



Baffinland Iron Mines Corporation Mary River Project

2024 KP85 Lake Baseline Survey: Water Quality, Benthic Invertebrates,
and Fish

REPORT

Prepared for Baffinland Iron Mines Corporation
By North/South Consultants Inc. • 83 Scurfield Blvd. • Winnipeg, MB • R3Y 1G4

**BAFFINLAND IRON MINES CORPORATION
MARY RIVER PROJECT**

**2024 KP85 LAKE BASELINE SURVEY:
WATER QUALITY, BENTHIC INVERTEBRATES, AND FISH**

Prepared for:

Baffinland Iron Mines Corporation

Prepared by:

North/South Consultants Inc.

March 2025



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EXECUTIVE SUMMARY

The Mary River Project is an operating iron ore mine located in the Qikiqtani Region of Nunavut. Baffinland Iron Mines Corporation (Baffinland; the Proponent) is the owner and operator of the Project. As part of the regulatory approval process, Baffinland submitted a Final Environmental Impact Statement (FEIS) to the Nunavut Impact Review Board (NIRB), which presented in-depth analyses and evaluation of potential environmental and socioeconomic effects associated with the Project (Baffinland 2012). In 2012, Baffinland received approval for the Mary River Project, which involves a 149-km long railway connecting the Mary River Mine to a year-round port in Steensby Inlet, through the issuance of Project Certificate No. 005 (NIRB 2012).

An application for a *Fisheries Act* Authorization (FAA) for the construction of the Steensby Rail and Port was submitted to Fisheries and Oceans Canada on February 1, 2024 (Knight Piésold Ltd. 2024). The proposed offsetting plan described in the FAA application entails the introduction of Arctic Char (*Salvelinus alpinus*) to a lake (KP85 Lake) located in the upper northwestern drainage of the Cockburn River system. Arctic Char are absent from the upper drainage and cannot access the area from Cockburn Lake due to a series of impassable falls. Ninespine Stickleback are present in the upper drainage including KP85 Lake. The offsetting plan was updated in early 2025 and the option for the introduction of Arctic Char to KP85 Lake is now identified as a contingency option (North/South Consultants Inc. [NSC] 2025a).

A baseline field survey was undertaken at KP85 Lake in July 2024 in support of the proposed Offsetting Plan presented in the FAA application. The baseline field program included the following:

- a bathymetry and substrate survey;
- water quality sampling;
- benthic invertebrate community sampling; and
- a survey of Ninespine Stickleback.

The objectives of the field program were to:

- characterize the bathymetry and substrate composition in the lake;
- describe water quality conditions in the lake during the open-water season (sampling was conducted previously in the ice-cover season in May/June 2024);
- collect information on the abundance and composition of the benthic invertebrate community in the lake; and
- collect information on the Ninespine Stickleback population in the lake.

The results of the bathymetry and substrate survey are presented in NSC (2025b). The methods and results of the water quality, benthic invertebrate, and fish surveys are presented in this report.

Surface and bottom water quality samples were collected and *in situ* depth profiles of dissolved oxygen (DO), pH, specific conductance, turbidity, and temperature were measured at two sites in KP85 Lake in late July 2024. KP85 Lake was thermally stratified (depth of the thermocline was approximately 9-11 m) but the lake was well-oxygenated across depth and all measurements of DO were above Canadian Council of Ministers of the Environment (CCME) guidelines for the protection of aquatic life (PAL). The lake was also characterized by relatively low pH and specific conductance and high clarity (i.e., low turbidity and a mean Secchi disk depth of 5.25 m). DO, specific conductance, and pH decreased somewhat across water depth in the lake.

KP85 Lake is nutrient poor (ultra-oligotrophic based on TP and oligotrophic based on TN and chlorophyll *a*), extremely soft (hardness <2 mg/L), slightly acidic (pH <7), and clear (turbidity <1 NTU). Only one water quality parameter exceeded CCME PAL guidelines; pH (laboratory and field) was below the CCME guideline range of 6.5-9.0 at both sites across the entirety, or part of, the water column.

Five benthic invertebrate samples, each consisting of three composited sub-samples, were collected using an Ekman grab sampler from each of two habitat types: water depth 2-10 m (SHALL); and water depth >10 m (DEEP). Samples were sieved through a 500 µm mesh, preserved in 10% formalin, and submitted for laboratory analysis to ZEAS Incorporated (Nobleton, ON). Ten sediment samples were collected for analysis of supporting parameters (i.e., total organic carbon [TOC] and particle size) and submitted to ALS Laboratories (Waterloo, ON).

Mean benthic invertebrate density was 2,790 per m² and 6,256 per m² in the deep and shallow habitat, respectively. Mean taxonomic richness was 9 and 10 taxa in the deep and shallow habitat, respectively. The benthic invertebrate community was dominated by Chironomidae (relative abundance of 91% in the deep habitat and 77% in the shallow habitat). Sediment composition was relatively similar across sites within each habitat type, although the deeper habitat contained a greater proportion of finer sediments and TOC.

Backpack electrofishing was conducted in the nearshore area of KP85 Lake along its perimeter and in five tributary streams (from the mouths to 100 m upstream) in July. Ten minnow traps were also deployed in KP85 Lake (overnight sets) in shallow (2-3 m) and deep (>10 m) habitat. A total of 134 Ninespine Stickleback were captured (an additional 20 fish were observed but not captured during electrofishing) from KP85 Lake and five of its tributaries.

Mean±standard deviation (SD) catch-per-unit-effort (CPUE) was 0.337±0.725 fish/60 seconds for all electrofishing passes in KP85 Lake and 1.391±0.866 fish/60 seconds for the tributaries (Tables 12 and 13). Electrofishing CPUE ranged from 0 to 3.238 fish/60 seconds in the lake survey and 0 to 2.500 fish/60 seconds in the tributary survey.

Forty-six Ninespine Stickleback were captured in minnow traps deployed in KP85 Lake with a mean±SD CPUE of 0.214±0.282 fish/hour. Only one fish was captured in the three minnow traps deployed in deep (>10 m) habitat versus a total of 45 fish captured in the seven traps deployed in shallow (2-3 m) habitat, though fishing effort was not equal between the two habitats.

Fork length ranged from 20-78 mm (mean±SD = 56.6±1.29 mm), weights ranged from 0.1-3.2 g (mean±SD = 1.48±0.08 g), and condition factor ranged from 0.463-1.250 (mean±SD = 0.744±0.015) for the total of 88 Ninespine Stickleback captured in the lake and tributary electrofishing survey. Of the 50 fish captured that were aged, the ages ranged from 0-5 years.

Examination of stickleback stomach contents indicated the presence of thirteen prey taxa. Copepoda was the most diverse group observed in char stomachs, comprising eight of the thirteen total prey types. Chironomidae (mostly in the pupal stage) was the dominant prey taxon, with a frequency of occurrence of 80.0%, a relative frequency of 83.3%, and a relative percentage of biomass of 94.5%.

One parasite species, *Schistocephalus pungitii*, was recovered in 34% of the 50 stickleback examined in the laboratory. This is a large tapeworm parasite that occupies the body cavity of sticklebacks and matures in the intestine of fish-eating birds. There are no records of this parasite infecting Arctic Char.

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ABBREVIATIONS AND ACRONYMS

CALA	Canadian Association for Laboratory Accreditation Inc.
CCME	Canadian Council for Ministers of the Environment
CoA(s)	Certificates of Analysis
CPUE	Catch-per-unit-effort
DELTs	Deformities, erosion, lesions and tumours
DFO	Fisheries and Oceans Canada
DL	Detection limit
DO	Dissolved oxygen
FAA	<i>Fisheries Act</i> Authorization
FEIS	Final Environmental Impact Statement
GPS	Global Positioning System
ITIS	Integrated Taxonomic Information System
K	Condition factor
NIRB	Nunavut Impact Review Board
NSC	North/South Consultants Inc.
OECD	Organization for Economic Cooperation and Development
PAL	Protection of aquatic life
QA/QC	Quality assurance/quality control
RPMD	Relative percent mean difference
TMS	Tricaine Methanesulfonate
TN	Total nitrogen
TOC	Total organic carbon
TP	Total phosphorus
UTM	Universal Transverse Mercator

1.0 INTRODUCTION

The Mary River Project is an operating iron ore mine located in the Qikiqtani Region of Nunavut. Baffinland Iron Mines Corporation (Baffinland; the Proponent) is the owner and operator of the Project. As part of the regulatory approval process, Baffinland submitted a Final Environmental Impact Statement (FEIS) to the Nunavut Impact Review Board (NIRB), which presented in-depth analyses and evaluation of potential environmental and socioeconomic effects associated with the Project (Baffinland 2012). In 2012, Baffinland received approval for the Mary River Project, which involves a 149-km long railway connecting the Mary River Mine to a year-round port in Steensby Inlet, through the issuance of Project Certificate No. 005 (NIRB 2012).

An application for a *Fisheries Act* Authorization (FAA) for the construction of the Steensby Rail and Port was submitted to Fisheries and Oceans Canada (DFO) on February 1, 2024 (Knight Piésold Ltd. 2024). The proposed Offsetting Plan described in the FAA application entails the introduction of Arctic Char (*Salvelinus alpinus*) to a lake (KP85 Lake) located in the upper northwestern drainage of the Cockburn River system (Figure 1). A notable feature of the entire sub-catchment that is drained by the northwest branch of the Cockburn River is the near total absence of lakes that could support overwintering and spawning for Arctic Char, and access from Cockburn Lake is precluded by several cataracts and high waterfalls located approximately 3.5 km north of the lake's north basin. Arctic Char are absent from, but Ninespine Stickleback (*Pungitius pungitius*) are present in the upper drainage including an unnamed lake located at approximately KP 85 of the Steensby Rail alignment referred to as "KP85 Lake". The offsetting plan was updated in early 2025 and the option for the introduction of Arctic Char to KP85 Lake is now identified as a contingency option (North/South Consultants Inc. [NSC] 2025a).

A baseline field survey was undertaken at KP85 Lake in July 2024 in support of the proposed Offsetting Plan presented in the FAA application. The baseline field program included the following:

- a bathymetry and substrate survey;
- water quality sampling;
- benthic invertebrate community sampling; and
- a survey of Ninespine Stickleback.

The objectives of the field program were to:

- characterize the bathymetry and substrate composition in the lake;
- describe water quality conditions in the lake during the open-water season (sampling was conducted previously in the ice-cover season in May/June 2024);
- collect information on the abundance and composition of the benthic invertebrate community in the lake; and
- collect information on the Ninespine Stickleback population in the lake.

The results of the bathymetry and substrate survey are presented in NSC (2025b). The methods and results of the water quality, benthic invertebrate, and fish surveys are presented in this report.

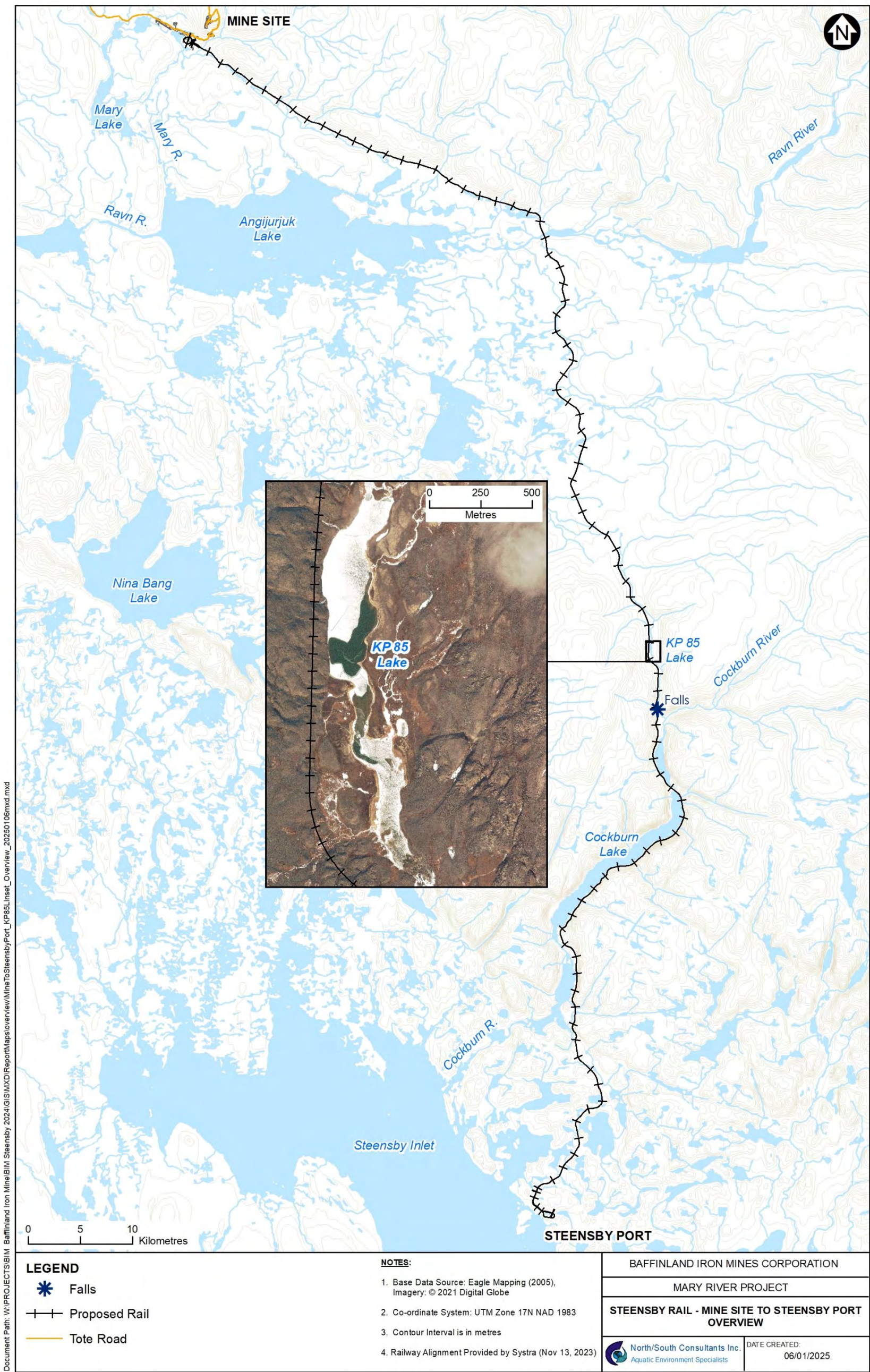


Figure 1. Location of KP85 Lake.

2.0 METHODS

The field program at KP85 Lake was conducted from July 19 to 23, 2024. A description of field, laboratory, and data analysis methods is provided below.

2.1 WATER QUALITY

2.1.1 Field Methods

Water quality was sampled at two locations in KP85 Lake (Figure 2). These sites were consistent with the sites sampled in May/June 2024. Sampling included measurement of *in situ* depth profiles and collection of samples for laboratory analysis.

In situ parameters (pH, temperature, specific conductance, dissolved oxygen [DO], and turbidity) were recorded using a YSI ProDSS Water Quality multi-probe near the water surface (i.e., 0.3 m) and at 1-m depth intervals.

