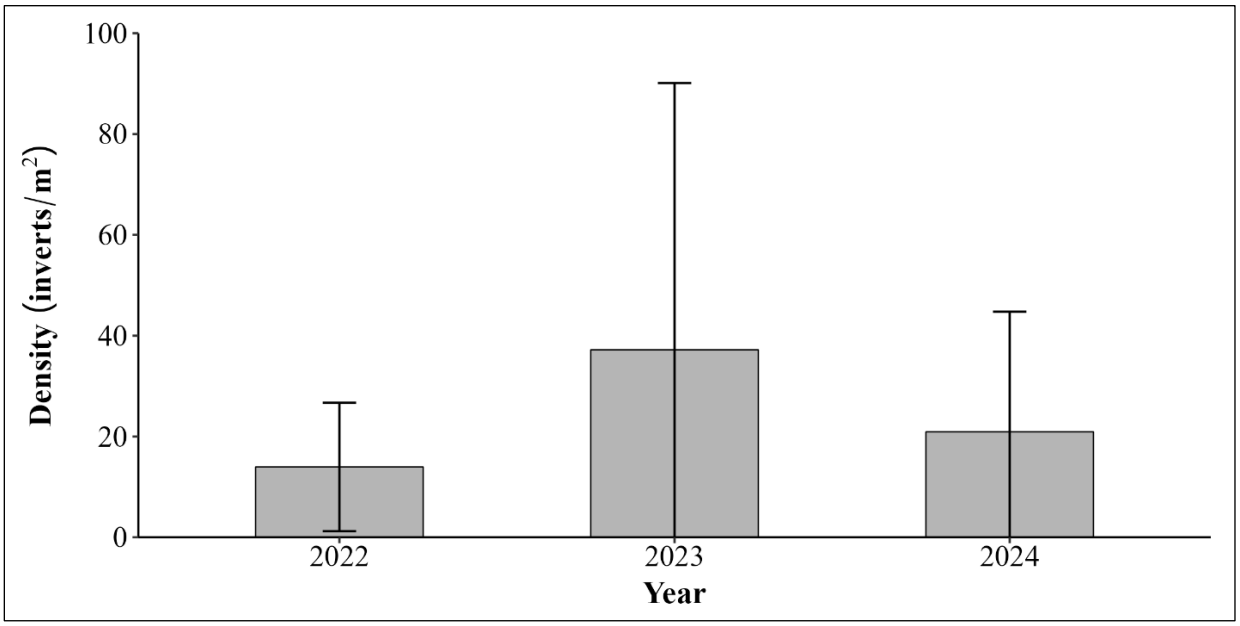


Figure 44.–Mean BMI density (± 1 SD) at Noa Creek, 2022–2024.

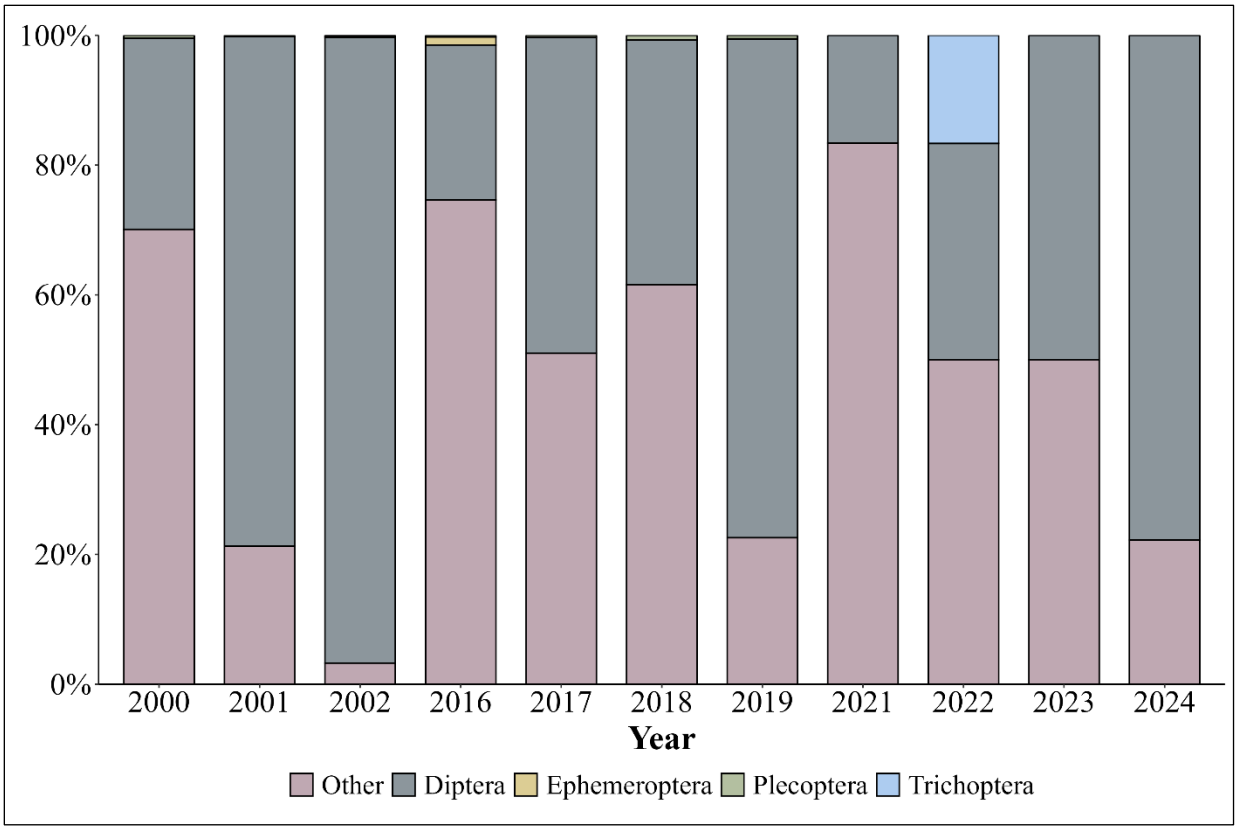


Figure 45.–Mean percent EPT, Diptera, and other taxa in Noa Creek BMI samples, 2000–2002 and 2016–2024.

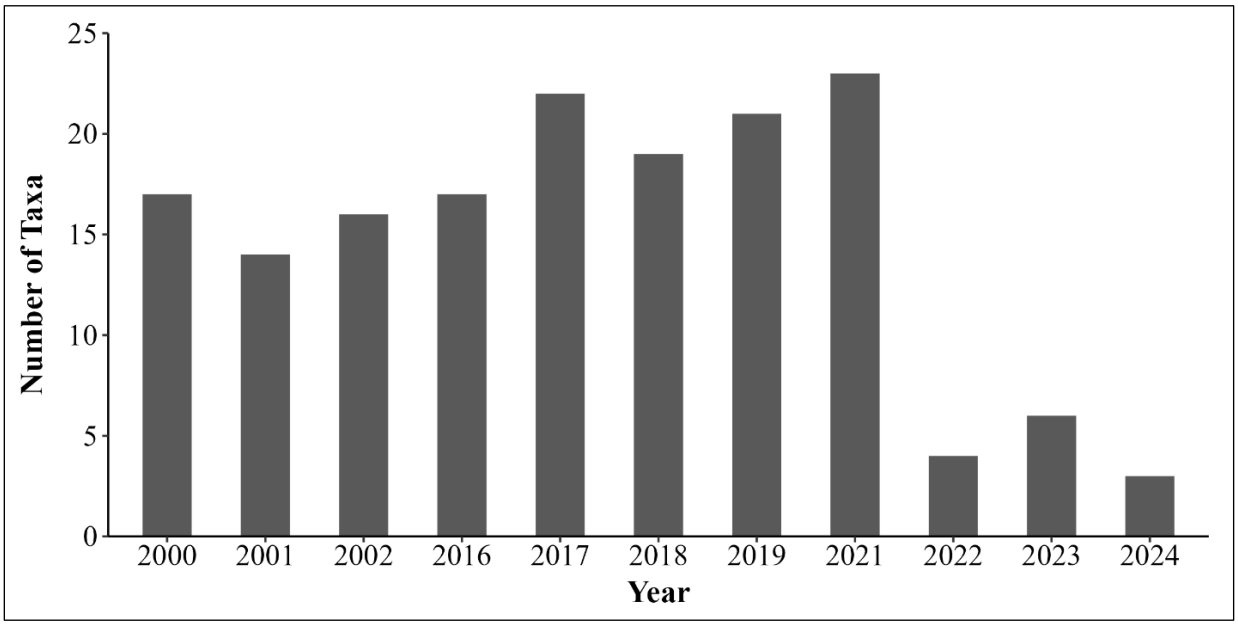


Figure 46.–Taxa richness in Noa Creek BMI samples, 2000–2002 and 2016–2024. Sampling method was changed from drift nets to Hess samplers in 2022.

### Sediment

Sediment element concentrations from Noa Creek and summary statistics from all 2024 sites are presented in Table 12. Cadmium, copper, lead, and zinc were all well below the 2024 mean. Zinc was the second lowest observed concentration for all AAEP sites. Mercury and selenium concentrations were slightly above the 2024 and were elevated compared to 2022 samples. The remainder of the sampled elements were lower in 2024 compared to 2022; zinc had a notably lower concentration in 2024.

Table 12.–Sediment sample element concentrations (mg/kg) in Noa Creek in 2022 and 2024 and summary statistics for all sites in 2024. Summary statistics were calculated with all sites (n = 16) sampled in July 2024. Mercury summary statistics exclude two sites that had no detection (n = 14).

| Element | Noa Creek | | All 2024 Sample Sites | | |
|---|---|---|---|---|---|
| | 2022 | 2024 | Mean | Minimum | Maximum |
| Cadmium | 0.45 | 0.23 | 4.59 | 0.10 | 26.80 |
| Copper | 112.0 | 46.1 | 117.1 | 22.5 | 649.0 |
| Lead | 13.2 | 13.0 | 22.72 | 5.36 | 84.30 |
| Mercury | 0.036 | 0.084 | 0.054 | 0.024 | 0.084 |
| Selenium | 1.50 | 2.73 | 2.10 | 1.22 | 3.26 |
| Zinc | 316.0 | 64.9 | 603.0 | 50.8 | 2,030.0 |

## IKALUKROK CREEK UPSTREAM OF NOA CREEK

### Water Quality

This was the first year that sampling was performed at Ikalukrok Creek upstream of Noa Creek. In July 2024 in situ pH was 8.07, water temperature was 3.4°C, dissolved oxygen was 12.9 mg/L, specific conductance was 456 µs/cm, and turbidity was 1.73 NTU (Appendix B).

### Periphyton

This was the first year that periphyton samples were collected at Ikalukrok Creek upstream of Noa Creek. Mean chlorophyll-a concentration in Ikalukrok Creek upstream of Noa Creek in 2024 was 0.32 mg/m$^2$ (SD = 0.19). Chlorophyll-a concentrations ranged from 0.11–0.64 mg/m$^2$ among samples.

### Benthic Macroinvertebrates

This was the first year that BMI were collected at Ikalukrok Creek upstream of Noa Creek. Mean BMI density was 274/$m^2$ (SD = 217) and taxa richness was 11. EPT taxa made up just 22.0% of the samples while Diptera made up 73.7% of the samples.

### Sediment

Sediment element concentrations for Ikalukrok Creek upstream of Noa Creek and summary statistics from all 2024 sites are presented in Table 13. This was the first year that a sediment sample was collected at Ikalukrok Creek upstream of Noa Creek. All element concentrations excluding zinc were lower or comparable to the mean concentrations. Zinc was higher than the mean concentration and was the second highest concentration observed in 2024.

Table 13.–Sediment sample element concentrations (mg/kg) in Ikalukrok Creek upstream of Noa Creek in 2024 and summary statistics for all sites in 2024. Summary statistics were calculated with all sites (n = 16) sampled in July 2024. Mercury summary statistics exclude two sites that had no detection (n = 14).

| Element | Ikalukrok above Noa Creek | All 2024 Sample Sites | | |
|---|---|---|---|---|
| | 2024 | Mean | Minimum | Maximum |
| Cadmium | 5.77 | 4.59 | 0.10 | 26.80 |
| Copper | 73.3 | 117.1 | 22.5 | 649.0 |
| Lead | 29.80 | 22.72 | 5.36 | 84.30 |
| Mercury | 0.057 | 0.054 | 0.024 | 0.084 |
| Selenium | 1.61 | 2.10 | 1.22 | 3.26 |
| Zinc | 1,270.0 | 603.0 | 50.8 | 2,030.0 |

## MOIL CREEK (STATION 211)

### Water Quality

Moil Creek has naturally degraded water quality. In the early 2000's, the overall water quality was poor with 95% of water samples exceeding the EPA chronic aquatic life criteria for cadmium, copper, nickel, and zinc and 65% of samples with a pH below the EPA chronic aquatic life criteria (Weber-Scannell and Ott, 2006; EPA 2024). In 2024, concentrations of zinc, aluminum, and cadmium were the highest measured among sites sampled, and nickel concentrations were the second highest (Appendix A). In July 2024 in situ pH was 4.18, water temperature was 2.9°C, dissolved oxygen was 13.0 mg/L, and specific conductance was 1,265 µs/cm (Appendix B). The water was opaque with a turbidity of 14.2 NTU and the rocks were stained orange.

