



REPORT

Chapter 7.0 Fish Health and Tissue Chemistry

2024 Milne Port Marine Environmental Effects Monitoring Program (MEEMP) and Non-Indigenous Species/Aquatic Invasive Species (NIS/AIS) Monitoring Program

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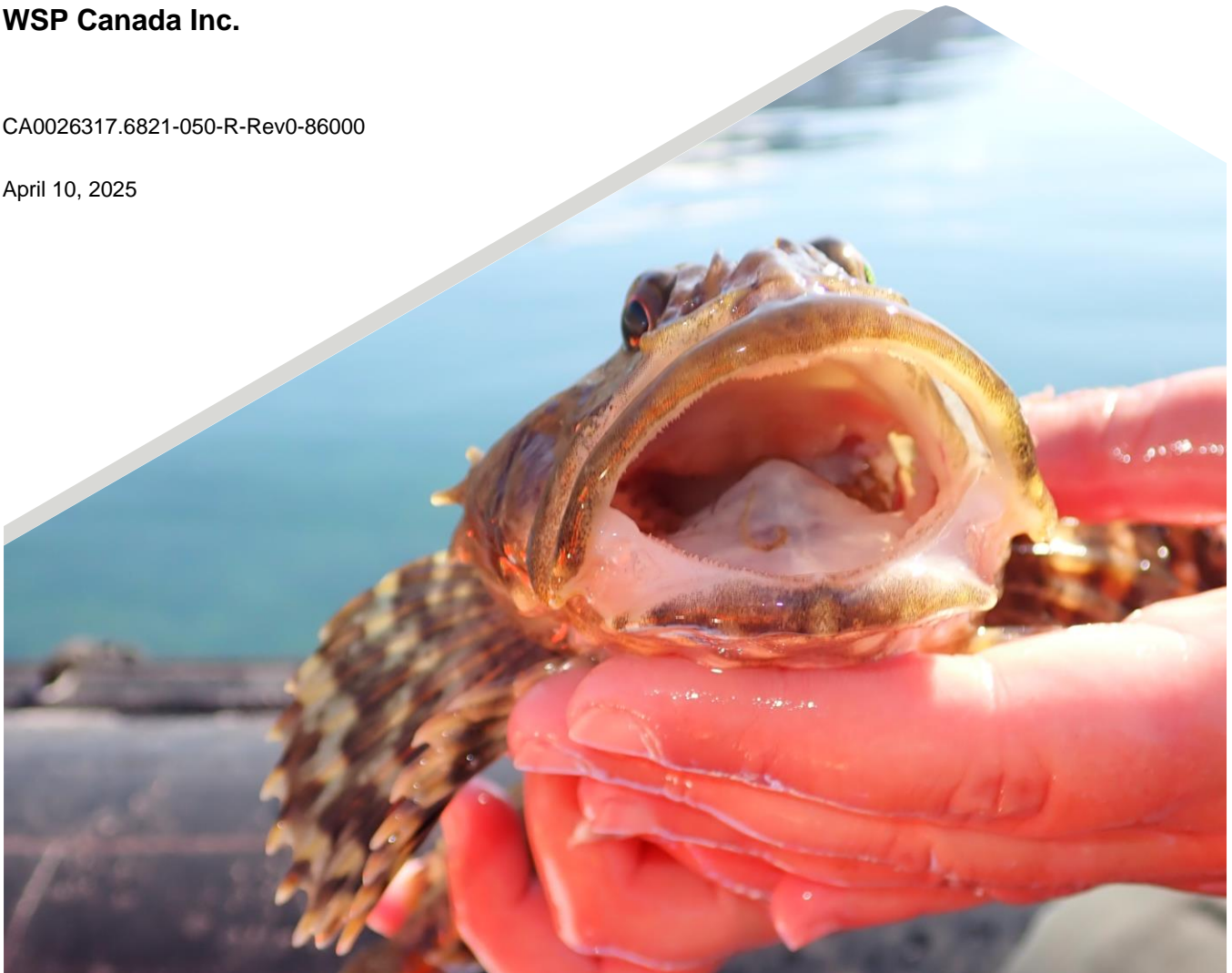


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APPENDICES

APPENDIX 7A

Fish Health Data

APPENDIX 7B

Fish Tissue Data

APPENDIX 7C

Fish Tissue Boxplots

APPENDIX 7D

Reference Area Supporting Environmental Data

APPENDIX 7E

Certificates of Analysis

ACRONYMS AND ABBREVIATIONS

Acronym or Abbreviation	Definitions
ANCOVA	analysis of covariance
ANOVA	analysis of variance
BC MOE	British Columbia Ministry of Environment
Biologica	Biologica Environmental Services Ltd.
BV labs	Bureau Veritas Laboratories
CES	critical effect size
COC	chain of custody
COPCs	constituents of potential concern
CRC ICPMS	collision reaction cell inductively coupled plasma mass spectrometry
DL	detection limit
dw	dry weight
EEM	Environmental Effects Monitoring
FEIS	2012 Final Environmental Impact Statement
g	gram
GAM	generalized additive model
GSI	gonadosomatic index
km	kilometre
K-S Test	Kolmogorov-Smirnov test
log ₁₀	log ₁₀ -transformed data
LR	Linear regression
LSI	liver somatic index
MDMER	Metal and Diamond Mining Effluent Regulations
MEEMP	Marine Environmental Effects Monitoring Program
mg/kg	milligrams per kilogram
nm	milligram
min	minimum
max	maximum
MSI	mantle somatic index
n	sample size
n/a	not applicable
nc	not calculated

Acronym or Abbreviation	Definitions
PAH	polycyclic aromatic hydrocarbon
PC	Project Certificate
<i>P</i> -value	probability value
QA/QC	quality assurance and quality control
RPD	relative percent differences
SD	Standard Deviation
SE	Standard Error
SR	studentized residuals
TARP	Trigger Action Response Plan
ww	wet weight

7.0 FISH HEALTH AND TISSUE CHEMISTRY

7.1 Introduction

This chapter presents the results of the 2024 fish health and tissue chemistry monitoring program, a component of the larger Marine Environmental Effects Monitoring Program (MEEMP) conducted in Milne Inlet during the 2024 open-water season. The fish health and tissue chemistry component was developed in consideration of the potential Project-related impacts to the marine environment as identified in the 2012 Final Environmental Impact Statement (FEIS) and subsequent addenda, as well as monitoring requirements outlined in the Project Certificate (PC) Conditions described in Chapter 1.0, Table 1-2. Those conditions related to the monitoring of fish health include PC Conditions No. 76, 83 (a), 99 (a), 113, and 114; a summary of monitoring components addressing specific PC conditions is presented in Table 7-1.

Table 7-1: Summary of Monitoring Components Addressing Project Certificate (PC) Conditions Related to Fish Health and Tissue Chemistry

PC Condition	Description	Monitoring Component
76	The Proponent shall develop a comprehensive Environmental Effects Monitoring Program to address concerns and identify potential impacts of the Project on the marine environment.	Fish Health & Tissue Chemistry – Spatial and Temporal Comparisons
83(a)	The Proponent shall [...] in the Milne Inlet Port area [...] determine the potential impacts arising from disturbance to sediments including re-suspension and subsequent transport and deposition of sediment. [...]. The monitoring program shall include an ongoing assessment of the potential introduction of metals that bio-accumulate in the marine food chain.	Tissue Chemistry – Temporal Comparisons
87	The Proponent shall develop a detailed monitoring program at a number of sites over the long term to evaluate changes to marine [...] organisms [...]. This program needs to be able to detect changes that may have biological consequences and [...] collect sufficient baseline data and should continue over the life of the Project.	Fish Health & Tissue Chemistry – Temporal Comparisons
99(a)	Establish shipping season, inter-annual baseline in [...] Milne Inlet that enables effective monitoring of physical and chemical effects of ballast water releases, sewage outfall, and bottom scour by ship props [...]. This shall include the selection and identification of [...] biological community/indicator components [...] including] both pelagic and benthic species but with emphasis on relatively sedentary benthic species (e.g., sculpins).	Arctic Char (pelagic) Fourhorn Sculpin (benthic) <i>Hiatella arctica</i> (benthic) Fish Health & Tissue Chemistry – Spatial and Temporal Comparisons
113	The Proponent shall conduct monitoring of marine fish and fish habitat, which includes but is not limited to, monitoring for Arctic Char stock size and health condition in Steensby Inlet and Milne Inlet, as recommended by the MEWG.	Arctic Char Fish Health – Temporal Comparisons
114	In the event of the development of a commercial fishery in the [...] Milne Inlet-Eclipse Sound [area], the Proponent [...] shall update its monitoring program for marine fish and fish habitat to ensure that the ability to identify Arctic Char stock(s) potentially affected by Project activities and monitor for changes in stock size and structure of affected stocks and fish health (condition, taste) is maintained to address any additional monitoring issues identified by the MEWG relating to the commercial fishery.	Arctic Char Fish Health – Temporal Components

Project Certificate (PC) Condition descriptions have been edited for conciseness and relevance to Milne Inlet: text that has been edited or removed is indicated using square brackets, [...].

MEWG = Marine Environment Working Group.

7.1.1 Objectives

The MEEMP objectives are outlined in Section 1.3 for the overall program. The objectives specific to the fish health and tissue chemistry component are:

- Better align the MEEMP with the Metal and Diamond Mining Effluent Regulations (MDMER) Environmental Effects Monitoring (EEM) program (Government of Canada 2002) through the selection of sentinel species, measurements of additional health indicators to monitor for effects from the Project, and comparisons with local reference areas.
- Evaluate the health of the sentinel species, Fourhorn Sculpin (*Myoxocephalus quadricornis*) and Wrinkled Rock-Borer (*Hiatella arctica*), through the assessment of established endpoints (see Section 7.2), length-frequency distributions, length-weight relationships, and visual assessment of internal and external abnormalities.
- Compile current and previously collected tissue chemistry data for Arctic Char (*Salvelinus alpinus*), Fourhorn Sculpin, and *H. arctica*, and assess concentrations of constituents of potential concern (COPCs) associated with the Project.

7.2 Study Design

The fish health and tissue chemistry components of the MEEMP were designed to monitor for potential Project-related impacts and changes to fish health and communities through collection of fish population data. Fish were collected using a combination of active and passive fishing methods, and sentinel species were assessed through health assessments and the analysis of tissue chemistry parameters. Incidental mortalities of Arctic Char were also included in the fish health assessment.

During baseline and early MEEMP surveys, fish tissue sampling was limited to incidental Arctic Char mortalities, the numbers of which fluctuated from year to year and did not always yield adequate samples to support a meaningful statistical analysis. In 2018, a local shellfish species (*H. arctica*) was added to the MEEMP as an additional effects indicator for the fish sampling program. *Hiatella arctica* is a resident species in the Project area, easily identifiable and measurable in the field, and abundant in the study area (Golder 2018). Measurement endpoints for *H. arctica* in 2018 and 2019 included age and tissue chemistry analysis.

In 2020, changes to the fish health and tissue chemistry program were implemented to better align the MEEMP with the Metal and Diamond Mining Effluent Regulations (MDMER) Environmental Effects Monitoring (EEM) program (Government of Canada 2002). While the Milne Port is not subject to the MDMER, the study design for the MEEMP was based on this framework as a best-practice reference for environmental effects monitoring. Fourhorn Sculpin and *H. arctica* were selected as sentinel species to monitor for effects from the Project. Lethal target sample sizes were established for Fourhorn Sculpin and *H. arctica* as part of the 2020 fish health program. Fish health effect indicators included measures of energy use (i.e., growth, reproduction), energy storage (i.e., condition) and survival (i.e., age), in addition to supporting endpoints (as appropriate for each species) such as length, body weight, the prevalence of external and internal abnormalities, organ weights, stomach fullness, parasite presence/absence, sex, life stage, and state-of-maturity (Section 7.4.1). In 2023, relative shell weight was added as an endpoint for *H. arctica* to better align the MEEMP program with MDMER EEM endpoints.

For fish tissue chemistry, concentrations of total metals¹ and polycyclic aromatic hydrocarbons (PAHs) were measured (Section 7.4.2; Appendix 7A) from each species (i.e., Arctic Char, Fourhorn Sculpin, and *H. arctica*) and compared to MEEMP data from previous years, where possible. Historical data available for comparison varied for each species, with data extending intermittently back to 2010 for Arctic Char, and back to 2018 for Fourhorn Sculpin and *H. arctica*.

7.2.1 Modifications to the Program (2024)

Reconnaissance surveys were undertaken in 2021, 2022, and 2023 with the goal of identifying a suitable reference area (Golder 2022, 2023; WSP 2024). Based on results of these surveys, suitable reference areas for Fourhorn Sculpin and *H. arctica* have been identified and implemented as part of the MEEMP. Tugaat River Estuary was previously identified as a suitable reference area for *H. arctica*, as sufficient numbers of individuals were captured to support the monitoring program. Results of the 2023 reconnaissance surveys indicated that Koluktoo Bay hosts a sufficient population of Fourhorn Sculpin to function as a reference area for this species. Therefore, in 2024 as in 2023, Koluktoo Bay and Tugaat River Estuary served as reference locations to support spatial comparisons, consistent with MDMER EEM program requirements, for fish health and tissue chemistry endpoints.

No other significant modifications were made to the fish health and tissue chemistry MEEMP component in 2024.

7.2.2 Indicators and Thresholds

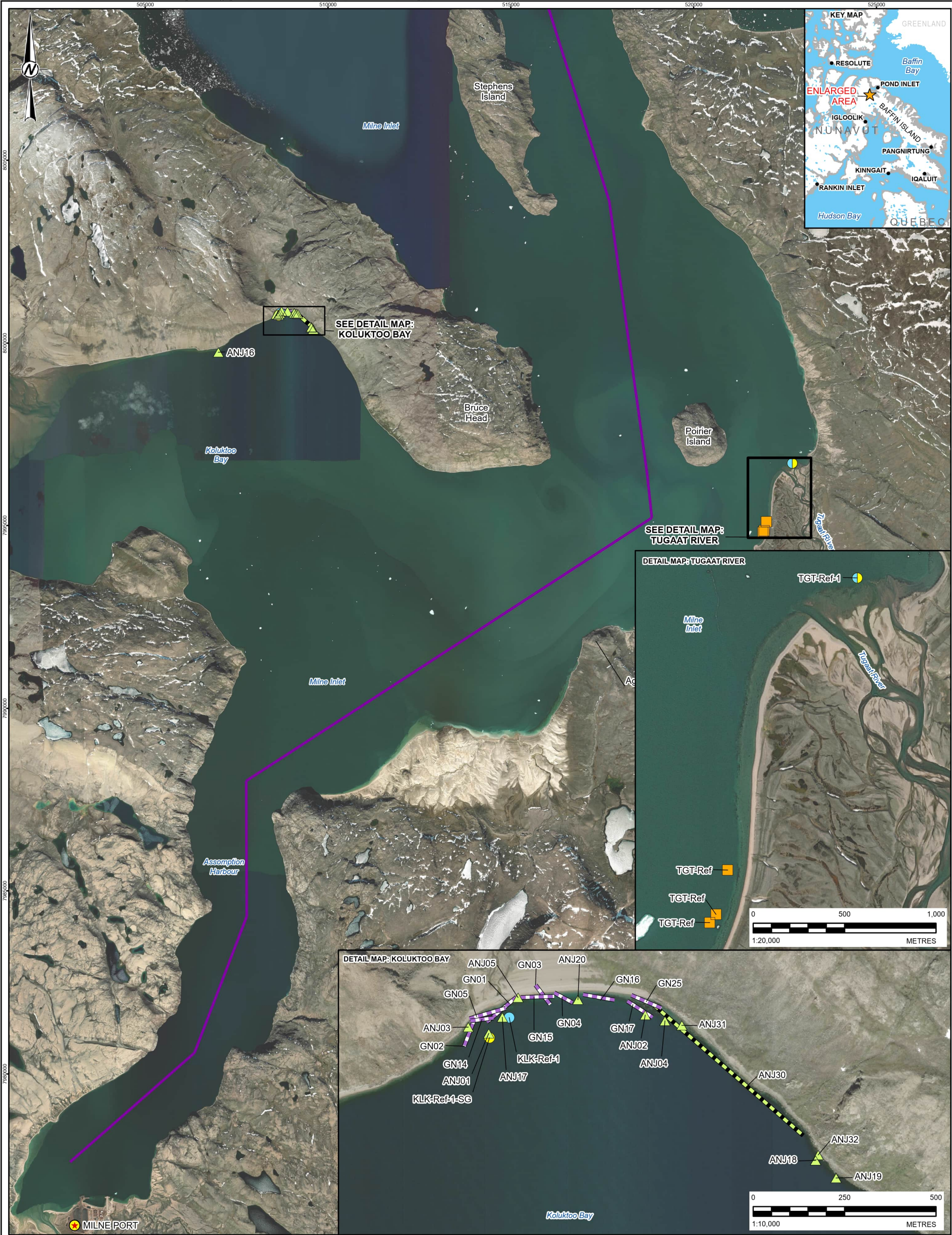
Along with several other components of the MEEMP, the fish health monitoring program has indicators, thresholds and risk categories that are part of Baffinland's Trigger Action Response Plan (TARP), an adaptive management process. The TARP uses effect indicators that are measured against a series of tiered thresholds (i.e., low, moderate and high-risk thresholds) that are designed to guide short-term and long-term adaptive management strategies as outlined in Baffinland (2024). The pre-defined actions identified in the TARP describe the responses that Baffinland would implement should the corresponding threshold levels be exceeded and assuming there is some degree of certainty that the measured change is Project-related. As adaptive management is beyond the scope of the present report, only the indicators, condition statuses, and thresholds are presented here (Section 1.4).

7.3 Materials and Methods

7.3.1 Sampling Areas

Fish health sampling occurred in 2024 in three areas: (1) near Milne Port (17W 503700m E, 7976400m N), approximately 80 km northwest of the Mary River Project (Figures 6-1 to 6-4), (2) in Koluktoo Bay, and (3) in Tugaat River Estuary (Figure 7 1). The latter two areas represent two reference areas to support the fish health program of the MEEMP.

¹ Includes metals, metalloids, and non-metals. Metals are broadly defined as elements which are good conductors of electricity and heat, which form cations by loss of electrons, and which yield basic oxides and hydroxides (Wood et al. 2012). Metalloids share some but not all properties of metals, while non-metals mostly lack characteristics of metals.



- LEGEND**
- COMMUNITY
 - ★ MILNE PORT
 - APPROXIMATE SHIPPING ROUTE
 - WATERBODY
- 2024 FISH HEALTH RECON STATIONS**
- ▲ ANGLING EFFORT
 - *Hiattella arctica* SAMPLING LOCATION
 - SEDIMENT QUALITY
 - WATER QUALITY
 - WATER QUALITY/SEDIMENT QUALITY
 - ANGLING EFFORT
 - GILL NET EFFORT

REFERENCE(S)
SHIPPING ROUTE DATA BY CLIENT, JULY 14, 2020. HYDROGRAPHY, POPULATED PLACE, AND PROVINCIAL BOUNDARY DATA OBTAINED FROM GEOGRATIS, © DEPARTMENT OF NATURAL RESOURCES CANADA. ALL RIGHTS RESERVED. IMAGERY COPYRIGHT © 2024/07/18 ESRI AND ITS LICENSORS. SOURCE: MAXAR. USED UNDER LICENSE. ALL RIGHTS RESERVED.
PROJECTED COORDINATE SYSTEM: NAD 1983 UTM ZONE 17N

CLIENT
BAFFINLAND IRON MINES CORPORATION

PROJECT
MARY RIVER PROJECT

TITLE
SAMPLING LOCATIONS IN KOLUKTOO BAY AND TUGAAT RIVER ESTUARY, MEEMP 2024

CONSULTANT	YYYY-MM-DD	2025-04-10
	DESIGNED	NZ
	PREPARED	AA
	REVIEWED	CA
	APPROVED	NZ

PROJECT NO. CA0026317.6821	CONTROL 86200.04	REV. 0	FIGURE 7-1
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Milne Port is located at the southern end of Milne Inlet, within a narrow fjord, surrounded by relatively steep, bedrock slopes. Fish habitat is composed mainly of coarse rock substrates (i.e., boulders with sparse cobbles) near the Ore Dock, and open-water habitat in the Milne Inlet. Sculpin species, including Fourhorn Sculpin and Shorthorn Sculpin (*Myoxocephalus scorpius*), are relatively abundant at Milne Port, as are Arctic Char (see Chapter 6.0 for further information).

The reference area for Fourhorn Sculpin is located in Koluktoo Bay (17X 506100m E, 7997100m N), approximately 20 km north of Milne Port. The Robertson River, which has formed a relatively large, sandy delta, feeds into Koluktoo Bay along the western shore. The remainder of the bay is bordered by gently sloping bedrock to the north, and steeper bedrock slopes to the south. Fish habitat is composed of a mixture of coarse rocks, cobbles, and fine sediments, comprising long, shallow, sandy littoral habitat and boulder/cobble reefs, prior to dropping off into deeper habitat. Previous reconnaissance surveys captured Fourhorn Sculpin, Shorthorn Sculpin, and Arctic Sculpin (*Myoxocephalus scorpioides*) in Koluktoo Bay (WSP 2023).

The reference area for *H. arctica* was located near Tugaat River Estuary (17X 522700m E, 7996700m N), approximately 28 km northeast of Milne Port, where the Tugaat River enters Milne Inlet. Substrates in Milne Inlet near Tugaat River Estuary were primarily fine sediments, being mainly composed of sand with some cobble.

Field Methodology

Arctic Char and Fourhorn Sculpin

Finfish community sampling was conducted at various locations near Milne Port and along the north shore of Koluktoo Bay, from 3 to 19 August 2024 (Figure 6-1 to Figure 6-5). Fishing effort included both active (i.e., angling by jigging, and trawling) and passive (i.e., hoop nets and gillnetting) capture methods. Captured fish were enumerated and measured for length and weight. Capture methods are described in detail in Section 6.4.1.3 of Chapter 6.0.

In Milne Port, captured Arctic Char were processed as part of the Marine Fish Community Program (Chapter 6.0). Incidental mortalities of Arctic Char were retained for analysis of age, stomach contents, and tissue metals concentrations. A subsample of 40 Fourhorn Sculpin captured in Milne Port were retained for fish health sampling to meet target sample sizes of 20 adult males and 20 adult females. Results of these analyses for Arctic Char are presented herein, with biometric measurements included, where relevant, as supporting information. At Koluktoo Bay, a subsample of 39 Fourhorn Sculpin captured were retained for fish health sampling, resulting in a total 20 female and 19 male fish. All other fish were released alive back to Milne Inlet at their location of capture.

The primary method of capture for Fourhorn Sculpin in 2024 was angling. Angling (i.e., jigging) efforts were focused on the western and eastern sides of the Ore Dock in coarse rock habitat at depths between 1 m and 5 m (consistent with previous years). Fishers angled by jigging from a stationary position, with two to five rods and lines deployed from the field vessel anchored adjacent to the riprap. Hooks or spoon lures (i.e., flashers) were lowered into the riprap at the target depth, then flicked upward to attract fish within the coarse rock habitat.

Hiattella arctica

Hiattella arctica were collected opportunistically from benthic infauna samples, with a target subsample of 40 individuals retained from each sampling area (i.e., Milne Port and Tugaat River Estuary) for fish health and tissue chemistry sampling. A total of 40 *H. arctica* were collected from Milne Port, while a total of 29 *H. arctica* were collected from Tugaat River Estuary. Collection methods for benthic infauna are described in Section 4.3.1 in Chapter 4.0. Each benthic sample was checked for the presence of *H. arctica*. In Milne Port, samples to be

retained for the fish health and tissue chemistry program were obtained from benthic grab samples collected from the northwestern, western, eastern, and northeastern transects (Figure 3-1). For both sampling areas, a maximum of five individuals were selected when benthic grab samples contained the greatest numbers of *H. arctica*. Specimens were selected for processing if the shell was intact, greater than 15 mm in length, and had no indications of damage to the umbo or hinge area.

7.3.2 Fish Processing

Arctic Char and Fourhorn Sculpin

Incidental mortalities of Arctic Char occurring as a result of fish community surveys (Chapter 6) collected in Milne Port were retained for processing. Fourhorn Sculpin that were retained for fish health sampling were held live in aerated 70 litre totes containing water from the captured location until they were lethally processed at Milne Port. Both external and internal assessments were completed on lethally sampled fish following standardized procedures consistent with MDMER EEM program requirements (Environment Canada 2012). Total lengths (± 1 mm) and total body weights (± 0.001 g) of the fish were documented, and external observations of fish features (i.e., body form, eyes, skin, thymus, opercula, gills, pseudobranchs, fins, vent, and parasites) were recorded. Abnormal features (e.g., wounds, tumours, parasites, fin fraying, gill parasites, or lesions) were documented and photographed. Fish were sacrificed by a concussive blow to the head followed by cervical dislocation (i.e., cutting the spinal cord behind the head). Each fish was handled using new nitrile gloves and dissected on a cutting board covered in a clean sheet of plastic wrap that was changed between fish. The condition of the internal organs (e.g., liver, spleen, gall bladder, and kidneys) was assessed immediately after opening the body cavity and documented. Any abnormalities in size, shape, or colouration of the internal organs were documented. Liver weight and an estimate of percent mesenteric fat were recorded. The gonads of each fish were removed, weighed (± 0.001 g), and photographed before assigning sex and maturity stage, based on the macroscopic features described in Table 7-2. Parasite presence and predominance were recorded, and parasite weight was documented if large parasites (e.g., tapeworms) were observed in the body cavity.

Stomachs, ageing structures (i.e., otoliths²), and dorsal muscle tissue samples were collected from Arctic Char and Fourhorn Sculpin. Sagittal otoliths were extracted as the primary aging structure, wrapped in parchment paper, and stored dry in individually labelled coin envelopes until submission for aging analysis. Stomach fullness was recorded, and the stomachs were removed, placed in individually labelled Nalgene containers, and preserved with 10% formalin. For Arctic Char and Fourhorn Sculpin, one muscle sample (> 10 g) without skin was collected from the left dorsal side of each fish using a fillet knife rinsed with 10% nitric acid then deionized ultrafiltered water. The fillets were weighed (± 0.001 g), placed on ice in individually labelled Whirlpack bags, and stored frozen until submission for metals analysis. A second muscle sample (> 10 g) without skin was collected from the right dorsal side of each fish using a fillet knife rinsed with acetone then deionized ultrafiltered water. The fillets were weighed (± 0.001 g) on tared aluminum foil, wrapped in aluminum foil, placed on ice in individually labelled Whirlpack bags, and stored frozen for PAH analysis.

² Otoliths are paired bony structures located behind the eyes in fish. Counting the annual growth rings on the otoliths is a common technique in estimating the age of many fish species.

Hiatella arctica

Those *H. arctica* retained for fish health sampling were selected based on the external condition of the shell (i.e., > 15 mm long with intact valves and no visible damage to the umbo). Individuals were measured along the largest axis (± 1 mm), weighed (± 0.001 g), and then placed on ice in individually labelled Whirlpack bags and stored frozen until submitted for further processing and tissue chemistry analysis.

Table 7-2: Gonad Maturity Stages for Male and Female Fish Used During the Fish Health Assessment, 2024

Sex	Stage	Code	Macroscopic features
Female	Unknown stage	10	Unable to determine stage.
	Immature	11	Small ovaries, often clear, blood vessels indistinct.
	Early Stage Development	12	Enlarging ovaries, blood vessels more distinct. Granular in appearance.
	Late Stage Development	13	Large ovaries filling the body cavity, prominent blood vessels. Individual oocytes visible.
	Ripe	14	Eggs released with gentle pressure on abdomen.
	Spent	15	Deflated ovaries, blood vessels prominent.
	Reabsorbing	16	Small atretic oocytes throughout the ovaries, which are hard and white.
	Resting	17	Small ovaries, blood vessels reduced but present.
Male	Unknown stage	20	Unable to determine stage.
	Immature	21	Small testes, often clear and threadlike.
	Early Stage Development	22	Small testes, semi-translucent, but easily identified.
	Late Stage Development	23	Testes large, firm, and lobate. White to purplish in colour. Granular appearance.
	Ripe	24	Milt released with gentle pressure on abdomen.
	Spent	25	Small and deflated testes. Blood vessels obvious. Violet-pink in colour.
	Reabsorbing	26	Not typically observed in males.
	Resting	27	Small testes, often threadlike.

Notes: Table modified from Brown-Peterson et al. (2011).

7.3.3 Laboratory Methodology

Samples collected from both fish species and *H. arctica* were submitted for laboratory analysis. For Arctic Char and Fourhorn Sculpin (Section 7.3.2.1), muscle samples were submitted for tissue chemistry analysis, stomachs were submitted for contents analysis, and ageing structures were submitted for age determination. Collected *H. arctica* (i.e., whole animals) were sent to a laboratory specialized in marine invertebrates for additional processing (per Section 7.3.3.2.1) and subsequent submission of tissues for tissue chemistry analysis.

7.3.3.1 Arctic Char and Fourhorn Sculpin

7.3.3.1.1 Age

Otoliths extracted from Arctic Char and Fourhorn Sculpin, were examined by North/South Consultants Inc. (Winnipeg, MB) to determine the age of the fish. Whole otoliths from individual fish were mounted on microscope slides to estimate age based on the number of annuli (i.e., growth rings) visible under a dissecting microscope. To verify that data quality objectives were met, 10% of fish age estimates were independently verified by a second qualified biologist.

7.3.3.1.2 Stomach Contents

Enumeration and taxonomic identification of stomach contents for Arctic Char and Fourhorn Sculpin were conducted by Biologica. Percent fullness and percent digestion was recorded for each stomach before dissection and identification based on the professional judgement of the taxonomist. Prey items were identified to the lowest practical taxonomic level (i.e., to species when possible) using published methods and taxonomic references. Digested and unidentifiable materials were categorized (e.g., unidentified insect parts, digested tissue, non-food, and others). The taxonomic composition within each stomach was determined as percentages of major invertebrate groups by abundance.

7.3.3.1.3 Tissue Chemistry

Muscle tissue samples collected from eight Arctic Char and eight Fourhorn Sculpin from Milne Port area and from eight Fourhorn Sculpin from Koluktoo Bay were submitted to Bureau Veritas Laboratories (BV Labs; Burnaby, BC) for tissue chemistry analyses (Appendix 7A, Table 7A-1). Moisture content and metals concentrations were measured; moisture content was determined by oven drying and metals concentrations were determined by collision reaction cell inductively coupled plasma mass spectrometry. Concentrations of PAHs were determined by gas chromatography mass spectrometry.