Secchi disk depth was measured as the average of two measurements: the depth at which the Secchi disk when lowered into the water was no longer visible; and the depth at which the disk re-appeared when raised from the water column. Water depth was measured using a Hawkeye Depthtrax 1H depth sounder.

At each location a near surface and near bottom water sample was collected with a Kemmerer water sampling device. The Kemmerer water sampler was rinsed with water from the site prior to sampling and was pre-cleaned prior to initiation of sampling. With the exception of samples for dissolved metals analysis, upon retrieval of the Kemmerer sampler from the desired sampling depth, sample bottles provided by the analytical laboratory were directly filled and preservatives added as directed by the analytical laboratory. Samples for dissolved metals were filtered in the field at the time of sample collection using an Acrodisc® 32 mm Syringe with a 0.45 µm Supor® membrane filter and the sample was preserved. Samples were kept cool and in the dark and shipped for analysis to ALS Laboratories (Waterloo, ON).

Field quality assurance/quality control (QA/QC) procedures included standard precautions to avoid sample contamination (e.g., clean nitrile gloves were worn during sample collection and handling), use of sampling protocols, inclusion of QA/QC samples (one duplicate sample and one trip blank), and daily calibration and verification of the water quality sonde.

2.1.2 Laboratory Methods

Water quality samples were submitted to an analytical laboratory accredited under the Canadian Association for Laboratory Accreditation Inc. (CALA; ALS Laboratories, Waterloo, ON) within the specified laboratory holding times. Samples were analysed for anions, nutrients, physical parameters, total and dissolved metals, chlorophyll *a* and total phenols. Laboratory analytical methods and reported detection limits (DL) are provided in the Certificates of Analysis (CoAs) provided by the analytical laboratory (Appendix 1).

2.1.3 Data Analysis

Prior to analysis, data were evaluated qualitatively for potential outliers and transcription or analytical errors. Relative percent mean difference (RPMD) was calculated for duplicate samples as follows:

$$\text{RPMD} = (\text{Value 1} - \text{Value 2}) / ((\text{Value 1} + \text{Value 2}) / 2) \times 100.$$

Where one or more of the measurements being compared was less than five times the analytical DL, an analysis of precision was not undertaken. Precision of the duplicate samples was evaluated using the criteria of 30% RPMD.

Trip blank results were reviewed to identify potential sample contamination issues; values that exceeded five times the DL were considered indicative of potential contamination.

Water quality data were compared to the Canadian Council for Ministers of the Environment (CCME) guidelines for the protection of freshwater aquatic life (PAL; CCME 1999; updated to 2025). Site-specific guidelines were calculated using supporting parameter measurements for each sample (e.g., water hardness for cadmium). Water hardness was outside the limits of application of the CCME PAL guideline for zinc in all samples (i.e., water hardness <23.4 mg/L). In addition, calculated site-specific PAL guidelines for ammonia for all but one sample (KP85-Lake-1-S) should be viewed with caution as the pH was less than 6.

Trophic status of KP85 Lake was classified utilizing:

- the CCME Canadian phosphorus guidance framework for the management of freshwater systems (CCME 1999; updated to 2025) and the trophic state categorization scheme based on total phosphorus (TP);
- the Organization for Economic Cooperation and Development (OECD 1982) categorization scheme based on chlorophyll *a*; and
- the categorization scheme for total nitrogen (TN) presented by Nürnberg (1996).



Figure 2. Water quality sampling locations.

2.2 BENTHIC INVERTEBRATES

2.2.1 Field Methods

Ten benthic invertebrate samples were collected using a stainless-steel tall Ekman grab sampler (152 x 152 mm, 0.023 m² sampling area) from a boat on July 20 and 21, 2024. Sampling locations were based on field verification of the substrate within two sampling areas delineated by water depth: DEEP >10 m; and SHALLOW 2-10 m (Figure 3). Both sampling areas were large enough to accommodate five replicate stations (R1 to R5) separated by a distance of at least 20 meters. Three sub-samples (single grab) were randomly collected from different sides of the anchored boat at each replicate station. Sub-samples were combined and sieved in a 500 µm mesh rinsing bucket to yield one composite replicate sample per station. Samples were transferred into labelled plastic sample jars, preserved in 10% formalin, and stored in Styrofoam coolers until submission to the analytical laboratory.

Ten sediment samples were also collected using a tall Ekman grab sampler (i.e., one grab from each replicate station) for analysis of supporting parameters (i.e., total organic carbon [TOC] and particle size). The sediment horizon (i.e., top 5-15 cm, at minimum) was sub-sampled using a stainless steel ladle and transferred into labelled plastic sample bags. Samples were placed in a Styrofoam cooler and stored under refrigeration until submission to the analytical laboratory.

Replicate station location data were recorded using a handheld Global Positioning System (GPS) unit. Water depth was measured for each benthic grab with a Depthtrax Hawkeye 1H handheld depth sounder. Descriptions of other supporting habitat attributes (i.e., riparian, algae, and substrates) were recorded and/or photographed at each replicate station.

Field QA/QC procedures included: use of sampling protocols and field data sheets; precautions to avoid sample contamination (i.e., thorough rinse of equipment between locations); reviewing data to avoid recording errors (e.g., re-checking sample labels, ensuring data sheet fields are complete); and the inclusion of one duplicate sediment sample [KP85-DEEP-R1]).

2.2.2 Laboratory Methods

2.2.2.1 Benthic Invertebrate Enumeration and Taxonomic Identification

Benthic invertebrate samples were processed and analyzed by ZEAS Incorporated (Nobleton, ON). Samples were rinsed through a 500 µm sieve and stained with a protein dye to improve sorting recovery. Samples were then sorted using a stereomicroscope under 7 to 10 times magnification.

Samples containing inorganic substrates were elutriated to separate the invertebrates from heavier sample material. The remaining inorganic material was closely inspected to remove heavy-bodied invertebrates (e.g., molluscs, caddisflies in cases). The floating (organic) sample portion was washed through a two stacked sieve (sizes 3.36 mm and 500 µm) and sorted separately to effectively remove invertebrates under a consistent magnification.

Benthic macroinvertebrates were enumerated (heads only) and sorted into major taxonomic groups (Order and Family) into labelled glass bottles and preserved with 80% ethanol for detailed analysis by a senior taxonomist.

Sub-sampling

Samples with large amounts of organic matter or high invertebrate densities were sub-sampled. Sub-sampling only applied to the organic portion retained in the 500 µm sieve. The portion of the sample retained in the 3.36 mm sieve and the dense inorganic sample portion were both sorted entirely for detailed identification.

Sub-sampling was conducted using the “pie method” where the surface area of the sample material was divided into the desired number of sub-samples based on a required minimum sorting time of approximately 4 hours. One or more pie sections were completely sorted for detailed identification.

Detailed Taxonomic Analysis

Sorted benthic macroinvertebrates were identified to genus or lowest practical level and based on the most recent publications and collection of taxonomic keys. Chironomids and oligochaetes were mounted on glass slides in a clearing media prior to identification using a compound microscope with up to 1,000 times magnification. Some chironomid taxa were identified and enumerated using a dissecting microscope (e.g., *Cryptochironomus*, *Chironomus*, and *Procladius*). The remaining chironomids were sorted into subfamilies and tribes, then further organized into groups according to similar characteristics (e.g., similar color, structure, and shapes). A minimum of 20% of individuals representing each group were slide mounted and identified to genus. Oligochaetes were analyzed following a similar procedure. Taxonomic nomenclature was checked against current taxonomic standards in the Integrated Taxonomic Information System (ITIS) online database.

Quality Assurance/Quality Control

Sorting efficiency was assessed by re-sorting two invertebrate samples completed by a second laboratory technician (KP85-DP-R5 and KP85-SH-R3). Invertebrates found during the second sorting were combined with the original sample but counted separately. Sorting efficiency was calculated by comparing the initial organism count to the count in the sorting audit to ensure that at least 90% of the invertebrates were recovered from the sample material.

Sub-sampling accuracy audits were conducted on two invertebrate samples by sorting two eighths of sample KP85-SH-R1 and four quarters of sample KP85-SH-R4. Sub-sampling error was determined by comparing the estimated counts from the sorted fraction to the actual counts from the whole sample (accuracy) and by comparing the estimated counts among sorted fractions (precision) to ensure less than 20% error where possible.

2.2.2.2 Supporting Sediment Parameters

Sediment samples were submitted to ALS Laboratories (Waterloo, ON) for analysis of particle size (percent sand, silt, and clay) and TOC. One duplicate sediment sample (KP85-DP-R1) was submitted for analysis. Laboratory analytical methods and reported DLs are presented in the CoA reports provided by the analytical laboratory (Appendix 2).

2.2.3 Data Analysis

Following benthic invertebrate taxonomic analysis, counts were corrected for sub-sampling to represent total number of taxa in a whole sample. Whole sample counts are presented as raw counts, density, and presence/absence. Invertebrate density (number of organisms per m²) was calculated using the raw count, area of the benthic sampler (0.023104 m²), and the number of grabs per sample (three).

$$\text{Density (no. per m}^2\text{)} = (\text{raw count} / 0.023104) / 3$$

Total benthic invertebrate density, taxonomic richness (to genus-level), relative composition of major groups, and the dominant taxa were presented for each sampling area with descriptions of supporting sediment composition, texture, and TOC. Summary statistics (mean, median, standard deviation [SD], standard error [SE], minimum (min), maximum (max), and sample size [n]) were calculated for benthic invertebrate metrics and supporting sediment parameters for each habitat.



Figure 3. Benthic invertebrate sampling locations.

2.3 NINESPINE STICKLEBACK

2.3.1 Field Methods

Fishing was undertaken in KP85 Lake via backpack electrofishing and minnow traps. Electrofishing was also conducted in five tributaries to KP85 Lake.

2.3.1.1 *Electrofishing*

Electrofishing was conducted using a Smith-Root Model LR-24 electrofisher, set to a voltage between 900 and 990 V and 30 Hz in the nearshore area of KP85 Lake and in five tributaries to the lake.

KP85 Lake

Nearshore electrofishing was conducted around the perimeter (5.3 km) of KP85 Lake along 100 m transects; transects were separated by 50 m reaches to minimize recaptures. Each electrofishing transect was fished for a minimum of 300 seconds. Start and end points were photographed and universal transverse mercator (UTMs) coordinates were recorded for each transect.

Tributaries

Electrofishing was also conducted at five tributaries to KP85 Lake along approximately 100 m reaches beginning at the stream mouths and moving upstream. Photographs were taken and UTM coordinates recorded at three transects within the 100 m reach at each tributary as follows: the stream mouth; 50 m upstream; and 100 m upstream. Stream morphology, substrate/habitat, and temperature were also recorded at each transect.

2.3.1.2 *Minnow Traps*

Ten minnow traps baited with bread were deployed (overnight sets) in two habitats within the lake: 2-3 m; and >10 m water depths. Traps were deployed near the bottom of the water column.

2.3.1.3 *Fish Processing*

All captured fish were enumerated and measured for fork length (± 1 mm) in the field using digital calipers. Stickleback captured via electrofishing were weighed (± 0.1 g) in the field using a OHAUS SPX2201 digital scale. Fish were examined for external condition including parasites and deformities, erosion, lesions and tumours (DELTs).

Fifty fish captured via electrofishing were retained for detailed laboratory analyses (i.e., placed in individually labelled whirlpaks and frozen), including:

- age determination;
- stomach content analysis;
- presence of internal parasites; and
- sex and maturity determination.

Retained fish were euthanized in accordance with the methods identified in the Ontario, Prairie and Arctic Animal Care Committee Animal Use Protocol Number OPA-ACC-2024-58. In brief, fish were euthanized in a Tricaine Methanesulfonate (TMS) solution (300 mg/L TMS) buffered with sodium bicarbonate (600 mg/L)

followed by cervical dislocation or decapitation. All other fish were released to the location of capture (i.e., KP85 Lake or a tributary stream).

2.3.2 Laboratory Methods

Laboratory analyses of Ninespine Stickleback were conducted at the NSC Laboratory (Winnipeg, MB).

2.3.2.1 Fish Processing

Fish retained for detailed laboratory analysis were measured for total length using digital calipers (± 0.01 mm) and weighed using a Mettler Toledo PM480 DeltaRange digital scale (± 0.001 g). Fish were examined externally for signs of physical abnormalities or disease and parasites. A ventral incision was then made to expose the body cavity and sex and state of maturity was determined based on examination of the gonads. Stomachs were removed and placed in an individually labelled sample bags and frozen until analysed for stomach contents. Otoliths were removed for age determination from each fish.

2.3.2.2 Ageing

Otoliths from Ninespine Stickleback were set whole on a labelled microscope slide with Cytoseal-60™. Otoliths were then viewed under a Leica DM 1000 compound microscope with transmitted or reflected light to optimize annuli visibility.

All ageing structures were read once by an experienced ageing technician. Nearly half (44%) percent of the samples were analysed by a second ageing technician to verify precision of measurements as part of the QA/QC program.

2.3.2.3 Stomach Content Analysis

Stomachs were partially thawed in a petri dish prior to processing. Total stomach weight (± 0.001 g) was recorded for all samples and the stomach was then cut open and contents were removed by gentle scraping into a glass petri dish and examined under magnification. All contents were sorted to the lowest taxonomic groups possible given their state of digestion, enumerated, weighed (± 0.001 g), placed in labeled Whirlpak bags, and refrozen. Taxonomic identification of contents was conducted using current keys and materials and the internal NSC photo library.

The stomach lumen, internal lining, and exterior surface were also inspected for parasites (free or attached) and embedded cysts. All parasites were sorted, identified to the lowest taxonomic level possible using relevant keys, and enumerated. Subsamples of parasites were preserved in 70% ethanol.

2.3.3 Data Analysis

Catches were tabulated by electrofishing pass or minnow trap. For fish captured by electrofishing, catch-per-unit-effort (CPUE) was expressed as the number of fish captured per minute. Fish that were observed but not captured during electrofishing passes were included in the CPUE calculations. CPUE for minnow traps was calculated as the number of fish captured/hour in each trap.

Condition factor (K) was calculated (after Fulton 1911 in Ricker 1975) for individual fish using the following equation:

$$K = W \times 10^5 / L^3$$

where: W = round weight (g); and
 L = fork length (mm).

Length-weight, age-length, and age-weight relationships were assessed using regression analysis on logarithmic transformations of fork length and round weights.

Length-frequency distributions were generated using length intervals of 5 mm. Data were analysed separately by each gear type. Age frequency distributions were plotted based on fish captured in the nearshore of the lake and lower reaches of the tributaries combined.

The ageing QA/QC results (i.e., readings of the same structure by two ageing technicians) were compared using RPMD calculated as described in Section 2.1.3.

Fish stomach content analysis results were presented as the frequency of occurrence (percentage of stomachs with each prey taxon), relative frequency (percentage of each prey taxon relative to the total number of prey items), and relative percentage of biomass (percentage of each taxon's wet weight relative to the total wet weight of all diet items) of diet items. Prevalence (% of stomachs with parasites) and mean intensity (number of parasites per infected stomach) were calculated for each parasite species.