## Periphyton

The mean chlorophyll-a concentration in Moil Creek in 2024 was 0.05 mg/m$^2$ (SD = 0.10) which is very similar to the means over the previous four years and within the historical range. Mean chlorophyll-a concentrations in Moil Creek have remained low compared to more productive streams in the area across all years, ranging from 0 mg/m$^2$ in 2002 to 0.14 mg/m$^2$ in 2017 (Figure 47). Periphyton data from 2024 are presented in Appendix C.

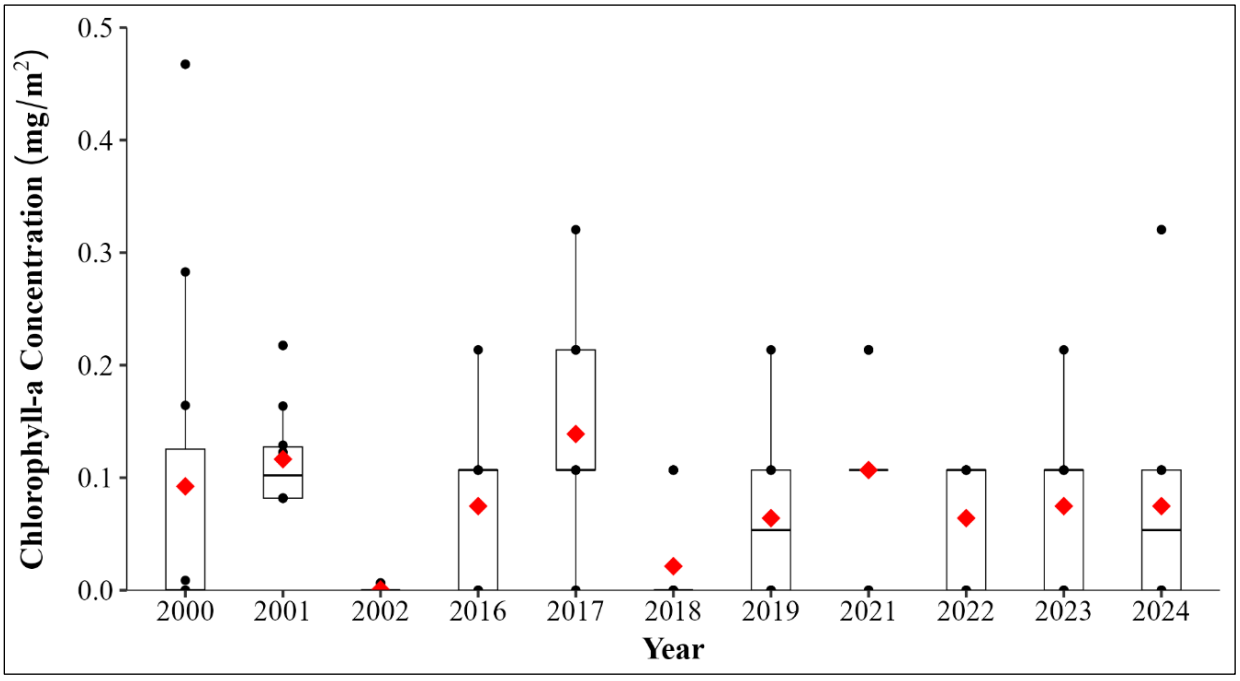


Figure 47.–Chlorophyll-a concentration boxplot by year at Moil Creek, 2000–2002 and 2016–2024. Raw data are depicted by black dots and mean values are depicted in red.

## Benthic Macroinvertebrates

Mean BMI density in Moil Creek in 2024 was 49/m$^2$ (SD = 19). This is approximately five times the density in 2023 and twenty-four times the density in 2022 (Figure 48). EPT taxa were present for the first time since 2021 and made up 4.8% of the samples. Diptera have made up over 50% of the samples in 5 out of 11 years of data and were present in all years except 2022 when "other" taxa made up 100% of the samples (Figure 49). Taxa richness in 2024 was 6 taxa which is three times the richness in 2023. Prior to 2022, taxa richness ranged from 13–24 taxa (Figure 50). The contrast with previous results may be due in part to the change in sampling methods from drift nets to Hess samplers beginning in 2022. BMI data from 2024 are presented in Appendix D.

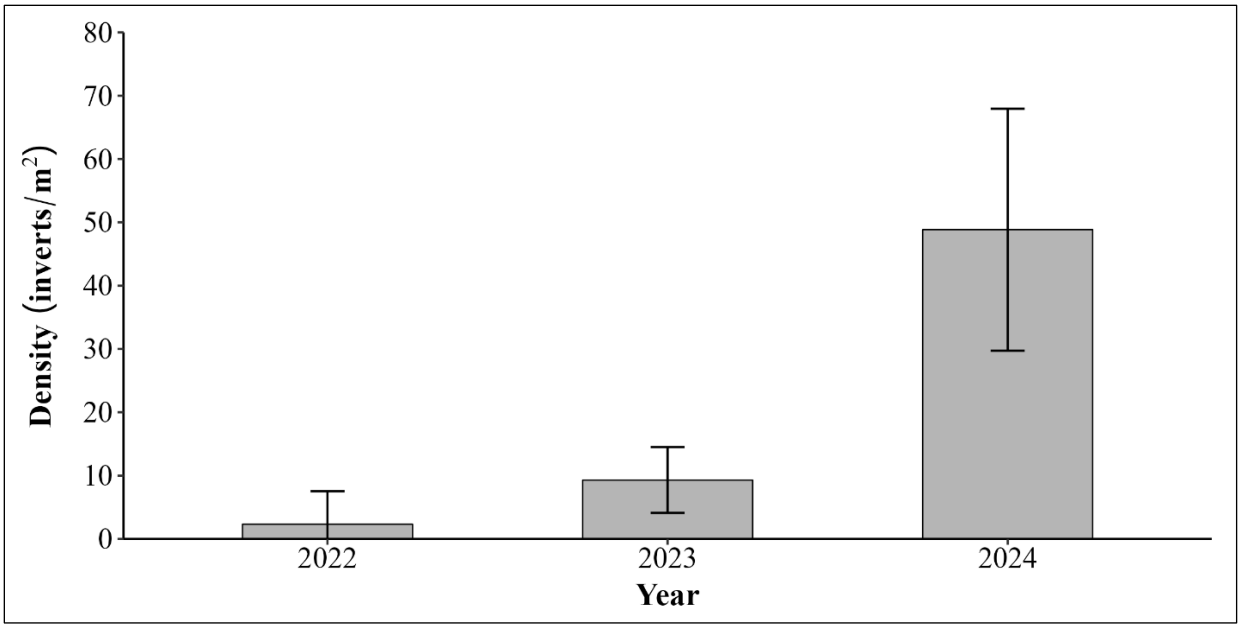


Figure 48.–Mean BMI density (± 1 SD) at Moil Creek, 2022–2024.

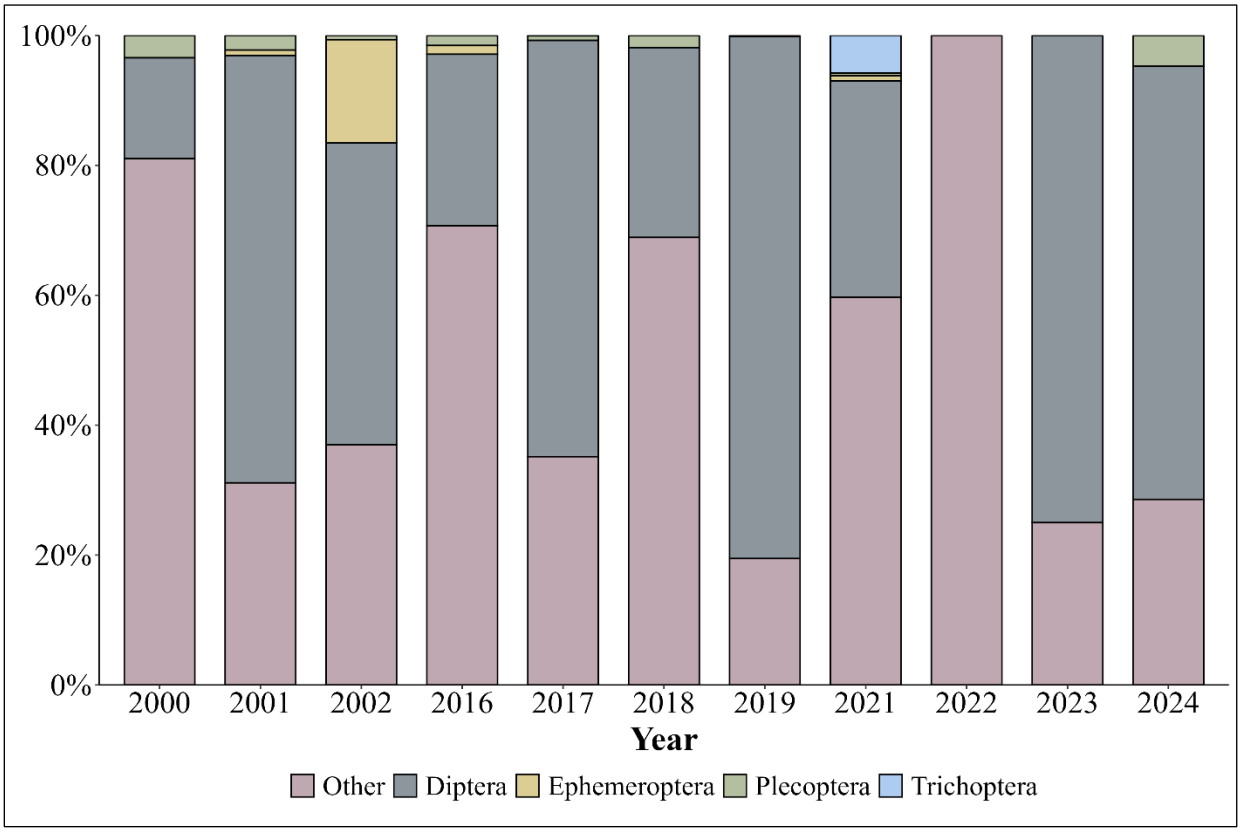


Figure 49.–Mean percent EPT, Diptera, and other taxa in Moil Creek BMI samples, 2000–2002 and 2016–2024.

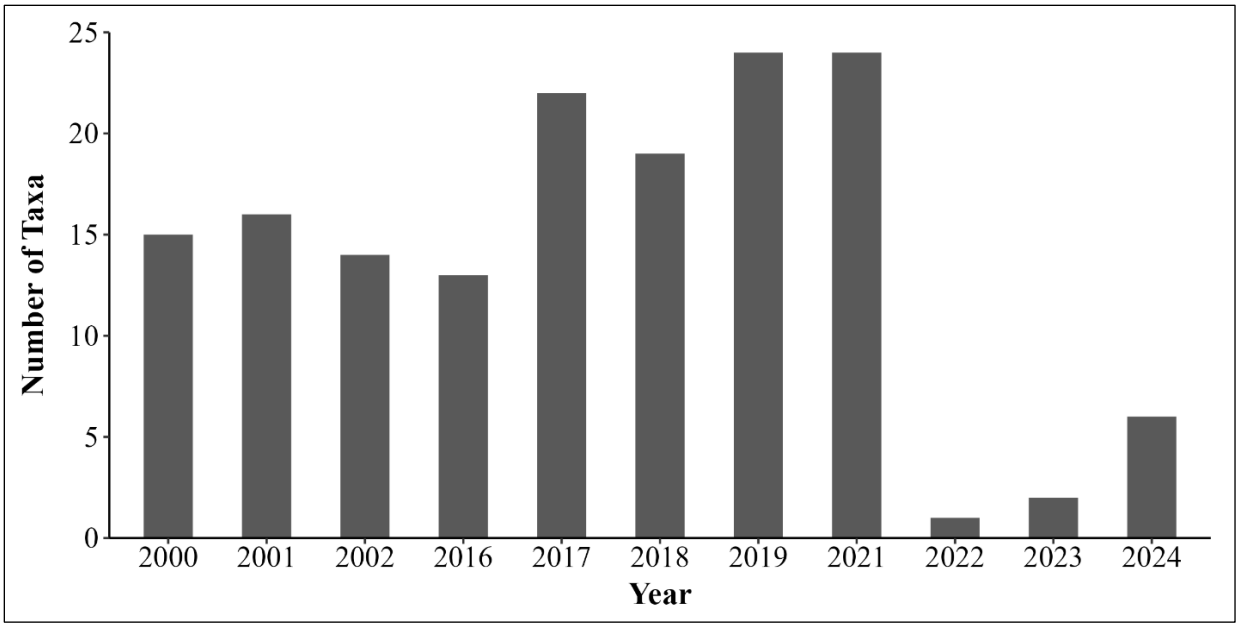


Figure 50.–Taxa richness in Moil Creek BMI samples, 2000–2002 and 2016–2024. Sampling method was changed from drift nets to Hess samplers in 2022.

## Sediment

Sediment element concentrations from Moil Creek and summary statistics from all 2024 sites are presented in Table 14. Concentrations of cadmium, copper, lead, and zinc were the lowest observed values across all AAEP sites. Selenium was the second highest observed concentration in 2024. Mercury was not detected in the sample. All element concentrations from 2024 were lower than those measured in 2022.