7.3.3.2 *Hiatella arctica*

7.3.3.2.1 Processing and Age Determination

Frozen *H. arctica* were processed by Biologica. *Hiatella arctica* were measured for total length, total width, and total weight, as well as wet weight (ww) of the whole organism, shells, soft tissues, and gonads. Shell dry weight (dw) was also measured. Ages of *H. arctica* were determined using shells.

For *H. arctica* ageing, each shell was sectioned through the umbo-rim axis using a lapidary saw with a diamond-impregnated blade and polished using progressively finer grit sandpaper. Polished shells were etched in a solution of 1% hydrochloric acid for one minute, rinsed with tap water, and dried. An acetate peel of the polished umbo surface was mounted on a slide and examined using a dissecting microscope. Distinct, continuous growth lines were counted to determine the age of the shell. To verify that data quality objectives were met, 10% of *H. arctica* age estimates were independently verified by a second qualified biologist.

7.3.3.2.2 Tissue Chemistry

A total of eight *H. arctica* composite soft tissue samples were submitted to BV Labs for tissue chemistry analyses (Appendix 7B, Table 7B-1). *Hiatella arctica* composites were composed of two to three individuals to satisfy weight requirements for metals analysis (Appendix 7B, 7B-2). For PAH analysis, no *H. arctica* composite samples were submitted in 2024 in order to maximize the number of samples that could be submitted for metals analysis, due to mass requirements for metals analysis (Appendix 7B, 7B-2 and 7B-8). PAH concentrations in *H. arctica* have consistently been below DL in previous programs. Concentrations of metals and PAHs and the percent moisture content were determined using the same methods as described in Section 7.3.3.1.3.

7.3.4 Data Analysis

Descriptive statistics (i.e., sample size, mean, median, standard deviation [SD], standard error [SE], minimum, and maximum values) were calculated for fish health and tissue chemistry data collected in 2024, as well as fish health endpoints and tissue concentrations of metals and PAHs in Arctic Char, Fourhorn Sculpin, and *H. arctica* available from 2018 to 2023.

Fish health indices for Arctic Char and Fourhorn Sculpin were calculated as follows:

$$\text{Condition factor} = \left(\frac{\text{total weight}}{\text{total length}^3} \right) \times 100,000$$

Additional fish health indices calculated for Fourhorn Sculpin were as follows:

$$\text{Gonadosomatic index (GSI)} = \left(\frac{\text{gonad weight}}{\text{total weight}} \right) \times 100$$

$$\text{Liver somatic index (LSI)} = \left(\frac{\text{liver weight}}{\text{total weight}} \right) \times 100$$

Fish health indices for *H. arctica* were calculated as follows:

$$\text{Condition factor} = \left(\frac{\text{total wet weight}}{\text{total length}^3} \right) \times 10,000$$

$$\text{Mantle somatic index (MSI)} = \left(\frac{\text{gonad wet weight}}{\text{soft tissue wet weight} - \text{gonad wet weight}} \right) \times 100$$

Weight and length measurements were reported in units of grams (g) and millimetres (mm), respectively. For Arctic Char, total length measurements were not collected in 2022. Therefore, total lengths were estimated using fork length-total length formulas in Peet (1978).

7.3.4.1 Fish Health Endpoints

For Arctic Char, Fourhorn Sculpin, and *H. arctica*, fish health endpoints were compared using statistical methods. Comparisons were completed temporally (i.e., among years for the Milne Port) for all fish species, and spatially (i.e., between the Milne Port and the references areas in 2024) for Fourhorn Sculpin and *H. arctica*.

For all analyses, data were log₁₀- or rank-transformed prior to analysis if it increased the coefficient of determination (R^2) and/or satisfied model assumptions. Significant differences between years or sampling areas were determined using an alpha (α) of 0.10 (i.e., P -values ($[P] < 0.10$ were considered significant).

Arctic Char and Fourhorn Sculpin

Limited fish health data are available for Arctic Char, and thus condition factor was used as the main fish health endpoint for this species. Condition factor comparisons for Arctic Char were conducted by pooling sexes and life stages (i.e., juvenile, adult) to detect potential differences between 2021, 2022, 2023, and 2024. These data were pooled as sex and life stage information were not available for individual fish from all sampling years. Trends in condition factor over time were assessed using a nonlinear regression model to account for nonlinear trends over time.

For Fourhorn Sculpin, comparisons were conducted separately by sex for the health endpoints presented in Table 7-3 to detect potential spatial differences between Milne Port and Koluktoo Bay in 2024. Comparisons between Milne Port and Koluktoo Bay were completed using general linear models. Differences in age were assessed using ANOVA. Differences in mean size-at-age, condition, relative liver weight, and relative gonad weight were assessed using analysis of covariance (ANCOVA). *Post hoc* comparisons among years for ANOVA and ANCOVA models were completed using Tukey's Honest Significant Difference test, with P -values adjusted for multiple comparisons (Tukey 1977).

In addition, temporal trend assessments were completed for fish health endpoints, separately by sex, for Fourhorn Sculpin captured in Milne Port in 2020, 2021, 2022, 2023, and 2024 at Milne Port. Trend assessments were completed using generalized additive models (GAM), an extension of general linear models that can incorporate nonlinear relationships (Wood 2017) between a dependent variable and predictor variables (i.e., sampling year). Temporal trend models were parameterized as:

$$y = \alpha + s(\text{Year}) + \varepsilon$$

where:

y is dependent variable,

α is the intercept,

$s(\text{Year})$ is the nonlinear effect of sampling Year, and

ε is the residual error.

Trends in age were assessed using a simple GAM model. Trends in mean size-at-age, condition, relative liver weight, and relative gonad weight, all of which depend on a linear covariate, were assessed on adjusted responses; ANCOVA models were used to adjust responses prior to trend assessments, using the following parameterization:

$$y = \alpha + \text{Year} + \text{Covariate} + \text{Year:Covariate}$$

where:

y is the response variable (e.g., total weight),

α is the intercept,

Year is the fixed, categorical effect of sampling Year,

Covariate is the fixed, continuous, linear effect of the covariate (e.g., age; Table 7-3), and

Year:Covariate is the interaction between sampling Year and the covariate.

Temporal trends were assessed based on the nonlinear Year effect in the GAM model: if this effect was significant, indicating significant temporal trends across sampling years, a *post hoc* slope trend test was used to assess trend significance during each sampling year.

Table 7-3: Statistical Procedures Used to Evaluate Fourhorn Sculpin Health Endpoints

Indicator	Endpoint	Response Variable (y)	Covariate (x)	Statistical Procedure
Spatial Comparisons				
Survival	Age	Age	n/a	ANOVA
Growth	Size-at-Age	Total Weight	Age	ANCOVA
Condition	Condition	Total Weight	Total Length	ANCOVA
	Relative Liver Weight	Liver Weight	Total Weight	ANCOVA
Reproduction	Relative Gonad Weight	Gonad Weight	Total Weight	ANCOVA
Temporal Comparisons				
Survival	Age	Age	n/a	GAM
Growth	Size-at-Age	Total Weight	Age	Covariate-adjusted GAM
Condition	Condition	Total Weight	Total Length	Covariate-adjusted GAM
	Relative Liver Weight	Liver Weight	Total Weight	Covariate-adjusted GAM
Reproduction	Relative Gonad Weight	Gonad Weight	Total Weight	Covariate-adjusted GAM

ANOVA = analysis of variance; ANCOVA = analysis of covariance; GAM = generalized additive model.

Shellfish

For *H. arctica*, statistical comparisons were conducted for fish health endpoints presented in Table 7-4 to detect potential spatial differences between Milne Port and Koluktoo Bay in 2024. Comparisons between Milne Port and Koluktoo Bay were completed using general linear models and nonparametric methods. Differences in length-frequency distributions between sampling areas were assessed using a two-sample Kolmogorov-Smirnov (K-S) test. This test compares the cumulative relative distributions of total length between years by comparing the maximum percent difference between the two cumulative relative frequency distributions to a critical value. The test assesses whether the maximum percent difference is large enough to indicate that the two distributions are from different populations. Differences in total weights (i.e., whole animal ww) were assessed using ANOVA. Differences in condition and reproduction endpoints were assessed using ANCOVA. *Post hoc* comparisons among years for ANOVA and ANCOVA models were completed using Tukey's Honest Significant Difference test, with *P*-values adjusted for multiple comparisons (Tukey 1977).

In addition, temporal trend assessments were completed for fish health endpoints for *H. arctica* collected in 2020, 2021, 2022, 2023, and 2024 at Milne Port. Trend assessments were completed using GAMs and nonparametric methods. Differences in length-frequency distributions among years were assessed using the K-S test, and *P*-values were adjusted using Holm's correction for multiple comparisons (Holm 1979). Trends in total weight (i.e., whole animal ww) were assessed using a simple additive model. Trends in condition and reproductive endpoints were assessed using GAMs that included a nonlinear effect for year and a linear effect associated with a given covariate (Table 7-4). *Post hoc* assessments of trends were completed using a *post hoc* slope trend test for each

sampling year. Note that trends in relative gonad weights were assessed among 2021, 2022, 2023, and 2024, as gonad tissues were not weighed in 2020.

Table 7-4: Statistical Procedures Used to Evaluate *Hiatella arctica* Health Indicators

Indicator	Endpoint	Response Variable (y)	Covariate (x)	Statistical Procedure
Spatial Comparisons				
Survival	Length-frequency	Total Length	n/a	K-S test
Growth	Total Weight (whole animal wet weight)	Total Wet Weight	n/a	ANOVA
Condition	Condition	Total Wet Weight	Total Length	ANCOVA
	Relative Shell Weight	Dry Shell Weight	Total Length	
Reproduction	Mantle Somatic Index	Gonad Weight	Tissue Wet Weight	ANCOVA
Temporal Comparisons				
Survival	Length-frequency	Total Length	n/a	K-S test ^(a)
Growth	Total Weight (whole animal wet weight)	Total Wet Weight	n/a	GAM
Condition	Condition	Total Wet Weight	Total Length	Covariate-adjusted GAM
	Relative Shell Weight	Dry Shell Weight	Total Length	Covariate-adjusted GAM
Reproduction	Mantle Somatic Index	Gonad Weight	Tissue Wet Weight	Covariate-adjusted GAM

K-S test = Kolmogorov-Smirnov test; ANOVA = analysis of variance; ANCOVA = analysis of covariance; GAM = generalized additive model; n/a = not applicable.

(a) *P*-values were adjusted using Holm's correction for multiple comparisons (Holm 1979) when there were more than two groups being compared (i.e., temporal trends).

7.3.4.2 Tissue Chemistry

The COPCs for the MEEMP fish tissue chemistry component are based on the primary constituents of the Project iron ore (i.e., aluminum, magnesium, and iron), as well as metals with existing regulatory guidelines for fish tissue (i.e., mercury and selenium). Tissue chemistry was evaluated for potential spatial differences between Milne Port and the reference areas in 2024 for Fourhorn Sculpin and *H. arctica*, and for temporal trends among years (i.e., 2018 to 2024) for Arctic Char, Fourhorn Sculpin, and *H. arctica*. Values below DL were estimated using robust regression on order statistics (rROS; Helsel 2012) only if the frequency of data below DL was no more than 50%.

Concentrations of COPCs were compared between sampling areas for Fourhorn Sculpin and *H. arctica*. For aluminum, magnesium, and iron, concentrations were compared using ANOVA. For mercury and selenium, fish length was included as a covariate using ANCOVA.

Trends in aluminum, magnesium, and iron were compared over years using GAMs. Trends in tissue concentrations of mercury and selenium in Arctic Char and Fourhorn Sculpin were compared over years and between sampling areas in 2024 using GAMs, with fish length as a covariate. Trends in COPCs were evaluated using *post hoc* slope trend tests for each sampling year; least square mean metal concentrations were also calculated to support trend assessment.

If length was found not to be significantly related to mercury or selenium concentrations, the covariate was removed and the analytical method was reduced to either a GAM without size adjustment, for evaluation of trends over sampling years, or to an ANOVA, for comparisons among sampling areas in 2024. Post hoc comparisons for ANOVA and ANCOVA were completed using Tukey's Honest Significant Differences test, with P -values adjusted for multiple comparisons (Tukey 1977). Significant temporal trends and differences between sampling areas were determined using an α of 0.10 (i.e., $P < 0.1$ was considered significant).

Tissue chemistry data were presented visually using boxplots, where the median value was indicated within each box and the first and third quartiles were represented by the lower and upper bounds of each box, respectively. Lower and upper whiskers were calculated as 1.5 times the interquartile range beyond the first and third quartile. Observations outside the upper and lower whiskers were plotted as individual points. Whiskers were extended to the minimum and maximum values within the dataset that fell within the fences. Where chemistry data included values below DL, at a frequency no greater than 80% of values below DL, boxplots statistics (i.e., median, quartiles, interquartile ranges) were estimated using rROS (Helsel 2012). Values below a DL were not included on boxplots; however, the DLs and the number of samples above DL were indicated on the boxplots. Boxplots were censored at the DL.

7.3.4.3 Testing Assumptions for Statistical Analysis

The assumptions of Gaussian models, including ANOVA, ANCOVA, and Gaussian additive models, are that the residuals of the data, after being fit to the model, are normally distributed and have equal variance among groups. The assumption of normality was assessed using the Shapiro-Wilk test, while Levene's test was used to assess equality of variances. Significant differences in assumptions were evaluated using an α of 0.01 (i.e., P -values < 0.01 indicated assumptions were not met). If the assumptions of normality and equality of variance were not met, the data were \log_{10} -transformed, and the assumptions were re-assessed. When the assumptions of a statistical model could not be met using a \log_{10} transformation, the nonparametric rank alternative was used and *post hoc* pairwise comparisons were made using a Tukey's method for multiple comparisons on rank values.

In addition to the assumptions of normality and equality of variance, ANCOVA has the additional assumption that the parameter regression slopes are parallel among sampling areas or years. To test this assumption, the ANCOVA was conducted by first fitting separate regression models for each sampling area using a general linear model that included an interaction term between the categorical variable (i.e., sampling area or year) and covariate:

$$\text{Full ANCOVA model: } y = \beta_0 + \beta_1(x) + \beta_2(\text{category}) + \beta_3(x) \times (\text{category}) + \varepsilon$$

where y is the response variable, x is the covariate, category is the categorical indicator variable, and ε is the error term. If the coefficient β_3 of the $(x) \times (\text{category})$ interaction term was not significant (i.e., $P > 0.01$), then the slopes were considered parallel and the ANCOVA proceeded by testing the significance of the coefficient β_2 of the (category) term in the reduced ANCOVA model that fits separate regressions for each categorical group, but with a common regression slope:

$$\text{Reduced ANCOVA model: } y = \beta_0 + \beta_1(x) + \beta_2(\text{category}) + \varepsilon$$

When a significant interaction was observed, the regression slopes were considered statistically significantly different. When the covariate was a strong predictor of the response variable, and the ANCOVA had a high coefficient of determination ($R^2 > 0.80$), the test for parallel slopes had high power to detect a difference that may

not be practically significant. In this case, when the interaction term in the full ANCOVA model was significant, the slopes were fixed as parallel by fitting the reduced ANCOVA model (because the reduced model explained almost as much [i.e., within 2%] of the variability in the response variable as the full model). In this case, the ANCOVA proceeded under the assumption that the regression slopes between groups were practically similar (Barrett et al. 2010). If slopes could not be considered practically parallel (difference in $R^2 > 0.02$), then endpoints were compared at the least and greatest overlapping covariate values (Section A1.7, Environment Canada 2012). For GAMs that included both linear effects of a covariate and nonlinear effects for time, the assumption of parallel regression slopes for the linear covariate were evaluated as described for ANCOVA models.

Statistical outliers were evaluated using studentized residuals (SR) from the statistical models. A magnitude of 3.5 for the SR was used to identify unusual observations. When an outlier was detected, the validity of the value was examined. If the outlier was determined to be the result of data entry error, the error was corrected; if the outlier was not the result of data entry error and could not be resolved otherwise, the outlier was removed from the analysis and documented.

All statistical comparisons were completed using R version 4.4.1 (R Core Team 2024).

7.3.4.4 *Magnitude of Effect*

The magnitude of effect for effect endpoints among sampling areas in 2024 was calculated when significant differences in endpoints or tissue concentrations were observed, by expressing the difference as a percentage of the reference mean as follows (Environment Canada 2012):

$$\text{Magnitude of Effect} = \frac{\bar{x}_{\text{Milne}} - \bar{x}_{\text{Reference}}}{\bar{x}_{\text{Reference}}} * 100$$

where \bar{x} is the mean of the endpoint, and *Milne* and *Reference* refer to Milne Port and the appropriate Reference area, respectively. If the statistical comparison was conducted on \log_{10} -transformed data, then the magnitude of effect was calculated using geometric means. For effect endpoints analyzed using rank ANOVA, the magnitude of effect was calculated using medians. For effect endpoints analyzed using ANCOVA, the magnitude of effect was calculated using least squares means.

For each finfish health endpoint, magnitudes of effect were compared with the critical effect size (CES) defined in the MDMER for that health endpoint. The CES for age, size-at-age, relative liver weight, and relative gonad weight is $\pm 25\%$ of the reference area mean; the CES for condition (relative total weight) is $\pm 10\%$ of the reference area mean.

For finfish and shellfish tissue chemistry, a CES of 100% was used for tissue chemistry endpoints to differentiate random variability from those differences of potential biological importance (Environment Canada 2012). This approach was taken to validate that differences in concentrations of metals between years were real and less likely to be attributed to analytical variability, limitations of reporting (i.e., low concentrations of target contaminants), or spatial and temporal variation.

7.3.4.5 Power Analysis

Power analyses were performed to determine the minimum detectable difference of fish health and tissue chemistry endpoints. Target sample sizes for fish health endpoints were 20 Fourhorn Sculpin of each sex (40 total) and 40 *H. arctica*, and eight samples (24 total) for tissue chemistry for each fish species (i.e., Arctic Char, Fourhorn Sculpin, *H. arctica*). These sample sizes were used to estimate the sensitivity of future comparisons to detect differences by expressing the minimum detectable difference as a percent change relative to the mean. Type I (α) and Type II (β) error rates were set to 0.10 (Environment Canada 2012). Power analyses were conducted using the power and sample size function in G*Power 3.1.9.7 (Faul et al., 2007).

7.3.5 Guideline Comparison

Tissue concentrations of mercury and selenium for Arctic Char and Fourhorn Sculpin sampled from 2018 to 2024 were compared to applicable tissue quality guidelines. Mercury concentrations were compared to Health Canada's Maximum Levels for Chemical Contaminants in Foods mercury consumption guideline of 0.5 mg/kg ww (Health Canada 2015). Selenium concentrations in Arctic Char and Fourhorn Sculpin were compared to the British Columbia Ministry of Environment (BC MOE) fish tissue guideline of 4 mg/kg dw (BC MOE 2014). Relevant guidelines were not available for other tissue chemistry parameters or for *H. arctica*.

7.3.6 Quality Management

The field and laboratory quality assurance and quality control (QA/QC) procedures described in the following sections were implemented at each stage of the fish survey (i.e., field sampling, data entry, sample shipment, laboratory analyses, data analyses and report preparation) to produce technically sound and scientifically defensible results.

7.3.6.1 Field QA/QC

As part of practices for field operations for this program, the following QA/QC procedures were undertaken:

- Detailed specific work instructions outlining each field task were provided to the field personnel prior to the field programs.
- A pre-field meeting with the field crew and project team lead was conducted to review the specific work instructions so that procedures were understood.
- Samples were collected by experienced personnel and were labelled, preserved, and shipped according to laboratory instructions following WSP standard operating procedures for fish health assessments.
- Fish identification was recorded to species, where possible, with identifications verified using fish field guides.
- Field equipment (e.g., electronic scales and water quality meters) were regularly calibrated according to manufacturer's recommendations.
- Detailed field notes were recorded in pencil in waterproof field notebooks, on waterproof pre-printed field data sheets, or directly entered electronically into an excel spreadsheet.
- Field data (i.e., data sheets, notebooks, and electronic spreadsheets) were checked at the end of each day for completeness and accuracy.

Samples were documented and tracked using chain of custody (COC) forms and receipt of samples by the analytical laboratory was confirmed. Field crews were responsible for managing sample shipment to the analytical laboratories. Prior to sample shipment, field crews confirmed the following:

- Required samples were collected and accounted for.
- COC and analytical request forms were complete and correct.
- Proper sample labelling and documentation procedures were followed.

7.3.6.2 Data Analysis QA/QC

Field-collected data, data sheets, and field notebooks were reviewed for completeness and unexpected values or trends. At minimum, 10% of the field data entered electronically were verified by a second person to identify transcription errors. If any errors were identified, a 100% quality check was implemented. Results of statistical data analyses were reviewed by an independent biologist experienced in statistical analysis. Tables containing data summaries and statistical results were reviewed and values were verified by a second, independent individual.

7.3.6.2.1 Tissue Chemistry

The fish tissue chemistry dataset was visually assessed for outliers using scatterplots, and erroneous values were corrected, if possible (i.e., if values were identified as data entry errors). Statistical analyses and data summary tables were independently reviewed and verified by a second individual experienced in statistical analysis. Internal laboratory QA/QC at BV Labs included analysis of duplicates to evaluate the variance in the measurement, matrix spikes to evaluate sample matrix interference, method blanks to identify laboratory contamination, reagent blanks to determine any analytical contamination, spiked samples to evaluate method accuracy, surrogates to evaluate extraction efficiency, and QC standards used as an independent check of method accuracy. Upon receipt of the tissue chemistry data from BV Labs, standard checks were performed to screen for potential data quality issues by:

- confirming that each requested variable was analyzed
- reviewing the reported units
- reviewing any hold time exceedances
- reviewing internal laboratory QA/QC results

Most results met the laboratory quality acceptance criteria for representativeness (e.g., no detected concentrations in procedural blanks) and accuracy (e.g., spiked blanks, containing a known amount of analyte, within acceptable range). Analysis of reference materials were an exception, where recovery of several metals did not meet acceptance criteria:

- Recovery of antimony, potassium, sodium, and tin exceeded (126 to 161%) acceptance criteria (75 to 125%). Reanalysis yielded similar results. Other quality control parameters were met, and data were considered acceptable.

Visual assessment of tissue chemistry data identified one Arctic Char, two Fourhorn Sculpin, and two *H. arctica* samples with reported concentrations of several metals which were anomalous (i.e., BAFF24UDPFARCH4002, BAFF24UKLKFHSC2005, BAFF24UDPFFHSC1016, BAFF24-REF-HTAR-COMP-METAL-1, BAFF24-REF-HTAR-COMP-METAL-2). Results of laboratory reanalysis confirmed reported concentrations in one Arctic Char sample and one Fourhorn Sculpin sample (BAFF24UDPFARCH4002, BAFF24UKLKFHSC2005); however, for the other Fourhorn Sculpin sample and the two *H. arctica*, re-analysis results indicated heterogeneity of the sample (personal communications, M. McIntosh, 24 December 2024, 3 February 2025). The geometric mean of metal concentrations for this sample determined during initial and re-analysis was chosen for inclusion in the MEEMP tissue chemistry dataset. Where at least one value was reported below DL, the geometric mean was estimated using rROS or nonparametric methods (Helsel 2012). Certificate of analysis forms, including those from sample re-analysis, are provided in Appendix 7E. Overall, the fish tissue chemistry data were considered reliable and representative of site conditions at the time of sampling.

7.3.7 TARP Assessment

As part of applying the Trigger Action Response Plan (TARP; Baffinland 2024), fish health and tissue chemistry performance indicators were screened against condition status/thresholds in 2024, in order to assess risk levels for each performance indicator. The following performance indicators and condition status/threshold values were used when evaluating fish health and tissue chemistry (Table 7-5).

Table 7-5: Marine Environment TARP Framework for Fish Health and Tissue Chemistry (Baffinland 2024)

Component	Performance Indicators ^(a)	Condition Status/Threshold		
		Low Risk	Moderate Risk	High Risk
Fish Health	<p>Fourhorn Sculpin</p> <ul style="list-style-type: none">▪ Age▪ Size-at-age (i.e., total weight at age)▪ Condition as relative total weight (i.e., total weight at total length)▪ Relative liver weight (i.e., liver weight at total weight)▪ Relative gonad weight (i.e., gonad weight at total weight) <p><i>Hiatella arctica</i></p> <ul style="list-style-type: none">▪ Length-frequency analysis▪ Whole animal wet weight▪ Condition as relative total weight (i.e., whole animal wet weight at total length)▪ Relative shell weight (i.e., dry shell weight at total length)▪ Relative gonad weight (i.e., gonad weight at whole animal wet weight)	A statistically significant difference ($P < 0.10$) in effect indicators relative to the reference area and change is in direction that indicates an impairment to fish health and is of magnitude greater than or equal to a defined critical effect size (CES) ^(b) for that effect indicator.	Confirmed ^(c) Low Risk Status/ Threshold and mean/median ^(d) for the same effect indicator is beyond the baseline (FEIS) normal range ^(e) (if available) or regional normal range ^(f) AND Is supported by consistent effects in one or more other study components (i.e., water quality, sediment quality and benthic invertebrates) which links the results to the Project.	To be determined based on outcome of moderate response investigations.
Fish Tissue Chemistry	<p>Primary constituents of Project iron ore:</p> <ul style="list-style-type: none">▪ Aluminum▪ Magnesium▪ Iron <p>Metals with the potential to bioaccumulate and biomagnify in the food web:</p> <ul style="list-style-type: none">▪ Mercury▪ Selenium	A statistically significant difference ($P < 0.1$) in one or more metals concentrations in a sentinel species relative to the reference area, and change is in the direction ^(g) that indicates impairment to fish health and is of magnitude ^(h) greater than or equal to the defined CES.	A confirmed ⁽ⁱ⁾ Low Risk Status/ Threshold for one or more metals that is also outside the regional normal range ^(j) , and is supported by consistent effects in one or more other study components (i.e., water quality, sediment quality and benthic invertebrates) which links the results to the Project. OR The mean mercury or selenium concentrations (or ≥50% of the individual samples) in Arctic Char tissue chemistry samples are beyond the respective CFIA ^(k) or BCMOE ^(l) guidelines.	To be determined based on outcome of moderate response investigations.

CES = critical effect size; FEIS = Final Environmental Impact Statement; CFIA = Canadian Food Inspection Agency; BC MOE = British Columbia Ministry of Environment.

- (a) The following endpoints were included or excluded relative to the proposed TARP framework in order to better align the Fish Health and Tissue Chemistry monitoring program with the MDMER EEM program: Fourhorn Sculpin – age (included), length-frequency analysis (excluded).
- (b) Definition of a magnitude of change that is indicative of impairment to fish health is based on the critical effect sizes defined by Environment Canada's Metal Mining Effluent Regulations Guidance Document (Environment Canada 2012) and refers to an increase or a decrease in fish health endpoints. Additional critical effect sizes may be defined in the future (i.e., beyond those defined by ECCC).
- (c) Confirmed indicates that the Risk Status/ Threshold trigger has been observed in at least two consecutive monitoring programs, whether during the regular monitoring schedule or confirmed through a special study. For fish, the two or more endpoints that triggered the Moderate Risk Status/ Threshold may be in one species (i.e., two endpoints in one species) or two species (i.e., one endpoint in one species, as second endpoint in another species).
- (d) The use of the mean or median will depend on the normality of the dataset used to calculate the normal range for each endpoint or tissue chemistry parameter (i.e., if raw or transformed data do not meet the assumptions of normality, the median will be used to provide an estimate of central tendency instead of the mean).
- (e) Baseline (FEIS) normal range is based on the FEIS dataset, including operational monitoring data from Milne Inlet and Steensby Inlet, and includes fish length, weight and condition (K).
- (f) Regional normal range will be calculated using all available reference area data (i.e., will include annual and ongoing reference area data as it becomes available).
- (g) For tissue chemistry, only an increase in concentration will be considered indicative of a toxicological response.
- (h) For fish tissue chemistry parameters, the critical effect size is a difference of 100%.
- (i) Confirmed indicates that the Action Status/Threshold trigger has been observed in at least two consecutive monitoring programs, whether during the regular monitoring schedule or confirmed through a special study.
- (j) Regional normal range is anticipated to include Arctic Char tissue chemistry data from the FEIS (i.e., Milne Inlet and Steensby Inlet) as well as ongoing reference area tissue chemistry data (for *Hiatella arctica* and Fourhorn Sculpin).
- (k) Value is 0.5 mg/kg ww total mercury per CFIA (2014) Canadian Food Inspection Agency Fish Products Standards and Methods Manual: Appendix 3 Canadian Guidelines for Chemical Contaminants and Toxins in Fish and Fish Products. Ottawa, ON.
- (l) Protection of aquatic life chronic criteria for fish tissue selenium concentrations are 15.1 mg/kg dw for ovary, 8.5 mg/kg dw for whole body, or 11.3 mg/kg dw for skinless, boneless muscle fillet per US EPA (2021) Technical Support for Fish Tissue Monitoring for Implementation of EPA's 2016 Selenium Criterion Draft, EPA 820-F-16-007, United States Environmental Protection Agency, Office of Water.

7.4 Results

In 2024, fish health data were collected for Arctic Char, Fourhorn Sculpin, and *H. arctica*, and tissue chemistry samples from all three species were submitted for analysis of metals and PAHs. Fish health data collected in 2024 are provided in Appendix 7A, Tables 7A-1 to 7A-3, and summaries of Fourhorn Sculpin and *H. arctica* fish health data collected in previous monitoring years are presented in Appendix 7A, Tables 7A-4 to 7A-5. Taxonomic results for stomach contents analysis from the laboratory are provided in Appendix 7A in Tables 7A-6 and 7A-7. Summaries of samples submitted for tissue chemistry analysis during current and past MEEMP studies are presented in Appendix 7B, Tables 7B-1 and 7B-2. Tissue chemistry data collected in 2024 are provided in Appendix 7B, Tables 7B-3 to 7B-8 and summaries of tissue chemistry data collected in previous monitoring years are presented in Appendix 7B, Tables 7B-9 to 7B-11. Boxplots summarizing tissue chemistry results are presented in Appendix 7C. Supporting environmental information for the reference areas are provided in Appendix 7D, and certificate of analysis forms are provided in Appendix 7E. Fish health and tissue chemistry data collected in previous sampling years are also provided in past MEEMP Reports (e.g., Golder 2019, 2020, 2021; WSP 2023, 2024).

7.4.1 Fish Health

7.4.1.1 Arctic Char

A total of 13 incidental mortalities of Arctic Char from Milne Inlet were processed in 2024 as part of the fish community assessment (Chapter 6.0), including 11 adults (eight females, three males) and two juveniles. Processed Arctic Char ranged in age from 7 to 16 years, in total length from 271 to 551 mm, and in weight from 192 to 3,111 g. Condition factor ranged from 0.94 to 2.63. Fish were considered to be in good health, with five fish being observed with parasite infections.