Figure 4. Locations of backpack electrofishing in KP85 Lake and tributaries.



Figure 5. Locations of minnow traps in KP85 Lake.

3.0 RESULTS

3.1 WATER QUALITY

KP85 Lake was thermally stratified when sampling was conducted in July 2024. The depth of the thermocline (defined as $\geq 1^{\circ}\text{C}$ temperature change across 1 m of water depth) was approximately 9-11 m on both sampling days (July 19 and 22, 2024; Figure 6; Appendix 3). A secondary, shallower thermocline occurred at a depth of 4-5 m on July 19, 2024.

In situ water quality measurements indicate that the lake was well-oxygenated across depth and all measurements of DO were above CCME PAL guidelines for freshwater aquatic life. The lake was also characterized by relatively low pH and specific conductance and high clarity (i.e., low turbidity and a mean Secchi disk depth of 5.25 m). DO, specific conductance, and pH decreased somewhat across water depth in the lake.

KP85 Lake is extremely soft (hardness < 2 mg/L), slightly acidic (pH < 7), clear (turbidity < 1 NTU; Table 1), and nutrient poor (ultra-oligotrophic based on TP and oligotrophic based on TN and chlorophyll *a*; Table 2). Only one water quality parameter exceeded CCME PAL guidelines; pH (laboratory and field) was below the CCME guideline range of 6.5-9.0 at both sites across the entirety, or part, of the water column.

Analytical laboratory report CoAs are provided in Appendix 1.

3.1.1 QA/QC

In situ measurements collected on July 19, 2024, concurrent with water sample collection for laboratory analysis indicated that DO measurements were suspect (i.e., percent saturation approximately 120% at the surface). Subsequent verification and inspection of the meter indicated the DO membrane required replacement. *In situ* measurements were repeated on July 22, 2024, following replacement of the membrane and meter calibration.

Results of the duplicate water quality samples were in good agreement and with two exceptions, RPMDs were less than 30% (for parameters where measurements were greater than 5 times the analytical DL; Table 3), indicating good replicability. Higher variability among the duplicate samples occurred for dissolved manganese (41.7%) and dissolved silicon (RPMD 31.7%).

Most parameters were not detected in the trip blank. Parameters that exceeded DLs (conductivity, total silicon and sodium, and dissolved aluminum, silicon, and sodium) were less than five times the DL indicating no issues with sample handling, storage, or preservation.

Table 1. Analytical laboratory results for water quality samples collected from KP85 Lake: July 19, 2024.

Parameter	Lowest Detection Limit	Units	KP85-Lake-1		KP85-Lake-2	
			Surface	Bottom	Surface	Bottom
Lab Sample ID			KP85-Lake-1-S	KP85-Lake-1-B	KP85-LAKE-2-S	KP85-LAKE-2-B
Physical Tests						
Conductivity	1.0	µS/cm	6.4	5.6	6.0	4.9
Alkalinity, total (as CaCO ₃)	2.0	mg/L	<2.0	<2.0	<2.0	<2.0
Hardness (as CaCO ₃), dissolved	0.50	mg/L	1.60	1.56	1.63	1.43
Total dissolved solids	10	mg/L	<17	<16	20	<17
Total suspended solids	1.0	mg/L	<1.0	<1.3	<1.0	<1.0
Turbidity	0.10	NTU	0.99	0.98	0.95	0.93
pH	0.10	pH units	6.23	5.99	6.19	6.00
Anions and Nutrients						
Ammonia, total	0.0050	mg N/L	<0.0050	<0.0050	<0.0050	0.0056
Bromide	0.10	mg/L	<0.10	<0.10	<0.10	<0.10
Chloride	0.50	mg/L	<0.50	<0.50	<0.50	<0.50
Total Kjeldahl nitrogen	0.050	mg/L	0.108	0.092	0.075	0.084
Nitrate	0.020	mg N/L	<0.020	<0.020	<0.020	<0.020
Nitrite	0.010	mg N/L	<0.010	<0.010	<0.010	<0.010
Phosphorus, total	0.0020	mg/L	0.0030	<0.0020	0.0024	0.0034
Sulfate (as SO ₄)	0.30	mg/L	0.32	<0.30	<0.30	<0.30
Organic / Inorganic Carbon						
Dissolved organic carbon	0.50	mg/L	2.00	2.29	2.07	2.76
Total organic carbon	0.50	mg/L	1.99	2.29	2.11	2.22
Total Metals						
Aluminum	0.0030	mg/L	0.0471	0.0501	0.0428	0.0600
Antimony	0.00010	mg/L	<0.00010	<0.00010	<0.00010	<0.00010
Arsenic	0.00010	mg/L	<0.00010	<0.00010	<0.00010	<0.00010
Barium	0.00010	mg/L	0.00145	0.00146	0.00140	0.00157
Beryllium	0.000020	mg/L	<0.000020	<0.000020	<0.000020	<0.000020
Bismuth	0.000050	mg/L	<0.000050	<0.000050	<0.000050	<0.000050
Boron	0.010	mg/L	<0.010	<0.010	<0.010	<0.010
Cadmium	0.000005	mg/L	<0.0000050	<0.0000050	<0.0000050	<0.0000050
Calcium	0.050	mg/L	0.388	0.365	0.364	0.333
Cesium	0.000010	mg/L	<0.000010	<0.000010	<0.000010	<0.000010
Chromium	0.00050	mg/L	<0.00050	<0.00050	<0.00050	<0.00050
Cobalt	0.00010	mg/L	<0.00010	<0.00010	<0.00010	<0.00010
Copper	0.00050	mg/L	<0.00050	0.00092	<0.00050	0.00102
Iron	0.010	mg/L	0.055	0.050	0.050	0.057
Lead	0.000050	mg/L	<0.000050	<0.000050	<0.000050	<0.000050
Lithium	0.0010	mg/L	<0.0010	<0.0010	<0.0010	<0.0010
Magnesium	0.0050	mg/L	0.172	0.159	0.165	0.146
Manganese	0.00010	mg/L	0.00088	0.00098	0.00083	0.00128
Mercury	0.0000050	mg/L	<0.0000050	<0.0000050	<0.0000050	<0.0000050
Molybdenum	0.000050	mg/L	<0.000050	<0.000050	<0.000050	<0.000050
Nickel	0.00050	mg/L	<0.00050	<0.00050	<0.00050	<0.00050
Phosphorus	0.050	mg/L	<0.050	<0.050	<0.050	<0.050
Potassium	0.050	mg/L	0.096	0.092	0.090	0.096
Rubidium	0.00020	mg/L	0.00048	0.00044	0.00042	0.00050
Selenium	0.000050	mg/L	<0.000050	<0.000050	<0.000050	<0.000050

Table 1. – continued –

Parameter	Lowest Detection Limit	Units	KP85-Lake-1		KP85-Lake-2	
			Surface	Bottom	Surface	Bottom
Lab Sample ID			KP85-Lake-1-S	KP85-Lake-1-B	KP85-LAKE-2-S	KP85-LAKE-2-B
Total Metals						
Silicon	0.10	mg/L	0.48	0.52	0.45	0.72
Silver	0.000010	mg/L	<0.000010	<0.000010	<0.000010	<0.000010
Sodium	0.050	mg/L	0.546	0.476	0.526	0.424
Strontium	0.00020	mg/L	0.00255	0.00238	0.00247	0.00223
Sulfur	0.50	mg/L	<0.50	<0.50	<0.50	<0.50
Tellurium	0.00020	mg/L	<0.00020	<0.00020	<0.00020	<0.00020
Thallium	0.000010	mg/L	<0.000010	<0.000010	<0.000010	<0.000010
Thorium	0.00010	mg/L	<0.00010	<0.00010	<0.00010	<0.00010
Tin	0.00010	mg/L	<0.00010	<0.00010	<0.00010	<0.00010
Titanium	0.00030	mg/L	0.00174	0.00187	0.00149	0.00202
Tungsten	0.00010	mg/L	<0.00010	<0.00010	<0.00010	<0.00010
Uranium	0.000010	mg/L	0.000026	0.000028	0.000026	0.000030
Vanadium	0.00050	mg/L	<0.00050	<0.00050	<0.00050	<0.00050
Zinc	0.0030	mg/L	<0.0030	<0.0030	<0.0030	<0.0030
Zirconium	0.00020	mg/L	0.00021	<0.00020	<0.00020	0.00024
Dissolved Metals						
Aluminum	0.0010	mg/L	0.0243	0.0236	0.0224	0.0323
Antimony	0.00010	mg/L	<0.00010	<0.00010	<0.00010	<0.00010
Arsenic	0.00010	mg/L	<0.00010	<0.00010	<0.00010	<0.00010
Barium	0.00010	mg/L	0.00133	0.00135	0.00134	0.00147
Beryllium	0.000020	mg/L	<0.000020	<0.000020	<0.000020	<0.000020
Bismuth	0.000050	mg/L	<0.000050	<0.000050	<0.000050	<0.000050
Boron	0.010	mg/L	<0.010	<0.010	<0.010	<0.010
Cadmium	0.0000050	mg/L	<0.0000050	<0.0000050	<0.0000050	<0.0000050
Calcium	0.050	mg/L	0.363	0.363	0.376	0.342
Cesium	0.000010	mg/L	<0.000010	<0.000010	<0.000010	<0.000010
Chromium	0.00050	mg/L	<0.00050	<0.00050	<0.00050	<0.00050
Cobalt	0.00010	mg/L	<0.00010	<0.00010	<0.00010	<0.00010
Copper	0.00020	mg/L	0.00027	0.00086	0.00026	0.00096
Iron	0.010	mg/L	0.026	0.018	0.024	0.026
Lead	0.000050	mg/L	<0.000050	<0.000050	<0.000050	<0.000050
Lithium	0.0010	mg/L	<0.0010	<0.0010	<0.0010	<0.0010
Magnesium	0.0050	mg/L	0.168	0.160	0.169	0.141
Manganese	0.00010	mg/L	0.00052	0.00055	0.00051	0.00094
Mercury	0.0000050	mg/L	<0.0000050	<0.0000050	<0.0000050	<0.0000050
Molybdenum	0.000050	mg/L	<0.000050	<0.000050	<0.000050	<0.000050
Nickel	0.00050	mg/L	<0.00050	<0.00050	<0.00050	<0.00050
Phosphorus	0.050	mg/L	<0.050	<0.050	<0.050	<0.050
Potassium	0.050	mg/L	0.099	0.100	0.096	0.098
Rubidium	0.00020	mg/L	0.00042	0.00038	0.00040	0.00043
Selenium	0.000050	mg/L	<0.000050	<0.000050	<0.000050	<0.000050
Silicon	0.050	mg/L	0.431	0.472	0.438	0.665
Silver	0.000010	mg/L	<0.000010	<0.000010	<0.000010	<0.000010
Sodium	0.050	mg/L	0.556	0.506	0.554	0.432
Strontium	0.00020	mg/L	0.00259	0.00243	0.00265	0.00228
Sulfur	0.50	mg/L	<0.50	<0.50	<0.50	<0.50
Tellurium	0.00020	mg/L	<0.00020	<0.00020	<0.00020	<0.00020

Table 1. – continued –

Parameter	Lowest Detection Limit	Units	KP85-Lake-1		KP85-Lake-2	
			Surface	Bottom	Surface	Bottom
Lab Sample ID			KP85-Lake-1-S	KP85-Lake-1-B	KP85-LAKE-2-S	KP85-LAKE-2-B
Dissolved Metals						
Thallium	0.000010	mg/L	<0.000010	<0.000010	<0.000010	<0.000010
Thorium	0.00010	mg/L	<0.00010	<0.00010	<0.00010	<0.00010
Tin	0.00010	mg/L	<0.00010	<0.00010	<0.00010	<0.00010
Titanium	0.00030	mg/L	0.00055	<0.00030	0.00035	0.00038
Tungsten	0.00010	mg/L	<0.00010	<0.00010	<0.00010	<0.00010
Uranium	0.000010	mg/L	0.000026	0.000024	0.000024	0.000031
Vanadium	0.00050	mg/L	<0.00050	<0.00050	<0.00050	<0.00050
Zinc	0.0010	mg/L	<0.0010	<0.0010	<0.0010	<0.0010
Zirconium	0.00030	mg/L	<0.00030	<0.00030	<0.00030	<0.00030
Aggregate Organics						
Phenols, total (4AAP)	0.0010	mg/L	<0.0010	<0.0010	<0.0010	<0.0010
Plant Pigments						
Chlorophyll <i>a</i>	0.010	µg/L	0.167	0.191	0.144	0.139
Pheophytin <i>a</i>	0.010	µg/L	0.24	0.32	0.24	0.28

Table 2. Trophic status of KP85 Lake.

Trophic Categories	Total Phosphorus (mg/L)	Total Nitrogen (mg/L)	Chlorophyll <i>a</i> (µg/L)
Ultra-oligotrophic	<0.004		
Oligotrophic	0.004-0.010	<0.350	<2.5
Mesotrophic	0.010-0.020	0.350-0.650	2.5-8
Meso-eutrophic	0.020-0.035		
Eutrophic	0.035-0.100	0.651-1.20	8-25
Hypereutrophic	> 0.100	>1.20	>25
Reference	CCME (1999; updated to 2024)	Nürnberg (1996)	OECD (1982)
KP85 Lake: Range	<0.0020-0.0034	0.090-0.123	0.139-0.191

Table 3. Results of duplicate and trip blank water quality samples: July 19, 2024.