Table 14.–Sediment sample element concentrations (mg/kg) in Moil Creek in 2022 and 2024 and summary statistics for all sites in 2024. Summary statistics were calculated with all sites (n = 16) sampled in July 2024. Mercury summary statistics exclude two sites that had no detection (ND; n = 14).

| Element | Moil Creek | | All 2024 Sample Sites | | |
|---|---|---|---|---|---|
| | 2022 | 2024 | Mean | Minimum | Maximum |
| Cadmium | 0.63 | 0.10 | 4.59 | 0.10 | 26.80 |
| Copper | 51.0 | 22.5 | 117.1 | 22.5 | 649.0 |
| Lead | 19.50 | 5.36 | 22.72 | 5.36 | 84.30 |
| Mercury | 0.077 | ND | 0.054 | 0.024 | 0.084 |
| Selenium | 9.70 | 3.24 | 2.10 | 1.22 | 3.26 |
| Zinc | 164.0 | 50.8 | 603.0 | 50.8 | 2,030.0 |

## VOLCANO CREEK

### Water Quality

Volcano Creek has some orange staining on the substrate, originating from a small seep 0.4 km upstream from the sample site. In July 2024 in situ pH was 8.24, water temperature was 2.2°C, dissolved oxygen was 13.2 mg/L, specific conductance was 769 µs/cm, and turbidity was 0.58 NTU (Appendix B).

### Periphyton

Mean chlorophyll-a concentration in Volcano Creek in 2024 was 0.75 mg/m$^2$ (SD = 0.42). Mean chlorophyll-a concentrations were consistently between 4 and 6 mg/m$^2$ from 2014–2017, then steadily decreased from 2018–2021 and have remained relatively low since (Figure 51). Mean chlorophyll-a concentrations in Volcano Creek have ranged from a low of 0.32 mg/m$^2$ in 2021 to a high of 6.32 mg/m$^2$ in 2014. Periphyton data from 2024 are presented in Appendix C.

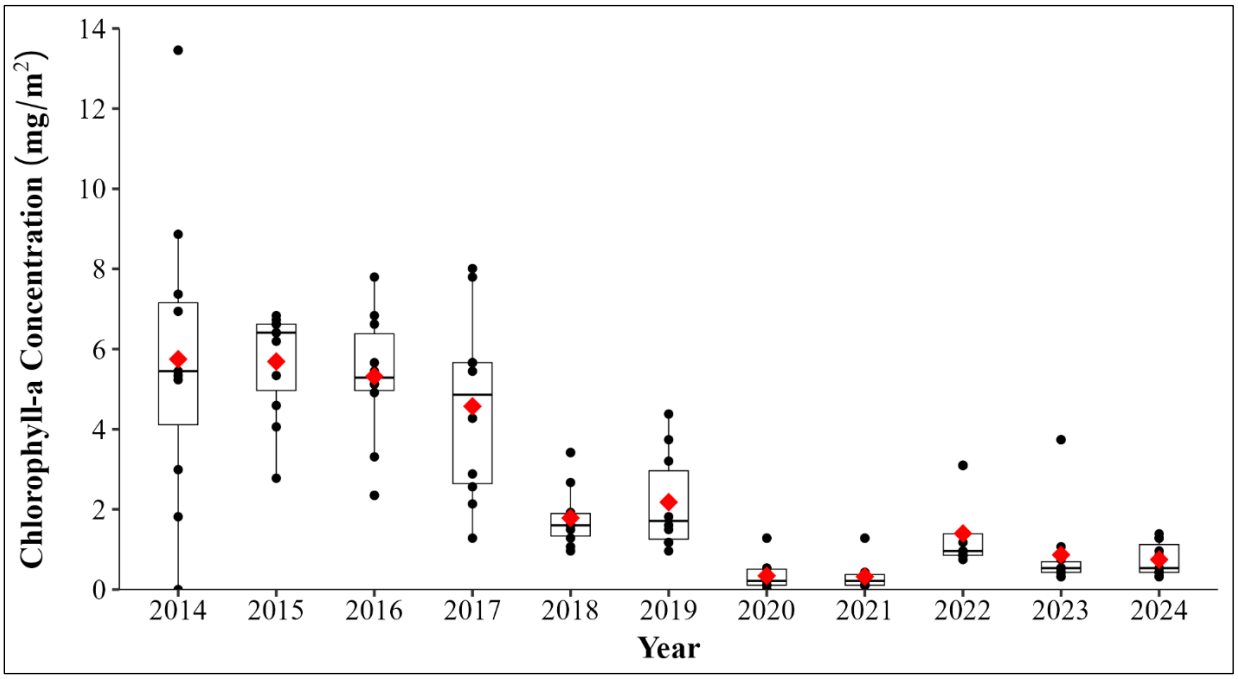


Figure 51.–Chlorophyll-a concentration boxplot by year at Volcano Creek, 2014–2024. Raw data are depicted by black dots and mean values are depicted in red.

### Benthic Macroinvertebrates

Mean BMI density in Volcano Creek in 2024 was 893/m$^2$ (SD = 768). This is more than twice the density in 2023 but just over one third the density in 2022 (Figure 52). Diptera made up 89.0%

and EPT taxa made up 9.7% of the samples in 2024. EPT taxa have been present in all years ranging from 2.9–39.1% of the samples (Figure 53). Diptera have made up over 50% of the samples in every year except 2016. Taxa richness was the lowest on record in 2024 at 7 taxa. The range is previous years was 9–26 (Figure 54). The contrast with previous results may be due in part to the change in sampling methods from drift nets to Hess samplers beginning in 2022. BMI data from 2024 are presented in Appendix D.

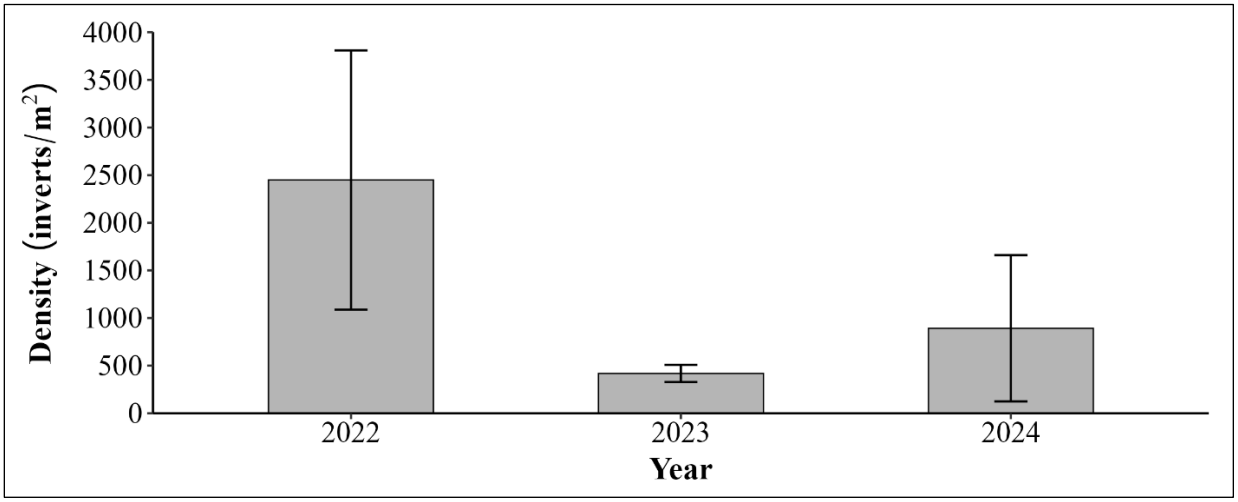


Figure 52.–Mean BMI density (± 1 SD) at Volcano Creek, 2022–2024.

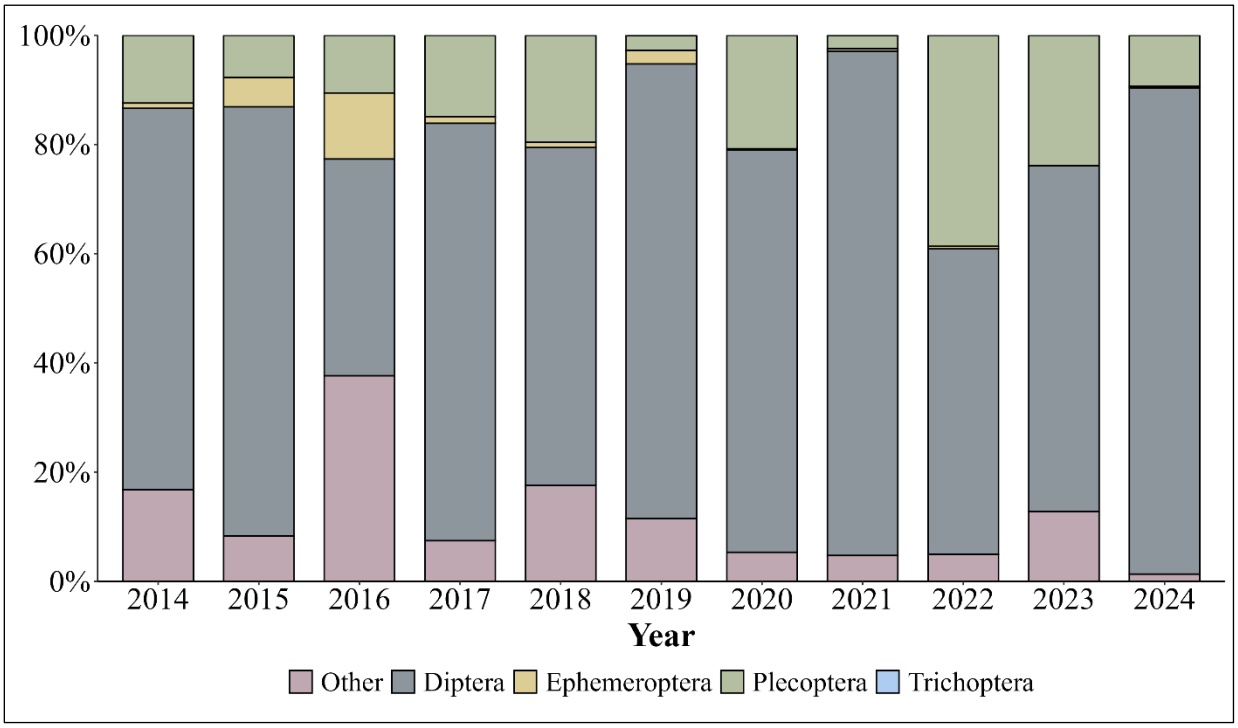


Figure 53.–Mean percent EPT, Diptera, and other taxa in Volcano Creek BMI samples, 2014–2024.

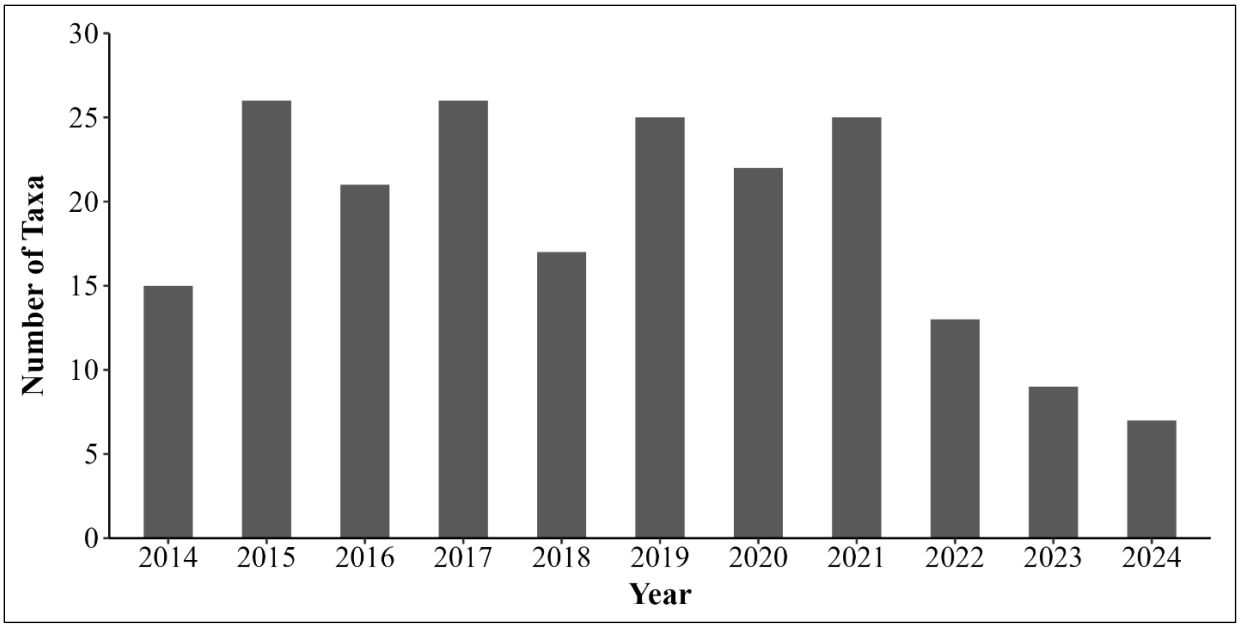


Figure 54.–Taxa richness in Volcano Creek BMI samples, 2014–2024. Sampling method was changed from drift nets to Hess samplers in 2022.