7.4.1.1.1 Survival - Age

Ages of incidental mortalities of Arctic Char were comparable between 2021, 2022, 2023, and 2024 (Figure 7-2). Ages ranged from 4 to 17 years in 2021, 4 to 22 years in 2022, 4 to 25 years in 2023, and 7 to 16 years in 2024, with maximum ages reported in 2024 being similar to those reported in previous years. Median ages sampled in each sampling year were also similar (2021: 8.5 years; 2022: 11.5 years; 2023: 9.0 years; 2024: 10.0 years; Figure 7-2).

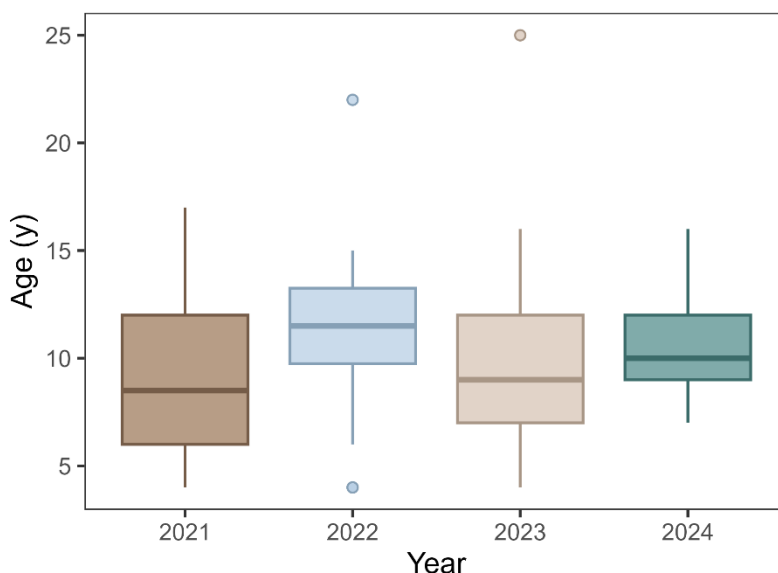


Figure 7-2: Boxplots of Ages of Arctic Char Incidental Mortalities Sampled from Milne Inlet, 2021 to 2024

7.4.1.1.2 Stomach Contents

Stomach contents of 10 incidental mortalities of Arctic Char from Milne Inlet were analyzed (Figure 7-3). Ten unique taxonomic groups of prey items were identified, including: five families of amphipods, one species of calanoid copepod, unidentified fish, two taxa of mysids, and unidentified crustaceans. The dominant prey item by weight consumed by Arctic Char in 2024 was crustaceans (98%), comprised of unidentified crustaceans (48%), amphipods (43%), mysids (5%), and calanoid copepods (<1%). Unidentified fish comprised 2% of prey consumed, by weight.

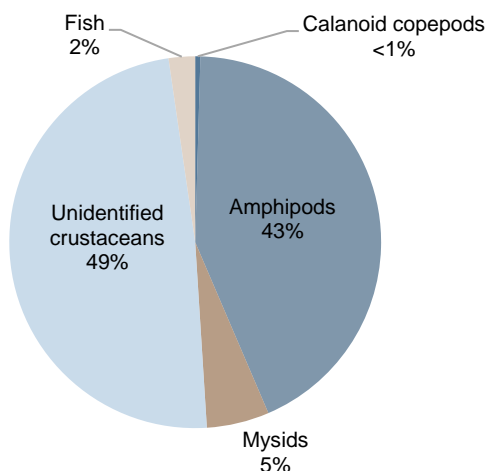
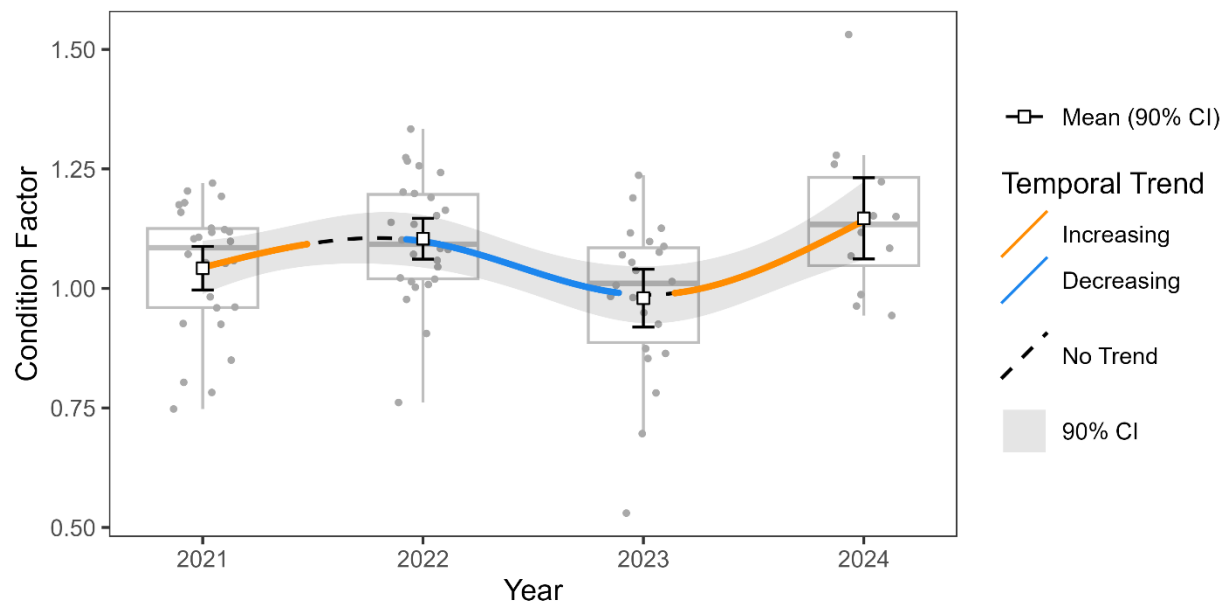


Figure 7-3: Relative Stomach Contents by Weight from Arctic Char Incidental Mortalities Sampled from Milne Inlet, 2024

7.4.1.1.3 Temporal Comparisons

7.4.1.1.3.1 Condition Factor

Condition factor of Arctic Char was compared between 2021, 2022, 2023, and 2024 (Table 7-6; Figure 7-4) and data for all sexes and life stages were combined as described in Section 7.3.3.1. Condition factor ranged from 0.75 to 1.22 in 2021, from 0.76 to 1.33 in 2022, 0.53 to 1.24 in 2023, and 0.94 to 2.63 in 2024. Condition factor varied significantly over sampling years ($F_{2.89,2.99} = 4.025$, $P = 0.008$), but with no consistent temporal trends. Variation over sampling years appeared to be due to natural variability.



One fish sampled in 2024 (FIN: BAFF24UIPFARCH4006) was omitted as an outlier.
CI = confidence interval.

Figure 7-4: Temporal Trends in Condition Factor for Arctic Char Captured throughout Milne Inlet, 2021 to 2024

Table 7-6: Descriptive Statistics for Arctic Char Biometrics Processed from Milne Inlet, 2021 to 2024

Parameter	Arctic Char						
	<i>n</i>	Min	Max	Median	Mean	SD	SE
2021^(a)							
Total Length (mm)	26	145	649	393	387	106.1	20.8
Fork Length (mm)	-	-	-	-	-	-	-
Total Weight (g)	26	25	2,139	660	712	478.9	93.9
Condition Factor	26	0.75	1.22	1.09	1.04	0.14	0.027
Age (y)	26	4	17	8.5	9.5	3.8	0.75
2022^(b)							
Total Length (mm)	-	-	-	-	-	-	-
Fork Length (mm)	26	219	700	487	474	112.4	22.05
Total Weight (g)	26	140	3,760	1,420	1,461	868.7	170.4
Condition Factor	26	0.76	1.33	1.09	1.10	0.13	0.025
Age (y)	24	4	22	11.5	11.2	4.0	0.81
2023^(a)							
Total Length (mm)	22	313	647	427	450	91.5	19.5
Fork Length (mm)	-	-	-	-	-	-	-
Total Weight (g)	22	319	2,015	878	953	497.9	106.1
Condition Factor	22	0.53	1.24	1.01	0.98	0.16	0.035
Age (y)	21	4	25	9.0	10.0	4.8	1.0
2024^(a)							
Total Length (mm)	13	271	551	400	406	78.9	21.9
Fork Length (mm)	-	-	-	-	-	-	-
Total Weight (g)	13	192	3,111	736	1034	889.1	246.6
Condition Factor	13	0.94	2.63	1.15	1.26	0.44	0.122
Age (y)	13	7	16	10.0	10.6	2.8	0.77

n = sample size; Min = minimum; Max = maximum; SD = standard deviation; SE = standard error.

(a) Fork length measurements were not collected in 2021, 2023, or 2024.

(b) Total length measurements were not collected in 2022.

7.4.1.2 *Fourhorn Sculpin*

A total of 40 Fourhorn Sculpin were processed from Milne Port during the 2024 fish health assessment, including 20 females and 20 males. A total of 39 Fourhorn Sculpin were processed from the Koluktoo Bay, including 20 females and 19 males. Summary statistics for processed fish are provided in Table 7-7. Length-frequency distributions for female and male Fourhorn Sculpin from Milne Port and Koluktoo Bay sampled in 2024 are presented in Figure 7-5. Length-weight relationships for Fourhorn Sculpin sampled in 2024 are presented in Figure 7-6.

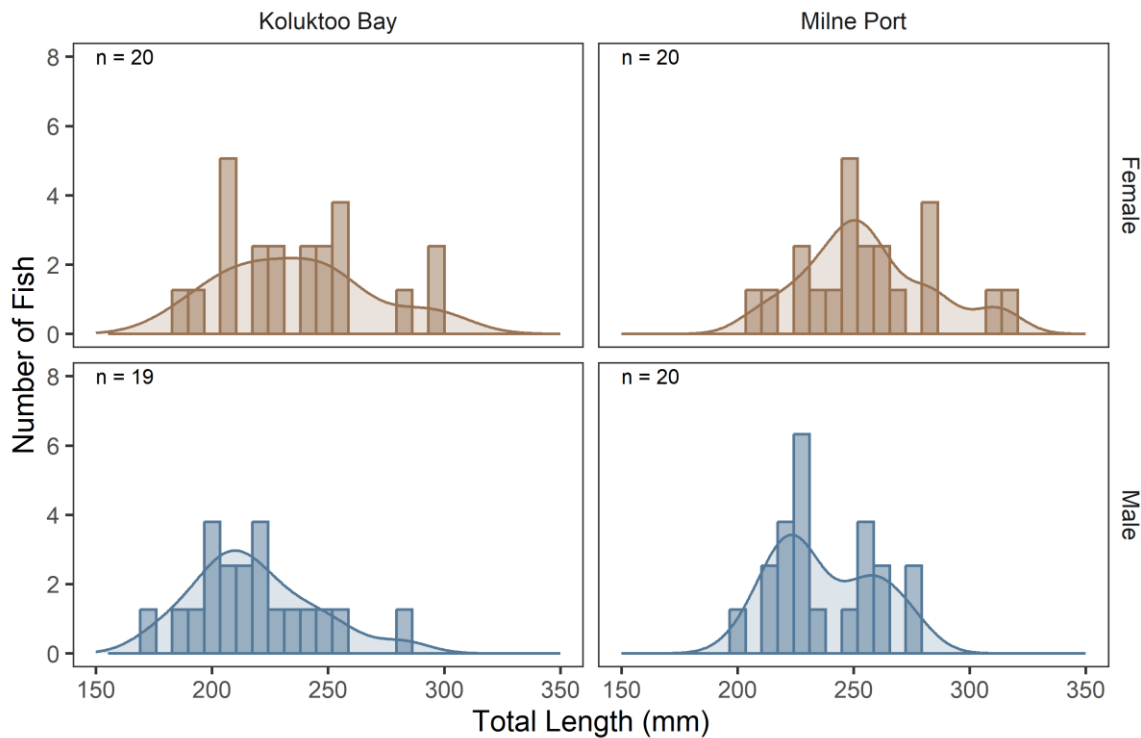
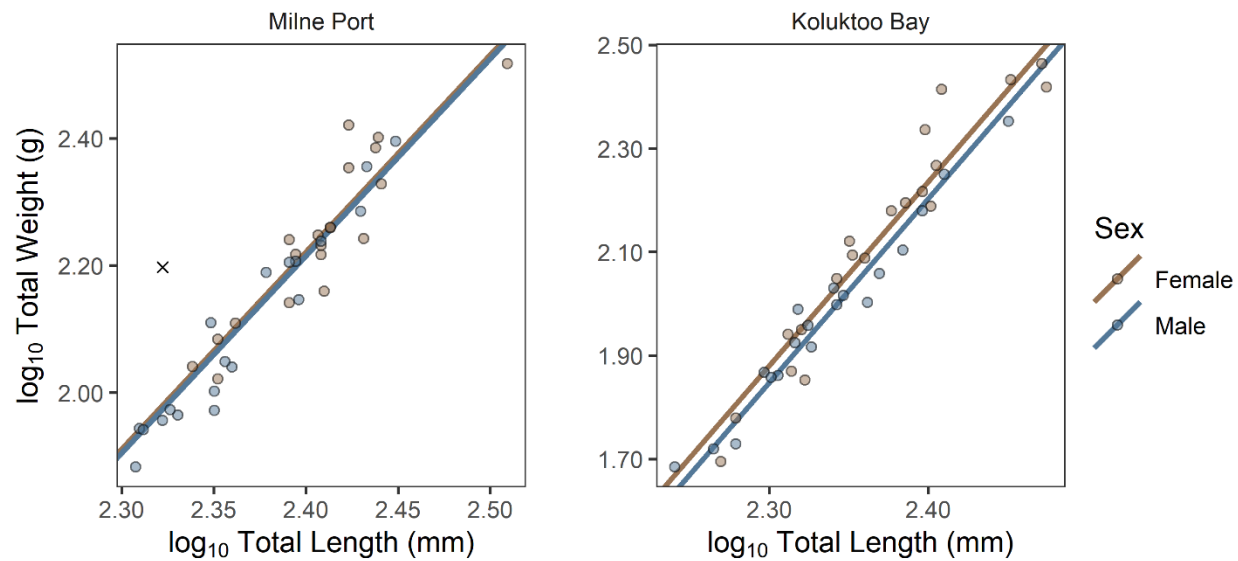


Figure 7-5: Length-Frequency Distributions of Female (Top) and Male (Bottom) Fourhorn Sculpin Sampled from Milne Port (Right) and Koluktoo Bay (Left), 2024



x = outlier omitted from length-weight relationship characterization.

Figure 7-6: Condition (Length-Weight Relationship) for Female and Male Fourhorn Sculpin Sampled from Milne Port (Left) and Koluktoo Bay (Right), 2024

Table 7-7: Descriptive Statistics for Fourhorn Sculpin Fish Health Endpoints Processed from Milne Port and Koluktoo Bay, 2024

Parameter	Milne Port							Koluktoo Bay						
	n	Min	Max	Median	Mean	SD	SE	n	Min	Max	Median	Mean	SD	SE
Female														
Total Length (mm)	20	208	314	252	256	27.8	6.22	20	186	298	233.5	236.2	32.0	7.16
Total Weight (g)	20	80	379	168	184	77.7	17.4	20	50	291	142	152	74.7	16.7
Carcass Weight (g)	20	41.2	197	90	97	41.1	9.18	20	27.4	153	75	80	37.6	8.40
Condition Factor	20	0.87	1.28	1.01	1.04	0.10	0.023	20	0.77	1.55	1.06	1.06	0.19	0.042
Liver Weight (g)	20	2.363	17.99	7.353	8.210	4.452	0.995	20	1.213	14.05	6.176	7.004	4.022	0.899
LSI	20	2.56	7.21	4.35	4.30	1.08	0.24	20	2.11	7.03	4.39	4.44	1.30	0.29
Gonad Weight (g)	20	1.988	16.06	5.830	7.055	3.867	0.865	20	1.649	13.42	5.638	6.116	3.339	0.747
GSI	20	2.40	6.13	3.39	3.70	0.96	0.22	20	2.52	6.35	3.83	3.97	0.90	0.20
Age (y)	20	4	11	6.5	6.6	1.7	0.38	20	4	10	7	6.9	1.7	0.37
Male														
Total Length (mm)	20	203	276	229	238	21.9	4.89	19	174	282	212	218	26.6	6.10
Total Weight (g)	20	78	216	119	132	40.3	9.0	19	48	226	98	102	44.3	10.2
Carcass Weight (g)	20	44.5	115	67	75	22.3	4.99	19	26.3	134	50.5	57.0	26.4	6.05
Condition Factor	20	0.87	1.16	0.94	0.96	0.073	0.016	19	0.78	1.09	0.94	0.93	0.08	0.018
Liver Weight (g)	20	1.407	6.929	3.111	3.442	1.353	0.303	19	0.937	7.526	2.964	3.478	1.932	0.443
LSI	20	1.80	3.67	2.68	2.59	0.55	0.124	19	1.81	4.98	2.94	3.28	1.03	0.24
Gonad Weight (g)	20	1.690	7.552	3.959	4.505	2.003	0.448	19	1.788	8.458	3.284	3.653	1.595	0.366
GSI	20	1.70	4.86	3.49	3.32	0.82	0.18	19	2.52	4.93	3.48	3.68	0.76	0.17
Age (y)	20	5	9	6	6.4	1.3	0.29	19	4	12	6	6.4	2.1	0.49

Data for previous monitoring years presented in Appendix 7A, Table 7A-4.

n = sample size; Min = minimum; Max = maximum; SD = standard deviation; SE = standard error; GSI = gonadosomatic index; LSI = liver somatic index

7.4.1.2.1 Spatial Comparisons

7.4.1.2.1.1 Survival – Age

Female ages ranged from 4 to 11 years in Milne Port and from 4 to 10 years in Koluktoo Bay, while male ages ranged from 5 to 9 years in Milne Port and from 4 to 12 years in Koluktoo Bay (Table 7-7; Figure 7-7). Mean ages for female and male Fourhorn Sculpin did not differ significantly between sampling areas (Table 7-8).

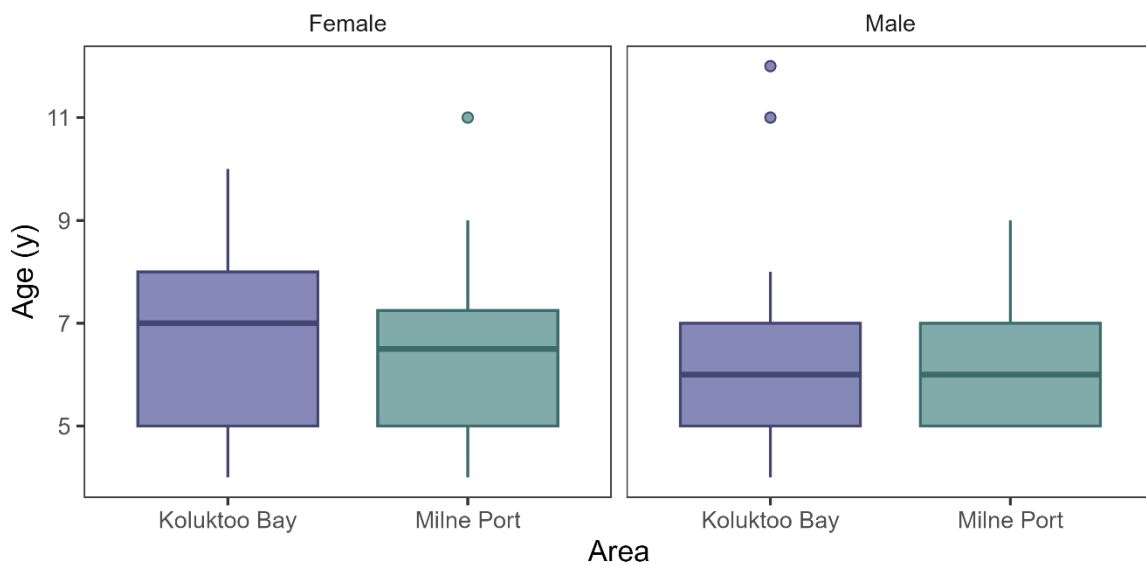


Figure 7-7: Boxplots of Ages of Female and Male Fourhorn Sculpin Sampled from Milne Port and Koluktoo Bay, 2024

7.4.1.2.1.2 Growth – Size-at-Age

For both female and male Fourhorn Sculpin, size-at-age was significantly greater in Milne Port compared to Koluktoo Bay (Figure 7-8; Table 7-8). Observed effect sizes for female and male Fourhorn Sculpin (36%, 30%, respectively) exceeded the CES ($\pm 25\%$). However, the direction of the observed effects (i.e., higher in Milne Port) did not indicate an impairment of the health of female or male Fourhorn Sculpin.

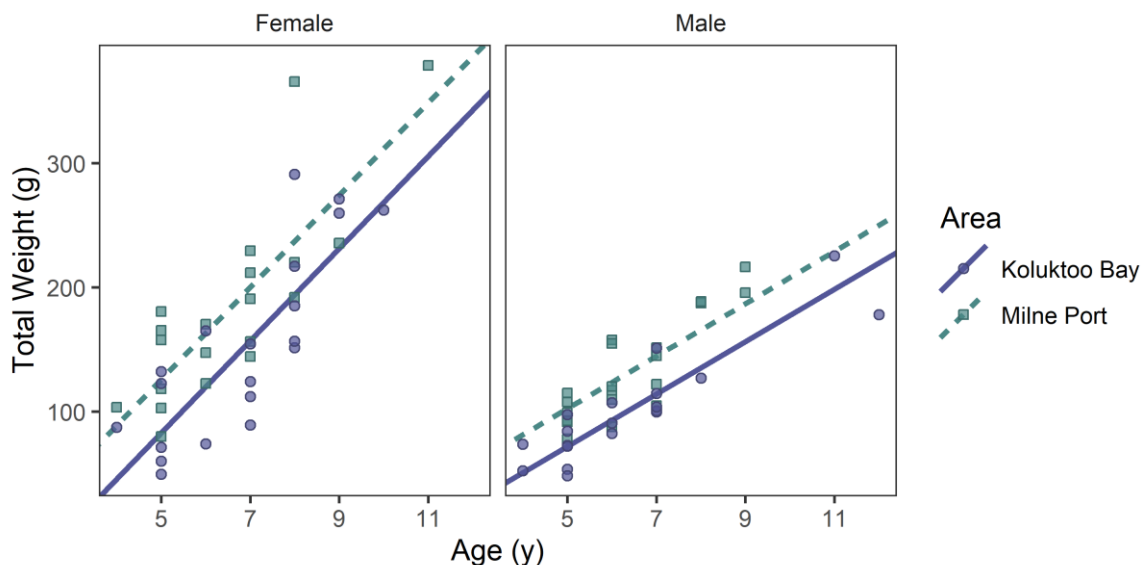


Figure 7-8: Size-at-Age Relationships for Female and Male Fourhorn Sculpin Sampled from Milne Port and Koluktoo Bay, 2024

7.4.1.2.1.3 Condition – Relative Total Weight and Relative Liver Weight

Condition factor for females ranged from 0.87 to 1.28 in Milne Port, and 0.77 to 1.55 in Koluktoo Bay; for males, condition factor ranged from 0.87 to 1.16 in Milne Port, and 0.78 to 1.09 in Koluktoo Bay (Table 7-7). Relative total weight differed significantly between areas for female Fourhorn Sculpin, but did not differ significantly between areas for male Fourhorn Sculpin (Figure 7-9; Table 7-8). For female Fourhorn Sculpin, relative total weight was significantly lower in Milne Port relative to Koluktoo Bay: the observed effect size (7%) was less than the CES ($\pm 10\%$).

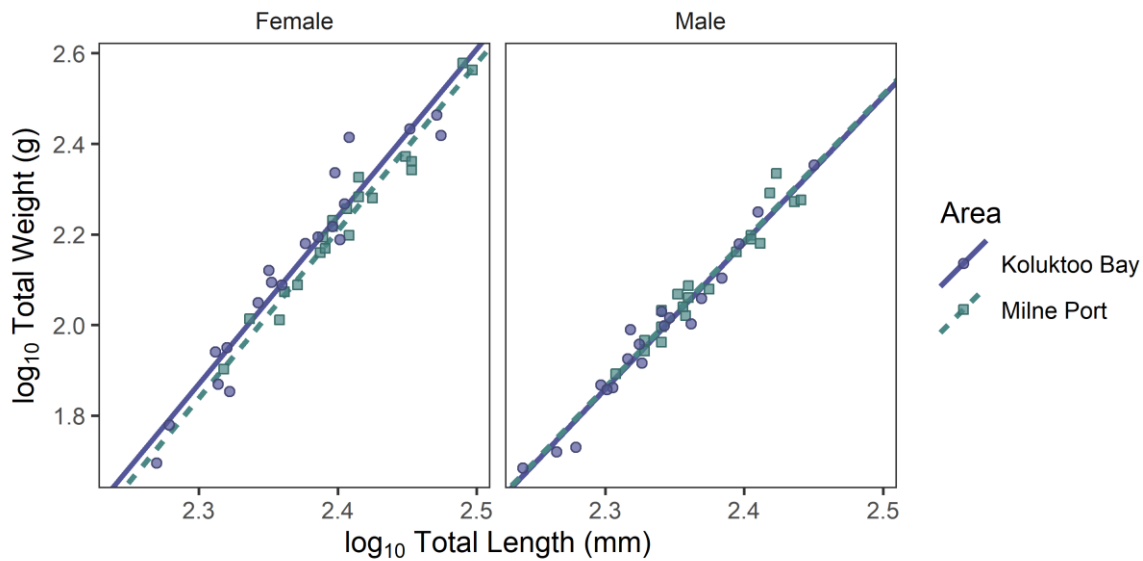


Figure 7-9: Weight-at-Length Relationships for Female and Male Fourhorn Sculpin Sampled from Milne Port and Koluktoo Bay, 2024

The LSI for female Fourhorn Sculpin ranged from 2.56 to 7.21 in Milne Port and from 2.11 to 7.03 in Koluktoo Bay; male LSI ranged from 1.80 to 3.67 in Milne Port and 1.81 to 4.98 in Koluktoo Bay (Table 7-7). In contrast to relative total weight, relative liver weight differed significantly between areas for male Fourhorn Sculpin but not for female Fourhorn Sculpin (Table 7-8; Figure 7-10). For male Fourhorn Sculpin, relative liver weight was significantly lower in Milne Port relative to Koluktoo Bay: the observed effect size (-26%) was greater than the CES ($\pm 25\%$; Table 7-8).

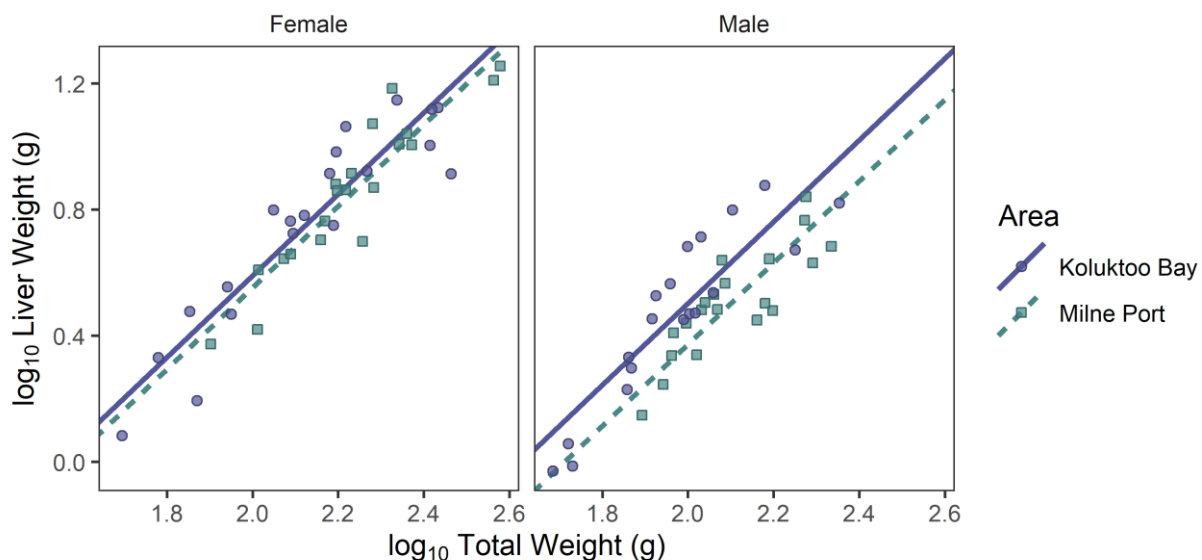


Figure 7-10: Relative Liver Weight for Female and Male Fourhorn Sculpin Sampled from Milne Port and Koluktoo Bay, 2024

7.4.1.2.1.4 Reproduction – Relative Gonad Weight

For females, GSI ranged from 2.40 to 6.13 in Milne Port, and 2.52 to 6.35 in Koluktoo Bay; for males, GSI ranged from 1.70 to 4.86 in Milne Port, and 2.52 to 4.93 in Koluktoo Bay (Table 7-7). Relative gonad weight did not differ among sampling areas for female or male Fourhorn Sculpin (Figure 7-11; Table 7-8).