Parameter	Lowest Detection Limit	Units	KP85-Lake-1			Trip Blank
			Bottom Dup 1	Bottom Dup 2	RPMD	
Lab Sample ID			KP85-Lake-1-B	QD-CC8_B	(%)	QD-BT8_B
Physical Tests						
Conductivity	1.0	µS/cm	5.6	5.0	11.3	2.1
Alkalinity, total (as CaCO ₃)	2.0	mg/L	<2.0	<2.0	-	<2.0
Hardness (as CaCO ₃), dissolved	0.50	mg/L	1.56	1.42	-	<0.50
Total dissolved solids	10	mg/L	<16	<18	-	<17
Total suspended solids	1.0	mg/L	<1.3	<1.0	-	<1.0
Turbidity	0.10	NTU	0.98	0.87	11.9	<0.10
pH	0.10	pH units	5.99	5.91	1.3	4.93
Anions and Nutrients						
Ammonia, total	0.0050	mg N/L	<0.0050	<0.0050	-	<0.0050
Bromide	0.10	mg/L	<0.10	<0.10	-	<0.10
Chloride	0.50	mg/L	<0.50	<0.50	-	<0.50
Total Kjeldahl nitrogen	0.050	mg/L	0.092	0.097	-	<0.050
Nitrate	0.020	mg N/L	<0.020	<0.020	-	<0.020
Nitrite	0.010	mg N/L	<0.010	<0.010	-	<0.010
Phosphorus, total	0.0020	mg/L	<0.0020	0.0024	-	<0.0020
Sulfate (as SO ₄)	0.30	mg/L	<0.30	<0.30	-	<0.30
Organic / Inorganic Carbon						
Dissolved organic carbon	0.50	mg/L	2.29	2.55	-	<0.50
Total organic carbon	0.50	mg/L	2.29	2.50	-	<0.50
Total Metals						
Aluminum	0.0030	mg/L	0.0501	0.0576	13.9	<0.0030
Antimony	0.00010	mg/L	<0.00010	<0.00010	-	<0.00010
Arsenic	0.00010	mg/L	<0.00010	<0.00010	-	<0.00010
Barium	0.00010	mg/L	0.00146	0.00155	6.0	<0.00010
Beryllium	0.000020	mg/L	<0.000020	<0.000020	-	<0.000020
Bismuth	0.000050	mg/L	<0.000050	<0.000050	-	<0.000050
Boron	0.010	mg/L	<0.010	<0.010	-	<0.010
Cadmium	0.000005	mg/L	<0.0000050	<0.0000050	-	<0.0000050
Calcium	0.050	mg/L	0.365	0.326	11.3	<0.050
Cesium	0.000010	mg/L	<0.000010	<0.000010	-	<0.000010
Chromium	0.00050	mg/L	<0.00050	<0.00050	-	<0.00050
Cobalt	0.00010	mg/L	<0.00010	<0.00010	-	<0.00010
Copper	0.00050	mg/L	0.00092	0.00116	-	<0.00050
Iron	0.010	mg/L	0.050	0.055	9.5	<0.010
Lead	0.000050	mg/L	<0.000050	<0.000050	-	<0.000050
Lithium	0.0010	mg/L	<0.0010	<0.0010	-	<0.0010
Magnesium	0.0050	mg/L	0.159	0.143	10.6	<0.0050
Manganese	0.00010	mg/L	0.00098	0.00118	18.5	<0.00010
Mercury	0.0000050	mg/L	<0.0000050	<0.0000050	-	<0.0000050
Molybdenum	0.000050	mg/L	<0.000050	<0.000050	-	<0.000050
Nickel	0.00050	mg/L	<0.00050	<0.00050	-	<0.00050
Phosphorus	0.050	mg/L	<0.050	<0.050	-	<0.050
Potassium	0.050	mg/L	0.092	0.094	-	<0.050
Rubidium	0.00020	mg/L	0.00044	0.00043	-	<0.00020
Selenium	0.000050	mg/L	<0.000050	<0.000050	-	<0.000050
Silicon	0.10	mg/L	0.52	0.70	29.5	0.24
Silver	0.000010	mg/L	<0.000010	<0.000010	-	<0.000010
Sodium	0.050	mg/L	0.476	0.420	12.5	0.194
Strontium	0.00020	mg/L	0.00238	0.00223	6.5	<0.00020
Sulfur	0.50	mg/L	<0.50	<0.50	-	<0.50

Table 3. – continued –

Parameter	Lowest Detection Limit	Units	KP85-Lake-1			Trip Blank
			Bottom Dup 1	Bottom Dup 2	RPMD (%)	
Lab Sample ID			KP85-Lake-1-B	QD-CC8_B		QD-BT8_B
Total Metals						
Tellurium	0.00020	mg/L	<0.00020	<0.00020	-	<0.00020
Thallium	0.000010	mg/L	<0.000010	<0.000010	-	<0.000010
Thorium	0.00010	mg/L	<0.00010	<0.00010	-	<0.00010
Tin	0.00010	mg/L	<0.00010	<0.00010	-	<0.00010
Titanium	0.00030	mg/L	0.00187	0.00188	0.5	<0.00030
Tungsten	0.00010	mg/L	<0.00010	<0.00010	0.0	<0.00010
Uranium	0.000010	mg/L	0.000028	0.000032	-	<0.000010
Vanadium	0.00050	mg/L	<0.00050	<0.00050	-	<0.00050
Zinc	0.0030	mg/L	<0.0030	<0.0030	-	<0.0030
Zirconium	0.00020	mg/L	<0.00020	0.00025	-	<0.00020
Dissolved Metals						
Aluminum	0.0010	mg/L	0.0236	0.0318	29.6	0.0014
Antimony	0.00010	mg/L	<0.00010	<0.00010	-	<0.00010
Arsenic	0.00010	mg/L	<0.00010	<0.00010	-	<0.00010
Barium	0.00010	mg/L	0.00135	0.00147	8.5	<0.00010
Beryllium	0.000020	mg/L	<0.000020	<0.000020	-	<0.000020
Bismuth	0.000050	mg/L	<0.000050	<0.000050	-	<0.000050
Boron	0.010	mg/L	<0.010	<0.010	-	<0.010
Cadmium	0.0000050	mg/L	<0.0000050	<0.0000050	-	<0.0000050
Calcium	0.050	mg/L	0.363	0.335	8.0	<0.050
Cesium	0.000010	mg/L	<0.000010	<0.000010	-	<0.000010
Chromium	0.00050	mg/L	<0.00050	<0.00050	-	<0.00050
Cobalt	0.00010	mg/L	<0.00010	<0.00010	-	<0.00010
Copper	0.00020	mg/L	0.00086	0.00107	-	<0.00020
Iron	0.010	mg/L	0.018	0.023	-	<0.010
Lead	0.000050	mg/L	<0.000050	<0.000050	-	<0.000050
Lithium	0.0010	mg/L	<0.0010	<0.0010	-	<0.0010
Magnesium	0.0050	mg/L	0.160	0.142	11.9	<0.0050
Manganese	0.00010	mg/L	0.00055	0.00084	41.7	<0.00010
Mercury	0.0000050	mg/L	<0.0000050	<0.0000050	-	<0.0000050
Molybdenum	0.000050	mg/L	<0.000050	<0.000050	-	<0.000050
Nickel	0.00050	mg/L	<0.00050	<0.00050	-	<0.00050
Phosphorus	0.050	mg/L	<0.050	<0.050	-	<0.050
Potassium	0.050	mg/L	0.100	0.101	-	<0.050
Rubidium	0.00020	mg/L	0.00038	0.00041	-	<0.00020
Selenium	0.000050	mg/L	<0.000050	<0.000050	-	<0.000050
Silicon	0.050	mg/L	0.472	0.650	31.7	0.231
Silver	0.000010	mg/L	<0.000010	<0.000010	-	<0.000010
Sodium	0.050	mg/L	0.506	0.439	14.2	0.203
Strontium	0.00020	mg/L	0.00243	0.00233	4.2	<0.00020
Sulfur	0.50	mg/L	<0.50	<0.50	-	<0.50
Tellurium	0.00020	mg/L	<0.00020	<0.00020	-	<0.00020
Thallium	0.000010	mg/L	<0.000010	<0.000010	-	<0.000010
Thorium	0.00010	mg/L	<0.00010	<0.00010	-	<0.00010
Tin	0.00010	mg/L	<0.00010	<0.00010	-	<0.00010
Titanium	0.00030	mg/L	<0.00030	0.00038	-	<0.00030
Tungsten	0.00010	mg/L	<0.00010	<0.00010	-	<0.00010
Uranium	0.000010	mg/L	0.000024	0.000029	-	<0.000010
Vanadium	0.00050	mg/L	<0.00050	<0.00050	-	<0.00050
Zinc	0.0010	mg/L	<0.0010	<0.0010	-	<0.0010

Table 3. – continued –

Parameter	Lowest Detection Limit	Units	KP85-Lake-1			Trip Blank
			Bottom Dup 1	Bottom Dup 2	RPMD (%)	
Lab Sample ID			KP85-Lake-1-B	QD-CC8_B		QD-BT8_B
Dissolved Metals						
Zirconium	0.00030	mg/L	<0.00030	<0.00030	-	<0.00030
Aggregate Organics						
Phenols, total (4AAP)	0.0010	mg/L	<0.0010	<0.0010	-	<0.0010
Plant Pigments						
Chlorophyll <i>a</i>	0.010	µg/L	0.191	0.172	10.5	<0.020
Pheophytin <i>a</i>	0.010	µg/L	0.32	0.28	-	<0.200

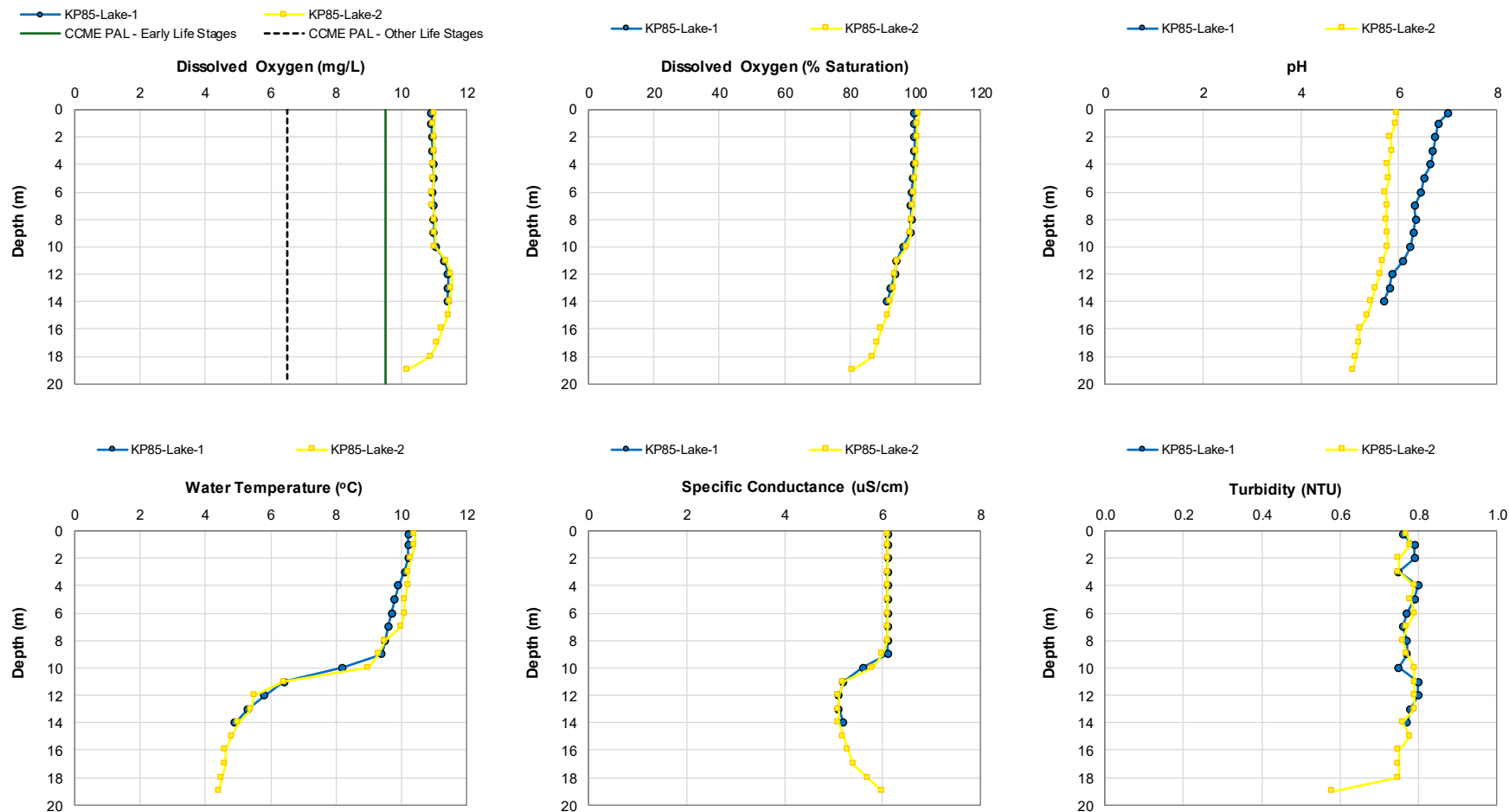


Figure 6. *In situ* depth profiles of dissolved oxygen, temperature, pH, specific conductance, and turbidity in KP85 Lake: July 22, 2024.

3.2 BENTHIC INVERTEBRATES

Mean benthic invertebrate density of the DEEP sampling area (KP85-DP) was 2,790 per m² (Table 4; Figure 7). Mean taxonomic richness was 9 taxa (Table 4; Figure 8). The substrate was predominantly silt and sand, with conditions at replicate stations ranging between a silt loam and loam texture; mean total organic carbon was 7% (Table 5; Figures 9 and 10). Overall composition of the sediments was relatively comparable among replicate stations; each contained varying amounts of soft clay mixed with organic matter (Figures 11 and 12; Photograph 1). The dominant taxa were Chironomidae (91%), Nemata (5%), and Clitellata (3%; Figure 13). Of the 13 Chironomidae taxa, five were most abundant (Chironominae: *Sergentia*, *Stictochironomus*, *Chironomus*, *Micropsectra*, and Tanypodinae: *Procladius*; Appendix 4)

Mean benthic invertebrate density of the SHALLOW sampling area (KP85-SH) was 6,256 per m² (Table 6; Figure 7). Mean taxonomic richness was 10 taxa (Table 6; Figure 8). The substrate was predominantly sand and silt, with composition of replicate stations ranging between a sandy loam and silt loam texture; mean total organic carbon was 3% (Table 7; Figures 9 and 10; Photograph 2). The dominant taxa were Chironomidae (77%), Ostracoda (13%), and Nemata (7%), however Ostracoda was only notably abundant in one replicate sample (KP85-SH-R3; Figure 13; Appendix 4). Of the 12 Chironomidae taxa, three were most abundant (Chironominae: *Tanytarsus*, *Stictochironomus*, and *Micropsectra*; Appendix 4).

Benthic invertebrate and supporting sediment sampling information and laboratory results are provided in Appendix 4. Analytical laboratory CoAs for the supporting sediment laboratory analyses are provided in Appendix 2.

3.2.1 QA/QC

Nine of ten benthic invertebrate samples were sub-sampled prior to analysis (Table 8). The mean sorting efficiency for two samples was 96% indicating very good recovery of organisms from the sample matrix (Table 9). Sub-sampling error results from sample KP85-SH-R1 indicated very good replicability among two fractions (3%) and each fraction was a very good estimation of the actual count (1%; Table 10). Mean sub-sampling error for sample KP85-SH-R4 indicated reasonable replicability among four fractions (22%) and each fraction was a good estimation of the actual count (14%; Table 10).

The RPMD for the duplicate sediment sample results ranged between 2.5 and 4.3% indicating good precision and replicability between the two samples (Table 11).

Table 4. Summary statistics for benthic invertebrate community metrics: DEEP sampling area (KP85-DP, n=5).

Parameter	Mean	SD	SE	Minimum	Maximum
Total Density	2790	1379.53	616.94	548	4170
Taxonomic Richness	9	3.96	1.77	4	15
Nemata	127	103.23	46.17	0	231
Clitellata	72	108.93	48.71	0	245
Prostigmata	29	49.98	22.35	0	115
Ostracoda	12	25.81	11.54	0	58
Chironomidae	2551	1247.39	557.85	462	3636

Table 5. Summary statistics for supporting sediment variables: DEEP sampling area (KP85-DP, n=5).

Parameter	Mean	SD	SE	Minimum	Maximum
% Sand	35.940	8.344	3.731	24.800	45.200
% Silt	49.160	7.031	3.144	42.200	58.600
% Clay	14.880	4.435	1.983	7.600	19.600
% TOC	6.730	2.182	0.976	4.950	10.500

Table 6. Summary statistics for benthic invertebrate community metrics: SHALLOW sampling area (KP85-SH, n=5).