## Sediment

Sediment element concentrations from Volcano Creek and summary statistics from all 2024 sites are presented in Table 15. Copper was the only element that fell below the mean concentration. Cadmium and zinc concentrations in Volcano Creek were the highest concentration observed among all sites in 2024. Element concentrations were generally similar when comparing 2022 and 2024 values, with lead and mercury concentrations moderately lower in 2024.

Table 15.–Sediment sample element concentrations (mg/kg) in Volcano Creek in 2022 and 2024 and summary statistics for all sites in 2024. Summary statistics were calculated with all sites (n = 16) sampled in July 2024. Mercury summary statistics exclude two sites that had no detection (n = 14).

| Element | Volcano Creek | | All 2024 Sample Sites | | |
|---|---|---|---|---|---|
| | 2022 | 2024 | Mean | Minimum | Maximum |
| Cadmium | 36.10 | 26.80 | 4.59 | 0.10 | 26.80 |
| Copper | 146.0 | 104.0 | 117.1 | 22.5 | 649.0 |
| Lead | 126.00 | 62.00 | 22.72 | 5.36 | 84.30 |
| Mercury | 0.116 | 0.070 | 0.054 | 0.024 | 0.084 |
| Selenium | 3.00 | 3.16 | 2.10 | 1.22 | 3.26 |
| Zinc | 2990.0 | 2,030.0 | 603.0 | 50.8 | 2,030.0 |

# UPPER NORTH FORK RED DOG CREEK NORTH TRIBUTARY

## Water Quality

Upper North Fork Red Dog Creek North Tributary has naturally 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. In July 2024 in situ pH was 8.06, water temperature was 2.0°C, dissolved oxygen was 12.6 mg/L, specific conductance was 532 µs/cm, and turbidity was 0.25 NTU (Appendix B).

## Periphyton

This was the first year that periphyton samples were collected at Upper North Fork Red Dog Creek North Tributary. The mean chlorophyll-a concentration in Upper North Fork Red Dog Creek North Tributary in 2024 was 14.30 mg/m$^2$ (SD = 17.92). Chlorophyll-a concentrations ranged from 1.39–54.47 mg/m$^2$ among samples. Periphyton data from 2024 are presented in Appendix C.

## Benthic Macroinvertebrates

This was the first year that BMI were collected at Upper North Fork Red Dog Creek North Tributary. Mean BMI density was the highest among all AAEP sites at 43,918/m$^2$ (SD = 21,827) and taxa richness was 23. EPT taxa made up just 2.87% of the samples while Diptera made up 86.1% of the samples. BMI data from 2024 are presented in Appendix D.

## Sediment

Sediment element concentrations from Upper North Fork Red Dog North Tributary and summary statistics from all 2024 sites are presented in Table 16. All elements except for cadmium were below mean concentrations. Cadmium was higher than the mean and was the second highest concentration observed in 2024. No sediment sample was collected in 2022.

Table 16.–Sediment sample element concentrations (mg/kg) in Upper North Fork Red Dog Creek North Tributary in 2024 and summary statistics for all sites in 2024. Summary statistics were calculated with all sites (n = 16) sampled in July 2024. Mercury summary statistics exclude two sites that had no detection (n = 14).

| Element | Upper NFRD North Tributary | All 2024 Sample Sites | | |
|---|---|---|---|---|
| | 2024 | Mean | Minimum | Maximum |
| Cadmium | 8.07 | 4.59 | 0.10 | 26.80 |
| Copper | 24.7 | 117.1 | 22.5 | 649.0 |
| Lead | 11.20 | 22.72 | 5.36 | 84.30 |
| Mercury | 0.056 | 0.054 | 0.024 | 0.084 |
| Selenium | 1.53 | 2.10 | 1.22 | 3.26 |
| Zinc | 465.0 | 603.0 | 50.8 | 2,030.0 |

# 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 2024 in situ pH was 7.93, water temperature was 2.0°C, dissolved oxygen was 12.6 mg/L, specific conductance was 269 µs/cm, and turbidity was 0.17 NTU (Appendix B).

## Periphyton

Periphyton sampling first occurred at Upper North Fork Red Dog Creek South Tributary in 2022 and resumed in 2024. The mean chlorophyll-a concentration in Upper North Fork Red Dog Creek South Tributary in 2024 was 3.56 mg/m$^2$ (SD = 2.16) up from 2.08 mg/m$^2$ in 2022 (Figure 58). The range of individual samples in 2024 was 1.17–8.65 mg/m$^2$. Periphyton data from 2024 are presented in Appendix C.

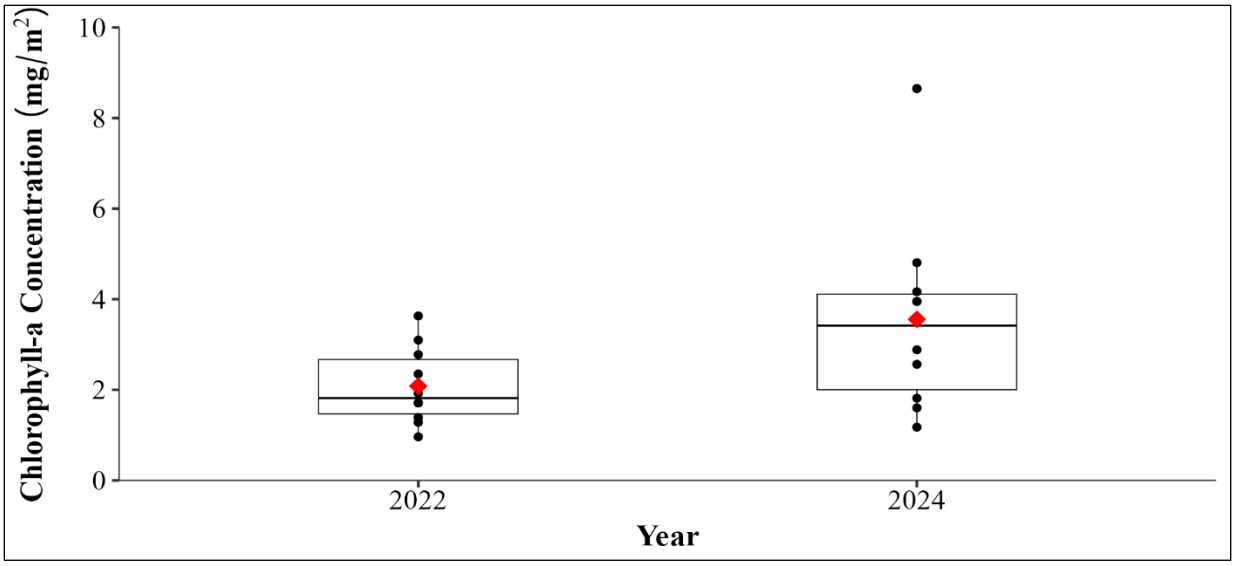


Figure 55.–Chlorophyll-a concentration boxplot by year at Upper North Fork Red Dog Creek South Tributary, 2022 and 2024. Raw data are depicted by black dots and mean values are depicted in red.

## 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 7,358/m$^2$ (SD = 5,055) which is similar to the density in 2022 (Figure 59). EPT taxa made up 14.6% of the samples in 2024 down from 21.0% in 2022. Diptera have made up over 50% of the samples in both years (Figure 60). Taxa richness in 2024 was 21 up from 16 in 2022 (Figure 61). BMI data from 2024 are presented in Appendix D.

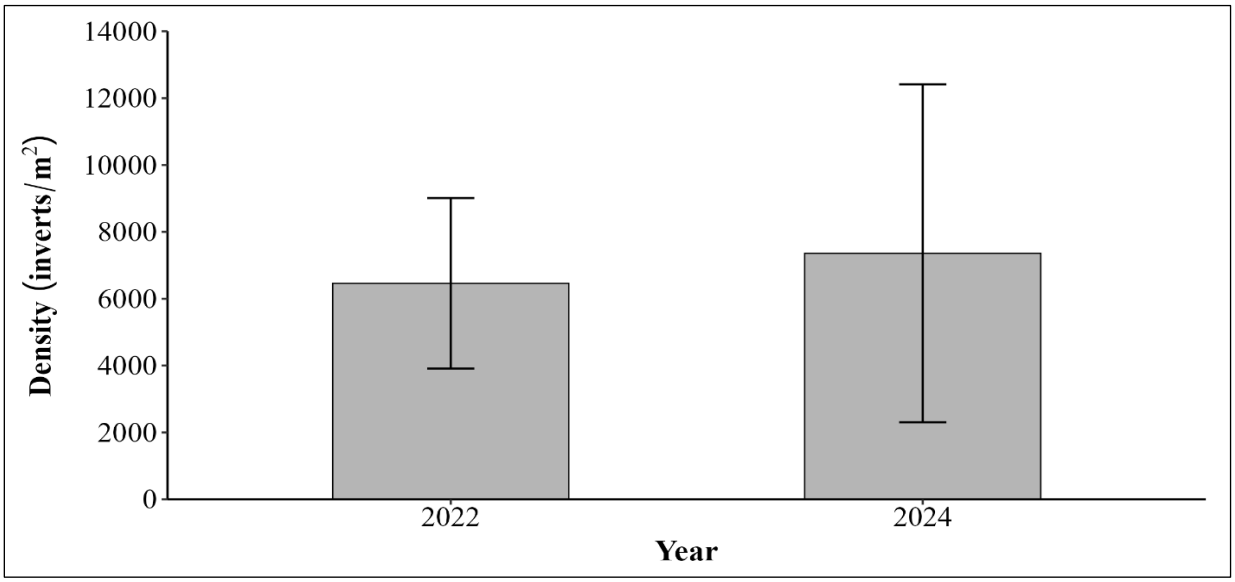


Figure 56.–Mean BMI density (± 1 SD) at Upper North Fork Red Dog Creek South Tributary, 2022 and 2024.

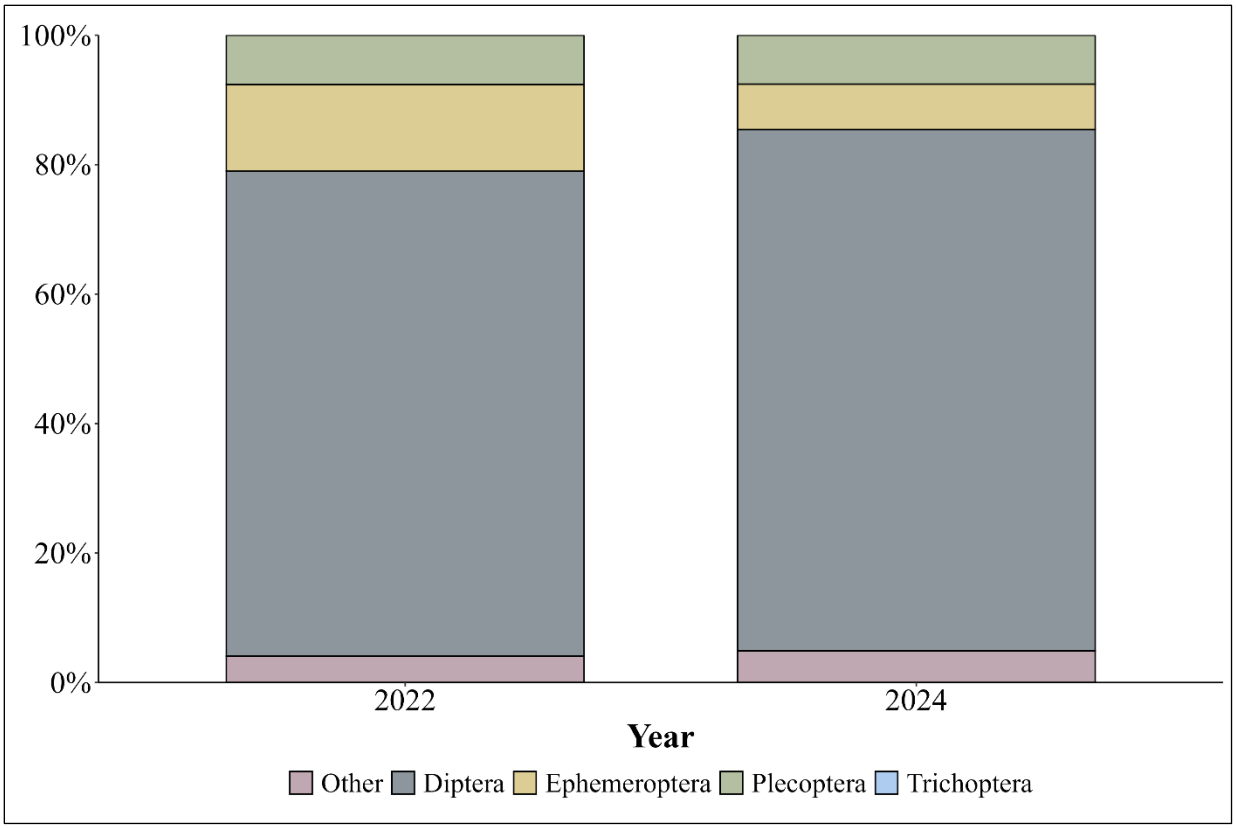


Figure 57.–Mean percent EPT, Diptera, and other taxa in Upper North Fork Red Dog Creek South Tributary BMI samples, 2022 and 2024.