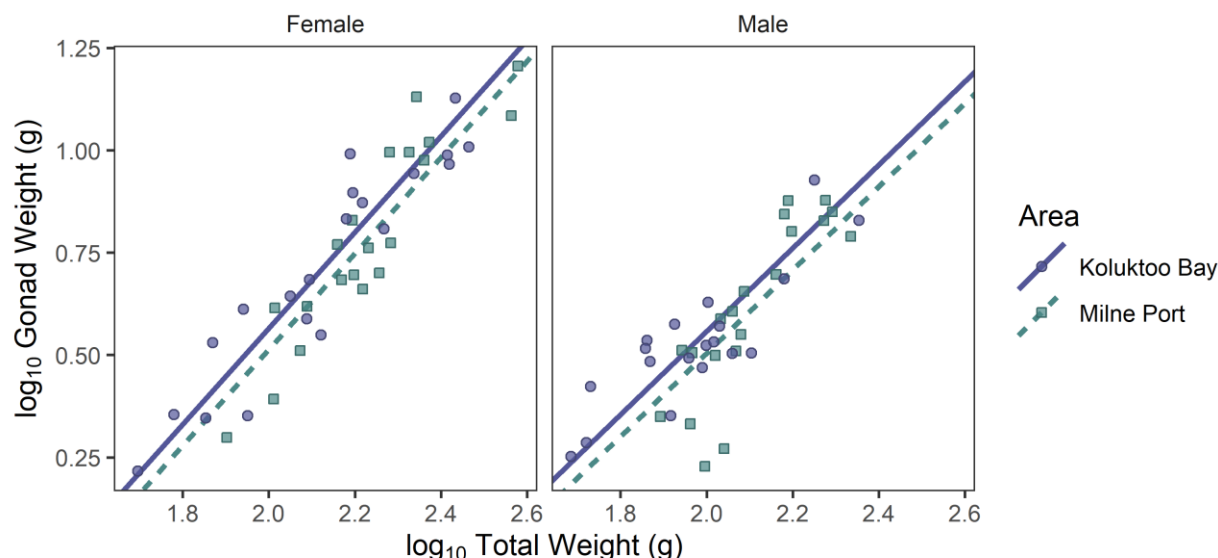


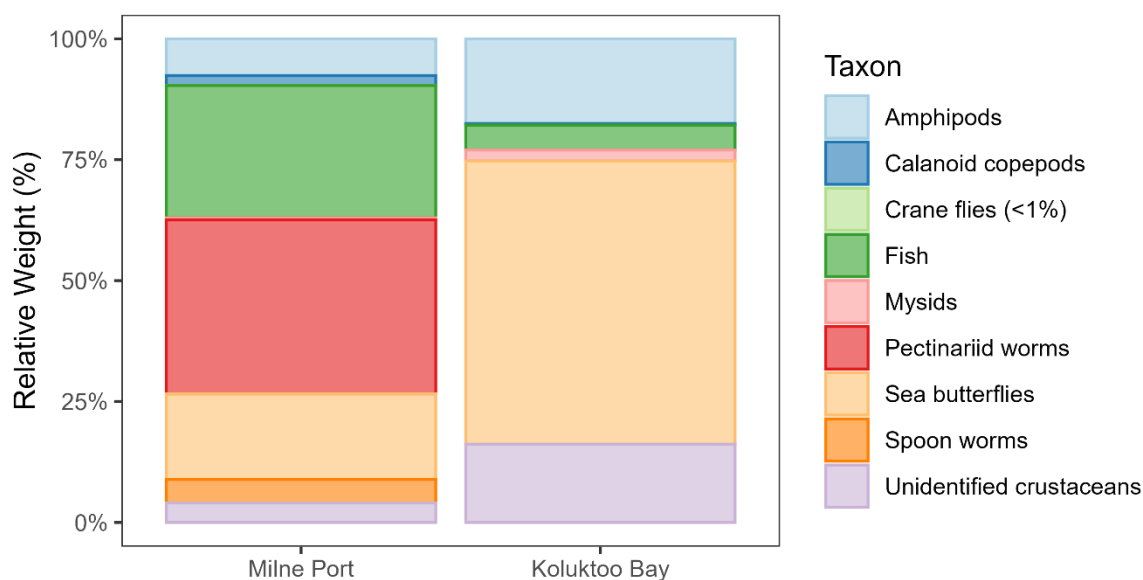
Figure 7-11: Relative Gonad Weight for Female and Male Fourhorn Sculpin Sampled from Milne Port and Koluktoo Bay, 2024

7.4.1.2.1.5 Stomach Contents

A total of 50 stomachs collected from Fourhorn Sculpin were analyzed for stomach contents: 25 from fish captured in Milne Port and 25 from fish captured in Koluktoo Bay. Stomach fullness ranged from 0% to 100% by volume. Eight stomachs from Fourhorn Sculpin collected from Koluktoo Bay and two stomachs from Fourhorn Sculpin collected in Milne Port were empty.

Relative stomach contents differed among sampling areas (Figure 7-12) reflecting variability in diets. In Milne Port, dominant prey items by weight for Fourhorn Sculpin included pectinariid worms (trumpet worms of the family Pectinariidae; 36%), fishes (27%), mainly comprising sand lance species (family Ammodytidae), and sea butterflies (*Limacina* spp.; 18%). Minor prey items by weight included amphipods (7.6%), spoon worms (class Polychaeta, subclass Echiura; 4.9%), unidentified crustaceans (4.1%), calanoid copepods (2.0%), mysids (0.4%), and crane flies (order Diptera, superfamily Tipuloidea; 0.1%).

In contrast, in Koluktoo Bay, the dominant prey item by weight for Fourhorn Sculpin was sea butterflies (59%). Minor prey items by weight included amphipods (18%), unidentified crustaceans (16%), unidentified fishes (5.2%), mysids (2.3%), and calanoid copepods (0.3%). Differences in stomach contents likely reflect differences in habitat and prey availability between the Milne Port and Koluktoo Bay. Site characterization surveys indicated a predominance of boulder habitat around Milne Port, whereas habitats in Koluktoo Bay were more variable, including boulders, cobble reefs, and sand bars. These habitat differences likely result in differences in prey items abundance and availability, thus driving differences in stomach contents of Fourhorn Sculpin among sampling areas.



Note: Amphipods include crustaceans in the order Amphipoda. Calanoid copepods include crustaceans in the genus *Calanus*. Crane flies include insects in the order Diptera, superfamily Tipuloidea. Mysids include crustaceans in the order Mysida. Pectinariid worms include polychaete worms in the family Pectinariidae. Sea butterflies include snails in the genus *Limacina*. Spoon worms include polychaete worms in the subclass Echiura.

Figure 7-12: Relative Stomach Contents by Weight from Fourhorn Sculpin Sampled from Milne Port and Koluktoo Bay, 2024

Table 7-8: Results of Statistical Comparisons Between Milne Port Area and Koluktoo Bay for Fourhorn Sculpin, 2024

Effect Indicator	Endpoint ^(a)	Covariate	Statistical Test	<i>n</i> Outlier	Sample Size		Least Squares Mean		Area <i>P</i> -value	Magnitude of Effect (%) ^(b)	Critical Effect Size (%) ^(c)	Direction of Effect	Power Analysis ^(d)	
					Milne Port	Koluktoo Bay	Milne Port	Koluktoo Bay					Minimum Detectable Difference ^(e)	Sensitivity ^(f)
Female														
Survival	Age	-	ANOVA	0	20	20	7	7	0.576	-	25%	-	100%	1.83
Growth	Size-at-Age ^(g)	Age	ANCOVA _{log10}	0	20	20	2.25	2.11	0.002	36%	25%	Milne > Ref	93% / 77%	19.44 / 77.1
Condition (Energy Storage)	Relative Total Weight	Total Length	ANCOVA _{log10}	0	20	20	2.16	2.20	0.067	-7%	10%	Milne < Ref	89% / 83%	23.13 / 14.4
	Relative Liver Weight	Total Weight	ANCOVA _{log10}	0	20	20	0.785	0.823	0.295	-	25%	-	97% / 87%	1.803 / 1.713
Reproduction	Relative Gonad Weight	Total Weight	ANCOVA _{log10}	0	20	20	0.725	0.776	0.120	-	25%	-	99% / 92%	1.576 / 1.235
Male														
Survival	Age	-	ANOVA _{rank} ^(g)	0	20	7	6	7	0.610	-	25%	-	100%	1.67
Growth	Size-at-Age	Age	ANCOVA	0	20	7	144	95.9	<0.001	30%	25%	Milne > Ref	100%	23.35
Condition (Energy Storage)	Relative Total Weight	Total Length	ANCOVA _{log10}	1	19	7	2.10	2.08	0.751	-	10%	-	100% / 99%	8.38 / 10.1
	Relative Liver Weight	Total Weight	ANCOVA _{log10}	0	20	7	0.654	0.680	0.002	-26%	25%	Milne < Ref	97% / 85%	1.249 / 0.495
Reproduction	Relative Gonad Weight	Total Weight	ANCOVA _{log10}	0	20	7	0.547	0.550	0.163	-	25%	-	97% / 85%	1.143 / 0.957

Notes: Statistically significant values and magnitudes of effect exceeding the CES are indicated in **bold**. Supporting information for statistical model results are provided in Appendix 7A, Table 7A-8. Statistical outliers are provided in Appendix 7A, Table 7A-12.

- (a) For model components, please see Table 7-3.
- (b) The magnitude of effect is calculated as the difference in least squares mean values between Milne Port and Koluktoo Bay: (Milne - Koluktoo) / Koluktoo × 100% (Environment Canada 2012).
- (c) Critical Effect Size (CES) expressed as a percentage of the Koluktoo Bay mean.
- (d) Power Analysis values presented on measurement scale. Log₁₀-transformed models include values for differences below and above the Koluktoo Bay mean.
- (e) Minimum detectable difference expressed as unit difference from the Koluktoo Bay mean.
- (f) Sensitivity is the minimum detectable difference expressed as a percent change in the Koluktoo Bay mean.
- (g) Rank ANOVA proceeded despite significant Shapiro-Wilk test based on visual inspection of the data.
- n = number; y = year; P-value = probability value; log₁₀ = log₁₀-transformed data; rank = rank-transformed data; ANOVA = analysis of variance; ANCOVA = analysis of covariance; n/a = not applicable.

7.4.1.2.1.6 Abnormalities

Few external or internal abnormalities were observed in Fourhorn Sculpin sampled from Milne Port or Koluktoo Bay (Table 7-9). With respect to external abnormalities, minor fin erosion was observed for 5% of fish the sampled, and 35% of fish were infected with external parasites. These included parasitic cysts embedded in their fins or skin or parasitic copepods in the gills. Fin erosion and parasites were most prevalent in Milne Port.

Internal abnormalities primarily consisted of variation in liver colour and parasites. Light or pale livers were observed in similar numbers of fish from both sampling areas, including two females and four males from Milne Port and three females and one male from Koluktoo Bay. Liver colour is closely tied to the level of blood perfusion (i.e., fresh circulating blood), and, therefore, the time elapsed between sacrifice and observation will influence the liver colour endpoint. Further, colour is subject to observer bias and is considered a less reliable indicator as a result. Internal parasites observed in Fourhorn Sculpin consisted of cysts embedded within the body cavity (i.e., on the stomach and digestive organs) or within the muscle tissue, which were present in one female and two males from Milne Port and one male from Koluktoo Bay.

Table 7-9: Number and Description of External and Internal Abnormalities Observed in Fourhorn Sculpin Sampled from Milne Port and Koluktoo Bay, 2024

Parameter	Milne Port		Koluktoo Bay	
	Female (n = 20)	Male (n = 20)	Female (n = 20)	Male (n = 19)
External				
Body Deformities	0	0	0	0
Eyes	0	0	0	0
Skin	0	0	0	0
Thymus	0	0	0	0
Opercula	0	0	0	0
Gills	0	0	0	0
Pseudobranchs	0	0	0	0
Fins	3	1	0	0
Vent	0	0	0	0
Parasitization ^(a)	12	9	4	3
Internal				
Liver ^(b)	2	4	3	1
Spleen	0	0	0	0
Gall bladder	0	0	0	0
Gonad	0	0	0	0
Kidney	0	0	0	0
Parasitization ^(c)	1	2	0	1

(a) External parasitization observations included cysts embedded in the fins and skin, as well as parasitic copepods in the gills.

(b) Liver abnormalities included pale coloration, focal discolouration, or general discolouration. Pale liver colouration/general or focal discolouration is typically associated with a lack of perfusion following sacrifice and cessation of the heart beating; pale or discoloured livers were noted and documented but are not considered further.

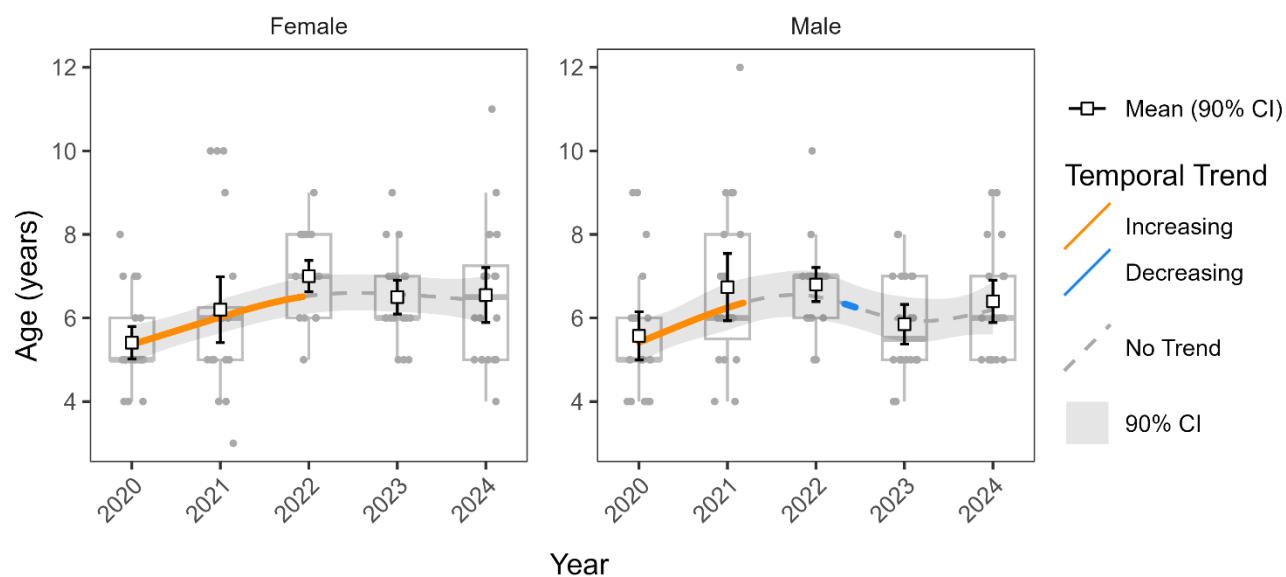
(c) Internal parasitization observations included cysts on internal organs and in the muscle.

- = no comments.

7.4.1.2.2 Temporal Comparisons

7.4.1.2.2.1 Survival – Age

Mean ages for female Fourhorn Sculpin varied significantly over sampling years, increasing from 2020 to 2022 and then stabilizing from 2022 to 2024 (Table 7-10; Figure 7-13). Similar trends were observed for male Fourhorn Sculpin with mean ages increasing from 2020 to pre-2022 and then decreasing from 2022 to 2023, and then stabilizing 2023 to 2024 (Table 7-10; Figure 7-13).

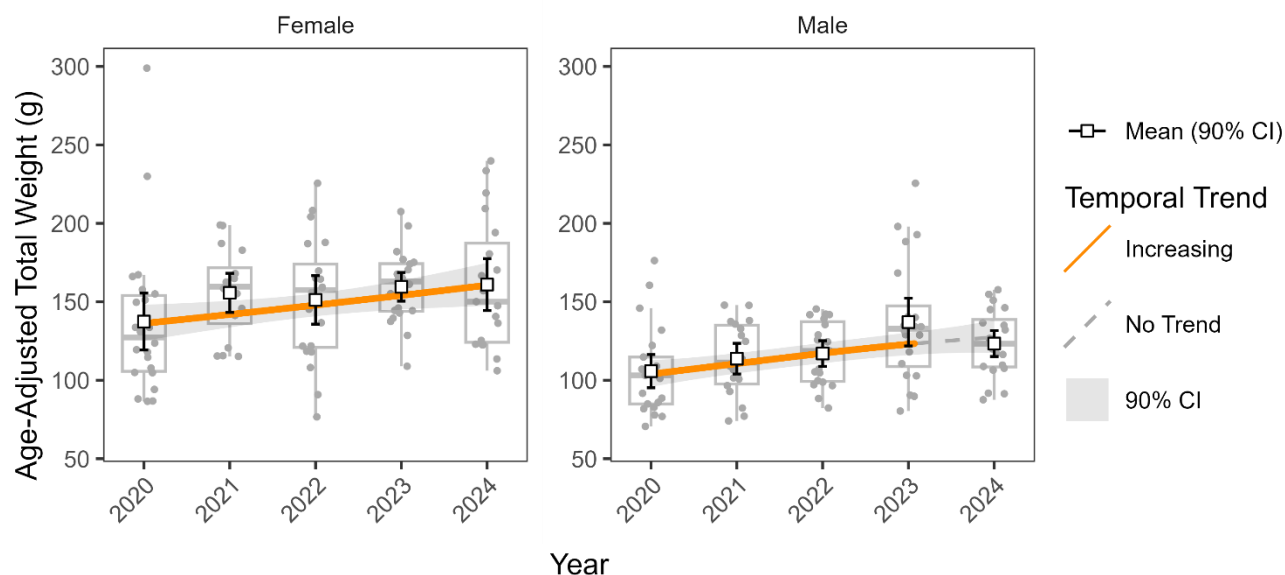


CI = confidence interval.

Figure 7-13: Temporal Trends in Ages of Female and Male Fourhorn Sculpin Sampled from Milne Port, 2020 to 2024

7.4.1.2.2.2 Growth – Size-at-Age

For female Fourhorn Sculpin, mean size-at-age varied significantly over sampling years, increasing from 2020 to 2024 (Table 7-10; Figure 7-14). Similarly, for male Fourhorn Sculpin, size-at-age increased significantly from 2020 to 2023 and then remained relatively stable from 2023 to 2024 (Table 7-10; Figure 7-14).



Notes: Female and male total weights adjusted to sex-specific mean ages (female: 6.1 years; male: 6.0 years). One female sampled in 2020 (FIN: BAFF20UMLNFHSC1023) was omitted as an outlier.

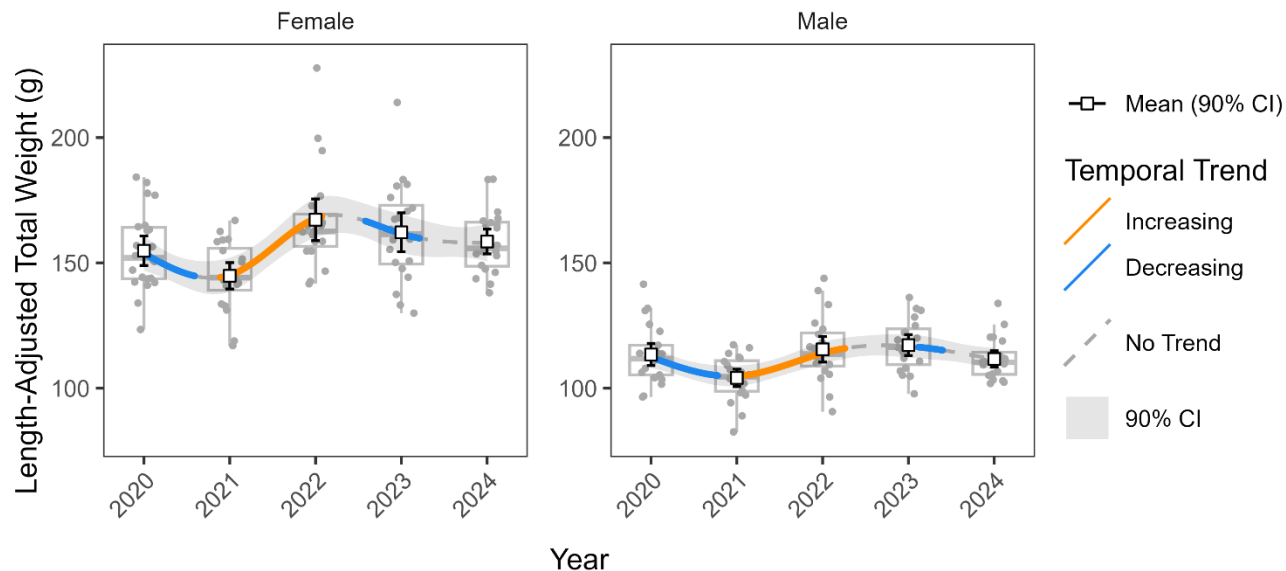
CI = confidence interval.

Figure 7-14: Temporal Trends in Age-Adjusted Total Weight (Size-at-Age) for Female and Male Fourhorn Sculpin Sampled from Milne Port, 2020 to 2024

7.4.1.2.2.3 Condition – Relative Total Weight and Relative Liver Weight

Relative total weight varied significantly across sampling years for both sexes, following similar trends (Table 7-10; Figure 7-15). For both female and male Fourhorn Sculpin, trends in mean relative total weight fluctuated over time (i.e., followed a roughly sinusoidal pattern), suggesting observed trends may be attributable to natural variability over time (Figure 7-15).

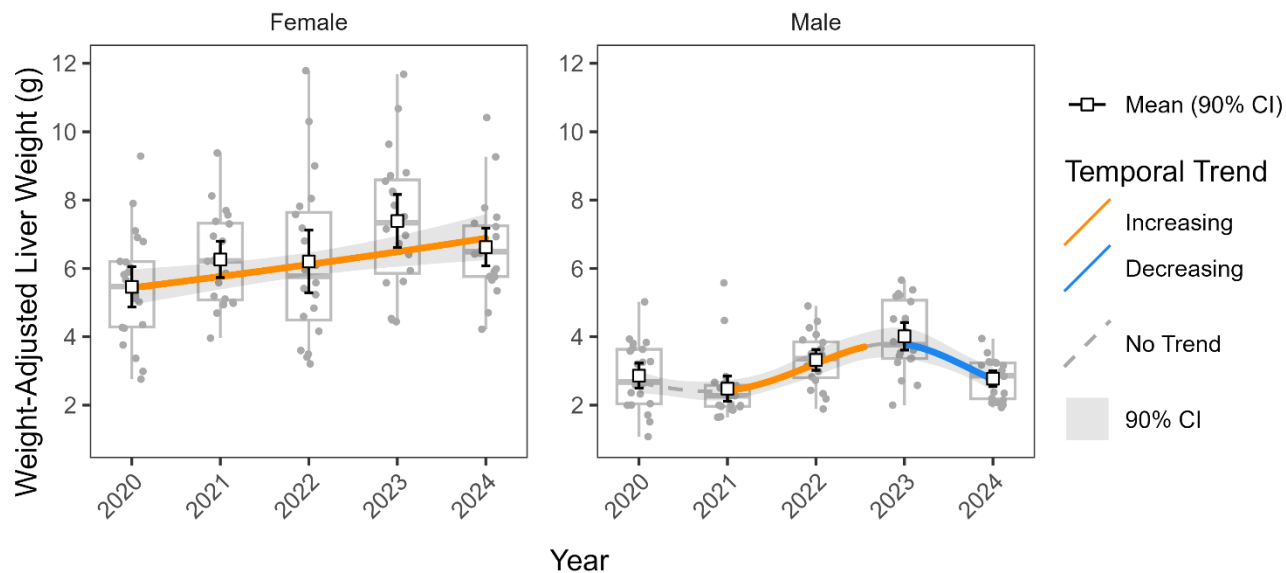
Relative liver weight varied significantly across sampling years for both female and male Fourhorn Sculpin (Table 7-10; Figure 7-16), but trends differed by sex. For female Fourhorn Sculpin, mean relative liver weight increased consistently between 2020 to 2024 by approximately 6.0% per year (Table 7-10; Figure 7-16). In contrast, for male Fourhorn Sculpin, relative liver weight showed no consistent temporal trends, instead fluctuating over time (Figure 7-16).



Notes: Female and male total weights adjusted to sex-specific mean total lengths (female: 247 mm; male: 230 mm). One male sampled in 2023 (FIN: BAFF23UDPFFHSC1007) was omitted as an outlier.

CI = confidence interval.

Figure 7-15: Temporal Trends in Length-Adjusted Total Weight (Relative Total Weight) for Female and Male Fourhorn Sculpin Sampled from Milne Port, 2020 to 2024



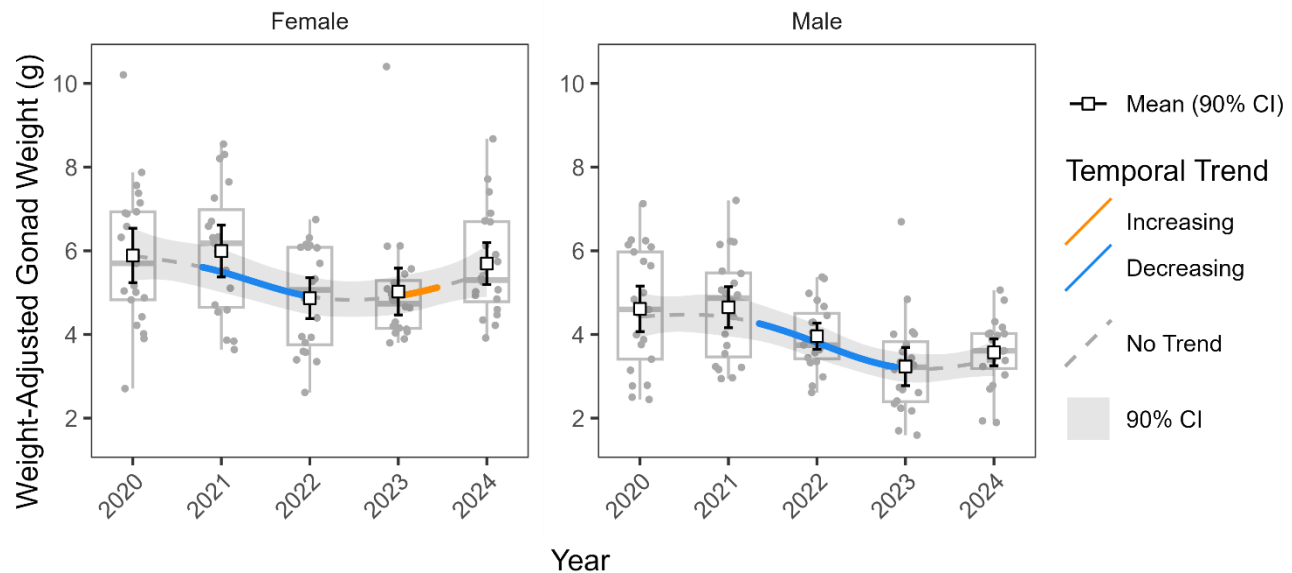
Notes: Female and male liver weights adjusted to sex-specific mean total weights (female: 154 g; male: 117 g).

CI = confidence interval.

Figure 7-16: Relative Liver Weight for Female and Male Fourhorn Sculpin Sampled from the Milne Port Area, 2020 to 2024

7.4.1.2.2.4 Reproduction – Relative Gonad Weight

Trends in relative gonad weight were similar among female and male Fourhorn Sculpin (Table 7-10). For females, relative gonad weight decreased from 2021 to 2022, increased from 2023 to 2024, and otherwise remained stable over time. For males, relative gonad weight decreased from 2021 to 2023 but otherwise remained stable (Figure 7-17).



Notes: Female and male gonad weights adjusted to sex-specific mean total weights (female: 152 g; male: 117 g). One female sampled in 2021 (FIN: BAFF21UMLNFRSC1019) was omitted as an outlier.

CI = confidence interval.

Figure 7-17: Relative Gonad Weight for Female and Male Fourhorn Sculpin Sampled from Milne Port, 2020 to 2024

Table 7-10: Summary of Statistical Comparisons for Fourhorn Sculpin Sampled from 2020 to 2024, Milne Port Area

Effect Indicator	Endpoint ^(a)	Statistical Test	n Outlier	Sample Size					Year P-value	Least Squares Mean					Year Trend P-value					Year Trend Slope Estimate					Trend Direction				
				2020	2021	2022	2024	2024		2020	2021	2022	2024	2024	2020	2021	2022	2024	2024	2020	2021	2022	2024	2024	2020	2021	2022	2024	2024
Female																													
Survival	Age	GAM _{log10}	0	22	20	20	20	20	0.003	0.730	0.780	0.815	0.817	0.807	0.030	0.001	0.154	0.579	0.605	0.052	0.046	0.019	-0.0078	-0.012	↑	↑	-	-	-
Growth	Size-at-Age	GAM _{log10} ^(b)	0	21	16	20	20	19	0.021	2.13	2.15	2.17	2.19	2.21	0.021	0.021	0.021	0.021	0.021	0.018	0.018	0.018	0.018	0.018	↑	↑	↑	↑	↑
Condition (Energy Storage)	Condition	GAM _{log10}	0	22	20	20	20	20	0.001	2.19	2.16	2.22	2.21	2.20	0.011	0.002	0.004	0.009	0.959	-0.054	0.034	0.033	-0.028	-0.0011	↓	↑	↑	↓	-
	Relative Liver Weight	GAM _{log10}	0	22	20	20	20	20	0.004	0.735	0.761	0.786	0.812	0.838	0.004	0.004	0.004	0.004	0.004	0.026	0.026	0.026	0.026	0.026	↑	↑	↑	↑	↑
Reproduction	Relative Gonad Weight	GAM _{log10}	0	22	19	20	20	20	0.053	0.770	0.740	0.691	0.692	0.739	0.564	0.020	0.129	0.126	0.141	-0.021	-0.046	-0.032	0.030	0.055	-	↓	-	-	-
Male																													
Survival	Age	GAM _{log10}	0	21	20	20	20	20	0.079	0.734	0.796	0.814	0.775	0.792	0.078	0.013	0.279	0.321	0.35	0.068	0.049	-0.023	-0.019	0.036	↑	↑	-	-	-
Growth	Size-at-Age	GAM _{log10} ^(b)	0	21	18	19	20	20	0.005	2.02	2.04	2.07	2.09	2.11	0.055	0.011	0.007	0.086	0.33	0.027	0.026	0.023	0.018	0.014	↑	↑	↑	↑	-
Condition (Energy Storage)	Condition	GAM _{log10}	0	21	20	20	19	20	0.006	2.05	2.02	2.06	2.07	2.05	0.005	0.343	0.000	0.254	0.16	-0.050	0.0081	0.035	-0.010	-0.025	↓	-	↑	-	-
	Relative Liver Weight	GAM _{log10}	0	21	20	20	20	20	<0.001	0.425	0.385	0.507	0.578	0.440	0.115	0.067	<0.001	0.121	0.001	-0.083	0.047	0.14	-0.040	-0.19	-	↑	↑	-	↓
Reproduction	Relative Gonad Weight	GAM _{log10}	0	21	20	20	20	20	<0.001	0.646	0.645	0.580	0.504	0.531	0.785	0.203	0.001	0.246	0.248	0.013	-0.030	-0.091	-0.027	0.055	-	-	↓	-	-

Notes: Statistically significant values are indicated in bold. Statistical outliers are provided in Appendix 7A, Table 7A-12. Detailed statistical results for size-adjustment are provided in Appendix 7A, Table 7A-13.

(a) For model components, please see Table 7-3.
(b) Temporal trends assessed over range of overlapping covariate values (i.e., Ages 4 to 9 years).
P-value = probability value; GAM = Gaussian additive model; log10 = log10-transformed data.