Parameter	Mean	SD	SE	Minimum	Maximum
Total Density	6256	3360.74	1502.97	2712	11196
Taxonomic Richness	10	3.63	1.62	5	14
Nemata	467	182.95	81.82	231	693
Clitellata	49	49.56	22.16	0	115
Prostigmata	107	83.88	37.51	0	231
Ostracoda	802	1557.96	696.74	0	3578
Chironomidae	4830	2184.77	977.06	2049	7387

Table 7. Summary statistics for supporting sediment variables: SHALLOW sampling area (KP85-SH, n=5).

Parameter	Mean	SD	SE	Minimum	Maximum
% Sand	47.500	21.974	9.827	21.500	71.300
% Silt	43.460	17.545	7.846	25.300	64.700
% Clay	9.020	4.529	2.025	3.400	13.800
% TOC	3.012	1.139	0.509	1.730	4.310

Table 8. Benthic invertebrate laboratory sample fractions sorted for analysis.

Sample ID	Fraction Sorted	Sample ID	Fraction Sorted
KP85-DP-R1	1/8	KP85-SH-R1	1/4 ¹
KP85-DP-R2	1/2	KP85-SH-R2	1/8
KP85-DP-R3	1/8	KP85-SH-R3	1/8
KP85-DP-R4	1/8	KP85-SH-R4	Whole ²
KP85-DP-R5	1/4	KP85-SH-R5	1/4

Notes:

1. two eighths sorted for subsampling QA/QC
2. four quarters sorted for subsampling QA/QC

Table 9. Benthic invertebrate laboratory QA/QC results: Sorting efficiency.

Sample ID	Organism Count (initial sort)	Total Count (initial + re-sort)	Sorting Efficiency
KP85-DP-R5	68	72	94%
KP85-SH-R3	95	97	98%
Mean Sorting Efficiency			96%

Table 10. Benthic invertebrate laboratory QA/QC results: Sub-sampling error.

Sample ID	Organism Count				Actual Count	Precision %			Accuracy %		
	Fraction 1	Fraction 2	Fraction 3	Fraction 4		Mean	Min	Max	Mean	Min	Max
KP85-SH-R1	36	37	-	-	73	3	-	-	1	-	-
KP85-SH-R4	35	46	49	58	188	22	6	40	14	2	26

Table 11. Duplicate sediment sample results.

Parameter	Sample Result	Duplicate Result	RPMD
% Sand (2.0 mm - 0.05 mm)	30.6	31.8	3.8%
% Silt (0.05 mm - 0.002 mm)	54.2	52.4	3.5%
% Clay (<0.002 mm)	15.1	15.7	4.3%
% Total Organic Carbon (TOC)	6.26	6.10	2.5%

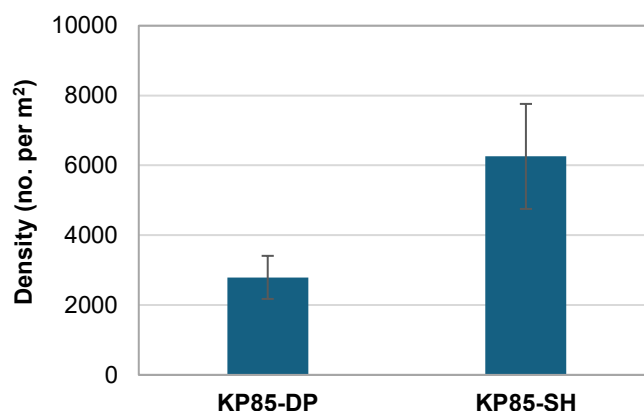


Figure 7. Mean±SE benthic invertebrate total density by habitat.

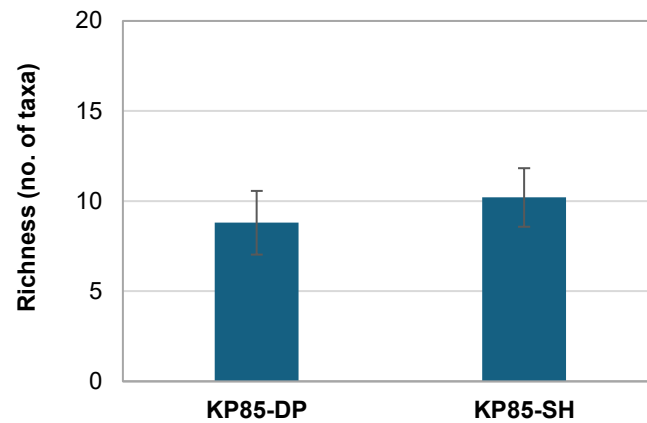


Figure 8. Mean±SE benthic invertebrate taxonomic richness by habitat.

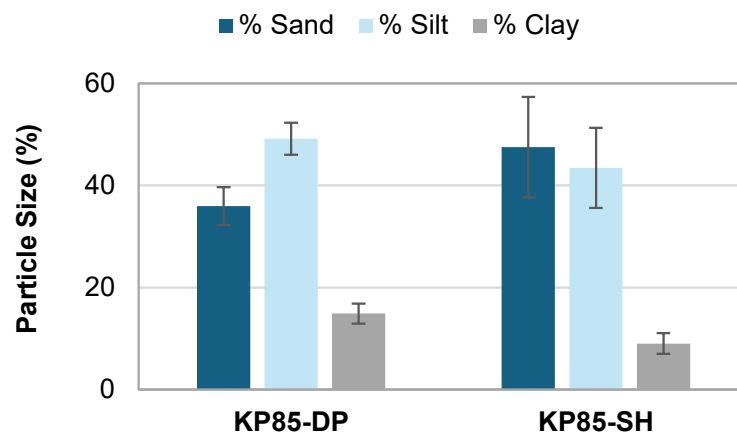


Figure 9. Mean±SE sediment particle size composition by habitat.

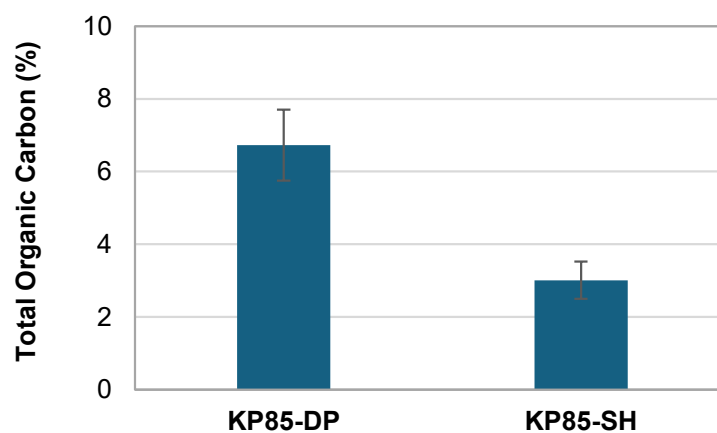


Figure 10. Mean±SE total organic carbon by habitat.

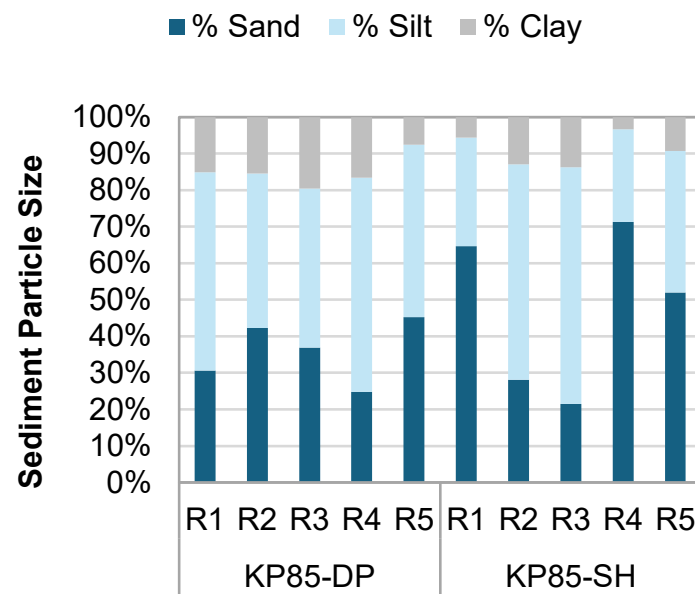


Figure 11. Relative proportions of sand, silt, and clay in sediments.

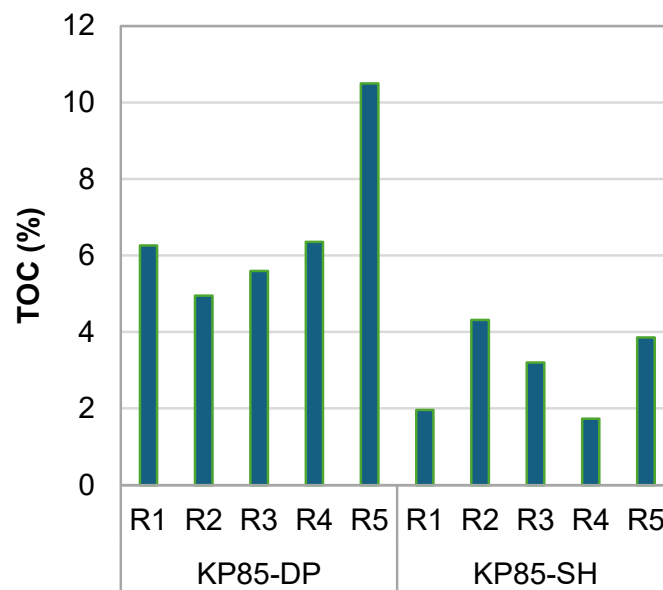


Figure 12. Total organic carbon in sediments.

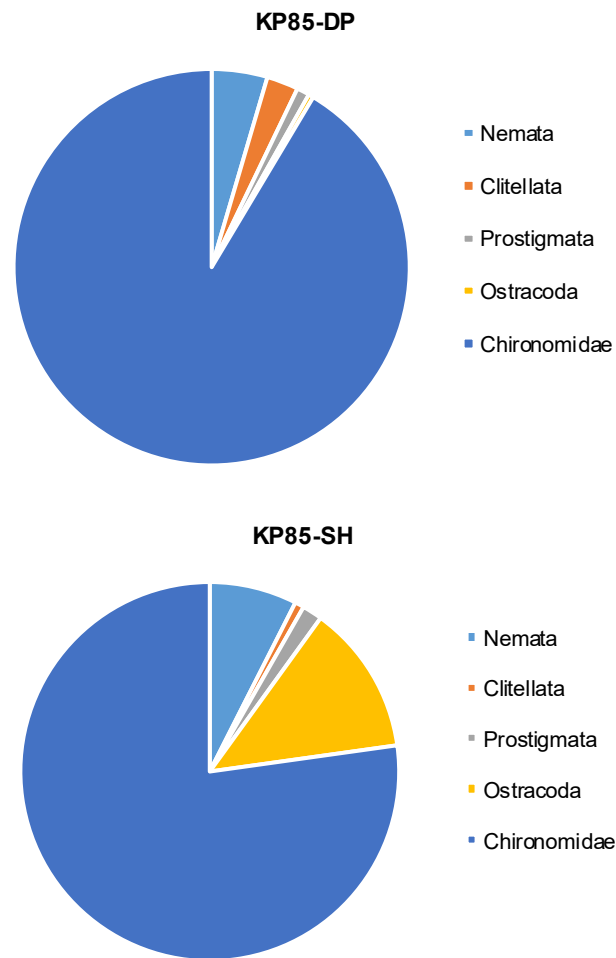
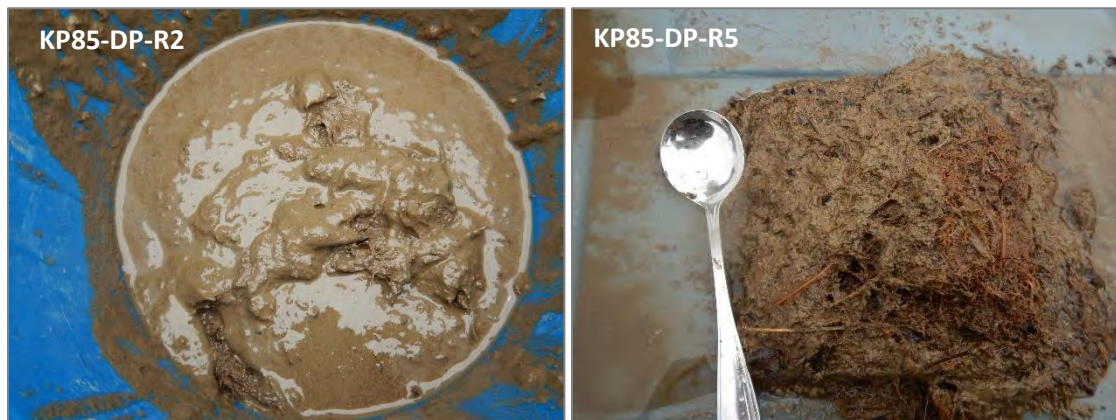


Figure 13. Relative densities of major benthic invertebrate groups by habitat.



Photograph 1. Sediments from the DEEP sampling area (KP85-DP) illustrating composition before and after washing soft clay through 500 micron sieve bucket at two replicate sampling locations.



Photograph 2. Sediments from the SHALLOW sampling area (KP85-SH) at two replicate sampling locations.

3.3 NINESPINE STICKLEBACK

A total of 134 Ninespine Stickleback were captured (an additional 20 fish were observed but not captured during electrofishing) from KP85 Lake and five of its tributaries. Detailed information on site conditions and fish captures, biometrics, diet, and parasites is provided in Appendix 5. Photographs of the nearshore area of KP85 Lake and tributary streams are provided in Photographs 3-4 to 5-9, respectively. A summary of the results of the field program is provided below.

3.3.1 Electrofishing Survey

A total of 65 Ninespine Stickleback were captured, or observed but not captured, in the nearshore area of KP85 Lake (total of 31 electrofishing passes) with a combined total fishing effort of 203.45 minutes (Table 12; Appendix 5). A total of 43 Ninespine Stickleback were captured, or observed but not captured, in the lower 100 m of stream habitat in the five tributaries to KP85 Lake that were surveyed with a combined total fishing effort of 29.95 minutes (Table 13; Appendix 5).

3.3.1.1 Catch-per-unit-effort

Mean \pm SD CPUE was 0.337 \pm 0.725 fish/60 seconds for all electrofishing passes in KP85 Lake and 1.391 \pm 0.866 fish/60 seconds for the tributaries (Tables 12 and 13). CPUE ranged from 0 to 3.238 fish/60 seconds in the lake survey and 0 to 2.500 fish/60 seconds in the tributary survey.

3.3.1.2 Size, Age, And Condition

Fork length ranged from 20-78 mm (mean \pm SD = 56.6 \pm 1.29 mm), weights ranged from 0.1-3.2 g (mean \pm SD = 1.48 \pm 0.08 g), and condition factor ranged from 0.463-1.250 (mean \pm SD = 0.744 \pm 0.015) for the total of 88 Ninespine Stickleback captured in the lake and tributary electrofishing survey (Table 14).