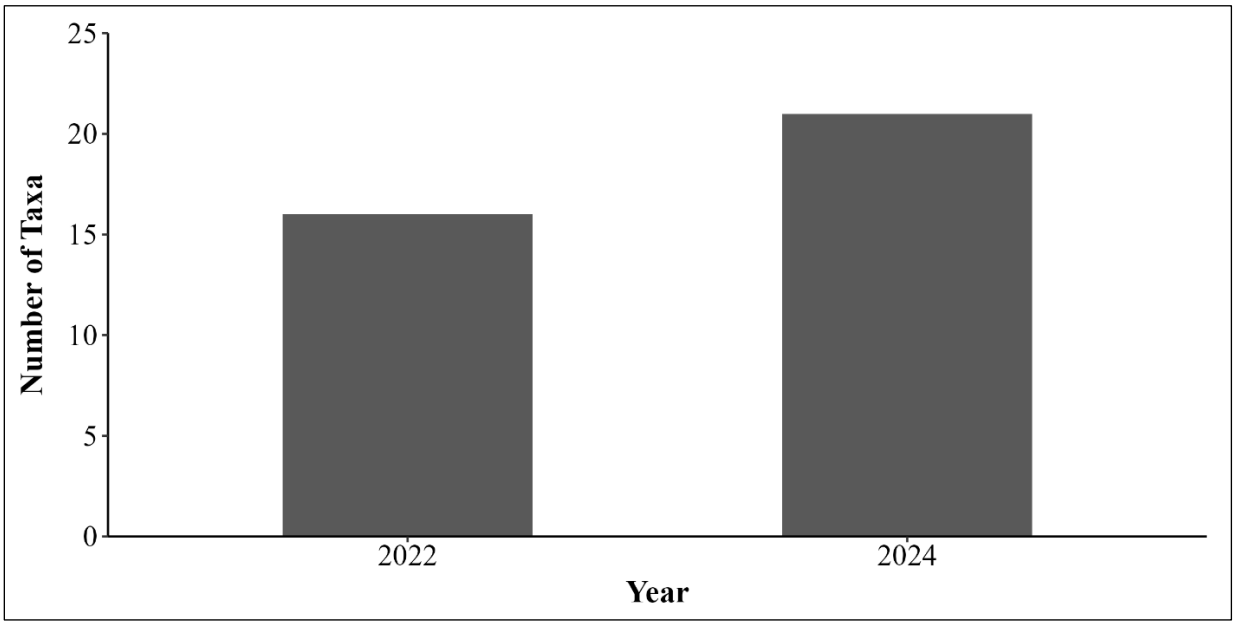


Figure 58.–Taxa richness in Upper North Fork Red Dog Creek South Tributary BMI samples, 2022 and 2024.

### Sediment

Sediment element concentrations from Upper North Fork Red Dog Creek South Tributary and summary statistics from all 2024 sites are presented in Table 17. All element concentrations were on the low end of observed concentrations and well below the mean. No sediment was collected in 2022.

Table 17.–Sediment sample element concentrations (mg/kg) in Upper North Fork Red Dog Creek South Tributary in 2024 and summary statistics for all sites in 2024. Summary statistics were calculated with all sites (n = 16) sampled in July 2024. Mercury summary statistics exclude two sites that had no detection (n = 14).

| Element | Upper NFRD South Tributary | All 2024 Sample Sites | | |
|---|---|---|---|---|
| | 2024 | Mean | Minimum | Maximum |
| Cadmium | 0.30 | 4.59 | 0.10 | 26.80 |
| Copper | 23.6 | 117.1 | 22.5 | 649.0 |
| Lead | 15.80 | 22.72 | 5.36 | 84.30 |
| Mercury | 0.038 | 0.054 | 0.024 | 0.084 |
| Selenium | 1.29 | 2.10 | 1.22 | 3.26 |
| Zinc | 166.0 | 603.0 | 50.8 | 2,030.0 |

# CONCLUSION

In 2024, in situ measurements of dissolved oxygen and water temperature at all sample sites were within ranges considered suitable for supporting aquatic life (EPA 2024). However, pH values at West Fork Ikalukrok, Noa, and Moil creeks indicated acidic conditions, and were below the lower limit of the EPA aquatic life criteria in freshwater, which is 6.5–9 (EPA 2024). Specific conductivity in streams near Red Dog Mine ranged from 309 to 1,416 µS/cm which is generally elevated when compared to other freshwater Arctic rivers (Koch et al. 2024). Streams with higher specific conductivity typically exhibited elevated concentrations of total recoverable metals. These higher conductivity 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).

Chlorophyll-a concentrations within all sites remained similar to recent years in 2024. Values in 2024 ranged from 0.01 mg/m$^2$ at Ikalukrok Creek downstream of Cub Creek to 14.30 mg/m$^2$ at Upper North Fork Red Dog Creek North Tributary. These values are similar to other streams monitored annually for the Red Dog Mine (Clawson 2025). Eleven of the AAEP sites fell within

the range of values (0.12–28.88 mg/m$^2$) observed in streams in the vicinity of the Arctic-Bornite exploratory mining prospects in 2024 (Edwards 2025b). The remaining five sites fell below this range.

The four sites with notably low pH also had the lowest BMI densities. EPT were absent from these sites except for a single Plecopteran in the Moil Creek samples. EPT taxa were present at all 12 remaining sites. The mean BMI density at Upper North Fork Red Dog North Tributary was highest among all sites and six times the second highest value. This mean BMI density of 43,919 BMI/m$^2$ is much higher than the maximum observed densities in streams in the vicinity of both the historic Illinois Creek mine and the Arctic-Bornite exploratory mining prospects (Edwards 2025; Edwards 2025b).

The AAEP biomonitoring program has identified notable changes in several streams in the vicinity of the AAEP. Documented declines in chlorophyll-a concentrations in Sourdock, Lower Competition, Grayling Junior, and Volcano creeks are likely due to an increased prevalence of natural mineral seeps over time. In addition, the general variability in biological data observed among and within sample sites illustrates the importance of continued 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 biomonitoring program including in situ water quality, periphyton, BMI, fish, and sediment sampling.

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# APPENDICES

# APPENDIX A. WATER QUALITY AND ELEMENT CONCENTRATION DATA FROM LOCATIONS NEAR THE AKTIGIRUQ-ANARRAAQ EXTENSION PROJECT, 2024.

Samples were collected by Teck and analyzed by external labs. Station numbers are in parentheses by the stream name. Seasonal means are presented in shaded rows with number of samples per parameter in parentheses.

| | EF Ikalukrok (208) | Grayling Jr (209) | Ikalukrok d/s Cub (207) | Ikalukrok (230) | Moil (211) | Noa (210) | WF Ikalukrok (231) |
|---|---|---|---|---|---|---|---|
| **pH** | 7.00 (n = 13) | 7.21 (n = 12) | 6.46 (n = 14) | 6.16 (n = 4) | 3.91 (n = 11) | 3.75 (n = 4) | 4.42 (n = 4) |
| Min | 5.71 | 6.70 | 5.23 | 5.56 | 3.68 | 3.55 | 3.88 |
| Max | 8.40 | 8.11 | 7.55 | 6.64 | 4.47 | 4.12 | 5.33 |
| **Temperature (°C)** | 3.7 (n = 13) | 3.8 (n = 12) | 3.3 (n = 14) | 3.4 (n = 4) | 2.8 (n = 11) | 1.4 (n = 4) | 2.9 (n = 4) |
| Min | 0.3 | 1.3 | -0.1 | 0.2 | 0.7 | 0.7 | 0.3 |
| Max | 7.6 | 7.7 | 8.1 | 6.9 | 5.2 | 2.4 | 5.9 |
| **Conductivity (µS/cm)** | 212.8 (n = 13) | 408.6 (n = 12) | 284.2 (n = 14) | 306.1 (n = 4) | 692.2 (n = 11) | 720.3 (n = 4) | 532.5 (n = 4) |
| Min | 89.2 | 178.3 | 113.9 | 119.1 | 297.4 | 475.3 | 186.8 |
| Max | 508.0 | 621.0 | 511.0 | 383.5 | 906.0 | 871.0 | 747.0 |
| **TDS (mg/L)** | 218 (n = 12) | 441 (n = 12) | 325 (n = 13) | 383 (n = 4) | 908 (n = 11) | 1214 (n = 5) | 800 (n = 4) |
| Min | 2 | 51 | 34 | 156 | 94 | 904 | 266 |
| Max | 604 | 788 | 664 | 480 | 1698 | 1400 | 1260 |
| **Zinc (µg/L)** | 396.0 (n = 13) | 147.0 (n = 13) | 1982.6 (n = 13) | 492.3 (n = 4) | 3705.4 (n = 11) | 3528.6 (n = 6) | 1535.5 (n = 4) |
| Min | 10.9 | 65.4 | 9.5 | 242.0 | 649.0 | 21.7 | 412.0 |
| Max | 2820.0 | 584.0 | 6370.0 | 627.0 | 7130.0 | 4960.0 | 2570.0 |
| **Lead (µg/L)** | 1.82 (n = 7) | 11.45 (n = 5) | 3.67 (n = 12) | 1.76 (n = 1) | 1.64 (n = 9) | 1.97 (n = 1) | 0.31 (n = 3) |
| Min | 0.18 | 0.17 | 0.11 | 1.76 | 0.32 | 1.97 | 0.11 |
| Max | 4.96 | 55.60 | 7.36 | 1.76 | 5.14 | 1.97 | 0.56 |
| **Aluminum (µg/L)** | 69.9 (n = 4) | 234.6 (n = 5) | 1480.0 (n = 4) | 903.8 (n = 4) | 15697.5 (n = 4) | 12532.0 (n = 5) | 2238.8 (n = 4) |
| Min | 16.7 | 114.0 | 1180.0 | 614.0 | 9090.0 | 8160.0 | 435.0 |
| Max | 132.0 | 420.0 | 1830.0 | 1140.0 | 21400.0 | 15900.0 | 3490.0 |
| **Cadmium (µg/L)** | 0.09 (n = 3) | 0.74 (n = 5) | 8.38 (n = 4) | 2.77 (n = 4) | 15.95 (n = 4) | 14.06 (n = 5) | 12.14 (n = 4) |
| Min | 0.08 | 0.55 | 4.59 | 1.22 | 12.20 | 11.70 | 3.06 |
| Max | 0.10 | 1.05 | 12.80 | 3.64 | 18.30 | 15.40 | 20.70 |
| **Nickel (µg/L)** | 5.82 (n = 4) | 52.48 (n = 5) | 295.50 (n = 4) | 274.00 (n = 4) | 1101.75 (n = 4) | 2297.27 (n = 6) | 502.00 (n = 4) |
| Min | 4.69 | 36.10 | 208.00 | 137.00 | 845.00 | 3.63 | 188.00 |
| Max | 6.93 | 78.70 | 346.00 | 348.00 | 1320.00 | 3120.00 | 734.00 |
| **Turbidity (NTU)** | 0.33 (n = 3) | 2.19 (n = 3) | 27.54 (n = 3) | 3.18 (n = 3) | 95.90 (n = 3) | 14.15 (n = 3) | 4.65 (n = 3) |
| Min | 0.25 | 0.92 | 2.22 | 1.52 | 63.00 | 6.25 | 0.18 |
| Max | 0.44 | 4.34 | 62.00 | 6.01 | 154.00 | 23.60 | 13.20 |

# APPENDIX B. IN SITU WATER QUALITY DATA FROM LOCATIONS NEAR THE AKTIGIRUQ-ANARRAAQ EXTENSION PROJECT, 2024.

| Site | Station | Coordinates | Date | Temperature (°C) | Dissolved Oxygen (mg/L) | Specific Conductivity (µs/cm) | Conductivity (µs/cm) | pH | Turbidity (NTU) |
|---|---|---|---|---|---|---|---|---|---|
| Upper Competition | 203 | 68.1411, -163.0033 | 7/9/24 | 1.3 | 13.1 | 1416 | 774 | 6.03 | 26.1 |
| Sourdock | 204 | 68.1397, -163.0045 | 7/9/24 | 1.2 | 13.2 | 779 | 425 | 7.9 | 7.96 |
| West Fork Ikalukrok | 205 | 68.1719, -162.9093 | 7/7/24 | 3.5 | 12.74 | 890 | 525 | 4.5 | 0.32 |
| Ikalukrok u/s WF Ikalukrok | 206 | 68.1723, -162.9077 | 7/7/24 | 5.5 | 11.96 | 444 | 279 | 7.38 | 0.81 |
| Ikalukrok d/s WF Ikalukrok | 230 | 68.1701, -162.9049 | 7/7/24 | 6.3 | 12.12 | 552 | 334 | 7.7 | 1.04 |
| Ikalukrok d/s Cub | 207 | 68.1544, -162.8636 | 7/7/24 | 5.9 | 11.82 | 573 | 363 | 7.16 | 2.46 |
| EF Ikalukrok | 208 | 68.1527, -162.8488 | 7/7/24 | 5.5 | 12.23 | 309 | 194 | 8.48 | 0.21 |
| Grayling Jr | 209 | 68.1364, -162.8719 | 7/8/24 | 7.0 | 11.57 | 720 | 473 | 8.3 | 0.63 |
| NF Grayling Jr | n/a | 68.155, -162.805 | 7/8/24 | 5.2 | 11.99 | 958 | 596 | 8.19 | 0.56 |
| EF Grayling Jr | n/a | 68.144, -162.7822 | 7/8/24 | 5.8 | 11.75 | 419 | 266 | 8.29 | 0.25 |
| Noa | 210 | 68.1264, -162.9026 | 7/7/24 | 0.7 | 13.65 | 1338 | 744 | 4.13 | 0.22 |
| Ikalukrok u/s Noa | n/a | 68.1269, -162.8976 | 7/7/24 | 3.4 | 12.9 | 456 | 267 | 8.07 | 1.73 |
| Moil | 211 | 68.1054, -162.9406 | 7/8/24 | 2.9 | 13.02 | 1265 | 732 | 4.18 | 14.2 |
| Volcano | n/a | 68.0832, -162.985 | 7/8/24 | 2.2 | 13.24 | 769 | 433 | 8.24 | 0.58 |
| Upper NFRD North | n/a | 68.1113, -162.7335 | 7/8/24 | 2.0 | 12.66 | 532 | 299 | 8.06 | 0.25 |
| Upper NFRD South | n/a | 68.0905, -162.7342 | 7/8/24 | 2.0 | 12.67 | 269 | 151 | 7.93 | 0.17 |