7.4.1.3 *Hiatella arctica*

In 2024, a total of 63 *H. arctica* were collected from Milne Port and Tugaat River Estuary and processed for fish health endpoints (Table 7-11). A total of 40 *H. arctica* were collected from Milne Port, ranging in length from 19.7 mm to 36.3 mm, with a median length of 26.8 mm, and whole animal wet weight ranging from 0.826 g to 4.88 g, with a median value of 2.12 g. Length data showed some right skewness but no multimodality at Milne Port (Figure 7-18). Length exhibited a strong relationship with total weight ($P < 0.001$; $R^2 = 0.73$). Gonad weights ranged from 0.006 g to 0.587 g, with a median value of 0.024 g; mantle somatic index (MSI) ranged from 1.3 to 1,238 with a median value of 3.96. *Hiatella arctica* sampled from Milne Port ranged in age from 5 to 82 years, with a median age of 13. Median condition factor in 2024 was 1.57, ranging from 0.97 to 2.32.

A total of 23 *H. arctica* were collected from Tugaat River Estuary, ranging in length from 17.3 to 36.7 mm, with a median length of 28.0 mm, and whole animal wet weight ranging from 0.93 g to 7.60 g, with a median value of 2.91 g. Length data showed some multimodality, likely due in part to the smaller sample size (i.e., $n = 23$; Figure 7-18). Length exhibited a strong relationship with whole animal wet weight ($P < 0.001$; $R^2 = 0.79$). Gonad weights ranged from 0.008 g to 0.050 g, with a median value of 0.023 g; MSI ranged from 1.34 to 5.50, with a median value of 3.31. *Hiatella arctica* sampled from Tugaat River Estuary ranged in age from 6 to 59 years, with a median age of 22. Median condition factor in 2024 was 3.31, ranging from 1.34 to 5.50.

Table 7-11: Descriptive Statistics for *Hiatella arctica* Health Endpoints from Milne Port and Tugaat River Estuary, 2024

Parameter	Milne Port Area							Tugaat River Estuary						
	<i>n</i>	Min	Max	Median	Mean	SD	SE	<i>n</i>	Min	Max	Median	Mean	SD	SE
<i>Hiatella arctica</i>														
Total Length (mm)	40	19.7	36.3	26.8	26.3	3.51	0.555	23	17.3	36.7	28.0	27.6	4.63	0.97
Whole Animal ww (g)	40	0.826	4.88	2.12	2.41	1.10	0.175	23	0.925	7.60	2.91	3.17	1.60	0.334
Shell ww (g)	40	0.435	3.50	1.11	1.36	0.810	0.128	23	0.450	5.56	1.56	1.97	1.20	0.250
Shell dw (g)	40	0.359	3.28	0.95	1.20	0.750	0.119	23	0.350	5.19	1.40	1.73	1.10	0.230
Tissue ww (g)	40	0.135	1.20	0.62	0.65	0.277	0.044	23	0.299	1.46	0.77	0.77	0.310	0.065
Condition factor	40	0.97	2.32	1.57	1.62	0.32	0.050	23	1.17	2.88	1.77	1.85	0.39	0.080
Gonad ww (g)	40	0.006	0.587	0.024	0.056	0.113	0.0179	23	0.007	0.050	0.023	0.026	0.013	0.003
MSI	40	1.63	1,238	3.96	46.6	202	31.9	23	1.34	5.50	3.31	3.43	1.02	0.21
Age (y)	38	5	82	13	20	19	3.1	22	6	59	22	24	17	3.6

Notes: Data for previous monitoring years presented in Appendix 7A, Table 7A-5.

ww = wet weight; dw = dry weight; MSI = Mantle Somatic Index; *n* = sample size; min = minimum; max = maximum; SD = standard deviation; SE = standard error.

Table 7-12: Summary of Statistical Comparisons for *Hiatella arctica* Health Endpoints between Milne Port and Tugaat River Estuary, 2024

Effect Indicator	Endpoint ^(a)	Dependent Variable	Covariate	Statistical Test	Sample Size		Least Squares Mean		Area <i>P</i> -value	Magnitude of Effect (%) ^(b)	Power Analysis ^(c)	
					Milne Port	Tugaat River Estuary	Milne Port	Tugaat River Estuary			Minimum Detectable Difference ^(d)	Sensitivity ^(e)
<i>Hiatella arctica</i>												
Survival	Length Frequency	Total Length	-	K-S Test	40	23	-	-	0.196	-	n/a	n/a
Growth	Total Wet Weight	Whole Animal ww	-	ANOVA _{log10}	40	23	0.451	0.560	0.048	-22%	0.975 / 1.401	30% / 44%
Condition	Relative Total Weight	Whole Animal ww	Total Length	ANCOVA _{log10}	40	23	0.469	0.529	0.011	-13%	0.443 / 0.515	14% / 16%
	Relative Shell Weight	Dry Shell Weight	Total Length	ANCOVA _{log10}	40	23	0.025	0.121	0.021	-20%	0.278 / 0.363	23% / 31%
Reproduction	Mantle Somatic Index	Gonad Weight	Tissue ww	ANCOVA _{log10}	36	23	-1.67	-1.69	0.594	-	0.001 / 0.001	25% / 33%

Notes: Statistically significant values are indicated in bold. Power analysis was completed assuming normality. Supporting information for statistical model results are provided in Appendix 7A, Table 7A-12.

(a) For model components, please see Table 7-4.

(b) The magnitude of effect is calculated as the difference in least squares mean values between Milne Port and Tugaat River Estuary.

(c) For log₁₀-transformed models, power analysis was completed for differences less than and greater than the mean. Minimum detectable difference and sensitivity were determined using back-transformed values and are presented as: differences lower than | greater than the mean.

(d) Minimum Detectable Difference expressed as difference from the overall mean.

(e) Sensitivity is the minimum detectable difference expressed as a percent change in Tugaat River Estuary mean.

ww = wet weight; log₁₀ = log₁₀-transformed dependent variable and covariate; data; K-S Test = Kolmogorov-Smirnov test; ANOVA = analysis of variance; ANCOVA = analysis of covariance; - = not applicable; nc = not calculated.

7.4.1.3.1 Spatial Comparisons

7.4.1.3.1.1 Survival – Length-Frequency Analysis

Results of the Kolmogorov-Smirnov tests indicate there was no significant difference in length-frequency distributions between areas for *H. arctica* (Table 7-12).

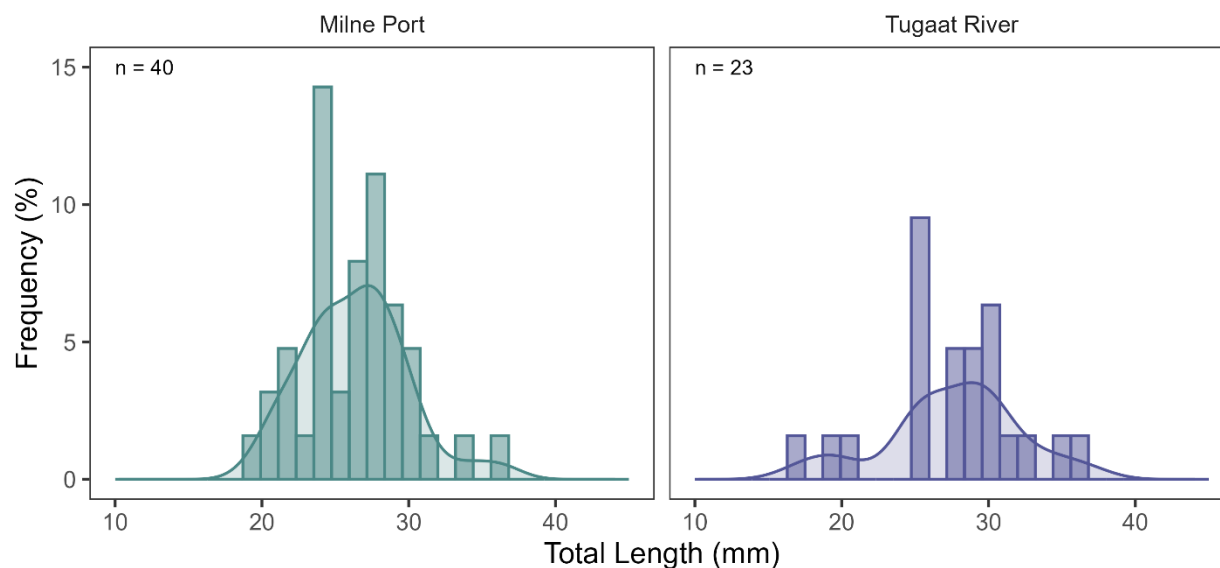


Figure 7-18: Length-Frequency Distribution for *Hiatella arctica* captured from Milne Port and Tugaat River Estuary, 2024

7.4.1.3.1.2 Growth – Whole Animal Wet Weight

Whole animal wet weight ranged from 0.826 to 4.88 g in Milne Port, and 0.925 to 7.60 g from Tugaat River Estuary (Table 7-11). Whole animal wet weight was significantly lower in *H. arctica* from Milne Port when compared to Tugaat River Estuary, with a magnitude of difference of -22% (Table 7-12; Figure 7-19).

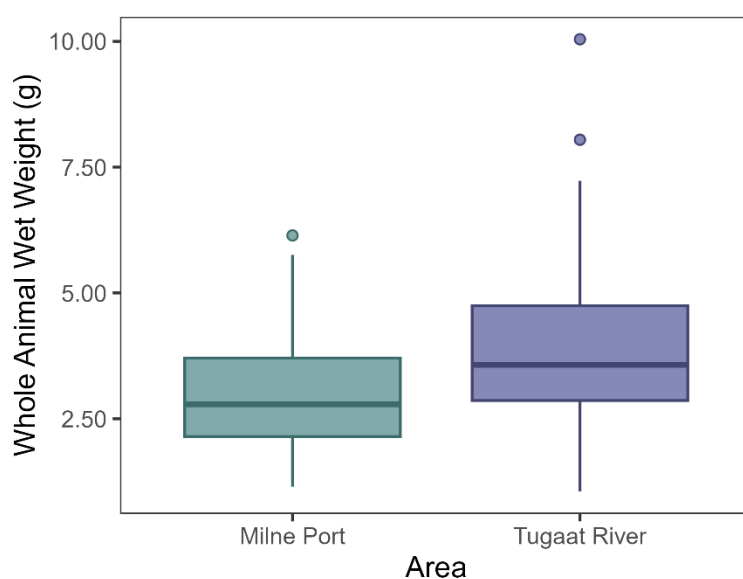


Figure 7-19: Boxplot of Whole Animal Wet Weight of *Hiatella arctica* captured from Milne Port and Tugaat River Estuary, 2024

7.4.1.3.1.3 Condition – Relative Total Weight and Relative Shell Weight

Differences in relative total weight and relative shell weight were evaluated over the shared range of lengths between sampling areas (i.e., 17 to 37 mm; Environment Canada 2012; Figure 7-20, Figure 7-21). Both relative total weight and relative shell weight were significantly lower in Milne Port compared to Tugaat River Estuary (Table 7-12). The magnitudes of difference were -13% and -20%, respectively (Table 7-12).

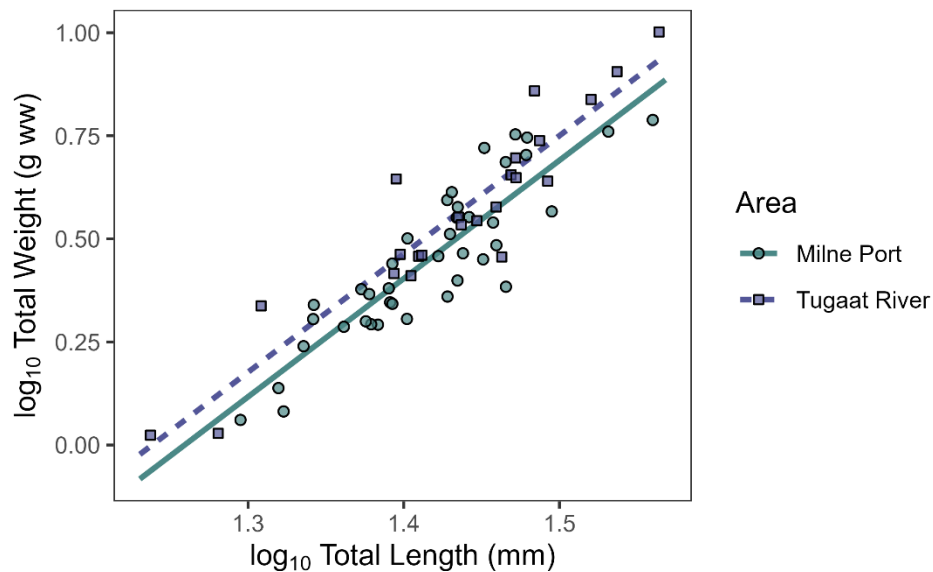


Figure 7-20: Relationship between Total Weight and Total Length of *Hiatella arctica* Captured from Milne Port and Tugaat River Estuary, 2024

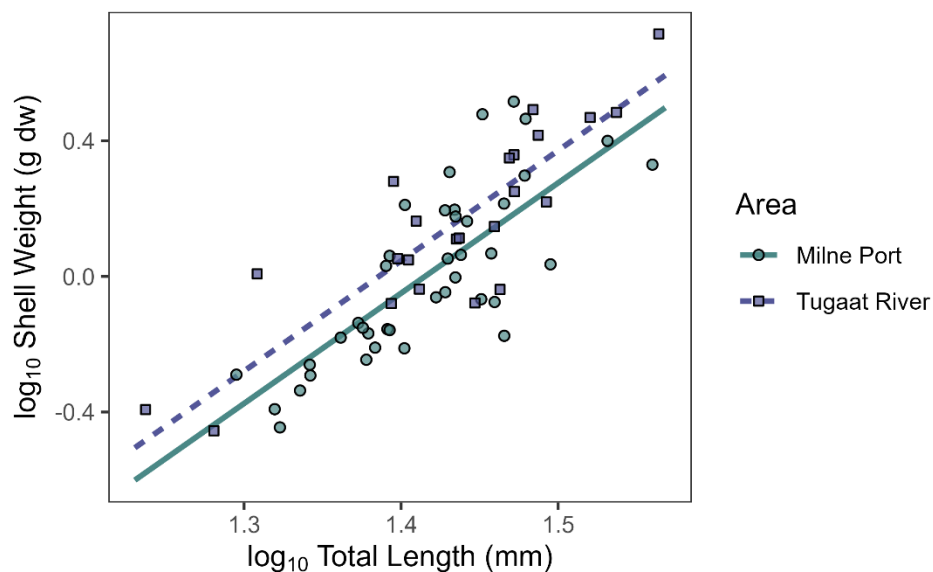
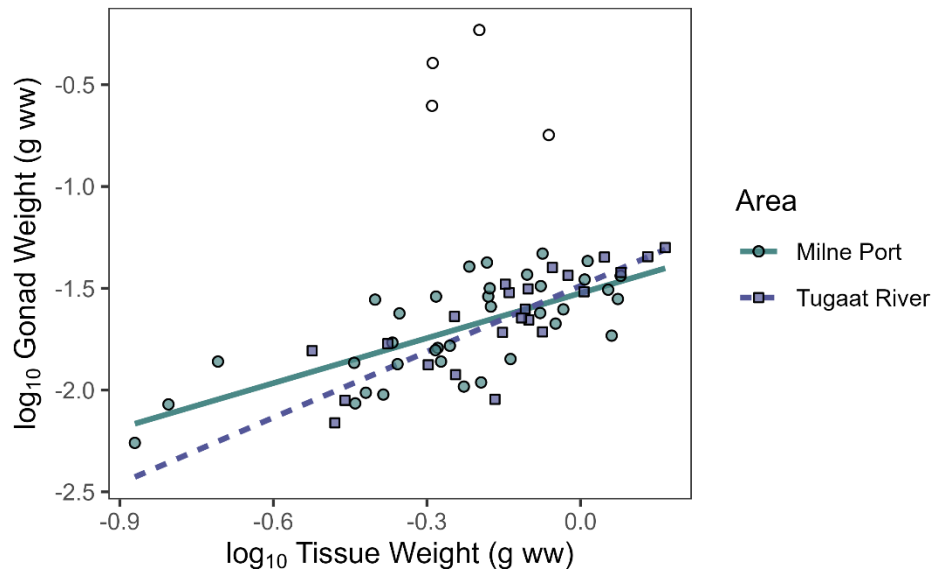


Figure 7-21: Relationship between Shell Weight and Total Length of *Hiatella arctica* Captured from Milne Port and Tugaat River Estuary, 2024

7.4.1.3.1.4 Reproduction – Mantle Somatic Index

Mantle somatic index (MSI) in *H. arctica* from Milne Port ranged from 1.63 to 1,238, and in *H. arctica* from Tugaat River Estuary ranged from 1.34 to 5.50 (Table 7-11). Relative gonad weight did not differ between sampling areas (Table 7-12; Figure 7-22).



○ = omitted from ANCOVA.

Figure 7-22: Relationship between Gonad Weight and Soft Tissue Weight of *Hiatella arctica* captured from Milne Port and Tugaat River Estuary, 2024

Table 7-13: Summary of Statistical Comparisons for *Hiatella arctica* Health Endpoints at Milne Port between 2020, 2021, 2022, 2023, and 2024

Effect Indicator	Endpoint ^(a)	Covariate	Statistical Test	Sample Size					Year <i>P</i> -value	Least Squares Mean					Year Trend <i>P</i> -value					Year Trend Slope Estimate					Trend Direction				
				2020	2021	2022	2024	2024		2020	2021	2022	2024	2024	2020	2021	2022	2024	2024	2020	2021	2022	2024	2024	2020	2021	2022	2024	2024
Hiatella arctica																													
Survival	Length Frequency ^(b)	n/a	K-S Test	50	35	44	40	40	-	29.09	30.45	29.53	30.47	26.80	-	0.234	0.797	0.797	<0.001	-	1.360	-0.925	0.940	-3.670	-	-	-	-	↓
Growth	Whole Animal Wet Weight	n/a	GAM _{log10}	50	35	44	40	40	<0.001	4.32	4.14	4.66	5.17	3.14	0.479	0.613	<0.001	0.001	<0.001	-0.323	0.11	0.92	-0.70	-2.69	-	-	↑	↓	↓
Condition (Energy Storage)	Condition ^(d)	Total Length	GAM _{log10}	49	34	44	40	39	0.004	0.62	0.58	0.63	0.65	0.59	0.020	0.479	0.001	0.052	0.006	-0.063	0.0088	0.052	-0.025	-0.074	↓	-	↑	↓	↓
	Relative Shell Weight ^(e)	Total Length	GAM _{log10}	50	27	27	36	23	0.106	0.194	0.262	0.193	0.245	0.201	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Reproduction	Mantle Somatic Index ^(f)	Tissue Wet Weight	GAM _{log10}	-	35	40	39	36	<0.001	-	-1.77	-1.80	-1.30	-1.54	-	<0.001	<0.001	<0.001	<0.001	-	-0.22	0.35	0.22	-0.47	-	↓	↑	↑	↓

Notes: Statistically significant values are indicated in bold. Statistical outliers are provided in Appendix 7A, Table 7A-12. Detailed statistical results are provided in Appendix 7A, Table 7A-11. Detailed statistical results for size-adjustment are provided in Appendix 7A, Table 7A-13.

- (a) For model components, please see Table 7-4.
- (b) Least squares mean values are median total lengths. *P*-values adjusted using Holm’s correction for multiple comparisons (Holm 1979). Trend slopes are sequential pairwise differences between years (e.g., between 2020 and 2021).
- (c) GAM analysis using log10-transformation proceeded despite significant Shapiro-Wilk test result as inspection of residuals did not suggest severe deviation from normality.
- (d) Evaluated over the range of overlapping covariate values (i.e., total lengths ranging from 20.00 to 37.40 mm).
- (e) Evaluated over the range of overlapping covariate values (i.e., whole animal wet weights ranging from 1.004 to 4.934 g).
- (e) Evaluated over the range of overlapping covariate values (i.e., tissue wet weights ranging from 1.000 to 4.934 g).

7.4.1.3.2 Temporal Comparisons

7.4.1.3.2.1 Survival – Length-Frequency

Results of the pairwise sequential Kolmogorov-Smirnov tests indicate there were no significant differences between most years in length-frequency distributions for *H. arctica*, except for between 2023 and 2024 (Table 7-13). *Hiatella* collected in 2024 were generally smaller than those collected in 2023 in Milne Port (Appendix 7A, Table 7A-5), with the median total length in 2024 (26.80 mm) being less than that in 2023 (30.50 mm).

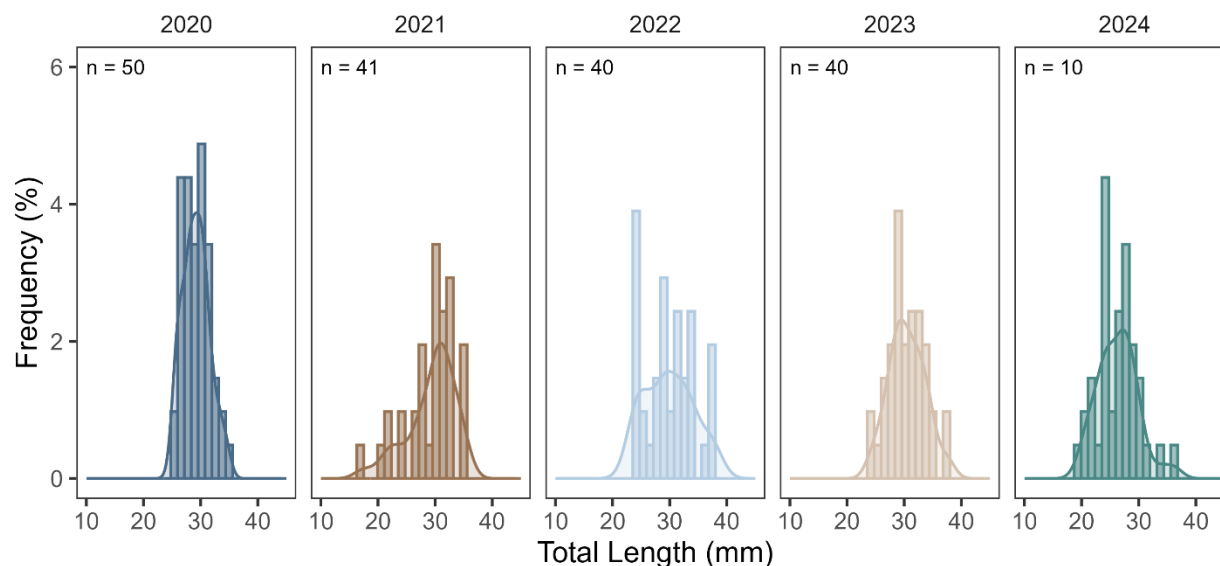
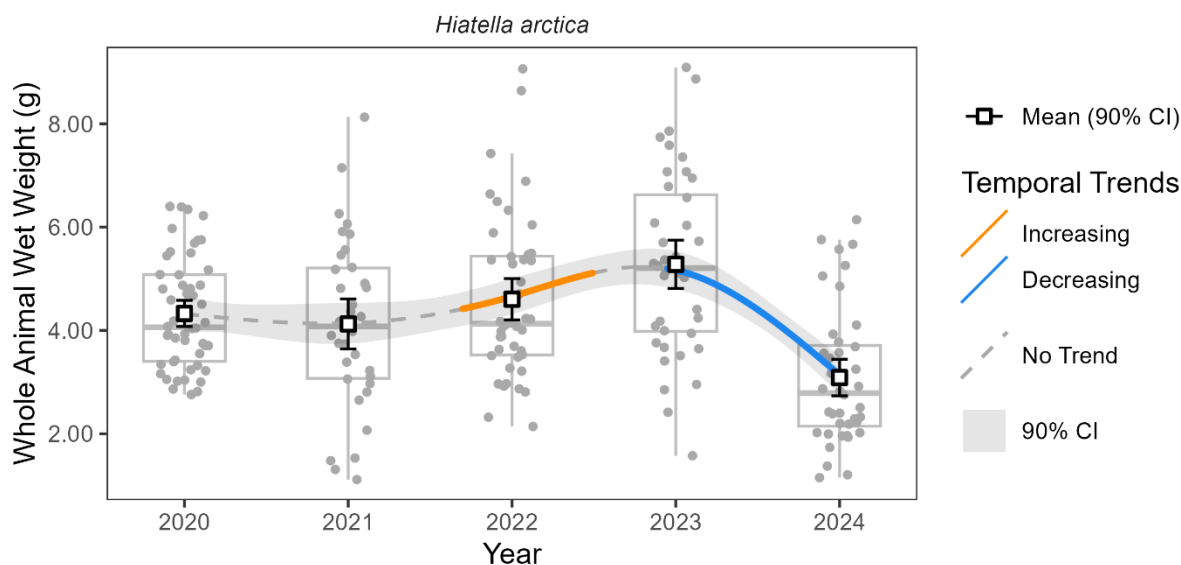


Figure 7-23: Length-Frequency Distributions for *Hiatella arctica* captured from Milne Port, 2020 to 2024

7.4.1.3.2.2 Growth – Whole Animal Wet Weight

Mean whole animal wet weight ranged from 3.09 in 2024 to 5.28 in 2023 (Appendix 7A, Table 7A-5). Mean whole animal wet weight varied significantly over sampling years, increasing from 2021 to 2023 and then decreasing from 2023 to 2024 (Table 7-13; Figure 7-24).

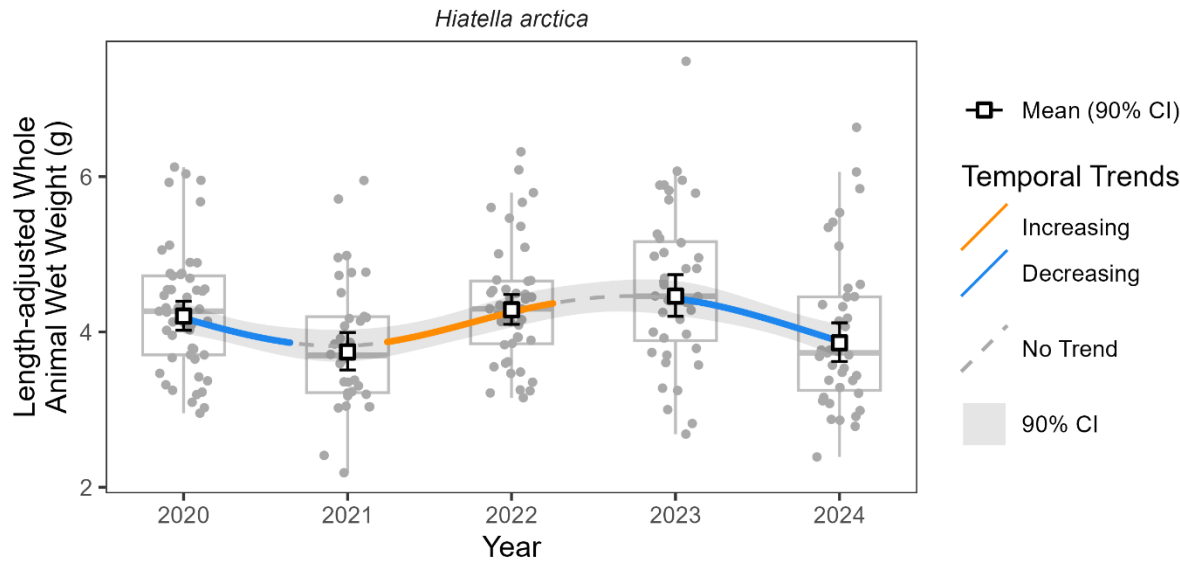


CI = confidence interval.

Figure 7-24: Temporal Trends in Whole Animal Wet Weight of *Hiatella arctica* captured from Milne Port, 2020 to 2024

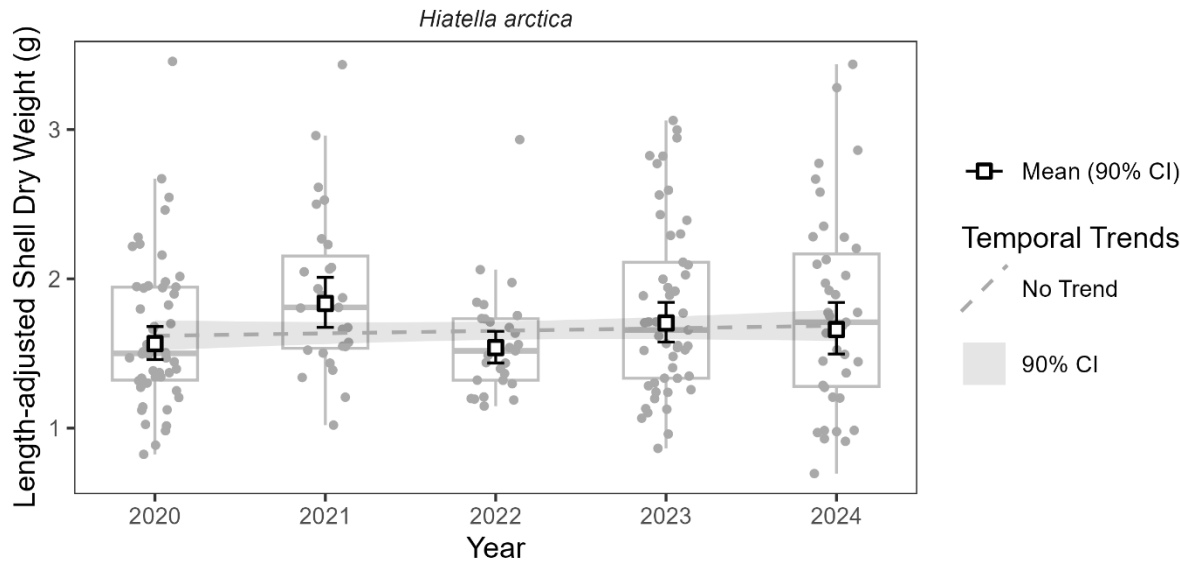
7.4.1.3.2.3 Condition – Relative Total Weight and Relative Shell Weight

Trends in relative total weight and relative shell weight were evaluated over the shared range of lengths (i.e., 20 to 38 mm for all years), per Environment Canada (2012). Relative total weight varied significantly among sampling years (Table 7-13). Observed trends suggested natural interannual variability, where mean relative total weights fluctuated between sampling years with no consistent, directional trends (Figure 7-25). In contrast, no trends in relative shell weight were observed from 2020 to 2024 (Figure 7-26; Table 7-13).



CI = confidence interval.