Of the 50 fish captured that were aged, ages ranged from 0-5 years. Results of ageing QA/QC (i.e., readings conducted by two technicians) indicate good agreement (Appendix 5); of the 22 fish aged twice, 18 were aged the same. Ages varied by 1 year between technicians for the remaining four fish.

There was a strong linear relationship between length and weight ($R^2 = 0.936$; $p < 0.0001$) of stickleback and significant but weaker relationships between fish age and length ($R^2 = 0.656$; $p < 0.0001$) and fish age and weight ($R^2 = 0.679$; $p < 0.0001$; Figure 14). Length- and age-frequency distributions are presented in Figures 15 and 16, respectively. Modal length and age frequencies were 56-60 mm and 4 years, respectively.

Of the fish where sex and maturity could be determined, a total of 12 sexually mature females and 24 sexually mature males were captured during nearshore lacustrine and tributary electrofishing (Table 15). Length, weight, age, and condition factor were similar between the sexes.

DELTs were only observed on a single stickleback. Fish #1023 captured along the shoreline of KP85 Lake, was missing its right eye which was likely the result of an injury sustained well before capture (Photograph 10).

3.3.1.3 Diet

Four of the 50 stickleback stomachs examined were empty. Thirteen prey taxa were identified from the remaining 46 stomachs (Table 16). Copepoda was the most diverse group observed in char stomachs, comprising eight of the thirteen total prey types. Chironomidae (mostly in the pupal stage) was the dominant prey taxon, with a frequency of occurrence of 80.0%, a relative frequency of 83.3%, and a relative percentage of biomass of 94.5% (Table 16; Figure 17). The ostracod, *Cyclocypris* sp. (22%), Cyclopidae copepods, unidentified Insecta, and Harpacticidae copepods were the only other taxa to appear in 10% or more of the stickleback stomachs. Arachnida (8.2%) and *Cyclocypris* sp. (4.9%) were the only other taxa that comprised more than 1.0% of the total number of observed diet items. Unidentified Insecta accounted for 4.9% of the biomass. Most other taxa had low to negligible wet weights.

3.3.1.4 Parasites

Only one parasite species, the plerocercoid stage of *Schistocephalus pungitii*, was recovered from stickleback samples (Appendix 5). This is a large tapeworm parasite (0.2-0.4 g per worm) that occupies the body cavity of sticklebacks and matures in the intestine of fish-eating birds. There are no records of this parasite infecting Arctic Char. Of the 50 fish examined in the laboratory, prevalence was 34% and mean intensity was 1.47 worms per infected fish (Photograph 11; Appendix 5). All infections were observed in

fish older than 2 years. These younger stickleback had relatively few of the intermediate cyclopoid copepods in their stomachs.

3.3.2 Minnow Traps

Forty-six Ninespine Stickleback were captured in minnow traps deployed in KP85 Lake (Table 17).

3.3.2.1 *Catch-per-unit-effort*

Mean \pm SD CPUE for Ninespine Stickleback captured in minnow traps deployed in KP85 Lake was 0.214 \pm 0.282 fish/hour with a total fishing effort of 218.7 decimal hours (Table 17). Only one fish was captured in the three minnow traps deployed in deep (>10 m) habitat versus a total of 45 fish captured in the seven traps deployed in shallow (2-3 m) habitat.

3.3.2.2 *Fork Length*

Fork length ranged from 40-77 mm for the total of 46 Ninespine Stickleback captured in minnow traps set in KP85 Lake (Table 17). A length frequency distribution is presented in Figure 18. Modal length was 61-65 mm.

Table 12. Catch-per-unit-effort for Ninespine Stickleback captured in the KP85 Lake nearshore electrofishing survey: July 2024.

Electrofishing Site	Date	Electrofishing Duration (seconds)	Catch	CPUE (No. fish/60 seconds)
EF-01	19-Jul	441	4	0.544
EF-02	19-Jul	412	0	0
EF-03	19-Jul	488	0	0
EF-04	19-Jul	451	0	0
EF-05	19-Jul	455	0	0
EF-06	23-Jul	373	0	0
EF-07	23-Jul	378	0	0
EF-08	23-Jul	221	0	0
EF-09	23-Jul	476	0	0
EF-10	23-Jul	455	3	0.396
EF-11	23-Jul	430	5	0.698
EF-101	22-Jul	382	0	0
EF-102	22-Jul	348	0	0
EF-103	22-Jul	387	15	2.326
EF-104	22-Jul	364	1	0.165
EF-105	22-Jul	305	4	0.787
EF-106	22-Jul	355	0	0
EF-107	22-Jul	452	2	0.265
EF-108	22-Jul	491	7	0.855
EF-109	22-Jul	373	0	0
EF-110	22-Jul	385	0	0
EF-111	22-Jul	395	0	0
EF-112	22-Jul	315	17	3.238
EF-113	23-Jul	449	0	0
EF-114	23-Jul	338	1	0.178
EF-115	23-Jul	485	0	0
EF-116	23-Jul	359	0	0
EF-117	23-Jul	378	0	0
EF-118	23-Jul	349	0	0
EF-119	23-Jul	354	0	0
EF-120	23-Jul	363	6	0.992
Mean		393.8	2.1	0.337
SD		61.5	4.2	0.725
SE		11.0	0.8	0.130
Minimum		221	0	0.000
Maximum		491	17	3.238
n		31	31	31

Table 13. Catch-per-unit-effort for Ninespine Stickleback captured in tributaries to KP85 Lake via electrofishing: July 2024.

Electrofishing Site	Date	Electrofishing Duration (seconds)	Catch	CPUE (No. fish/60 seconds)
KP85-S1	22-Jul	333	9	1.620
KP85-S2	22-Jul	332	5	0.903
KP85-S3	23-Jul	408	17	2.500
CV-081-4a	23-Jul	373	12	1.930
CV-081-5a	23-Jul	351	0	0
Mean		359.4	8.6	1.391
SD		31.9	6.5	0.968
SE		14.3	2.9	0.433
Minimum		332	0	0.000
Maximum		408	17	2.500
n		5	5	5

Table 14. Summary statistics for Ninespine Stickleback fork length, weight, condition factor, and age captured by electrofishing.

Metric	Mean	Median	SD	SE	Min	Max	n
Length (mm)	56.6	58.0	12.1	1.29	20.0	78.0	88
Weight (g)	1.48	1.50	0.75	0.08	0.10	3.20	88
Condition Factor	0.744	0.728	0.142	0.015	0.463	1.250	88
Age (years)	3.02	3.00	1.10	0.16	0	5	50

Notes:

1. SD = standard deviation; SE = standard error; Min = minimum; and Max = maximum

Table 15. Summary statistics for sexually mature Ninespine Stickleback length, weight, condition factor, and age captured by electrofishing: (A) females; and (B) males.

(A)

Metric	Females						
	Mean	Median	SD	SE	Min	Max	n
Length (mm)	61.1	58.0	11.7	3.4	41	78	12
Weight (g)	1.82	1.80	0.82	0.24	0.6	3.2	12
Condition Factor	0.769	0.783	0.157	0.045	0.463	1.025	12
Age (years)	3.58	4.00	0.67	0.19	2	4	12

(B)

Metric	Males						
	Mean	Median	SD	SE	Min	Max	n
Length (mm)	62.7	64.0	6.4	1.4	50	78	21
Weight (g)	1.99	2.10	0.51	0.11	0.9	3.2	21
Condition Factor	0.802	0.827	0.136	0.030	0.583	1.134	21
Age (years)	3.62	4.00	0.67	0.15	3	5	21

Table 16. Summary statistics for diet of Ninespine Stickleback captured in KP85 Lake.

Diet Taxon	Number observed	Frequency of Occurrence (%)	Relative Frequency (%)	Total wet weight (g)	Relative Percent of Biomass (%)
Insecta	6	12.0	0.40	0.128	4.90
Diptera					
Chironomidae	1255	80.0	83.33	2.468	94.49
Tipulidae	1	2.0	0.07	0.001	0.04
Copepoda	3	6.0	0.20	<0.001	N/A
Cyclopoida	1	2.0	0.07	<0.001	N/A
Cyclopidae	13	14.0	0.86	<0.001	N/A
<i>Megacyclops viridis</i>	2	2.0	0.13	<0.001	N/A
<i>Cyclops scutifer</i>	4	4.0	0.27	<0.001	N/A
Harpacticoida	4	6.0	0.27	<0.001	N/A
Canthocamptidae	6	4.0	0.40	<0.001	N/A
Harpacticidae	15	10.0	1.00	0.002	0.08
Ostracoda					
Podocopida					
Cyclocyprididae					
<i>Cyclocypris</i> sp.	73	22.0	4.85	0.012	0.46
Arachnida	123	6.0	8.17	0.001	0.04

Table 17. Catch-per-unit-effort and length for Ninespine Stickleback captured in minnow traps in KP85 Lake: July 2024.

Minnow Trap Site	Total Water Depth (m)	Catch	Set Duration (dec. hrs)	CPUE (No. fish/hour)	Mean (Range) Fork Length (mm)
MT-01	2.5	1	22.47	0.045	69.0
MT-02	2.0	0	22.48	0	0
MT-03	2.0	2	22.32	0.090	69.0 (67-71)
MT-04	2.6	7	22.12	0.316	62.0 (54-70)
MT-05	2.6	6	21.92	0.274	62.2 (40-77)
MT-09	2.0	20	21.32	0.938	62.3 (55-72)
MT-10	2.5	9	21.08	0.427	63.4 (54-71)
MEAN SHALLOW	2.3	6.43	21.96	0.298	62.91 (40-77)
MT-06	16.5	0	21.77	0	0
MT-07	10.5	1	21.65	0.046	61.0
MT-08	20.3	0	21.60	0	0
MEAN DEEP	15.8	0.3	21.67	0.015	61
OVERALL MEAN	6.4	4.6	21.87	0.214±0.282 SD	62.87 (40-77)

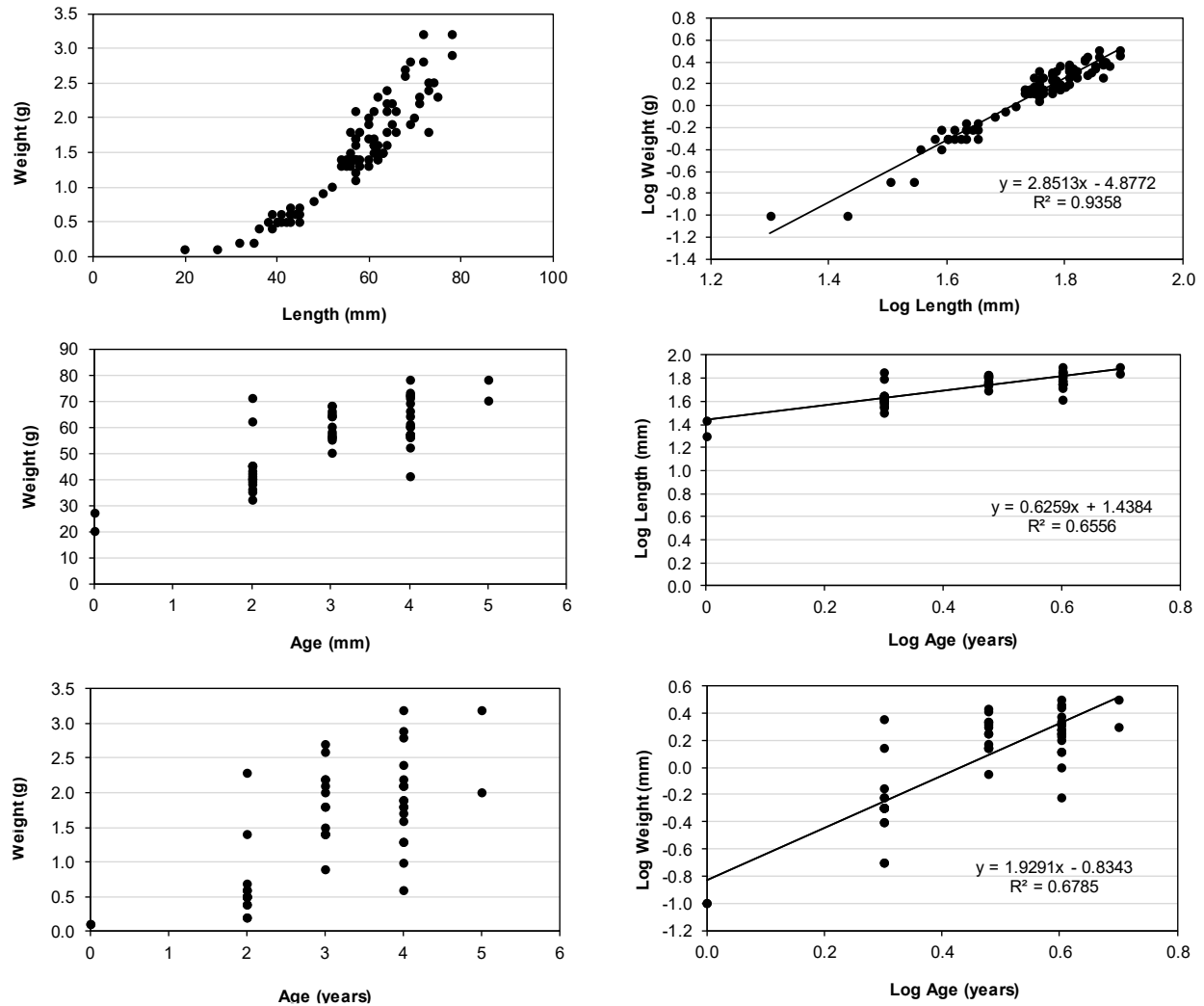


Figure 14. Linear regressions between fork length and weight (upper), age and fork length (middle), and age and weight (lower).

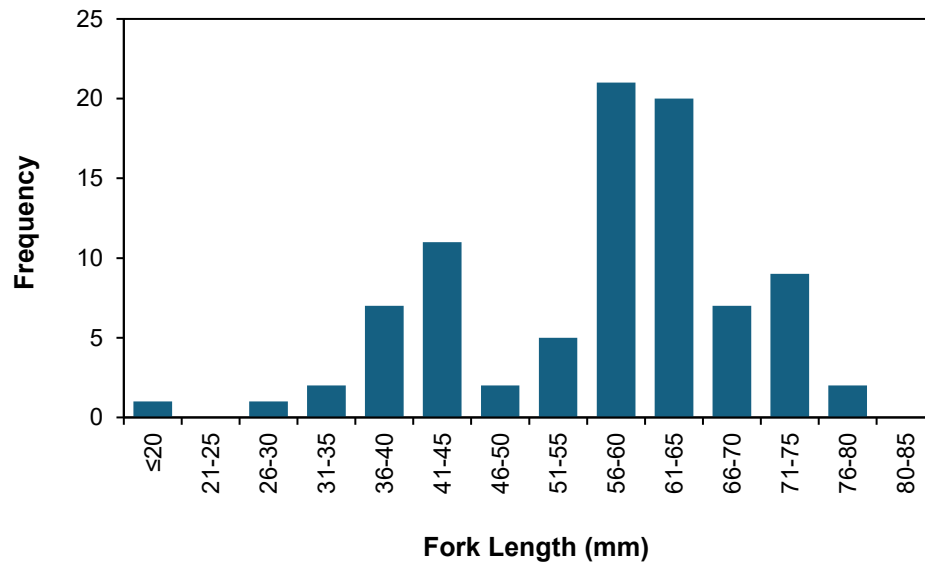


Figure 15. Length-frequency distribution for Ninespine Stickleback captured during electrofishing surveys of KP85 Lake and tributaries.