# APPENDIX C. CHLOROPHYLL DATA FROM LOCATIONS NEAR THE AKTIGIRUQ-ANARRAAQ EXTENSION PROJECT, 2024.

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 0.14.

| IDL = 0.14 mg/m^2 | | | | | Linear Check Maximum = 69.02 mg/m^2 | | | |
|---|---|---|---|---|---|---|---|---|
| EDL = 0.51 mg/m^2 | | | | | **Phaeo Corrected** | | | |
| | | Date | Vial | Chl a | **Chl a** | **664/665** | Chl b | Chl c |
| Daily Vial | Site | Analyzed | Chl a | mg/m2 | **mg/m2** | **Ratio** | mg/m2 | mg/m2 |
| 2 | Ikalukrok d/s Cub | 11/26/2024 | 0.00 | 0.00 | 0 | 0 | 0 | 0 |
| 3 | Ikalukrok d/s Cub | 11/26/2024 | 0.00 | 0.00 | 0 | 0 | 0 | 0 |
| 5 | Ikalukrok d/s Cub | 11/26/2024 | 0.00 | 0.00 | 0 | 0 | 0 | 0.09808 |
| 4 | Ikalukrok d/s Cub | 11/26/2024 | 0.01 | 0.04 | 0.1068 | 0 | 0.05176 | 0.061 |
| 6 | Ikalukrok d/s Cub | 11/26/2024 | 0.00 | 0.00 | 0 | 0 | 0 | 0 |
| 7 | Ikalukrok d/s Cub | 11/26/2024 | 0.00 | 0.00 | 0 | 0 | 0 | 0 |
| 8 | Ikalukrok d/s Cub | 11/26/2024 | 0.00 | 0.00 | 0 | 0 | 0 | 0 |
| 9 | Ikalukrok d/s Cub | 11/26/2024 | 0.00 | 0.00 | 0 | 0 | 0 | 0 |
| 10 | Ikalukrok d/s Cub | 11/26/2024 | 0.00 | 0.00 | 0 | 0 | 0 | 0.09808 |
| 11 | Ikalukrok d/s Cub | 11/26/2024 | 0.00 | 0.00 | 0 | 0 | 0.07348 | 0.06768 |
| 12 | Ikalukrok d/s WF Ikalukrok | 11/26/2024 | 0.01023 | 0.04092 | 0.1068 | 0 | 0.05176 | 0.061 |
| 13 | Ikalukrok d/s WF Ikalukrok | 11/26/2024 | 0 | 0 | 0 | 0 | 0 | 0 |
| 14 | Ikalukrok d/s WF Ikalukrok | 11/26/2024 | 0 | 0 | 0 | 0 | 0 | 0 |
| 15 | Ikalukrok d/s WF Ikalukrok | 11/26/2024 | 0 | 0 | 0 | 0 | 0 | 0 |
| 16 | Ikalukrok d/s WF Ikalukrok | 11/26/2024 | 0 | 0 | 0 | 0 | 0 | 0 |
| 17 | Ikalukrok d/s WF Ikalukrok | 11/26/2024 | 0.01023 | 0.04092 | 0.1068 | 0 | 0.05176 | 0.061 |
| 18 | Ikalukrok d/s WF Ikalukrok | 11/26/2024 | 0 | 0 | 0 | 0 | 0 | 0 |
| 19 | Ikalukrok d/s WF Ikalukrok | 11/26/2024 | 0 | 0 | 0 | 0 | 0 | 0 |
| 20 | Ikalukrok d/s WF Ikalukrok | 11/26/2024 | 0 | 0 | 0 | 0 | 0 | 0 |
| 21 | Ikalukrok d/s WF Ikalukrok | 11/26/2024 | 0 | 0 | 0 | 0 | 0 | 0 |
| 22 | Upper NFRD North Trib | 11/26/2024 | 14.55739 | 58.22956 | 54.468 | 1.661478599 | 2.36504 | 4.46884 |
| 23 | Upper NFRD North Trib | 11/26/2024 | 0.81089 | 3.24356 | 3.204 | 1.731707317 | 0 | 0.41932 |
| 24 | Upper NFRD North Trib | 11/26/2024 | 0.37663 | 1.50652 | 1.3884 | 1.65 | 0 | 0.19252 |
| 25 | Upper NFRD North Trib | 11/26/2024 | 0.57014 | 2.28056 | 2.136 | 1.666666667 | 0 | 0.2212 |
| 26 | Upper NFRD North Trib | 11/26/2024 | 0.50066 | 2.00264 | 2.0292 | 1.76 | 0.04212 | 0.1936 |
| 27 | Upper NFRD North Trib | 11/26/2024 | 6.80752 | 27.23008 | 25.632 | 1.662983425 | 2.77532 | 2.59512 |
| 27 | Upper NFRD North Trib duplicate | 11/26/2024 | 6.76174 | 27.04696 | 25.7388 | 1.675070028 | 2.78872 | 2.55416 |
| 28 | Upper NFRD North Trib | 11/26/2024 | 0.45334 | 1.81336 | 1.7088 | 1.666666667 | 0.13964 | 0.12224 |
| 29 | Upper NFRD North Trib | 11/26/2024 | 1.63632 | 6.54528 | 6.1944 | 1.674418605 | 0.26504 | 0.5448 |
| 30 | Upper NFRD North Trib | 11/26/2024 | 9.00021 | 36.00084 | 33.3216 | 1.643298969 | 4.50844 | 2.15108 |
| 31 | Upper NFRD North Trib | 11/26/2024 | 0.37355 | 1.4942 | 1.4952 | 1.736842105 | 0.13408 | 0.13172 |
| 32 | EF Ikalukrok | 11/26/2024 | 0.68 | 2.73 | 2.5632 | 1.666666667 | 0.09392 | 0.13088 |
| 33 | EF Ikalukrok | 11/26/2024 | 0.30 | 1.19 | 1.068 | 1.625 | 0 | 0.10392 |
| 34 | EF Ikalukrok | 11/26/2024 | 0.15 | 0.59 | 0.534 | 1.625 | 0.0222 | 0.0858 |
| 35 | EF Ikalukrok | 11/26/2024 | 0.33 | 1.33 | 1.2816 | 1.705882353 | 0 | 0.08388 |
| 36 | EF Ikalukrok | 11/26/2024 | 0.11 | 0.45 | 0.4272 | 1.666666667 | 0.01388 | 0.03816 |
| 37 | EF Ikalukrok | 11/26/2024 | 0.98 | 3.93 | 3.738 | 1.68627451 | 0 | 0.2956 |
| 38 | EF Ikalukrok | 11/26/2024 | 0.08 | 0.32 | 0.3204 | 1.75 | 0 | 0.0886 |
| 39 | EF Ikalukrok | 11/26/2024 | 0.32 | 1.28 | 1.1748 | 1.647058824 | 0.00096 | 0.15824 |
| 40 | EF Ikalukrok | 11/26/2024 | 0.74 | 2.97 | 2.8836 | 1.710526316 | 0 | 0.32404 |
| 41 | EF Ikalukrok | 11/26/2024 | 0.12 | 0.50 | 0.534 | 1.833333333 | 0.06564 | 0.09916 |
| 42 | Noa | 11/26/2024 | 1.08 | 4.31 | 3.0972 | 1.439393939 | 0.32088 | 0.48268 |
| 43 | Noa | 11/26/2024 | 0.07 | 0.27 | 0.3204 | 2 | 0.02728 | 0 |
| 44 | Noa | 11/26/2024 | 0.22 | 0.87 | 0.7476 | 1.583333333 | 0 | 0.1134 |
| 45 | Noa | 11/26/2024 | 0.07 | 0.27 | 0.2136 | 1.5 | 0.01664 | 0.09528 |
| 46 | Noa | 11/26/2024 | 0.21 | 0.86 | 0.7476 | 1.583333333 | 0.11232 | 0.24876 |
| 47 | Noa | 11/26/2024 | 0.11 | 0.45 | 0.4272 | 1.666666667 | 0.01388 | 0.03816 |
| 48 | Noa | 11/26/2024 | 1.05 | 4.22 | 3.6312 | 1.576271186 | 0.26956 | 0.62452 |
| 49 | Noa | 11/26/2024 | 0.19 | 0.77 | 0.7476 | 1.7 | 0.0088 | 0.12676 |
| 50 | Noa | 11/26/2024 | 0.32 | 1.28 | 1.1748 | 1.647058824 | 0.00096 | 0.15824 |
| 51 | Noa | 11/26/2024 | 0.29 | 1.17 | 1.068 | 1.625 | 0.11788 | 0.23928 |