Figure 7-25: Temporal Trends in Length-Adjusted Whole Animal Wet Weight of *Hiatella arctica* captured from Milne Port, 2020 to 2024

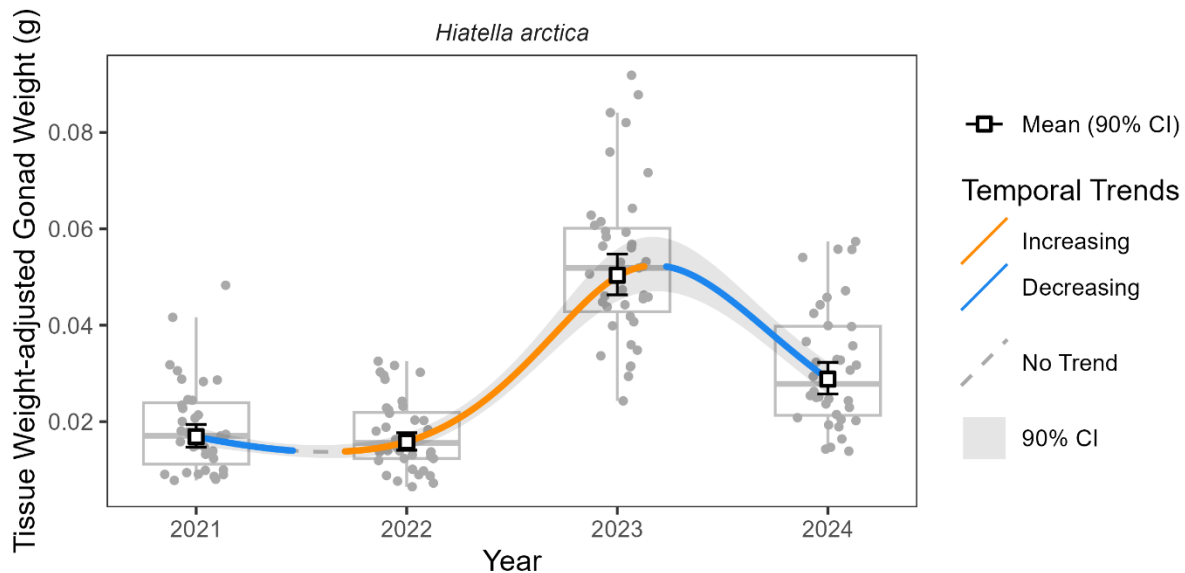


CI = confidence interval.

Figure 7-26: Temporal Trends in Length-Adjusted Shell Dry Weight of *Hiatella arctica* Captured from Milne Port, 2020 to 2024

7.4.1.3.2.4 Reproduction – Mantle Somatic Index

Due to a narrow range of overlapping tissue weights (Appendix 7A, Table 7A-5), gonad weight was standardized to 0.850 g tissue wet weight prior to trend assessment. Relative gonad weights varied significantly over sampling years (Table 7-13). Mean gonad weight decreased from 2021 to 2022, increased to the highest value in 2023, before decreasing to 2024 (Figure 7-27).



CI = confidence interval.

Figure 7-27: Relationship between Gonad Weight and Soft Tissue Weight of *Hiatella arctica* captured from Milne Port, 2021 to 2024

Results of fish health analysis for Arctic Char, Fourhorn Sculpin, and *Hiatella arctica* were within FEIS predictions and subsequent addenda, which indicated the potential for low magnitude reductions in fish health and condition associated with Project activities. Results presented herein do not exceed predicted effects on fish health due to Project activities.

7.4.2 Fish Tissue Chemistry

A total of 413 fish tissue samples were submitted for metals analysis and 135 fish tissue samples were submitted for PAH analysis from Milne Port from 2010 to 2024. A summary of sample sizes by species and year are provided in Appendix 7B, Table 7B-1. The analyses presented herein focus on data collected since 2018. Summaries of tissue chemistry data collected in previous monitoring years are presented in Appendix 7B, Tables 7B-9 to 7B-11, and visual comparisons of the entire data series, including years prior to 2018, are shown as boxplots in Appendix 7C. A summary of sample sizes analyzed in 2024 and those previously analyzed is provided in Table 7-14. Results for individual species are described in the following sections.

Table 7-14: Summary of Sample Sizes Achieved for Tissue Chemistry Analysis

Species	Analytical Group	Sample Size	
		Previously Analyzed	2024
Milne Port			
Arctic Char	Metals	113	8
	PAHs	58	8
Fourhorn Sculpin	Metals	70	8
	PAHs	40	8
<i>Hiatella arctica</i>	Metals	144	8
	PAHs	22	0
Reference Areas			
Fourhorn Sculpin	Metals	12	8
	PAHs	8	8
<i>Hiatella arctica</i>	Metals	4	6
	PAHs	1	0

PAH = polycyclic aromatic hydrocarbons.

7.4.2.1 Spatial Comparisons

7.4.2.1.1 Fourhorn Sculpin

Tissue Metals

In 2024, 16 Fourhorn Sculpin tissue samples were analyzed for metals (i.e., eight samples from Milne Port and eight samples from Koluktoo Bay). Summary statistics for metals concentrations are provided in Table 7-15 and these results are presented as boxplots in Appendix 7C, Figures 7C-1 to 7C-31. Statistical comparisons for COPCs among sampling areas are provided in Table 7-16.

Concentrations of metals in Fourhorn Sculpin were generally similar between Milne Port and Koluktoo Bay (Appendix 7C, Figures 7C-1 to 7C-31), with a few exceptions. The range of measured concentrations of arsenic in samples from Koluktoo Bay appeared to be greater than the range of measured concentrations in Milne Port (Appendix 7C, Figure 7C-3). These results are likely related to localized differences in water or sediment chemistry nearby the sampling area and are considered to represent natural variability in the environment due to their association with the reference area.

Concentrations of all COPCs in Fourhorn Sculpin tissues were not statistically different between sampling areas (Table 7-16).

Polycyclic Aromatic Hydrocarbons

In 2024, 16 Fourhorn Sculpin tissue samples were analyzed for PAHs (i.e., eight samples collected from Milne Port and eight samples collected from Koluktoo Bay). The reported concentrations of PAHs were below DL for all parameters analyzed in Fourhorn Sculpin (Appendix 7B, Table 7B-7).

Results of chemical analyses of metals and PAHs in Fourhorn Sculpin tissues were within FEIS predictions and subsequent addenda, which indicated the potential for low magnitude increases in fish tissue concentrations of metals and/or PAHs associated with Project activities. Results presented herein do not exceed predicted effects on fish tissue chemistry due to Project activities.

Table 7-15: Descriptive Statistics for Fourhorn Sculpin Tissue Chemistry Data Analyzed from Milne Port Area and Koluktoo Bay, 2024

Parameter (mg/kg ww)	DL	Milne Port							Koluktoo Bay						
		N >DL / N Total	Min	Max	Median	Mean	SD	SE	N >DL / N Total	Min	Max	Median	Mean	SD	SE
Aluminum	0.50	100	0.57	1.9	1.4	1.4	0.41	0.14	100	0.62	1.9	1.2	1.2	0.45	0.16
Antimony	0.0020	100	<0.0020	0.025	0.0049	0.0072	0.0076	0.0027	100	0.0025	0.0085	0.0056	0.0053	0.0021	0.00075
Arsenic	0.0050	100	2.2	6.0	3.2	3.4	1.2	0.42	100	1.9	8.4	3.5	4.2	2.2	0.79
Barium	0.010	100	0.016	0.19	0.029	0.050	0.057	0.020	100	0.016	0.099	0.042	0.049	0.031	0.011
Beryllium	0.0020	13	<0.0020	<0.0020	<0.0020	<0.0020	-	-	0	<0.0020	<0.0020	<0.0020	<0.0020	-	-
Bismuth	0.0013	75	<0.0013	0.0063	0.0027	0.0031	0.0018	0.00064	0	<0.0013	<0.0013	<0.0013	<0.0013	-	-
Boron	0.20	13	<0.20	<0.20	<0.20	<0.20	-	-	0	<0.20	<0.20	<0.20	<0.20	-	-
Cadmium	0.0013	100	0.0035	0.016	0.0073	0.0088	0.0049	0.0017	100	0.0037	0.012	0.0077	0.0073	0.0028	0.00099
Calcium	4.0	100	110	3500	150	620	1200	420	100	100	310	120	160	74	26
Chromium	0.025	50	<0.025	0.26	0.034	0.061	0.085	0.030	38	<0.025	0.15	<0.025	0.032	0.050	0.018
Cobalt	0.0013	100	0.0052	0.016	0.013	0.011	0.0038	0.0013	100	0.0068	0.022	0.014	0.014	0.0047	0.0017
Copper	0.013	100	0.32	0.68	0.47	0.50	0.13	0.045	100	0.32	0.72	0.39	0.43	0.13	0.044
Iron	0.25	100	5.7	19	7.2	9.4	5.0	1.8	100	5.2	43	6.8	12	13	4.5
Lead	0.0013	100	0.0022	0.017	0.0082	0.0083	0.0046	0.0016	100	0.0040	0.012	0.0067	0.0071	0.0030	0.0011
Magnesium	0.40	100	190	300	220	240	46	16	100	210	310	230	240	34	12
Manganese	0.010	100	0.11	0.64	0.18	0.26	0.18	0.064	100	0.16	0.51	0.24	0.27	0.12	0.042
Mercury	0.0020 - 0.010	100	0.11	0.32	0.15	0.18	0.069	0.025	100	0.067	0.36	0.12	0.17	0.11	0.040
Molybdenum	0.0080	0	<0.0080	<0.0080	<0.0080	<0.0080	-	-	0	<0.0080	<0.0080	<0.0080	<0.0080	-	-
Nickel	0.010	100	<0.010	0.37	0.034	0.074	0.12	0.043	100	0.011	0.26	0.029	0.061	0.083	0.029
Phosphorus	2.0	100	2000	4300	2200	2500	760	270	100	2000	2400	2200	2200	110	40
Potassium	2.5	100	3300	3900	3800	3700	180	65	100	3500	3900	3700	3700	130	47
Selenium	0.010	100	0.45	0.72	0.53	0.55	0.095	0.033	100	0.45	0.78	0.60	0.61	0.12	0.044
Silver	0.0013	25	<0.0013	0.0056	<0.0013	<0.0013	0.0020	0.00069	0	<0.0013	<0.0013	<0.0013	<0.0013	-	-
Sodium	2.5	100	590	890	720	720	94	33	100	680	1200	760	810	160	56
Strontium	0.013	100	0.34	18	0.55	3.0	6.1	2.1	100	0.40	1.7	0.58	0.76	0.48	0.17
Thallium	0.00040	100	0.00055	0.0019	0.0010	0.0011	0.00043	0.00015	100	0.00050	0.0012	0.00075	0.00078	0.00024	0.000085
Tin	0.020	75	<0.020	0.047	0.022	0.025	0.012	0.0041	38	<0.020	0.044	<0.020	<0.020	0.014	0.0049
Titanium	0.13	100	0.28	0.57	0.31	0.34	0.096	0.034	100	0.27	0.39	0.29	0.30	0.041	0.014
Uranium	0.00040	50	<0.00040	0.0042	<0.00040	0.0014	0.0018	0.00064	25	<0.00040	0.00056	<0.00040	<0.00040	0.00011	0.000038
Vanadium	0.020	0	<0.020	<0.020	<0.020	<0.020	-	-	13	<0.020	<0.020	<0.020	<0.020	-	-
Zinc	0.20	100	10	31	14	17	6.8	2.4	100	11	34	16	20	9.0	3.2

Notes: Data for previous monitoring years presented in Appendix 7B, Table 7B-9.
N > DL / N Total = number of samples above DL / sample size; mg/kg = milligram per kilogram wet weight; > = greater than; DL = detection limit; n = sample size; min = minimum; max = maximum; SD = standard deviation; SE = standard error.

Table 7-16: Summary of Spatial Comparisons of Constituents of Potential Concern in Fourhorn Sculpin and *Hiatella arctica* Tissue Samples Collected from Milne Port and Reference Areas, 2024

Parameter	Statistical Test	Sample Size		<i>n</i> Outliers	Coefficient of Determination (R ²)		Interaction <i>P</i> -value	Area <i>P</i> -value	Least Squares Means		Magnitude of Effect (%)	Power Analysis ^(a)	
		Milne Port	Reference		Full Model	Reduced Model			Milne Port	Reference		Minimum Detectable Difference ^(b)	Sensitivity ^(c)
Fourhorn Sculpin													
Aluminum	ANOVA	8	8	0	0.071	-	-	0.317	1.408	1.19	-	0.766	59%
Iron	ANOVA _{rank}	8	8	0	0.001	-	-	0.921	7.17	6.47	-	7.6	111%
Magnesium	ANOVA	8	8	0	0.010	-	-	0.714	236	244	-	71.2	30%
Mercury	ANCOVA _{log} ^(d)	8	8	0	0.581	0.569	0.570	0.909	-0.810	-0.819	-	3.00 / 5.56	46% / 85%
Selenium	ANOVA ^(e)	8	8	0	0.093	-	-	0.250	0.546	0.612	-	0.196	34%
Hiatella arctica													
Aluminum	ANOVA	8	5	1	0.449	-	-	0.012	55	109	-49%	86	105%
Iron	ANOVA	8	5	1	0.206	-	-	0.120	137	189	-	147	90%
Magnesium	ANOVA	8	6	0	0.203	-	-	0.106	896	1041	-	418	43%
Mercury	ANOVA	8	6	0	0.200	-	-	0.109	0.0413	0.0324	-	0.0261	71%
Selenium	ANOVA	8	5	1	0.346	-	-	0.035	1.61	1.87	-14%	0.527	30%

Note: Significant differences indicated in **bold**. Supporting information for statistical model results are provided in Appendix 7B, Table 7B-12.

(a) Power Analysis values presented on measurement scale. Log₁₀-transformed models include values for differences below and above the grand mean.

(b) Minimum Detectable Difference expressed as difference from the overall mean.

(c) Sensitivity is the minimum detectable difference expressed as a percent change in the overall mean.

(d) Length was included as a covariate for ANCOVA.

(e) Length was not significantly related to selenium concentrations in Fourhorn Sculpin in 2024; therefore, ANOVA was used.

ANOVA = analysis of variance; ANCOVA = analysis of covariance; log = log₁₀-transformed data; rank = rank-transformed data; - = not calculated, not applicable.

7.4.2.1.2 *Hiatella arctica*

Tissue Metals

In 2024, a total of 14 *H. arctica* samples were analyzed for metals (i.e., eight composite samples composed of shellfish collected from Milne Port, and six composite samples composed of shellfish collected from Tugaat River Estuary). Summary statistics for *H. arctica* metals concentrations are provided in Table 7-17 and are presented visually as boxplots in Appendix 7C, Figures 7C-1 to 7C-31. Statistical comparisons for COPCs among years are provided in Table 7-16.

Concentrations of metals in *Hiatella* were generally similar between Milne Port and Tugaat River Estuary, with a few exceptions. The range of measured concentrations of barium and selenium in samples from Tugaat River Estuary appeared to be greater than the range of measured concentrations in Milne Port in 2024 (Appendix 7C, Figures 7C-4 and 7C-23). These results are likely related to localized differences in water or sediment chemistry nearby or upstream of the estuary and are considered to represent natural variability in the environment due to their association with the reference area. Concentrations of COPCs were generally not significantly different between sampling areas, with the exception of aluminum and selenium (Table 7-16). Mean aluminum and selenium concentrations were significantly lower in samples from Milne Port compared to Tugaat River Estuary: the magnitudes of effect were 49% and 12%, respectively, which are below the CES.

Polycyclic Aromatic Hydrocarbons

In 2024, no tissue samples of *H. arctica* were analyzed for PAHs, due to low sample masses and the high mass requirements for PAHs compared to metals analysis. Given PAH concentrations in *H. arctica* have consistently been below DL since 2020, it is expected the concentrations remain below DL in 2024.

Results of chemical analyses of metals in *Hiatella arctica* tissues were within FEIS predictions and subsequent addenda, which indicated the potential for low magnitude increases in fish tissue concentrations of metals and associated with Project activities. Results presented herein do not exceed predicted effects on fish tissue chemistry due to Project activities.

Table 7-17: Descriptive Statistics for *Hiatella arctica* Tissue Chemistry Data Analyzed from Milne Port Area and Tugaat River Estuary, 2024

Parameter	DL	Milne Port							Tugaat River Estuary						
		N > DL / N Total	Min	Max	Median	Mean	SD	SE	N > DL / N Total	Min	Max	Median	Mean	SD	SE
Aluminum	0.50	8 / 8	21	120	56	55	33	12	6 / 6	71	280	120	140	73	30
Antimony	0.0020	8 / 8	0.0027	0.023	0.0048	0.0078	0.0071	0.0025	6 / 6	0.0038	0.014	0.0048	0.0062	0.0039	0.0016
Arsenic	0.0050	8 / 8	1.5	2.2	1.9	1.9	0.24	0.084	6 / 6	1.8	2.6	2.2	2.1	0.29	0.12
Barium	0.010	8 / 8	3.7	53	5.0	16	18	6.4	6 / 6	2.9	140	27	44	52	21
Beryllium	0.0020	8 / 8	<0.0020	0.0077	0.0040	0.0042	0.0021	0.00076	6 / 6	0.0058	0.020	0.0067	0.0093	0.0055	0.0022
Bismuth	0.0013	8 / 8	0.0016	0.0078	0.0025	0.0030	0.0020	0.00070	6 / 6	0.0020	0.0049	0.0030	0.0032	0.0012	0.00049
Boron	0.20	8 / 8	2.1	3.1	2.8	2.7	0.35	0.12	6 / 6	2.7	5.2	3.3	3.6	1.0	0.41
Cadmium	0.0013	8 / 8	0.80	1.3	0.86	0.92	0.17	0.059	6 / 6	0.73	1.3	1.1	1.1	0.23	0.092
Calcium	4.0	8 / 8	680	1400	1100	1100	250	88	6 / 6	860	2100	1200	1300	450	180
Chromium	0.025	8 / 8	0.15	0.39	0.22	0.25	0.092	0.032	6 / 6	0.23	0.70	0.34	0.39	0.17	0.068
Cobalt	0.0013	8 / 8	0.20	0.33	0.26	0.27	0.041	0.014	6 / 6	0.24	0.49	0.29	0.32	0.093	0.038
Copper	0.013	8 / 8	1.2	1.7	1.5	1.5	0.19	0.068	6 / 6	1.1	2.1	1.7	1.6	0.41	0.17
Iron	0.25	8 / 8	80	260	140	140	59	21	6 / 6	140	490	200	240	130	52
Lead	0.0013	8 / 8	0.044	0.13	0.084	0.079	0.030	0.011	6 / 6	0.11	0.35	0.20	0.20	0.087	0.036
Magnesium	0.40	8 / 8	650	1100	880	900	140	48	6 / 6	850	1300	1000	1000	180	72
Manganese	0.010	8 / 8	14	31	20	21	5.5	1.9	6 / 6	16	36	20	22	7.4	3.0
Mercury	0.0010-0.0020	8 / 8	0.030	0.050	0.043	0.041	0.0085	0.0030	6 / 6	0.020	0.048	0.028	0.032	0.011	0.0045
Molybdenum	0.0080	8 / 8	0.12	0.19	0.17	0.17	0.022	0.0079	6 / 6	0.11	0.29	0.17	0.18	0.061	0.025
Nickel	0.010	8 / 8	0.43	0.73	0.58	0.57	0.11	0.037	6 / 6	0.41	0.85	0.66	0.64	0.18	0.073
Phosphorus	2.0	8 / 8	950	2000	1300	1300	320	110	6 / 6	1200	1600	1400	1400	160	66
Potassium	2.5	8 / 8	830	1200	1000	1000	120	42	6 / 6	1200	1500	1200	1300	150	61
Selenium	0.010	8 / 8	1.3	1.8	1.6	1.6	0.15	0.053	6 / 6	1.0	2.2	1.9	1.7	0.42	0.17
Silver	0.0013	8 / 8	0.0030	0.011	0.0066	0.0066	0.0024	0.00085	6 / 6	0.0094	0.033	0.011	0.015	0.0091	0.0037
Sodium	2.5	8 / 8	2200	5600	4600	4300	1200	430	6 / 6	4600	5600	4800	4900	360	150
Strontium	0.013	8 / 8	8.2	13	10	10	1.5	0.53	6 / 6	8.1	17	12	12	3.0	1.2
Thallium	0.00040	8 / 8	0.0021	0.0048	0.0034	0.0033	0.0011	0.00040	6 / 6	0.0035	0.0079	0.0041	0.0046	0.0017	0.00068
Tin	0.020	0 / 8	<0.020	<0.020	<0.020	<0.020	-	-	0 / 6	<0.020	<0.020	<0.020	<0.020	-	-
Titanium	0.13	8 / 8	0.66	3.7	1.6	1.7	1.0	0.35	6 / 6	2.5	12	4.3	5.2	3.4	1.4
Uranium	0.00040	8 / 8	0.056	0.11	0.073	0.077	0.020	0.0069	6 / 6	0.061	0.16	0.11	0.11	0.037	0.015
Vanadium	0.020	8 / 8	0.45	0.91	0.71	0.67	0.17	0.059	6 / 6	0.56	1.2	0.79	0.80	0.22	0.091
Zinc	0.20	8 / 8	13	17	16	16	1.9	0.66	6 / 6	10	20	15	15	3.7	1.5

Data for previous monitoring years presented in Appendix 7B, Table 7B-10.

N > DL / N Total = number of samples above DL / sample size; mg/kg = milligram per kilogram wet weight; > = greater than; DL = detection limit; N = sample size; min = minimum; max = maximum; SD = standard deviation; SE = standard error.

7.4.2.2 Temporal Comparisons

7.4.2.2.1 Arctic Char

Tissue Metals

From 2018 to 2024, a total of 113 Arctic Char were analyzed for metals from Milne Port. Summary statistics for metals concentrations from Arctic Char collected in 2024 are provided in Table 7-18 (data from all years are presented as boxplots in Appendix 7C, Figures 7C-1 to 7C-31). Statistical evaluation of trends in COPCs (i.e., aluminum, iron, magnesium, mercury, and selenium) among years (i.e., 2018 to 2024) are provided Table 7-19 and Appendix 7B, Table 7B-12.

Concentrations of many metals were similar among years; however, some demonstrated inter-annual variability (e.g., cadmium, manganese, potassium, selenium, strontium, titanium; Appendix 7C, Figures 7C-1 to 7C-31). Among COPCs, significant temporal trends were observed for aluminum, iron, magnesium, and length-adjusted selenium (Table 7-19; Figure 7-28, Figure 7-29, Figure 7-30, Figure 7-32). No trends were observed for length-adjusted mercury in Arctic Char (Table 7-19; Figure 7-31).

- Trends in rank-transformed aluminum concentrations in Arctic Char demonstrated interannual variability, with concentrations fluctuating across sampling years (Figure 7-28). Concentrations in 2024 were higher than previous sampling years.
- Trends in rank-transformed iron concentrations in Arctic Char demonstrated a low-magnitude increase in mean iron concentrations from 2018 to 2024 (Figure 7-29). However, interannual trends were generally not significant, aside from an increase from 2020 to 2023. Concentrations measured in 2024 were within the range of those measured in previous sampling years.
- Magnesium concentrations in Arctic Char demonstrated a significant increasing trend from 2018 to 2020, after which concentrations remained relatively stable, with no significant trends observed post-2020 (Figure 7-30). Concentrations measured in 2024 were within the range of those measured in previous sampling years.
- Length-adjusted selenium concentrations in Arctic Char demonstrated interannual variability, with mean concentrations fluctuating over sampling years (Figure 7-32), with no consistent temporal trends. Concentrations measured in 2024 were within the range of those measured in previous sampling years.

Mercury concentrations for all Arctic Char sampled from 2018 to 2024 were below Health Canada's Maximum Levels for Chemical Contaminants in Foods mercury consumption guideline of 0.5 mg/kg ww (Health Canada 2015), with tissue mercury concentrations ranging from 0.011 to 0.297 mg/kg ww.

Selenium concentrations for Arctic Char were also below the BC MOE fish tissue guideline of 4 mg/kg dw (BC MOE 2014), with tissue concentrations ranging from 0.912 to 3.19 mg/kg dw from 2018 to 2024.

Table 7-18: Descriptive Statistics for Arctic Char Tissue Chemistry Data Analyzed from 2024

Parameter (mg/kg ww)	DL	2024						
		N > DL / N Total	Min	Max	Median	Mean	SD	SE
Arctic Char								
Aluminum	0.50	8 / 8	0.58	32	1.0	4.9	11	3.9
Antimony	0.0020	7 / 8	<0.0020	0.0068	0.0035	0.0036	0.0016	0.00058
Arsenic	0.0050	8 / 8	0.52	1.7	0.97	1.0	0.35	0.12
Barium	0.010	4 / 8	<0.010	0.087	<0.010	0.019	0.030	0.010
Beryllium	0.0020	0 / 8	<0.0020	<0.0020	<0.0020	<0.0020	-	-
Bismuth	0.0013	0 / 8	<0.0013	<0.0013	<0.0013	<0.0013	-	-
Boron	0.20	0 / 8	<0.20	<0.20	<0.20	<0.20	-	-
Cadmium	0.0013	8 / 8	0.0025	0.023	0.0054	0.0071	0.0065	0.0023
Calcium	4.0	8 / 8	75	250	97	130	76	27
Chromium	0.025	1 / 8	<0.025	<0.025	<0.025	<0.025	-	-
Cobalt	0.0013	8 / 8	0.0039	0.0070	0.0057	0.0055	0.0011	0.00037
Copper	0.013	8 / 8	0.23	0.96	0.44	0.49	0.25	0.089
Iron	0.25	8 / 8	2.4	33	5.4	8.4	10	3.5
Lead	0.0013	8 / 8	0.0017	0.024	0.0042	0.0075	0.0076	0.0027
Magnesium	0.40	8 / 8	260	340	310	310	27	9.5
Manganese	0.010	8 / 8	0.068	0.13	0.10	0.10	0.018	0.0062
Mercury	0.0010 - 0.0020	8 / 8	0.034	0.14	0.051	0.061	0.035	0.012
Molybdenum	0.0080	1 / 8	<0.0080	<0.0080	<0.0080	<0.0080	-	-
Nickel	0.010	6 / 8	<0.010	0.075	0.049	0.040	0.026	0.0090
Phosphorus	2.0	8 / 8	2700	3400	3100	3100	210	74
Potassium	2.5	8 / 8	3900	5000	4600	4600	370	130
Selenium	0.010	8 / 8	0.30	0.48	0.40	0.40	0.071	0.025
Silver	0.0013	0 / 8	<0.0013	<0.0013	<0.0013	<0.0013	-	-
Sodium	2.5	8 / 8	310	460	400	390	53	19
Strontium	0.013	8 / 8	0.13	0.37	0.15	0.20	0.091	0.032
Thallium	0.00040	8 / 8	0.0015	0.0048	0.0022	0.0026	0.0011	0.00039
Tin	0.020	0 / 8	<0.020	<0.020	<0.020	<0.020	-	-
Titanium	0.13	8 / 8	0.36	0.51	0.41	0.42	0.055	0.019
Uranium	0.00040	0 / 8	<0.00040	<0.00040	<0.00040	<0.00040	-	-
Vanadium	0.020	0 / 8	<0.020	<0.020	<0.020	<0.020	-	-
Zinc	0.20	8 / 8	4.0	6.9	5.4	5.4	1.2	0.41

Data for previous monitoring years presented in Appendix 7B, Table 7B-11.

N > DL / N Total = number of samples above DL / sample size; mg/kg ww = milligram per kilogram wet weight; > = greater than; DL = detection limit; SD = Standard deviation; SE = standard error.