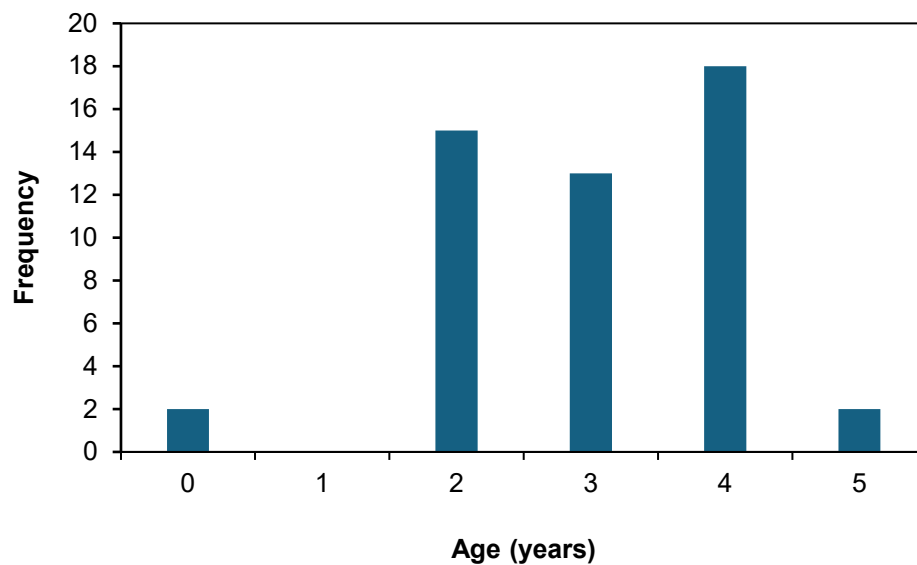


Figure 16. Age-frequency distribution for Ninespine Stickleback captured during electrofishing surveys of KP85 Lake and tributaries.

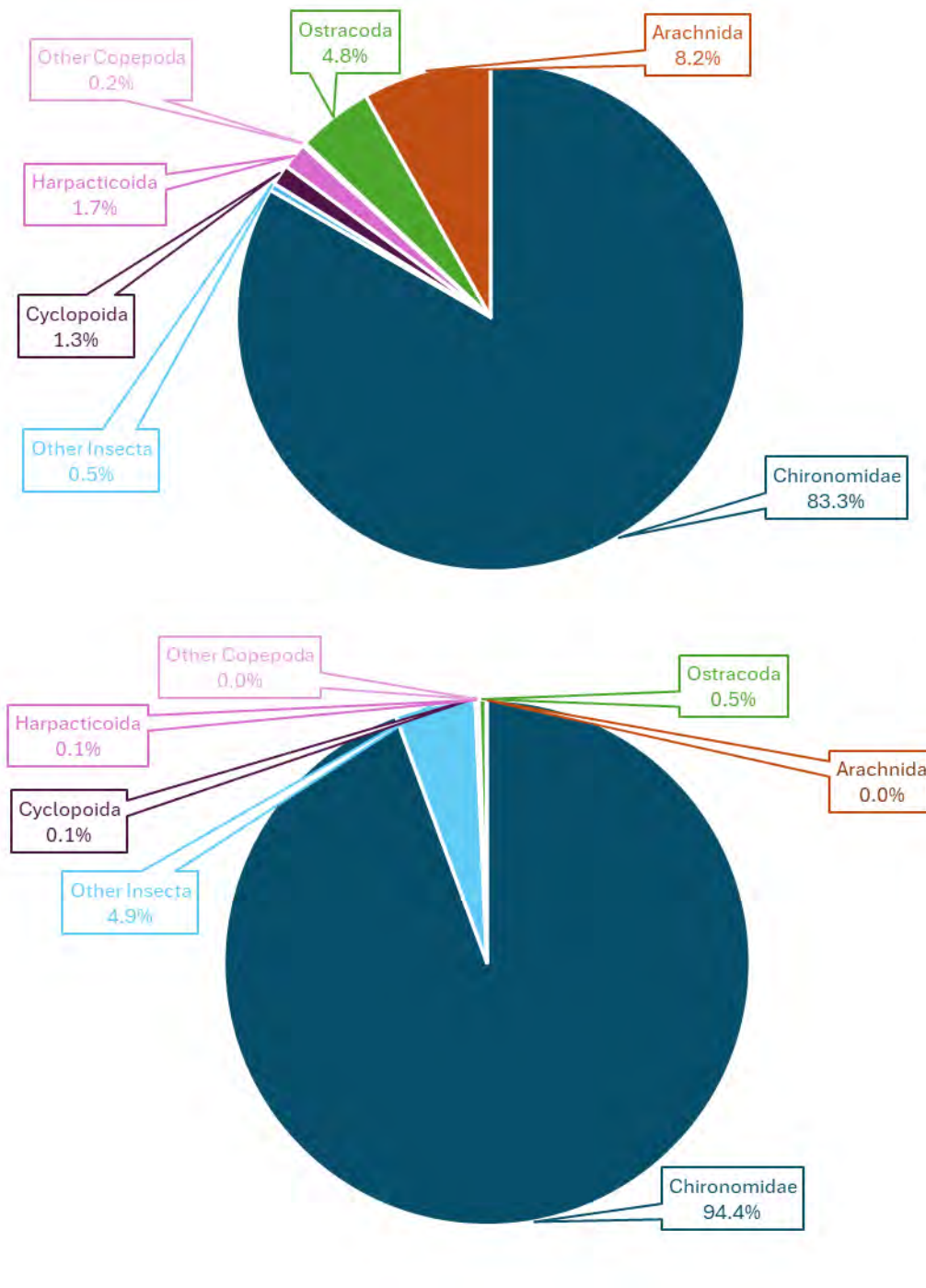


Figure 17. The relative frequency (top) and relative biomass (bottom) of prey taxa identified from Ninespine Stickleback stomachs.

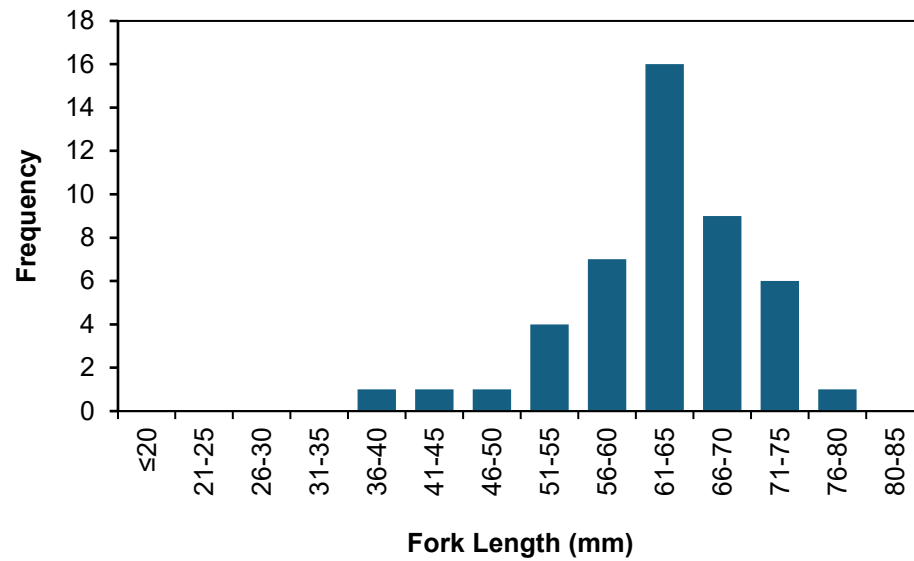
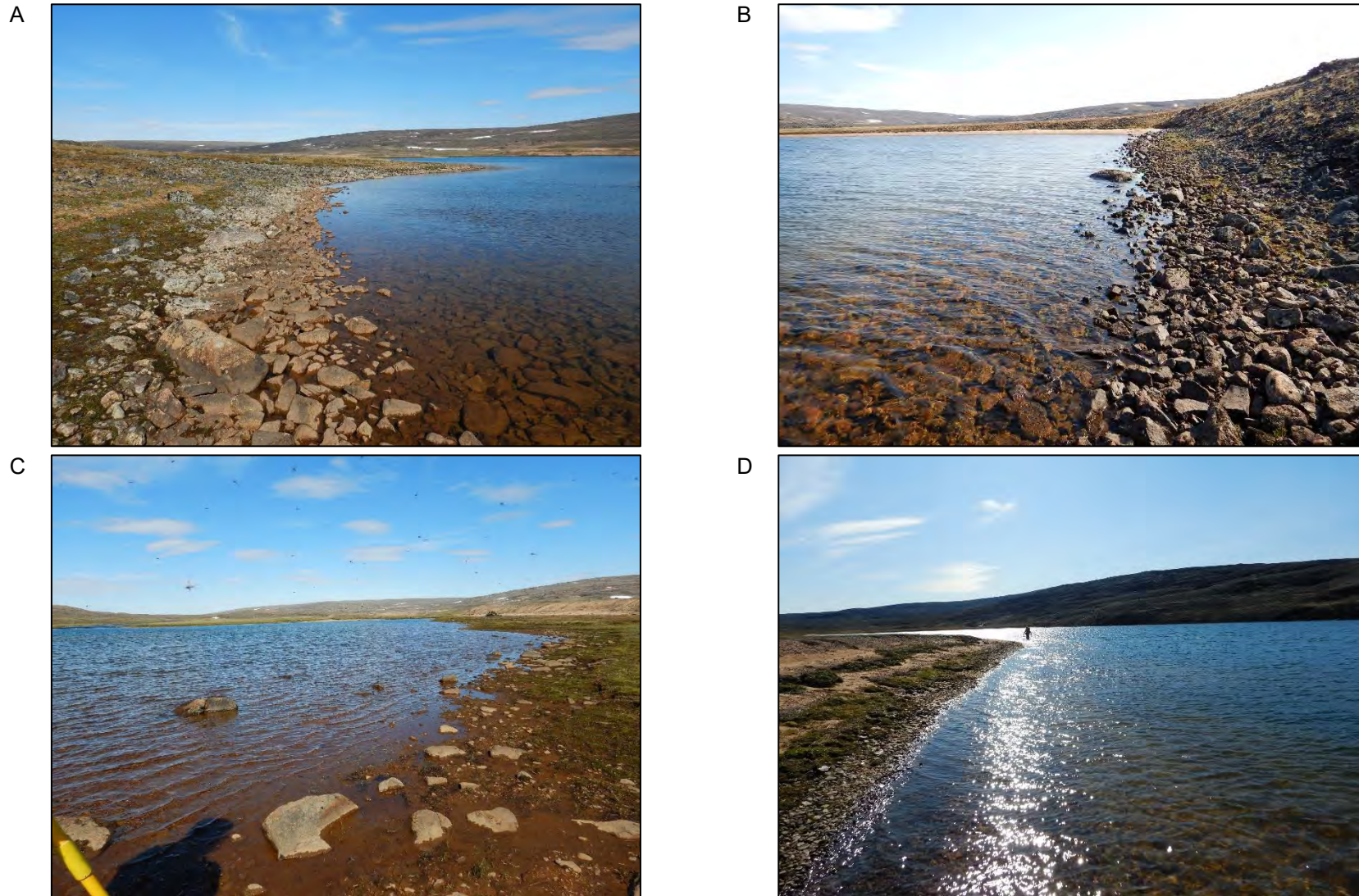
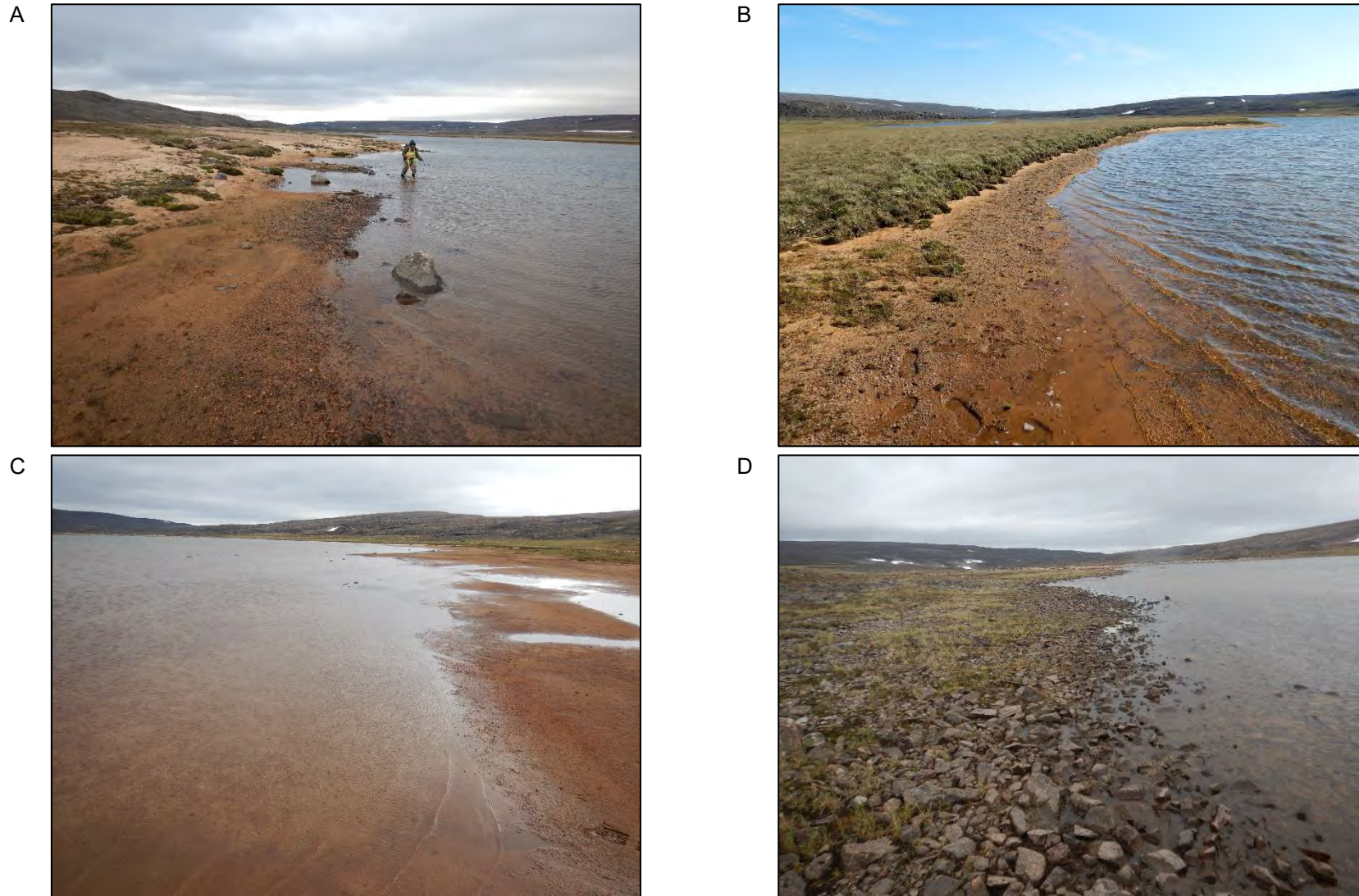