| IDL = 0.14 mg/m^2 | | | | | Linear Check Maximum = 69.02 mg/m^2 | | | |
|---|---|---|---|---|---|---|---|---|
| EDL = 0.51 mg/m^2 | | | | | **Phaeo Corrected** | | | |
| | | Date | Vial | Chl a | **Chl a** | **664/665** | Chl b | Chl c |
| Daily Vial | Site | Analyzed | Chl a | mg/m2 | **mg/m2** | **Ratio** | mg/m2 | mg/m2 |
| 12 | Ikalukrok u/s WF Ikalukrok | 11/27/2024 | 0.01 | 0.04 | 0.1068 | 0 | 0.05176 | 0.061 |
| 13 | Ikalukrok u/s WF Ikalukrok | 11/27/2024 | 0.01 | 0.04 | 0.1068 | 0 | 0.05176 | 0.061 |
| 14 | Ikalukrok u/s WF Ikalukrok | 11/27/2024 | 0.01 | 0.04 | 0.1068 | 0 | 0.05176 | 0.061 |
| 15 | Ikalukrok u/s WF Ikalukrok | 11/27/2024 | 0.00 | 0.00 | 0 | 0 | 0 | 0 |
| 16 | Ikalukrok u/s WF Ikalukrok | 11/27/2024 | 0.02 | 0.09 | 0.2136 | 0 | 0.03004 | 0.05432 |
| 17 | Ikalukrok u/s WF Ikalukrok | 11/27/2024 | 0.00 | 0.00 | 0 | 0 | 0 | 0 |
| 18 | Ikalukrok u/s WF Ikalukrok | 11/27/2024 | 0.00 | 0.01 | 0 | 0 | 0 | 0.0304 |
| 19 | Ikalukrok u/s WF Ikalukrok | 11/27/2024 | 0.00 | 0.00 | 0 | 0 | 0 | 0 |
| 20 | Ikalukrok u/s WF Ikalukrok | 11/27/2024 | 0.01 | 0.04 | 0.1068 | 0 | 0.05176 | 0.061 |
| 21 | Ikalukrok u/s WF Ikalukrok | 11/27/2024 | 0.01 | 0.04 | 0.1068 | 0 | 0.05176 | 0.061 |
| 22 | Competition u/s Sourdock | 11/27/2024 | 0.01 | 0.05 | 0.1068 | 0 | 0 | 0.0914 |
| 23 | Competition u/s Sourdock | 11/27/2024 | 0.00 | 0.00 | 0 | 0 | 0 | 0 |
| 24 | Competition u/s Sourdock | 11/27/2024 | 0.00 | 0.00 | 0 | 0 | 0 | 0 |
| 25 | Competition u/s Sourdock | 11/27/2024 | 0.00 | 0.00 | 0 | 0 | 0 | 0 |
| 26 | Competition u/s Sourdock | 11/27/2024 | 0.00 | 0.00 | 0 | 0 | 0 | 0 |
| 27 | Competition u/s Sourdock | 11/27/2024 | 0.00 | 0.00 | 0 | 0 | 0 | 0 |
| 27 | Competition u/s Sourdock | 11/27/2024 | 0.00 | 0.00 | 0 | 0 | 0 | 0 |
| 28 | Competition u/s Sourdock | 11/27/2024 | 0.00 | 0.00 | 0 | 0 | 0 | 0 |
| 29 | Competition u/s Sourdock | 11/27/2024 | 0.01 | 0.04 | 0.1068 | 0 | 0.05176 | 0.061 |
| 30 | Competition u/s Sourdock | 11/27/2024 | 0.01 | 0.04 | 0.1068 | 0 | 0.05176 | 0.061 |
| 31 | Grayling Jr | 11/27/2024 | 0.10 | 0.41 | 0.3204 | 1.5 | 0.0356 | 0.04484 |
| 32 | Grayling Jr | 11/27/2024 | 0.08 | 0.32 | 0.3204 | 1.75 | 0 | 0.0886 |
| 33 | Grayling Jr | 11/27/2024 | 0.10 | 0.41 | 0.4272 | 1.8 | 0 | 0.07524 |
| 34 | Grayling Jr | 11/27/2024 | 0.24 | 0.96 | 0.9612 | 1.75 | 0.00604 | 0.06964 |
| 35 | Grayling Jr | 11/27/2024 | 0.06 | 0.22 | 0.2136 | 1.666666667 | 0.049 | 0.00388 |
| 36 | Grayling Jr | 11/27/2024 | 0.08 | 0.31 | 0.3204 | 1.75 | 0.07904 | 0.0582 |
| 37 | Grayling Jr | 11/27/2024 | 0.03 | 0.14 | 0.3204 | 0 | 0.00832 | 0.04764 |
| 38 | Grayling Jr | 11/27/2024 | 0.15 | 0.60 | 0.6408 | 1.857142857 | 0 | 0.01812 |
| 39 | Grayling Jr | 11/27/2024 | 0.14 | 0.54 | 0.534 | 1.714285714 | 0.04392 | 0.09248 |
| 40 | Grayling Jr | 11/27/2024 | 0.07 | 0.27 | 0.2136 | 1.5 | 0.01664 | 0.09528 |
| 41 | Moil | 11/27/2024 | 0.01 | 0.04 | 0 | 1 | 0.05176 | 0.061 |
| 42 | Moil | 11/27/2024 | 0.03 | 0.12 | 1.853E-16 | 1 | 0.14464 | 0.28108 |
| 43 | Moil | 11/27/2024 | 0.03 | 0.12 | 0.1068 | 1.5 | 0.14464 | 0.28108 |
| 44 | Moil | 11/27/2024 | 0.00 | 0.00 | 0 | 0 | 0 | 0 |
| 45 | Moil | 11/27/2024 | 0.03 | 0.14 | 0.3204 | 0 | 0.00832 | 0.04764 |
| 46 | Moil | 11/27/2024 | 0.01 | 0.05 | 0.1068 | 0 | 0 | 0 |
| 47 | Moil | 11/27/2024 | 0.00 | 0.00 | 0 | 0 | 0 | 0 |
| 48 | Moil | 11/27/2024 | 0.01 | 0.04 | 0.1068 | 0 | 0.05176 | 0.061 |
| 49 | Moil | 11/27/2024 | 0.01 | 0.04 | 0.1068 | 0 | 0.05176 | 0.061 |
| 50 | Moil | 11/27/2024 | 0.01 | 0.03 | 0 | 1 | 0.12524 | 0.12868 |
| 51 | Sourdock | 11/27/2024 | 0.01 | 0.04 | 0.1068 | 0 | 0.05176 | 0.061 |
| 52 | Sourdock | 11/27/2024 | 0.01 | 0.04 | 0 | 1 | 0.05176 | 0.061 |
| 53 | Sourdock | 11/27/2024 | 0.02 | 0.09 | 0.1068 | 2 | 0.0194 | 0.1524 |
| 54 | Sourdock | 11/27/2024 | 0.05 | 0.22 | 0.3204 | 2.5 | 0.11184 | 0.16964 |
| 55 | Sourdock | 11/27/2024 | 0.02 | 0.08 | 0.2136 | 0 | 0.10352 | 0.122 |
| 2 | Upper Grayling Jr North | 12/2/2024 | 0.02 | 0.09 | 0 | 1 | 0.03004 | 0.05432 |
| 3 | Upper Grayling Jr North | 12/2/2024 | 0.09 | 0.36 | 0.4272 | 2 | 0.04668 | 0.1496 |
| 4 | Upper Grayling Jr North | 12/2/2024 | 0.02 | 0.09 | 0.2136 | 0 | 0.03004 | 0.05432 |
| 5 | Upper Grayling Jr North | 12/2/2024 | 0.02 | 0.09 | 0.2136 | 0 | 0.03004 | 0.05432 |
| 6 | Upper Grayling Jr North | 12/2/2024 | 0.11 | 0.45 | 0.4272 | 1.666666667 | 0.01388 | 0.03816 |
| 7 | Upper Grayling Jr North | 12/2/2024 | 0.09 | 0.36 | 0.3204 | 1.6 | 0.05732 | 0.05152 |
| 8 | Upper Grayling Jr North | 12/2/2024 | 0.10 | 0.41 | 0.3204 | 1.5 | 0.0356 | 0.04484 |
| 9 | Upper Grayling Jr North | 12/2/2024 | 0.06 | 0.22 | 0.2136 | 1.666666667 | 0.03836 | 0.10196 |
| 10 | Upper Grayling Jr North | 12/2/2024 | 0.21 | 0.82 | 0.8544 | 1.8 | 0 | 0.12008 |
| 11 | Upper Grayling Jr North | 12/2/2024 | 0.01 | 0.05 | 0.1068 | 0 | 0 | 0 |

| IDL = 0.14 mg/m^2 | | | | | Linear Check Maximum = 69.02 mg/m^2 | | | |
|---|---|---|---|---|---|---|---|---|
| EDL = 0.51 mg/m^2 | | | | | **Phaeo Corrected** | | | |
| | | Date | Vial | Chl a | **Chl a** | **664/665** | Chl b | Chl c |
| Daily Vial | Site | Analyzed | Chl a | mg/m2 | **mg/m2** | **Ratio** | mg/m2 | mg/m2 |
| 12 | Upper Grayling Jr South | 12/2/2024 | 0.18 | 0.73 | 0.6408 | 1.6 | 0.03052 | 0.13344 |
| 13 | Upper Grayling Jr South | 12/2/2024 | 0.11 | 0.45 | 0.4272 | 1.666666667 | 0.00324 | 0.13624 |
| 14 | Upper Grayling Jr South | 12/2/2024 | 0.01 | 0.04 | 0.1068 | 0 | 0.05176 | 0.061 |
| 15 | Upper Grayling Jr South | 12/2/2024 | 0.06 | 0.23 | 0.2136 | 1.666666667 | 0 | 0.03428 |
| 16 | Upper Grayling Jr South | 12/2/2024 | 0.04 | 0.18 | 0.2136 | 2 | 0.06008 | 0.10864 |
| 17 | Upper Grayling Jr South | 12/2/2024 | 0.06 | 0.23 | 0.2136 | 1.666666667 | 0 | 0.03428 |
| 18 | Upper Grayling Jr South | 12/2/2024 | 0.03 | 0.14 | 0.3204 | 0 | 0.00832 | 0.04764 |
| 19 | Upper Grayling Jr South | 12/2/2024 | 0.02 | 0.09 | 0.2136 | 0 | 0.03004 | 0.05432 |
| 20 | Upper Grayling Jr South | 12/2/2024 | 0.08 | 0.31 | 0.2136 | 1.4 | 0.07904 | 0.0582 |
| 21 | Upper Grayling Jr South | 12/2/2024 | 0.08 | 0.31 | 0.3204 | 1.75 | 0.07904 | 0.0582 |
| 22 | Volcano | 12/2/2024 | 0.12 | 0.50 | 0.4272 | 1.571428571 | 0.06564 | 0.09916 |
| 23 | Volcano | 12/2/2024 | 0.33 | 1.31 | 1.2816 | 1.705882353 | 0.14748 | 0.09076 |
| 24 | Volcano | 12/2/2024 | 0.11 | 0.45 | 0.4272 | 1.666666667 | 0.08736 | 0.10584 |
| 25 | Volcano | 12/2/2024 | 0.11 | 0.45 | 0.4272 | 1.666666667 | 0.08736 | 0.10584 |
| 26 | Volcano | 12/2/2024 | 0.10 | 0.41 | 0.3204 | 1.5 | 0.02496 | 0.14292 |
| 27 | Volcano | 12/2/2024 | 0.25 | 1.00 | 0.9612 | 1.692307692 | 0 | 0.16104 |
| 28 | Volcano | 12/2/2024 | 0.36 | 1.45 | 1.3884 | 1.684210526 | 0.06104 | 0.26688 |
| 28 | Volcano duplicate | 12/2/2024 | 0.35 | 1.41 | 1.2816 | 1.631578947 | 0.00928 | 0.20588 |
| 29 | Volcano | 12/2/2024 | 0.14 | 0.54 | 0.534 | 1.714285714 | 0.04392 | 0.09248 |
| 30 | Volcano | 12/2/2024 | 0.08 | 0.31 | 0.3204 | 1.75 | 0.15252 | 0.12588 |
| 31 | Volcano | 12/2/2024 | 0.21 | 0.86 | 0.8544 | 1.727272727 | 0.12296 | 0.15068 |
| 32 | WF Ikalukrok | 12/2/2024 | 0.05 | 0.18 | 0.1068 | 1.333333333 | 0 | 0.04096 |
| 33 | WF Ikalukrok | 12/2/2024 | 0.02 | 0.09 | 0.2136 | 0 | 0.03004 | 0.05432 |
| 34 | WF Ikalukrok | 12/2/2024 | 0.12 | 0.50 | 0.534 | 1.833333333 | 0.06564 | 0.09916 |
| 35 | WF Ikalukrok | 12/2/2024 | 0.17 | 0.68 | 0.6408 | 1.666666667 | 0.05224 | 0.14012 |
| 36 | WF Ikalukrok | 12/2/2024 | 0.01 | 0.04 | 0.1068 | 0 | 0.05176 | 0.061 |
| 37 | WF Ikalukrok | 12/2/2024 | 0.10 | 0.41 | 0.3204 | 1.5 | 0.02496 | 0.14292 |
| 38 | WF Ikalukrok | 12/2/2024 | 0.11 | 0.45 | 0.4272 | 1.666666667 | 0.00324 | 0.13624 |
| 39 | WF Ikalukrok | 12/2/2024 | 0.07 | 0.27 | 0.3204 | 2 | 0.01664 | 0.09528 |
| 40 | WF Ikalukrok | 12/2/2024 | 0.10 | 0.41 | 0.4272 | 1.8 | 0.02496 | 0.14292 |
| 41 | WF Ikalukrok | 12/2/2024 | 0.03 | 0.14 | 0.1068 | 1.5 | 0.00832 | 0.04764 |
| 42 | Ikalukrok u/s Noa | 12/2/2024 | 0.10 | 0.41 | 0.4272 | 1.8 | 0.0356 | 0.04484 |
| 43 | Ikalukrok u/s Noa | 12/2/2024 | 0.02 | 0.09 | 0.1068 | 2 | 0.03004 | 0.05432 |
| 44 | Ikalukrok u/s Noa | 12/2/2024 | 0.08 | 0.31 | 0.3204 | 1.75 | 0.07904 | 0.0582 |
| 45 | Ikalukrok u/s Noa | 12/2/2024 | 0.02 | 0.09 | 0.1068 | 2 | 0.03004 | 0.05432 |
| 46 | Ikalukrok u/s Noa | 12/2/2024 | 0.17 | 0.69 | 0.6408 | 1.666666667 | 0 | 0.07244 |
| 47 | Ikalukrok u/s Noa | 12/2/2024 | 0.14 | 0.54 | 0.534 | 1.714285714 | 0.04392 | 0.09248 |
| 48 | Ikalukrok u/s Noa | 12/2/2024 | 0.05 | 0.18 | 0.1068 | 1.333333333 | 0 | 0.04096 |
| 49 | Ikalukrok u/s Noa | 12/2/2024 | 0.02 | 0.09 | 0.2136 | 0 | 0.03004 | 0.05432 |
| 50 | Ikalukrok u/s Noa | 12/2/2024 | 0.07 | 0.27 | 0.3204 | 2 | 0.02728 | 0 |
| 51 | Ikalukrok u/s Noa | 12/2/2024 | 0.13 | 0.50 | 0.4272 | 1.571428571 | 0 | 0.12956 |
| 52 | Upper NFRD South Trib | 12/2/2024 | 0.31 | 1.23 | 1.1748 | 1.6875 | 0.02268 | 0.16492 |
| 53 | Upper NFRD South Trib | 12/2/2024 | 0.39 | 1.55 | 1.602 | 1.789473684 | 0.0176 | 0.25352 |
| 54 | Upper NFRD South Trib | 12/2/2024 | 0.47 | 1.87 | 1.8156 | 1.708333333 | 0 | 0.27444 |
| 55 | Upper NFRD South Trib | 12/2/2024 | 1.02 | 4.07 | 3.9516 | 1.711538462 | 0 | 0.34324 |
| 56 | Upper NFRD South Trib | 12/2/2024 | 0.78 | 3.11 | 2.8836 | 1.658536585 | 0 | 0.37168 |
| 57 | Upper NFRD South Trib | 12/2/2024 | 1.05 | 4.21 | 4.1652 | 1.735849057 | 0 | 0.51936 |
| 58 | Upper NFRD South Trib | 12/2/2024 | 0.67 | 2.69 | 2.5632 | 1.685714286 | 0 | 0.29644 |
| 59 | Upper NFRD South Trib | 12/2/2024 | 1.24 | 4.97 | 4.806 | 1.703125 | 0 | 0.51764 |
| 60 | Upper NFRD South Trib | 12/2/2024 | 2.22 | 8.87 | 8.6508 | 1.716814159 | 0 | 0.9788 |
| 61 | Upper NFRD South Trib | 12/2/2024 | 1.05 | 4.21 | 3.9516 | 1.672727273 | 0 | 0.51936 |