Table 7-19: Summary of Inter-annual Comparisons of Constituents of Potential Concern in Arctic Char, Fourhorn Sculpin and *Hiatella arctica* Tissue Samples Collected from Milne Port from 2018 to 2024

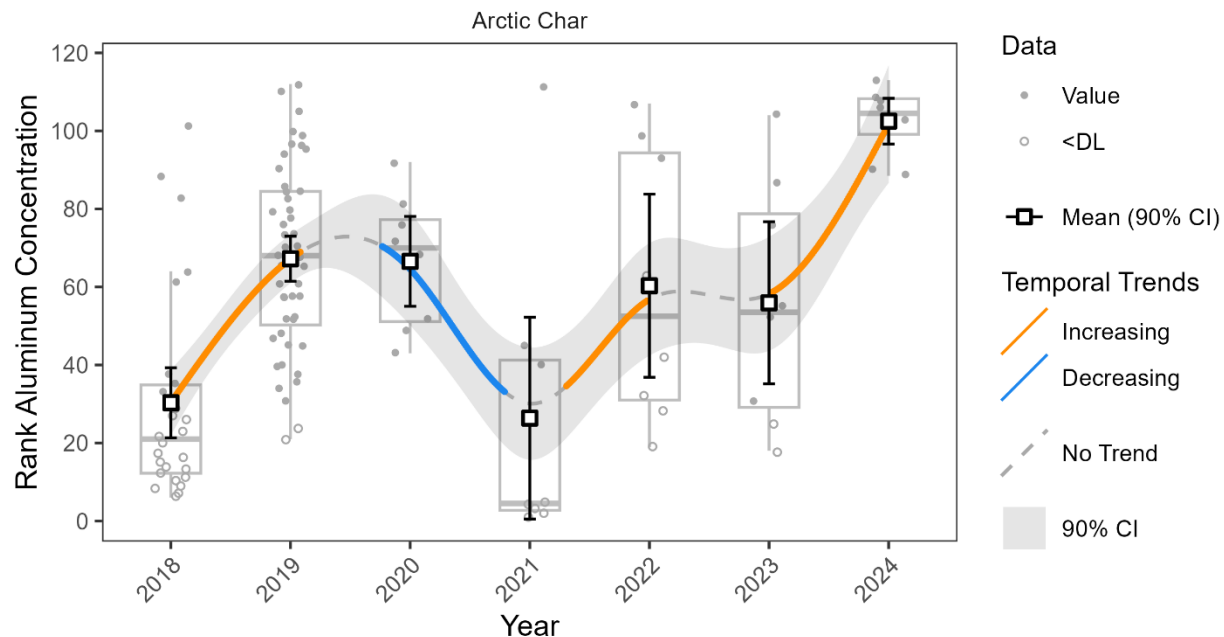
Parameter	Statistical Test	Trend P-value	Least Squares Means ^(a)							Year Trend P-value							Year Trend Slope Estimate ^(b)							Trend Direction ^(b)						
			2018	2019	2020	2021	2022	2024	2024	2018	2019	2020	2021	2022	2024	2024	2018	2019	2020	2021	2022	2024	2024	2018	2019	2020	2021	2022	2024	2024
Arctic Char																														
Aluminum	GAM _{rank}	<0.001	30	67	65	30	57	58	102	<0.001	0.006	<0.001	0.872	0.078	0.093	0.002	44	23	-33	-2	18	15	58	↑	↑	↓	-	↑	↑	↑
Iron	GAM _{rank}	0.014	50	53	56	61	66	72	78	0.480	0.255	0.060	0.021	0.027	0.078	0.163	3	3	4	5	6	6	6	-	-	↑	↑	↑	↑	-
Magnesium	GAM	<0.001	285	301	311	314	311	306	302	0.001	<0.001	0.071	0.916	0.225	0.300	0.626	17.8	13.6	5.8	-0.4	-4.5	-4.6	-3.3	↑	↑	↑	-	-	-	-
Length-Adjusted Mercury	GAM _{log10}	0.977	-1.35	-1.35	-1.35	-1.35	-1.35	-1.35	-1.35	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Length-Adjusted Selenium	GAM _{log10}	<0.001	-0.473	-0.400	-0.478	-0.401	-0.374	-0.421	-0.409	<0.001	0.100	0.435	<0.001	0.191	0.222	0.469	0.125	-0.032	-0.015	0.089	-0.031	-0.026	0.031	↑	↓	-	↑	-	-	-
Fourhorn Sculpin																														
Aluminum	GAM _{log10}	<0.001	-	0.329	-0.469	-0.319	-0.152	-0.268	0.114	-	<0.001	<0.001	0.002	0.509	0.347	0.005	-	-1.04	-0.30	0.33	-0.067	0.085	0.53	-	↓	↓	↑	-	-	↑
Iron	GAM _{log10}	0.039	-	0.940	0.860	0.819	0.819	0.858	0.913	-	0.040	0.015	0.442	0.433	0.126	0.252	-	-0.088	-0.064	-0.020	0.021	0.050	0.058	-	↓	↓	-	-	-	-
Magnesium	GAM _{log10}	0.003	-	2.45	2.45	2.44	2.43	2.41	2.38	-	0.783	0.937	0.228	0.021	0.008	0.044	-	0.004	-0.001	-0.009	-0.019	-0.028	-0.031	-	-	-	-	↓	↓	↓
Length-Adjusted Mercury	GAM _{log10}	0.002	-	-0.837	-0.848	-0.738	-0.659	-0.846	-0.805	-	0.570	0.192	0.001	0.039	0.004	0.134	-	-0.038	0.046	0.15	-0.091	-0.12	0.12	-	-	-	↑	↓	↓	-
Length-Adjusted Selenium	GAM _{log10}	0.003	-	-0.292	-0.341	-0.325	-0.279	-0.246	-0.265	-	0.016	0.166	0.025	0.007	0.697	0.311	-	-0.065	-0.018	0.039	0.048	0.006	-0.032	-	↓	-	↑	↑	-	-
Hiatella arctica																														
Aluminum	GAM _{rank}	<0.001	44	88	78	76	67	43	6	<0.001	0.096	0.132	0.892	0.121	0.001	0.040	59	14	-12	-1	-17	-32	-40	↑	↑	-	-	-	↓	↓
Iron	GAM _{rank}	<0.001	41	83	80	80	82	77	8	<0.001	0.067	0.402	0.890	0.590	0.001	<0.001	55	17	-7	2	6	-35	-86	↑	↑	-	-	-	↓	↓
Magnesium	GAM _{log10}	<0.001	3.39	3.58	3.51	3.51	3.47	3.40	2.96	<0.001	0.348	0.146	0.771	0.787	<0.001	<0.001	0.257	0.041	-0.060	-0.016	-0.015	-0.244	-0.536	↑	-	-	-	-	↓	↓
Mercury	GAM _{log10}	0.044	-1.60	-1.53	-1.51	-1.51	-1.52	-1.50	-1.43	0.046	0.069	0.824	0.764	0.938	0.208	0.147	0.076	0.048	0.005	-0.008	-0.002	0.042	0.080	↑	↑	-	-	-	-	-
Selenium	GAM	0.001	1.19	1.38	1.35	1.35	1.34	1.39	1.58	0.001	0.193	0.446	0.989	0.984	0.053	0.073	0.256	0.070	-0.040	0.001	-0.001	0.126	0.222	↑	-	-	-	-	↑	↑

Notes: Significant differences indicated in **bold**. Supporting information for statistical model results are provided in Appendix 7B, Table 7B-13.

(a) Least squares means were calculated using regression relationships for regression models for each sampling year. For rank-transformed models, rank least squares means are presented.

(b) Slope estimates and directions are presented only for statistically significant trends.

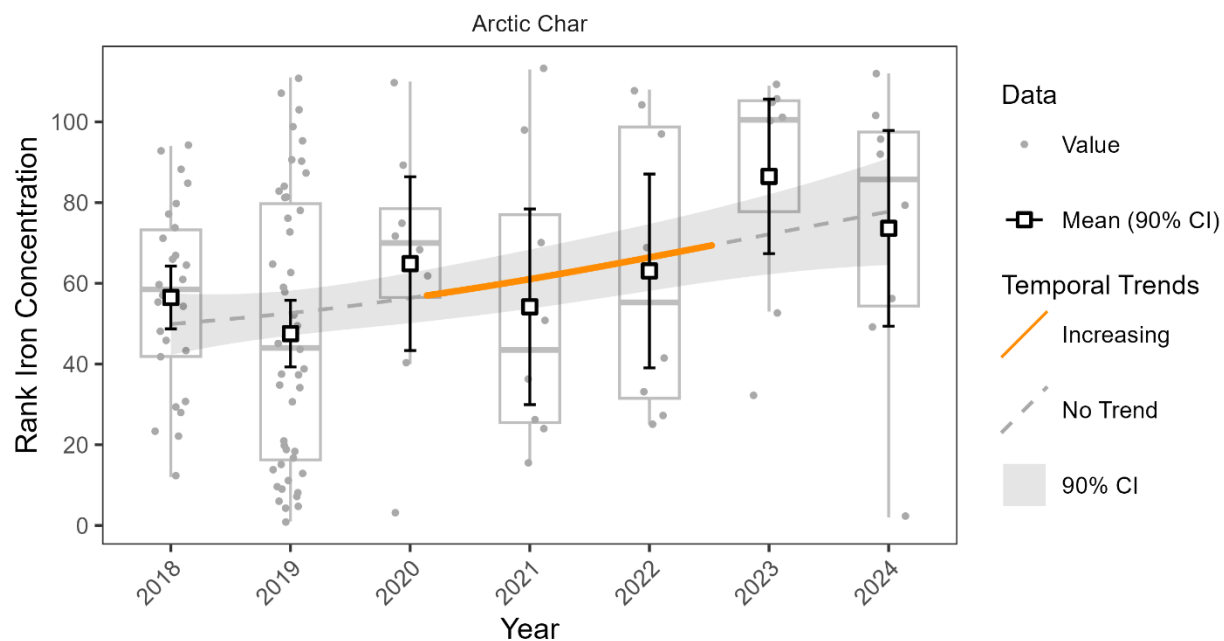
GAM = Gaussian additive model; log = log10-transformed data; rank = rank-transformed data; - = not calculated, no data available.



Note: rank transformation results in unitless values.

DL = detection limit; CI = confidence interval.

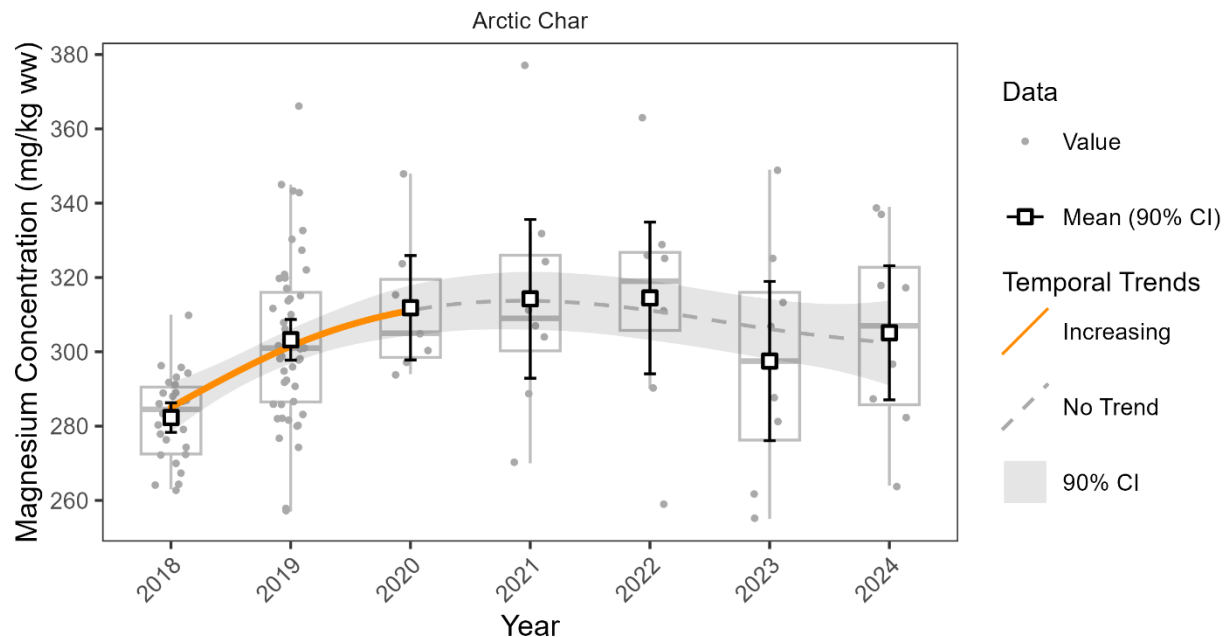
Figure 7-28: Temporal Trends in Rank Aluminum Concentrations in Arctic Char Sampled from Milne Port, 2018 to 2024



Note: rank transformation results in unitless values.

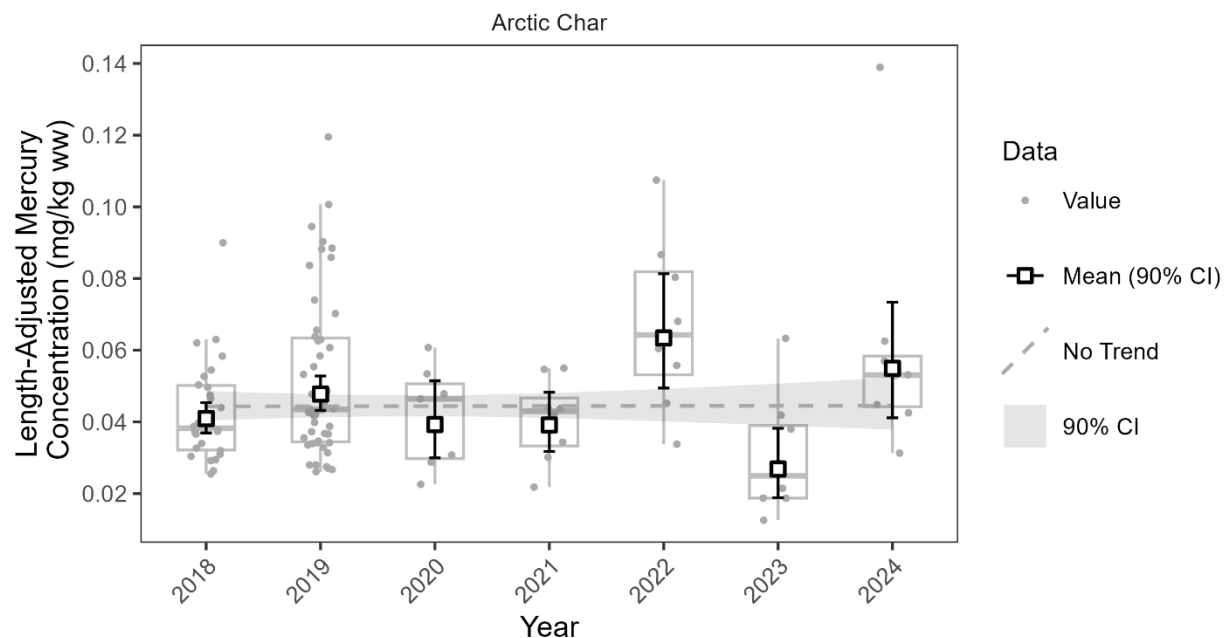
CI = confidence interval.

Figure 7-29: Temporal Trends in Rank Iron Concentrations in Arctic Char Sampled from Milne Port, 2018 to 2024.



CI = confidence interval.

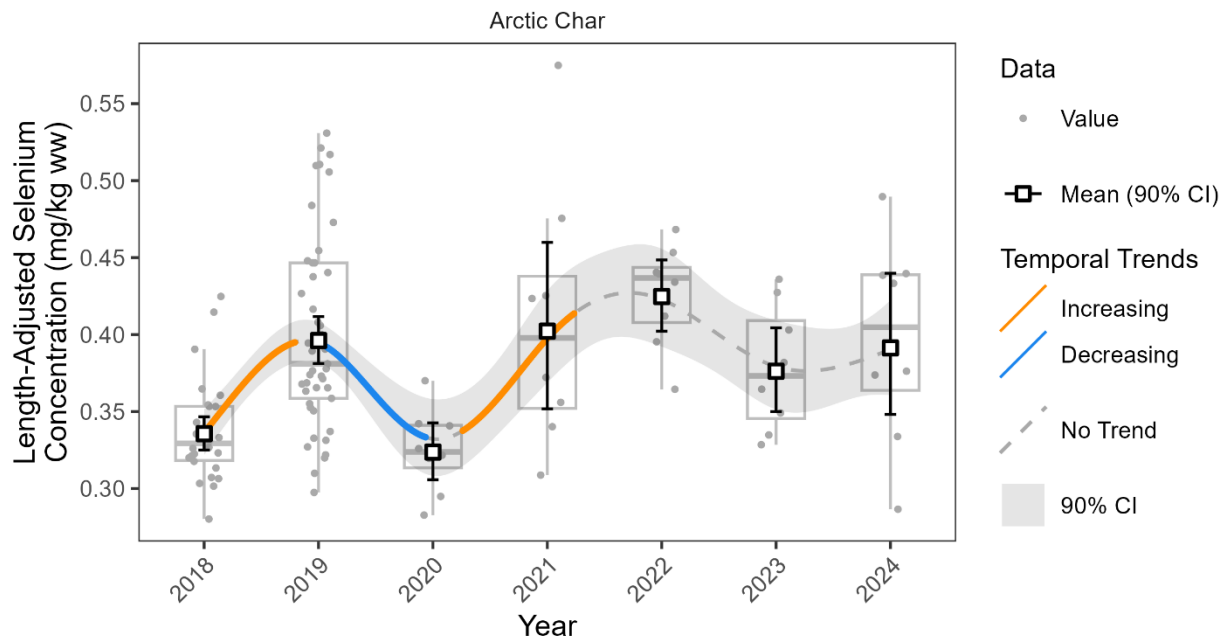
Figure 7-30: Temporal Trends in Magnesium Concentrations in Arctic Char Sampled from Milne Port, 2018 to 2024.



Note: Concentrations were adjusted to 399 mm fork length prior to temporal trend assessment. One fish (FIN: BAFF-20-U-MLN-GN18-ARCH-003) captured in 2020 was omitted as a statistical outlier.

CI = confidence interval.

Figure 7-31: Temporal Trends in Length-Adjusted Mercury Concentrations in Arctic Char Sampled from Milne Port, 2018 to 2024.



Note: Concentrations were adjusted to 399 mm fork length prior to temporal trend assessment. One fish (FIN: GN7-P1 19-072-157) captured in 2019 was omitted as a statistical outlier.

CI = confidence interval.

Figure 7-32: Temporal Trends in Length-Adjusted Selenium Concentrations in Arctic Char Sampled from Milne Port, 2018 to 2024.

Polycyclic Aromatic Hydrocarbons

From 2010 to 2023, a total of 64 Arctic Char were analyzed for polycyclic aromatic hydrocarbons (PAHs) from Milne Port. In 2024, a total of eight Arctic Char were analyzed for PAHs in muscle tissue. Concentrations of PAHs were below DLs for all parameters analyzed in Arctic Char (Appendix 7B, Table 7B-6).

Results of chemical analyses of metals and PAHs in Arctic Char tissues were within FEIS predictions and subsequent addenda, which are consistent with low magnitude increases in fish tissue concentrations of metals and/or PAHs associated with Project activities. These results do not exceed predicted effects on fish tissue chemistry due to Project activities.

7.4.2.2.2 Fourhorn Sculpin Tissue Metals

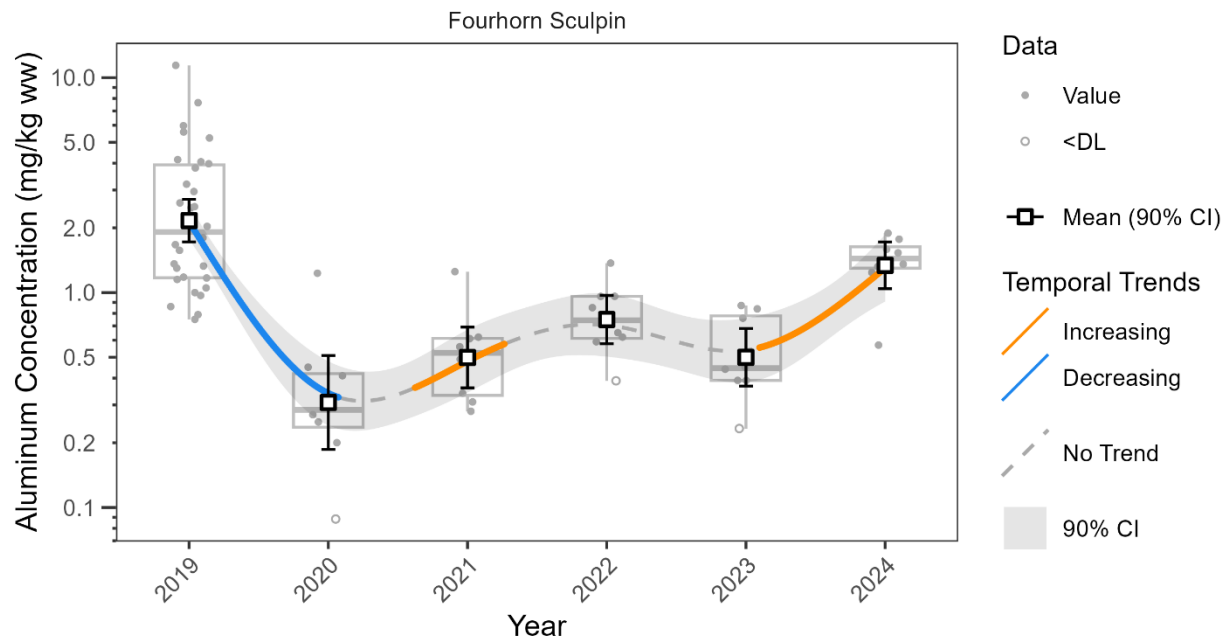
A total of 70 Fourhorn Sculpin samples were analyzed for metals from Milne Port from 2019 to 2024, including 30 samples in 2019, and eight samples in 2020, 2021, 2022, 2023, and 2024, respectively. Summary statistics for metals concentrations in 2023 are provided in Table 7-15; results from all monitoring years are presented as boxplots in Appendix 7C, Figures 7C-1 to 7C-31 and as summary statistics in Appendix 7B, Tables 7B-9 to 7B-11. Statistical comparisons for COPCs among years are provided in Table 7-19 and Appendix 7B, Table 7B-12.

Concentrations of metals in Fourhorn Sculpin were generally more variable than Arctic Char (Section 7.4.2.2.1). Significant trends among years were observed for all COPCs (i.e., aluminum, iron, magnesium, length-adjusted mercury, length-adjusted selenium; Table 7-19).

- Trends in mean aluminum concentrations demonstrated interannual variability over years, with a low magnitude increase in mean concentrations from 2020 to 2024 (Figure 7-33). Concentrations decreased significantly from 2019 to 2020, by a factor of approximately six, but have generally increased since 2020. Measured concentrations in 2024 were above those measured from 2020 to 2023, but within the range of those measured in 2019.
- Iron concentrations in Fourhorn Sculpin demonstrated a significant decreasing trend from 2019 to 2020, after which concentrations have remained relatively stable, with no significant trends observed post-2020 (Figure 7-34). Concentrations measured in 2024 were within the range of those measured in previous sampling years.
- Magnesium concentrations in Fourhorn Sculpin were relatively stable from 2019 to 2022, showing no trends (Figure 7-35). However, concentrations have decreased significantly from 2022 to 2024. Concentrations measured in 2024 were within the range of those measured in previous sampling years.
- Length-adjusted mercury concentrations in Fourhorn Sculpin demonstrated interannual variability with no consistent temporal trends observed (Figure 7-36). Mean concentrations were stable from 2019 to 2020, increased from 2020 to 2022, and decreased from 2022 to 2023, after which they remained stable. Concentrations measured in 2024 were below those measured in 2022 and were within the range of those measured in other sampling years.
- Length-adjusted selenium concentrations in Fourhorn Sculpin demonstrated interannual variability, with a low-magnitude increasing trend observed from 2020 to 2023 (Figure 7-37). Concentrations measured in 2024 were comparable to those measured in 2023 and were within the range of concentrations measured in previous sampling years.

Mercury concentrations for all Fourhorn Sculpin sampled from 2019 to 2024 were below Health Canada's Maximum Levels for Chemical Contaminants in Foods mercury consumption guideline of 0.5 mg/kg ww (Health Canada 2015), ranging from 0.039 to 0.43 mg/kg ww.

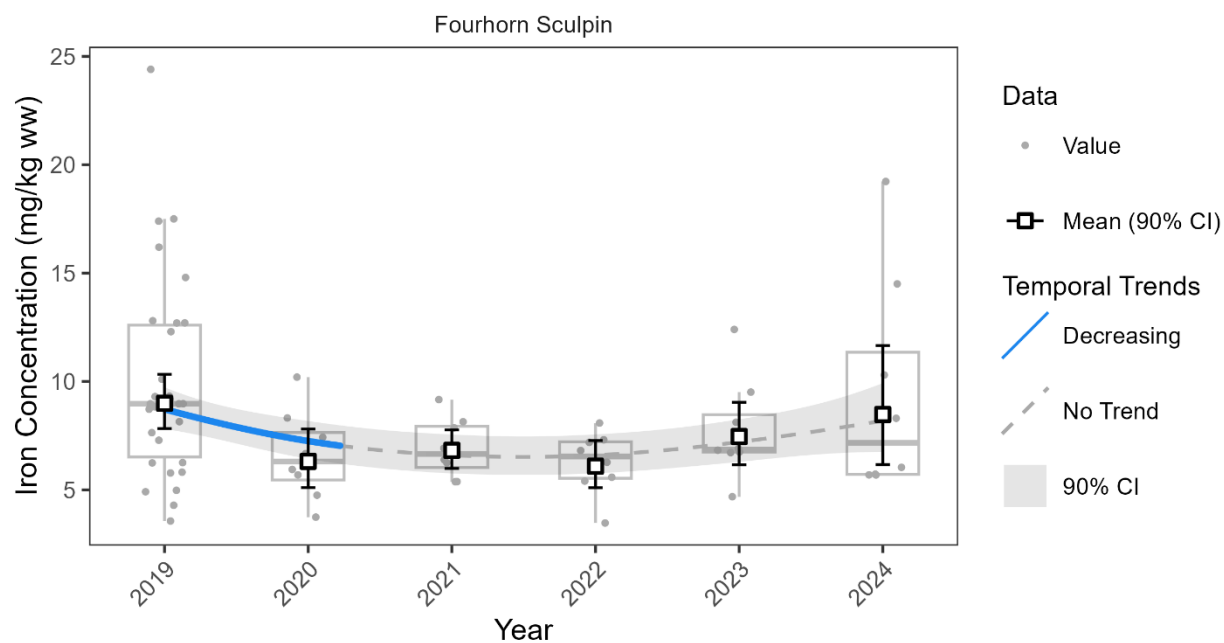
Selenium concentrations were also below BC MOE fish tissue guideline of 4 mg/kg dw (BC MOE 2014) in all Fourhorn Sculpin captured in Milne Port, ranging from 1.72 to 3.57 mg/kg dw from 2019 to 2024. In Koluktoo Bay Fourhorn Sculpin were below the BC MOE selenium guideline, ranging from 2.12 to 3.72 mg/kg dw, with the exception of one fish sampled in 2024 (FIN: BAFF24UKLKFHSC2004; 4.20 mg/kg dw selenium).



Note: y-axis is \log_{10} -scaled to improve interpretability.

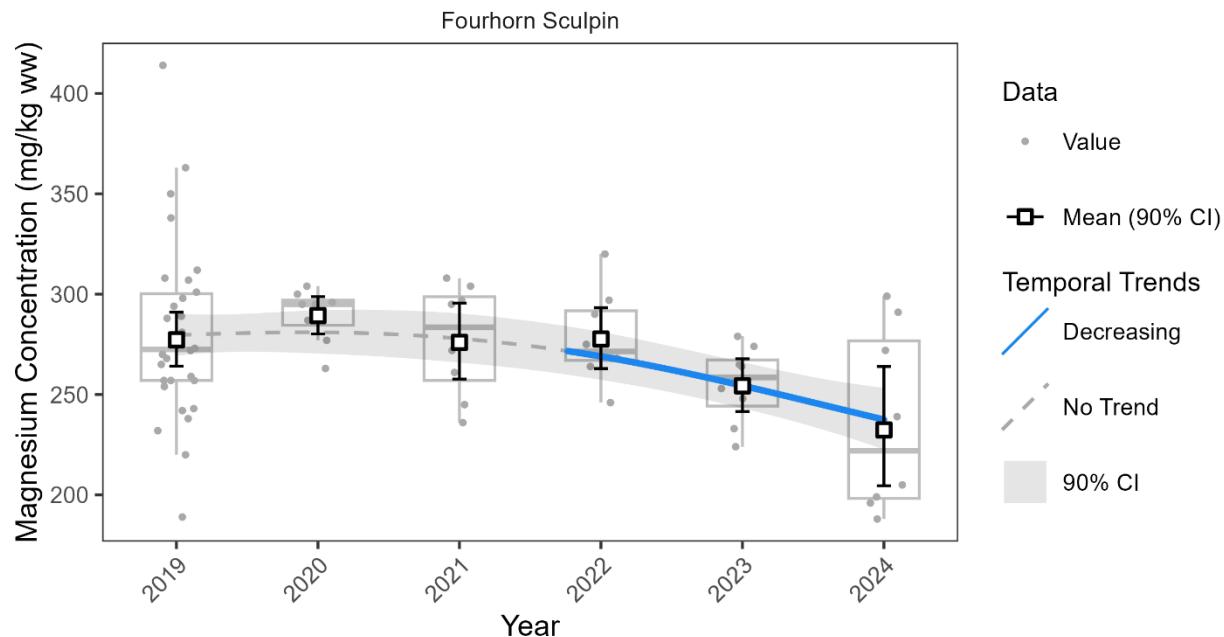
DL = detection limit; CI = confidence interval.

Figure 7-33: Temporal Trends in Aluminum Concentrations in Fourhorn Sculpin Sampled from Milne Port, 2019 to 2024



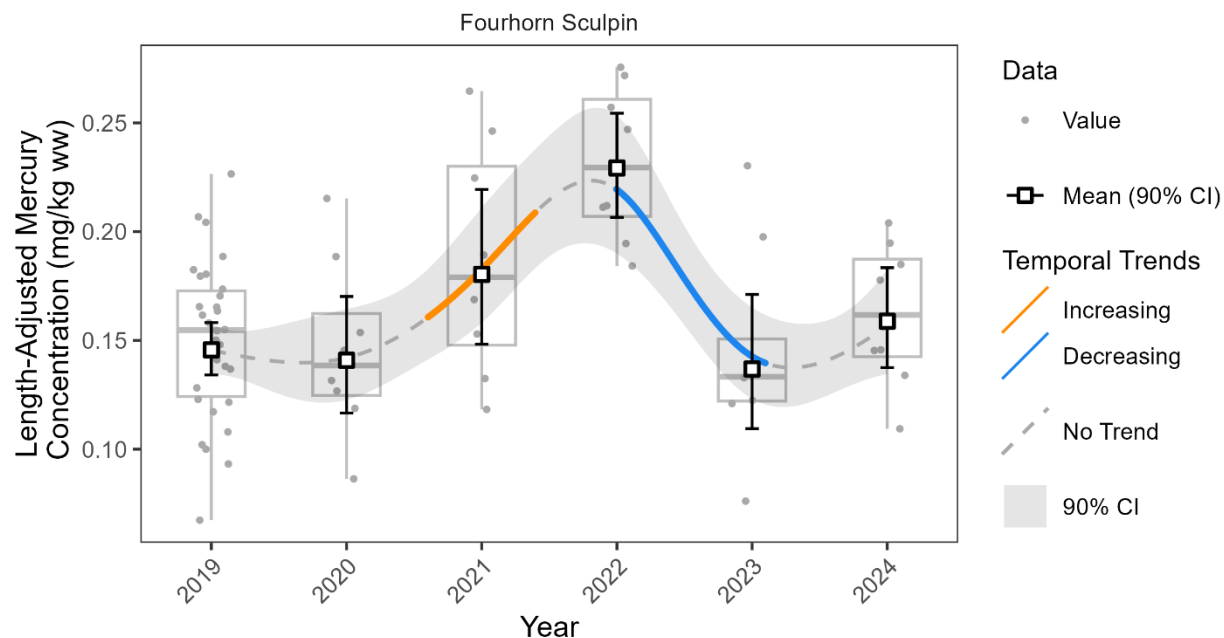
CI = confidence interval.

Figure 7-34: Temporal Trends in Iron Concentrations in Fourhorn Sculpin Sampled from Milne Port, 2019 to 2024



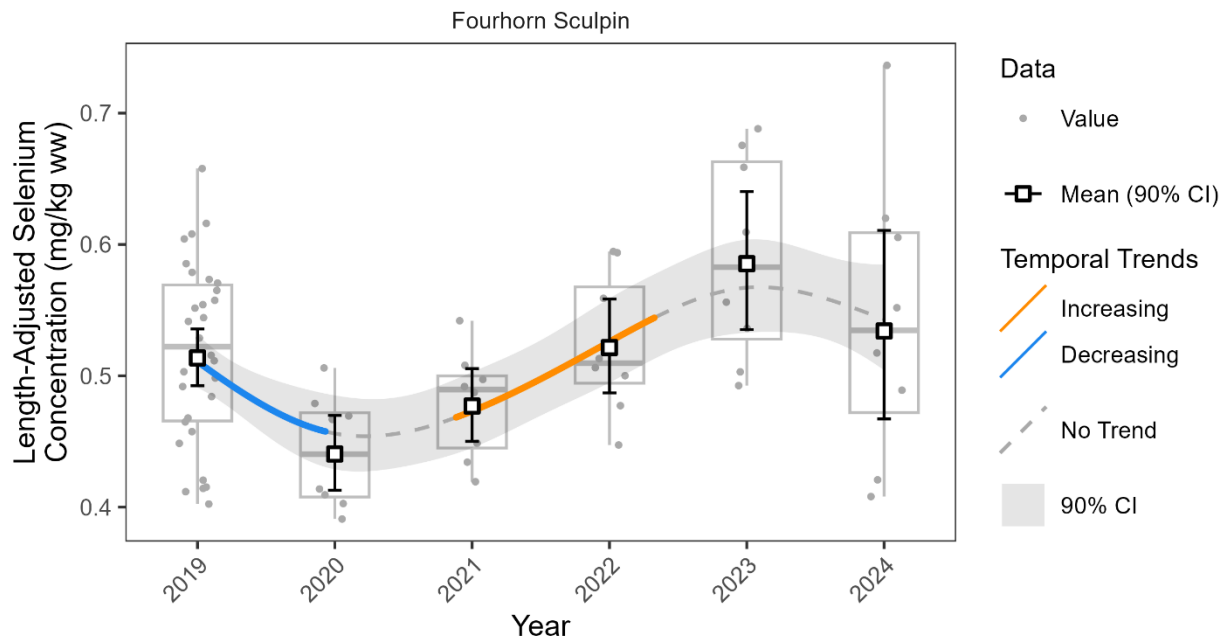
CI = confidence interval.