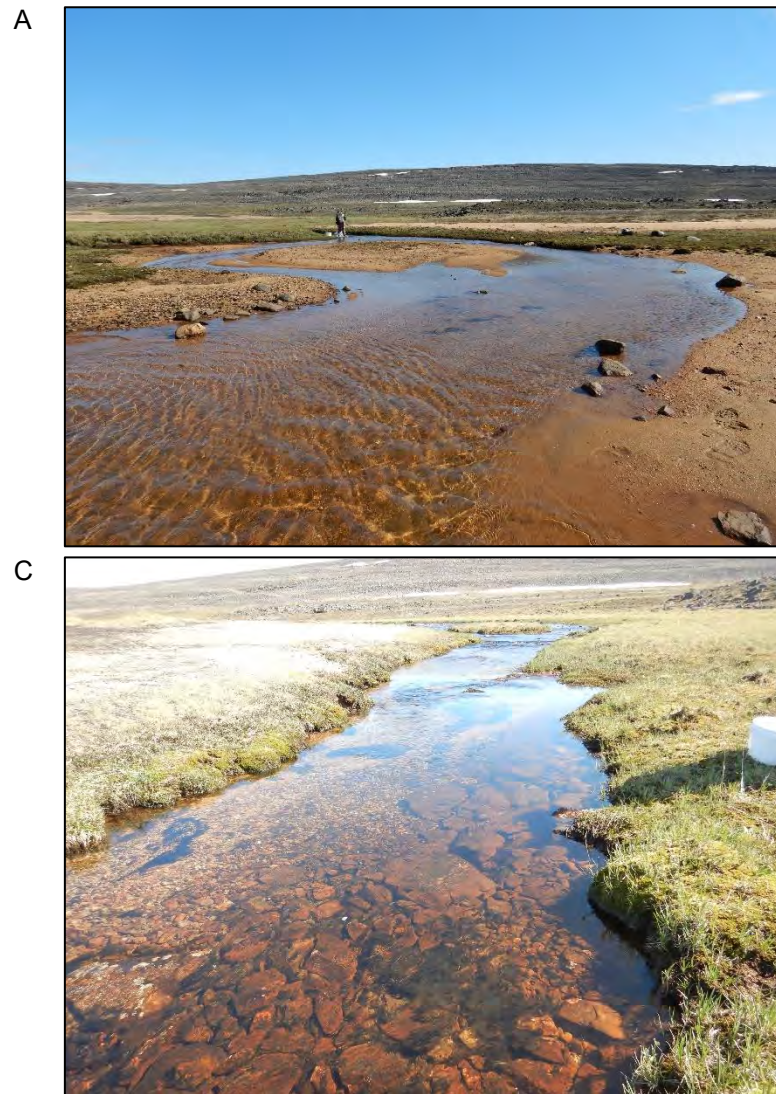
Figure 18. Length-frequency distribution for Ninespine Stickleback captured in minnow traps in KP85 Lake.



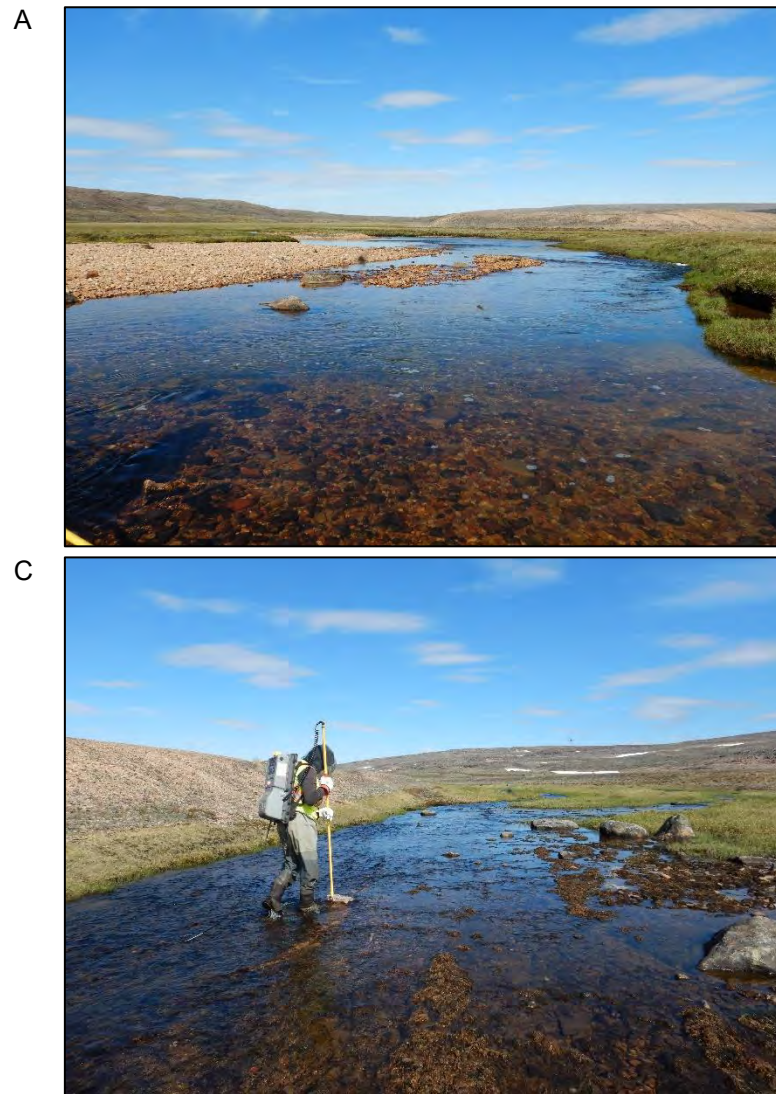
Photograph 3. Photographs of nearshore electrofishing sites in KP85 Lake: (A) Site EF-107; (B) Site EF-112; (C) Site EF-104; and (D) Site EF-02.



Photograph 4. Photographs of nearshore electrofishing sites in KP85 Lake: (A) Site EF-115; (B) Site EF-105; (C) Site EF-118; and (D) Site EF-11.



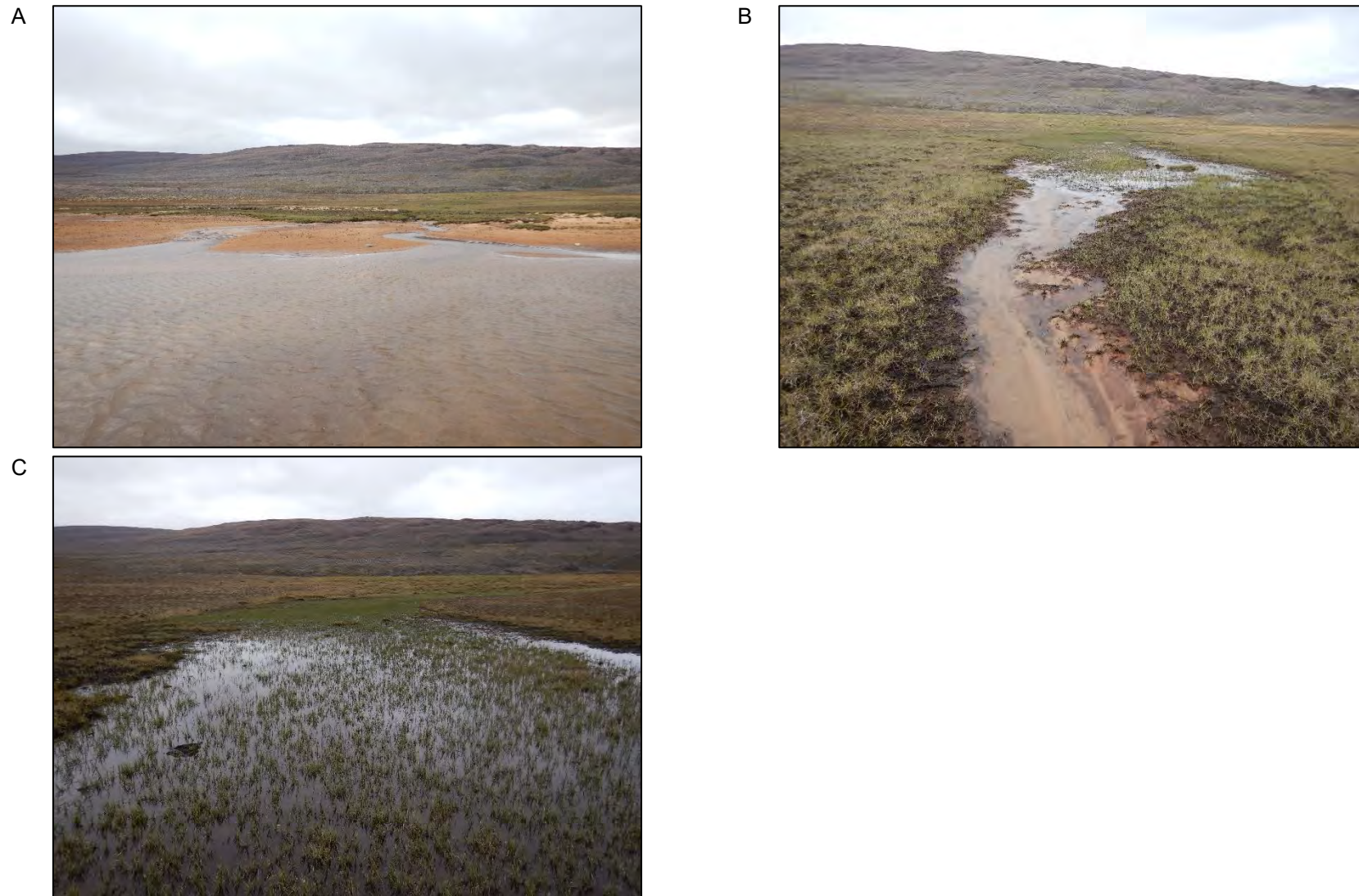
Photograph 5. Photographs of KP85 Lake tributary KP85-S2: (A) stream mouth; (B) 50 m upstream; and (C) 100 m upstream.



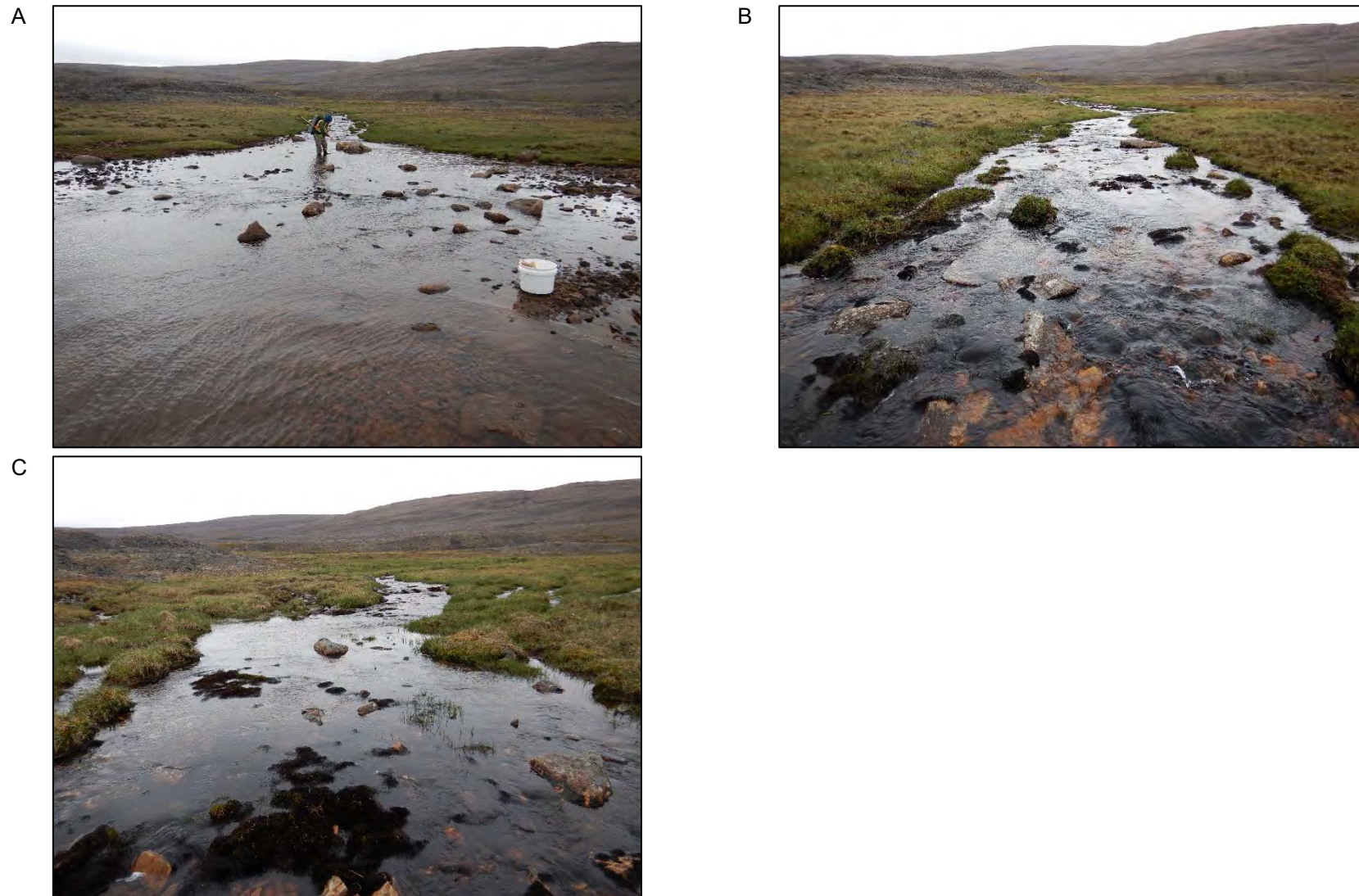
Photograph 6. Photographs of KP85 Lake tributary KP85-S1: (A) stream mouth; (B) 50 m upstream; and (C) 100 m upstream.



Photograph 7. Photographs of KP85 Lake tributary CV-080-1c: (A) stream mouth; (B) 50 m upstream; and (C) 100 m upstream.



Photograph 8. Photographs of KP85 Lake tributary CV-081-4a: (A) stream mouth; (B) 50 m upstream; and (C) 100 m upstream.



Photograph 9. Photographs of KP85 Lake tributary CV-081-5a: (A) stream mouth; (B) 50 m upstream; and (C) 100 m upstream.



Photograph 10. Ninespine Stickleback #1023 with missing right eye.



Photograph 11. Ninespine Stickleback #1024 infected with the internal parasites *Schistocephalus pungitii*.

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