# APPENDIX D. BENTHIC MACROINVERTEBRATES IDENTIFIED IN SAMPLES AND CORRECTED FOR SUBSAMPLING FROM LOCATIONS NEAR THE AKTIGIRUQ-ANARRAAQ EXTENSION PROJECT, 2024.

| Year | Order | Family | Genus | EF Grayling Jr | EF Ik | Grayling Jr | Ik d/s Cub | Ik d/s WF Ik | Ik u/s Noa | Ik u/s WF Ik | Moil |
|---|---|---|---|---|---|---|---|---|---|---|---|
| 2024 | Acari | Acarina | spp | 1 | 13 | 0 | 0 | 1 | 1 | 0 | 1 |
| 2024 | Coleoptera | Staphylinidae | spp | 1 | 0 | 0 | 1 | 0 | 0 | 0 | 0 |
| 2024 | Coleoptera | spp | spp | 0 | 0 | 1 | 0 | 0 | 0 | 0 | 0 |
| 2024 | Collembola | Poduridae | spp | 0 | 3 | 0 | 0 | 0 | 0 | 0 | 0 |
| 2024 | Collembola | Isotomidae | spp | 0 | 0 | 0 | 0 | 0 | 1 | 0 | 0 |
| 2024 | Collembola | Neanuridae | spp | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 1 |
| 2024 | Collembola | Sminthuridae | Sminthurus | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 1 |
| 2024 | Collembola | Entomobryidae | spp | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 2024 | Collembola | spp | spp | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 2024 | Copepoda | Cyclopoida | spp | 0 | 1 | 0 | 1 | 0 | 0 | 0 | 0 |
| 2024 | Copepoda | Harpacticoida | spp | 0 | 6 | 0 | 0 | 0 | 0 | 1 | 0 |
| 2024 | Copepoda | spp | spp | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 2024 | Diptera | Chironomidae | spp | 19 | 1203 | 61 | 96 | 133 | 86 | 98 | 14 |
| 2024 | Diptera | Empididae | Chelifera | 0 | 2 | 0 | 0 | 0 | 0 | 0 | 0 |
| 2024 | Diptera | Empididae | Clinocera | 0 | 1 | 0 | 0 | 0 | 0 | 0 | 0 |
| 2024 | Diptera | Empididae | Heterodromia | 0 | 1 | 0 | 0 | 0 | 0 | 0 | 0 |
| 2024 | Diptera | Empididae | spp | 0 | 3 | 0 | 0 | 0 | 0 | 0 | 0 |
| 2024 | Diptera | Pediciidae | Dicranota | 0 | 1 | 0 | 0 | 0 | 0 | 0 | 0 |
| 2024 | Diptera | Simuliidae | spp | 0 | 119 | 2 | 1 | 1 | 1 | 7 | 0 |
| 2024 | Diptera | Tipulidae | Tipula | 0 | 1 | 1 | 0 | 0 | 0 | 0 | 0 |
| 2024 | Diptera | spp | spp | 0 | 1 | 0 | 0 | 2 | 0 | 0 | 0 |
| 2024 | Diptera | Simuliidae | Simulium | 0 | 0 | 0 | 0 | 1 | 0 | 0 | 0 |
| 2024 | Diptera | Ephydrididae | spp | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 2024 | Diptera | Muscidae | spp | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 2024 | Ephemeroptera | Heptageniidae | Cinygmula | 9 | 171 | 4 | 8 | 10 | 15 | 3 | 0 |
| 2024 | Ephemeroptera | Baetidae | Baetis | 0 | 15 | 0 | 0 | 0 | 0 | 0 | 0 |
| 2024 | Ephemeroptera | Baetidae | spp | 0 | 35 | 0 | 0 | 2 | 3 | 0 | 0 |
| 2024 | Ephemeroptera | Heptageniidae | Epeorus | 0 | 15 | 0 | 0 | 0 | 3 | 2 | 0 |
| 2024 | Ephemeroptera | Heptageniidae | spp | 0 | 1 | 0 | 0 | 0 | 0 | 0 | 0 |
| 2024 | Ephemeroptera | spp | spp | 0 | 30 | 0 | 0 | 0 | 0 | 1 | 0 |
| 2024 | Ephemeroptera | Ameletidae | Ameletus | 0 | 0 | 1 | 0 | 0 | 0 | 0 | 0 |
| 2024 | Ephemeroptera | Ephemerellidae | spp | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 2024 | Hymenoptera:Symphyta | spp | spp | 0 | 0 | 0 | 1 | 1 | 0 | 0 | 3 |
| 2024 | Nematoda | spp | spp | 0 | 8 | 0 | 0 | 0 | 0 | 0 | 0 |
| 2024 | Oligochaeta | spp | spp | 0 | 534 | 0 | 0 | 1 | 1 | 0 | 0 |
| 2024 | Ostracoda | spp | spp | 0 | 20 | 0 | 0 | 0 | 2 | 0 | 0 |
| 2024 | Platyhelminthes | spp | spp | 0 | 26 | 0 | 0 | 0 | 0 | 0 | 0 |
| 2024 | Plecoptera | Capniidae | spp | 1 | 190 | 1 | 3 | 0 | 2 | 0 | 1 |
| 2024 | Plecoptera | Nemouridae | Ostrocerca | 1 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 2024 | Plecoptera | Nemouridae | spp | 1 | 3 | 0 | 0 | 2 | 0 | 0 | 0 |
| 2024 | Plecoptera | Perlodidae | spp | 1 | 0 | 0 | 0 | 0 | 2 | 0 | 0 |
| 2024 | Plecoptera | spp | spp | 3 | 29 | 1 | 0 | 1 | 0 | 0 | 0 |
| 2024 | Plecoptera | Capniidae | Capnia | 0 | 92 | 0 | 0 | 0 | 1 | 0 | 0 |
| 2024 | Plecoptera | Chloroperlidae | Suwallia | 0 | 2 | 0 | 0 | 0 | 0 | 0 | 0 |
| 2024 | Plecoptera | Nemouridae | Podmosta | 0 | 5 | 4 | 0 | 0 | 0 | 2 | 0 |
| 2024 | Plecoptera | Perlodidae | Isoperla | 0 | 2 | 0 | 0 | 0 | 0 | 0 | 0 |
| 2024 | Plecoptera | Perlodidae | Perlomyia | 0 | 0 | 0 | 0 | 1 | 0 | 0 | 0 |
| 2024 | Plecoptera | Chloroperlidae | spp | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 2024 | Plecoptera | Nemouridae | Zapada | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 2024 | Plecoptera | Chloroperlidae | Haploperla | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 2024 | Trichoptera | spp | spp | 0 | 0 | 0 | 0 | 1 | 0 | 0 | 0 |
| 2024 | Trichoptera | Limnephilidae | spp | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |

| Year | Order | Family | Genus | NF Grayling Jr | Noa | Upr Competition | Upr NFRD N Trib | Upr NFRD S Trib | Volcano | WF Ik |
|---|---|---|---|---|---|---|---|---|---|---|
| 2024 | Acari | Acarina | spp | 0 | 0 | 1 | 484 | 7 | 0 | 1 |
| 2024 | Coleoptera | Staphylinidae | spp | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 2024 | Coleoptera | spp | spp | 0 | 0 | 0 | 1 | 0 | 0 | 0 |
| 2024 | Collembola | Poduridae | spp | 0 | 0 | 0 | 0 | 0 | 1 | 0 |
| 2024 | Collembola | Isotomidae | spp | 0 | 0 | 2 | 0 | 0 | 0 | 1 |
| 2024 | Collembola | Neanuridae | spp | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 2024 | Collembola | Sminthuridae | Sminthurus | 0 | 0 | 0 | 1 | 0 | 0 | 1 |
| 2024 | Collembola | Entomobryidae | spp | 1 | 0 | 0 | 0 | 0 | 0 | 0 |
| 2024 | Collembola | spp | spp | 2 | 0 | 0 | 1 | 0 | 0 | 5 |
| 2024 | Copepoda | Cyclopoida | spp | 0 | 0 | 0 | 21 | 2 | 0 | 0 |
| 2024 | Copepoda | Harpacticoida | spp | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 2024 | Copepoda | spp | spp | 1 | 0 | 0 | 0 | 4 | 0 | 0 |
| 2024 | Diptera | Chironomidae | spp | 43 | 5 | 3 | 16210 | 2506 | 338 | 9 |
| 2024 | Diptera | Empididae | Chelifera | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 2024 | Diptera | Empididae | Clinocera | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 2024 | Diptera | Empididae | Heterodromia | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 2024 | Diptera | Empididae | spp | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 2024 | Diptera | Pediciidae | Dicranota | 0 | 0 | 0 | 15 | 6 | 0 | 0 |
| 2024 | Diptera | Simuliidae | spp | 10 | 2 | 0 | 18 | 35 | 2 | 0 |
| 2024 | Diptera | Tipulidae | Tipula | 1 | 0 | 0 | 0 | 0 | 0 | 0 |
| 2024 | Diptera | spp | spp | 0 | 0 | 0 | 10 | 0 | 2 | 0 |
| 2024 | Diptera | Simuliidae | Simulium | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 2024 | Diptera | Ephydrididae | spp | 0 | 0 | 0 | 0 | 1 | 0 | 0 |
| 2024 | Diptera | Muscidae | spp | 0 | 0 | 0 | 0 | 1 | 0 | 0 |
| 2024 | Ephemeroptera | Heptageniidae | Cinygmula | 0 | 0 | 0 | 70 | 176 | 0 | 0 |
| 2024 | Ephemeroptera | Baetidae | Baetis | 0 | 0 | 0 | 0 | 1 | 0 | 0 |
| 2024 | Ephemeroptera | Baetidae | spp | 0 | 0 | 0 | 90 | 19 | 0 | 0 |
| 2024 | Ephemeroptera | Heptageniidae | Epeorus | 0 | 0 | 0 | 2 | 13 | 0 | 0 |
| 2024 | Ephemeroptera | Heptageniidae | spp | 0 | 0 | 0 | 0 | 1 | 0 | 0 |
| 2024 | Ephemeroptera | spp | spp | 0 | 0 | 0 | 18 | 2 | 0 | 0 |
| 2024 | Ephemeroptera | Ameletidae | Ameletus | 0 | 0 | 0 | 34 | 10 | 1 | 0 |
| 2024 | Ephemeroptera | Ephemerellidae | spp | 0 | 0 | 0 | 9 | 0 | 0 | 0 |
| 2024 | Hymenoptera:Symphyta | spp | spp | 0 | 2 | 0 | 6 | 0 | 0 | 2 |
| 2024 | Nematoda | spp | spp | 0 | 0 | 0 | 21 | 1 | 0 | 0 |
| 2024 | Oligochaeta | spp | spp | 1 | 0 | 0 | 375 | 135 | 0 | 0 |
| 2024 | Ostracoda | spp | spp | 0 | 0 | 0 | 1156 | 0 | 0 | 0 |
| 2024 | Platyhelminthes | spp | spp | 1 | 0 | 0 | 24 | 5 | 4 | 0 |
| 2024 | Plecoptera | Capniidae | spp | 0 | 0 | 0 | 79 | 126 | 5 | 0 |
| 2024 | Plecoptera | Nemouridae | Ostrocerca | 0 | 0 | 0 | 63 | 11 | 7 | 0 |
| 2024 | Plecoptera | Nemouridae | spp | 1 | 0 | 0 | 1 | 3 | 2 | 0 |
| 2024 | Plecoptera | Perlodidae | spp | 0 | 0 | 0 | 12 | 0 | 0 | 0 |
| 2024 | Plecoptera | spp | spp | 0 | 0 | 0 | 49 | 2 | 0 | 0 |
| 2024 | Plecoptera | Capniidae | Capnia | 0 | 0 | 0 | 8 | 40 | 22 | 0 |
| 2024 | Plecoptera | Chloroperlidae | Suwallia | 0 | 0 | 0 | 0 | 3 | 0 | 0 |
| 2024 | Plecoptera | Nemouridae | Podmosta | 0 | 0 | 0 | 68 | 44 | 0 | 0 |
| 2024 | Plecoptera | Perlodidae | Isoperla | 0 | 0 | 0 | 0 | 9 | 0 | 0 |
| 2024 | Plecoptera | Perlodidae | Perlomyia | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 2024 | Plecoptera | Chloroperlidae | spp | 0 | 0 | 0 | 1 | 0 | 0 | 0 |
| 2024 | Plecoptera | Nemouridae | Zapada | 0 | 0 | 0 | 34 | 0 | 0 | 0 |
| 2024 | Plecoptera | Chloroperlidae | Haploperla | 0 | 0 | 0 | 0 | 1 | 0 | 0 |
| 2024 | Trichoptera | spp | spp | 0 | 0 | 0 | 3 | 0 | 0 | 0 |
| 2024 | Trichoptera | Limnephilidae | spp | 0 | 0 | 0 | 1 | 0 | 0 | 0 |