Figure 7-35: Temporal Trends in Magnesium Concentrations in Fourhorn Sculpin Sampled from Milne Port, 2019 to 2024



CI = confidence interval.

Figure 7-36: Temporal Trends in Length-Adjusted Mercury Concentrations in Fourhorn Sculpin Sampled from Milne Port, 2019 to 2024



CI = confidence interval.

Figure 7-37: Temporal Trends in Length-Adjusted Selenium Concentrations in Fourhorn Sculpin Sampled from Milne Port, 2019 to 2024

Polycyclic Aromatic Hydrocarbons

From 2020 to 2024, a total of 40 Fourhorn Sculpin samples have been analyzed for PAHs, comprising eight samples per year. In 2024, eight Fourhorn Sculpin were analyzed for PAHs in muscle tissue. Polycyclic aromatic hydrocarbons were below DL for all parameters analyzed in Fourhorn Sculpin (Appendix 7B, Table 7B-7).

Results of chemical analyses of metals and PAHs in Fourhorn Sculpin tissues were within FEIS predictions and subsequent addenda, which indicated the potential for low magnitude increases in fish tissue concentrations of metals and/or PAHs associated with Project activities. Results presented herein do not exceed predicted effects on fish tissue chemistry due to Project activities.

7.4.2.2.3 *Hiatella arctica*

Tissue Metals

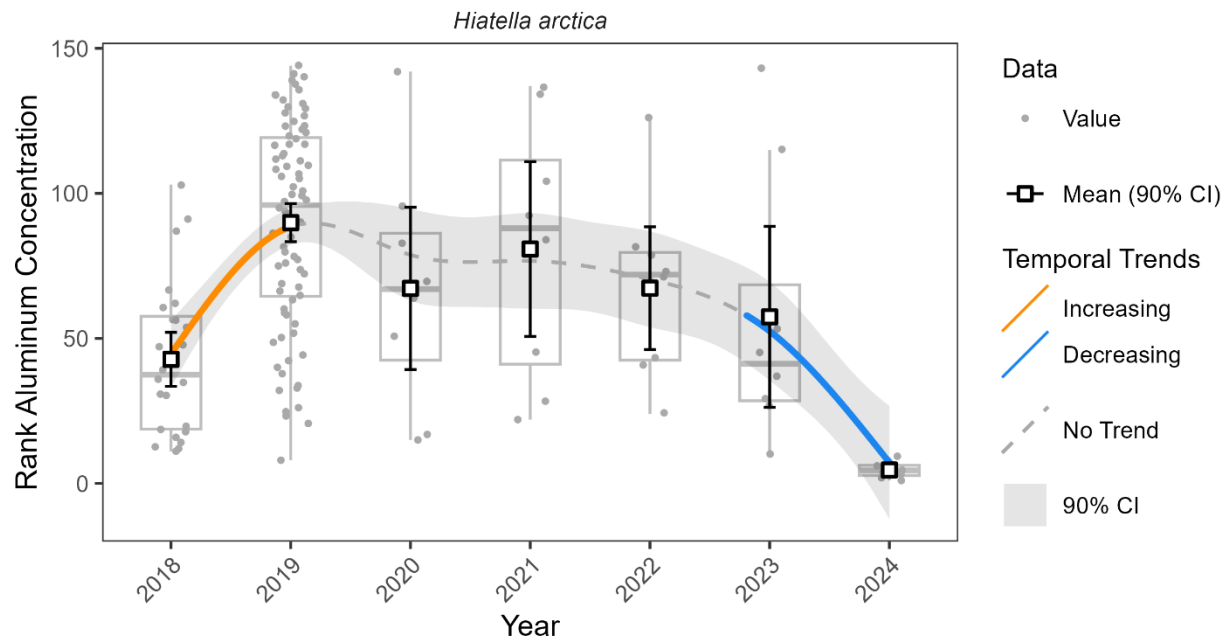
A total of 144 *H. arctica* samples were analyzed for metals from Milne Port from 2018 to 2024, including 24 samples in 2018, 80 in 2019, eight in 2020, eight in 2021, eight in 2022, eight in 2023, and eight in 2024. Summary statistics for *H. arctica* metals concentrations are provided in Table 7-17 and these results are presented as boxplots in Appendix 7C, Figures 7C-1 to 7C-31. Statistical comparisons for COPCs among years are provided in Table 7-19 and Appendix 7B, Table 7B-12.

Concentrations of metals in *H. arctica* tissue were generally similar among years with a few exceptions. Chromium, molybdenum, nickel, tin, and titanium exhibited more interannual variability compared to other metals (Appendix 7C). Greater concentrations of most metals were observed for *H. arctica* when compared to Arctic Char and Fourhorn Sculpin (Appendix 7C, Figures 7C-1 to 7C-31). Differences in species-specific bioaccumulation processes (e.g., filter feeder versus non-filter feeder) and tissue type (i.e., whole body versus muscle) likely contributed to the interspecies differences in tissue metal concentrations observed, with molluscs typically accumulating greater concentrations of some metals compared to fish (Bonsignore et al. 2018).

Significant trends in concentrations were observed for all COPCs (i.e., aluminum, iron, magnesium, mercury, selenium; Table 7-19).

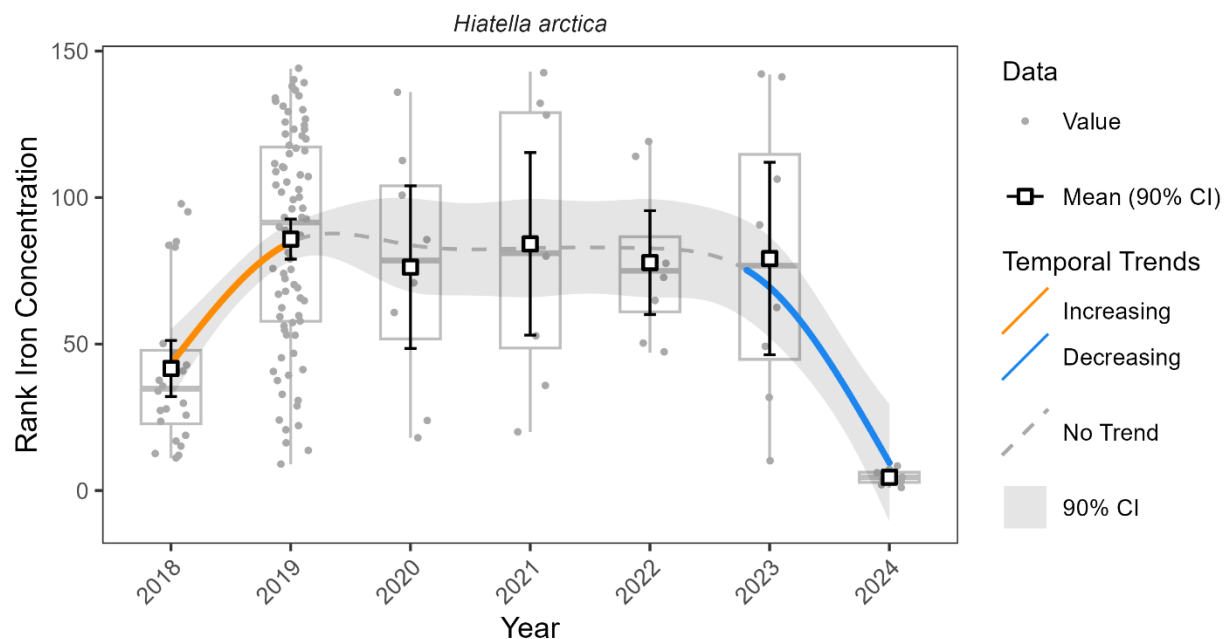
- Aluminum and iron demonstrated similar trends over time, whereby concentrations increased significantly from 2018 to 2019, then remained relatively stable from 2019 to 2023, after which they decreased to 2024 (Figure 7-38; Figure 7-39). Concentrations of both COPCs measured in 2024 were lower than those measured in previous sampling years.
- Trends in magnesium were visually similar to those of aluminum and iron (Figure 7-40). Magnesium concentrations had increased from 2018 to 2019, remained relatively stable from 2019 to 2023, after which they decreased to 2024. Concentrations measured in 2024 were lower than those measured in previous sampling years.
- Mercury and selenium also demonstrated similar trends over time (Figure 7-41; Figure 7-42). Concentrations increased significantly from 2018 to 2019, then remained relatively stable from 2019 to 2023. Despite appearing elevated relative to previous years, mercury and selenium concentrations measured in 2024 were not significantly greater than previous years.

For all COPCs, interannual variability appears to be the main driver of observed trends, as no consistent changes over time have been noted and the magnitude of observed trends is not considered ecologically relevant.



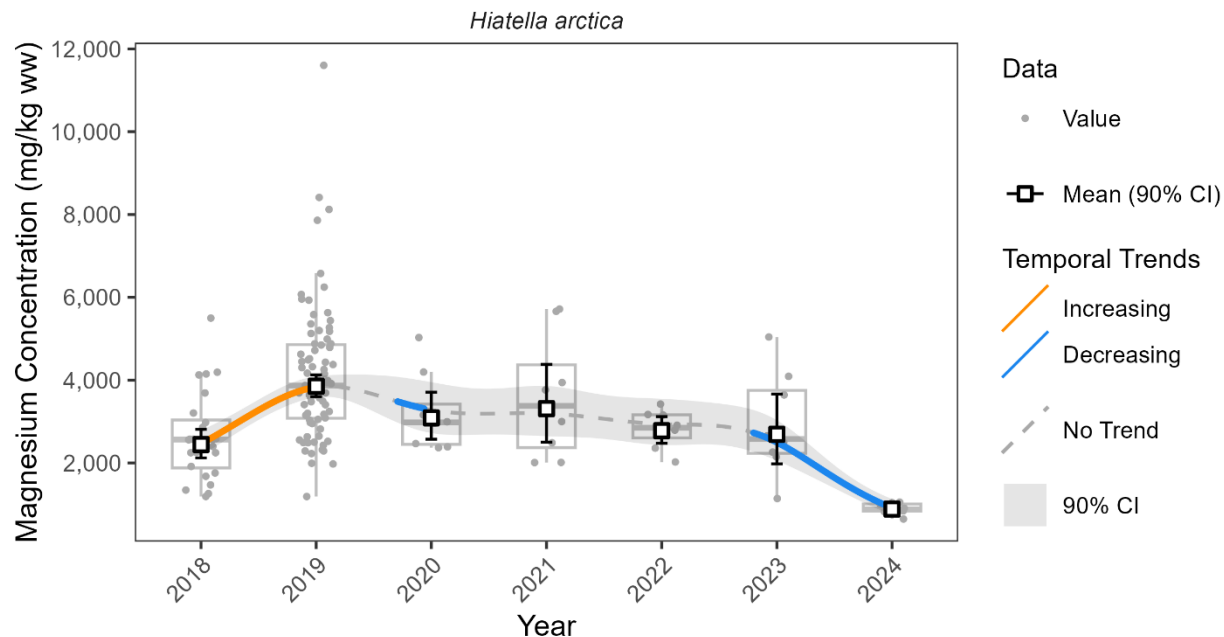
Note: y-axis is \log_{10} -scaled to improve interpretability. DL = detection limit; CI = confidence interval.

Figure 7-38: Temporal Trends in Aluminum Concentrations in *Hiattella arctica* Sampled from Milne Port, 2018 to 2024



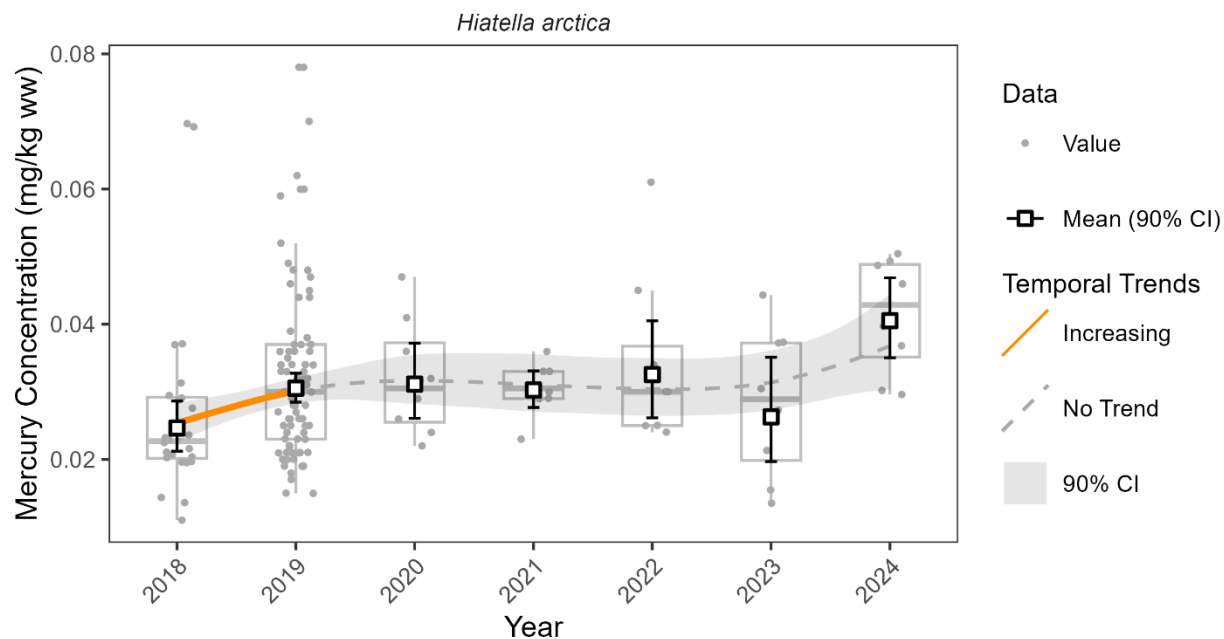
Note: y-axis is \log_{10} -scaled to improve interpretability. DL = detection limit; CI = confidence interval.

Figure 7-39: Temporal Trends in Iron Concentrations in *Hiattella arctica* Sampled from Milne Port, 2018 to 2024



DL = detection limit; CI = confidence interval.

Figure 7-40: Temporal Trends in Magnesium Concentrations in *Hiatella arctica* Sampled from Milne Port, 2018 to 2024



Note: y-axis is log₁₀-scaled to improve interpretability. DL = detection limit; CI = confidence interval.

Figure 7-41: Temporal Trends in Mercury Concentrations in *Hiatella arctica* Sampled from Milne Port, 2018 to 2024

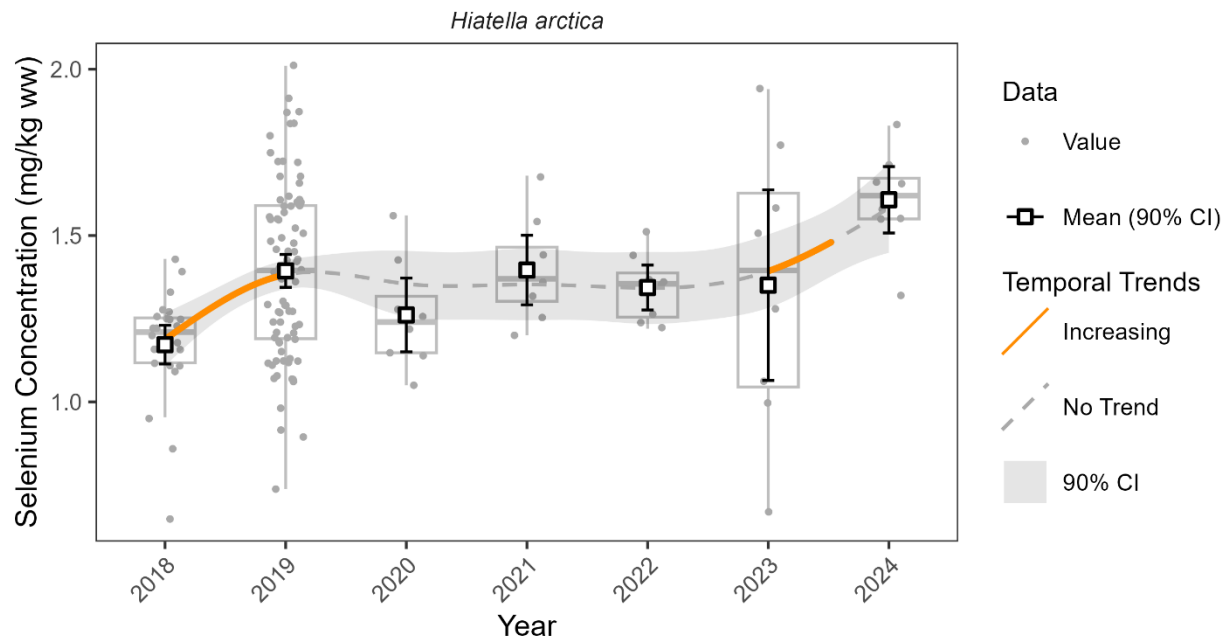


Figure 7-42: Temporal Trends in Selenium Concentrations in *Hiatella arctica* Sampled from Milne Port, 2018 to 2024

Polycyclic Aromatic Hydrocarbons

From 2020 to 2023, a total of 22 samples of *H. arctica* were analyzed for PAHs. In 2024, no tissue samples of *H. arctica* were analyzed for PAHs, due to low sample masses and the high mass requirements for PAHs compared to metals analysis (Appendix 7B, Table 7B-8); however, PAH concentrations in *H. arctica* have consistently been below DL since 2020.

Results of chemical analyses of metals and PAHs in *Hiatella arctica* tissues were within FEIS predictions and subsequent addenda, which indicated the potential for low magnitude increases in fish tissue concentrations of metals and/or PAHs associated with Project activities. Results presented herein do not exceed predicted effects on fish tissue chemistry due to Project activities.

7.5 TARP Assessment

7.5.1 Fish Health

Results of fish health endpoint assessments were screened against the TARP criteria (Table 7-20). The 'Low Risk' threshold was exceeded for endpoints that were significantly different between Milne Port and the relevant reference area, with a magnitude of effect exceeding the CES. In addition, the direction of effect must be indicative of a potential impairment to fish health. In 2024, one fish health endpoint in Fourhorn Sculpin exceeded the 'Low Risk' threshold: male Fourhorn Sculpin relative liver weight was significantly different between Milne Port and Koluktoo Bay, and the associated effect size (-26%) exceeded the CES ($\pm 25\%$) in a direction indicative of potential impairment to fish health. No additional endpoints for Fourhorn Sculpin exceeded TARP thresholds.

For *H. arctica*, three fish health endpoints exceeded the 'Low Risk' threshold: whole animal ww, condition (as relative total weight), and relative shell weight were all significantly lower in *H. arctica* from Milne Port compared to Tugaat River Estuary, and the associated effect sizes (-22%, -13%, -20%, respectively) were in a direction indicative of potential impairment to fish health. There are currently no CES values associated with shellfish health endpoints. No additional endpoints for *H. arctica* exceeded TARP thresholds.

Table 7-20: Comparison of Fish Health Endpoints for Fourhorn Sculpin and *Hiatella arctica* with TARP Thresholds, MEEMP 2024

TARP Performance Indicators	CES	2024 MEEMP Results (Effect Size)		TARP Threshold Exceeded	
		Female	Male	Female	Male
Fourhorn Sculpin					
Age	±25%	=	=	None	None
Size-at-age (i.e., total weight at age)	±25%	Milne > Reference (36%)	Milne > Reference (30%)	None	None
Condition as relative total weight (i.e., total weight at total length)	±10%	Milne < Reference (-7%)	=	None	None
Relative liver weight (i.e., liver weight at total weight)	±25%	=	<u>Milne < Reference</u> (-26%)	None	Low Risk
Relative gonad weight (i.e., gonad weight at total weight)	±25%	=	=	None	None
Hiatella arctica					
Length-frequency analysis	_(a)	=		None	
Whole animal wet weight	_(a)	Milne < Reference (-22%)		Low Risk ^(b)	
Condition as relative total weight (i.e., whole animal wet weight at total length)	_(a)	Milne < Reference (-13%)		Low Risk ^(b)	
Relative shell weight (i.e., dry shell weight at total length)	_(a)	Milne < Reference (-20%)		Low Risk ^(b)	
Relative gonad weight (i.e., gonad weight at whole animal wet weight)	_(a)	=		None	

Effect sizes are shown in parentheses. Non-bolded values indicate a significant difference ($P < 0.10$) that does not exceed the CES. **Bold** text indicates a significant difference ($P < 0.10$). Underlined text indicates a magnitude of effect greater than the CES in a direction indicative of a potential impairment to fish health.

(a) There are no critical effect sizes associated with shellfish health endpoints (Environment Canada 2012).

(b) In the absence of CES values for shellfish health endpoints, a conservative assessment was applied, wherein significant differences in a direction potentially indicative of an impairment to shellfish health were considered Low Risk.

TARP = Trigger Action Response Plan; '=' = no statistically significant difference ($P > 0.10$); '-' = not applicable.

7.5.2 Fish Tissue Chemistry

Results of fish tissue chemistry assessments were screened against the TARP criteria (Table 7-21). In 2024, concentrations of all COPCs in Fourhorn Sculpin did not differ between Milne Port and Koluktoo Bay. For *H. arctica*, concentrations of aluminum and selenium were significantly lower in Milne Port compared to Tugaat River Estuary. However, the magnitudes of observed effects for *H. arctica* were below the CES (+100%) or in a direction not consistent with Project-related effects. Thus, no fish tissue chemistry endpoints exceeded TARP thresholds in 2024.

Table 7-21: Comparison of Fish Tissue Chemistry Endpoints for Fourhorn Sculpin and *Hiatella arctica* with TARP Thresholds, MEEMP 2024

TARP Performance Indicators	2024 MEEMP Results (Effect Size)	TARP Threshold Exceeded
Fourhorn Sculpin		
Aluminum	=	None
Iron	=	None
Magnesium	=	None
Mercury	=	None
Selenium	=	None
<i>Hiatella arctica</i>		
Aluminum	Milne < Tugaat (-49%)	None
Iron	=	None
Magnesium	=	None
Mercury	=	None
Selenium	Milne < Tugaat (-14%)	None

Unbolded text indicates a significant difference ($P < 0.10$) with a magnitude of effect below the CES.

TARP = Trigger Action Response Plan; '=' = no statistically significant difference ($P > 0.10$).

7.6 Discussion

7.6.1 Fish Health

Detailed fish health data were collected for Fourhorn Sculpin and *H. arctica* from Milne Port annually from 2020 to 2024 and from reference areas in 2023 and 2024 (i.e., Koluktoo Bay [Fourhorn Sculpin] and Tugaat River Estuary [*H. arctica*]). In addition, biometric data for Arctic Char were collected from incidental mortalities from Milne Inlet annually from 2021 to 2024, to support the evaluation of Arctic Char health and condition. A summary of results of the fish health assessment for Fourhorn Sculpin and *H. arctica* is provided in Table 7-22 and Table 7-23, respectively.

For Arctic Char, condition factor varied over sampling years with no consistent trend. Mean condition factor increased from 2021 to 2022, decreased from 2022 to 2023, and increased from 2023 to 2024. Observed variation in Arctic Char condition factor likely reflected natural variability attributable to seasonal and interannual differences in the Arctic Char population of Milne Inlet.

For Fourhorn Sculpin, several fish health endpoints differed between Milne Port and Koluktoo Bay (Table 7-22). In both female and male Fourhorn Sculpin, size-at-age was significantly greater at Milne Port compared to Koluktoo Bay, with a magnitude of effect exceeding the CES. However, the direction of effect did not indicate potential impairment to fish health, as Fourhorn Sculpin at Milne Port appeared to be growing faster (i.e., larger size-at-age) compared to Koluktoo Bay. Similar trends in size-at-age for female and male Fourhorn Sculpin at Milne Port over time indicated steady increases in mean size-at-age from 2020 to 2022/2023 for each sex, respectively. Potential differences in prey availability, indicated by stomach contents, may be contributing to observed differences in size-at-age between Milne Port and Koluktoo Bay. Fourhorn Sculpin in Milne Port appear to consume relatively more trumpet worms (i.e., pectinariid worms) and fish and fewer crustaceans compared to Fourhorn Sculpin in Koluktoo Bay. In addition, condition (as relative total weight) for female Fourhorn Sculpin was significantly lower in Milne Port compared to Koluktoo Bay, but the magnitude of effect was less than the CES. No difference in condition was observed for male Fourhorn Sculpin.

Relative liver weight was significantly lower for male Fourhorn Sculpin in Milne Port compared to those in Koluktoo Bay, with a magnitude of effect exceeding the CES. This CES exceedance resulted in a 'Low Risk' TARP threshold exceedance. No differences were observed for female Fourhorn Sculpin relative liver weight between sampling areas. Trends in relative liver weight for male Fourhorn Sculpin in Milne Port demonstrated no consistent changes over time but instead were considered to reflect natural interannual variability. Mean LSI, a metric for relative liver weight, has varied by 5-49% (as RPD) among sampling years for male Fourhorn Sculpin in Milne Port. Similar interannual variation in LSI for male Fourhorn Sculpin was observed in fish sampled from Koluktoo Bay (18% as RPD, between 2023 and 2024). Interannual variability in LSI has been observed in many marine and freshwater fish species (e.g. Nunes et al. 2011; Rodgveller 2019; Scott and Pankhurst 1992; Vidal et al. 2020; Yaragina and Marshall 2000) as populations respond to long-term environmental fluctuations. These studies suggest that interannual variation in LSI exceeding 30% is not abnormal within a given population. The observed range of interannual variability and the absence of a consistent trend in relative liver weight over time in Milne Port together suggest the observed difference in relative liver weight for male Fourhorn Sculpin between Milne Port and Koluktoo Bay may be a result of interannual variability. Continued monitoring will provide additional insight into the variability of fish health endpoints for this fish species.

Some *H. arctica* health endpoints differed between Milne Port and Tugaat River Estuary (Table 7-23). Whole animal weight, condition (as relative whole animal wet weight), and relative shell weight were all significantly lower in Milne Port compared to Tugaat River Estuary. Temporal trends support some of these findings (Table 7-23). Significant decreasing trends were observed from 2023 to 2024 in whole animal wet weight and condition. No trends were observed for relative shell weight. In addition, length frequency distributions differed significantly between 2023 and 2024, where median *H. arctica* total length was lower in 2024 compared to 2023. Given the limited data currently available for *H. arctica* in Milne Port (i.e., four years) and for Tugaat River Estuary (i.e., three years), it is uncertain whether observed differences represent expected variability within the species or if differences are indicative of potential effects of localized stressors. Given the wide range of ages reported in the sampled population of *H. arctica* from both Milne Port and Tugaat River Estuary (i.e., 5 to 82 years), it is expected that growth and condition would vary within the species depending on stage of life. At present, little is known about age-length relationships for *H. arctica*. Differences in *H. arctica* health endpoints have not previously been observed.

Sample timing of *H. arctica* appears to be appropriate for assessing reproductive endpoints, as gonads were retrieved from collected samples in 2021, 2022, 2023, and 2024 from Milne Port, and in 2022, 2023, and 2024 from Tugaat River Estuary. Some variability in relative gonad weight was observed over time (Table 7-23),

suggesting natural variability in spawning timing for this shellfish. Timing of spawning for *H. arctica* may be associated with phytoplankton biomass and varies with geographical location (Brandner et al. 2017). Gonadal development for this species may also be asynchronous, with multiple overlapping spawning events occurring throughout the year, potentially leading to a high degree of variability in gonad size regardless of sample timing. While MSI data from 2024 do not exhibit high variability, observed differences between 2021, 2022, 2023, and 2024 indicate considerable interannual variability in gonadal development. Additional data collected in future years will improve understanding of the variability in gonadal development for *H. arctica*.

Results of the fish health analysis for Arctic Char, Fourhorn Sculpin, and *Hiatella arctica* were within FEIS predictions and subsequent addenda, which indicated the potential for low magnitude reductions in fish health and condition associated with Project activities. Results presented herein do not exceed predicted effects on fish health due to Project activities.

Table 7-22: Summary of Results of Fish Health Assessment for Fourhorn Sculpin, MEEMP 2024

Fish Health Endpoint	CES	Fourhorn Sculpin (Effect Size)	
		Female	Male
Spatial Comparisons			
Age	±25%	-	-
Size-at-age (i.e., total weight at age)	±25%	Milne > Reference (36%)	Milne > Reference (30%)
Condition as relative total weight (i.e., total weight at total length)	±10%	Milne < Reference (-7%)	-
Relative liver weight (i.e., liver weight at total weight)	±25%	=	Milne < Reference (-26%)
Relative gonad weight (i.e., gonad weight at total weight)	±25%	-	-
Temporal Comparisons			
Age	n/a	Increasing in past years 2020 ↑ 2021 ↑ 2022, 2023, 2024	Increasing in past years 2020 ↑ 2021 ↑ 2022, 2023, 2024
Size-at-age (i.e., total weight at age)	n/a	Increasing in past years 2020 ↑ 2021 ↑ 2022, 2023, 2024	Increasing in past years 2020 ↑ 2021 ↑ 2022 ↑ 2023, 2024
Condition as relative total weight (i.e., total weight at total length)	n/a	No consistent trends 2020 ↓ 2021 ↑ 2022 ↑ 2023 ↓ 2024	No consistent trends 2020 ↓ 2021, 2022 ↑ 2023, 2024
Relative liver weight (i.e., liver weight at total weight)	n/a	Increasing over time 2020 ↑ 2021 ↑ 2022 ↑ 2023 ↑ 2024 ↑	Increasing in past years 2020, 2021 ↑ 2022 ↑ 2023, 2024 ↓
Relative gonad weight (i.e., gonad weight at total weight)	n/a	Relatively stable over time 2020 ↓ 2021, 2022, 2023, 2024	Relatively stable over time 2020, 2021 ↓ 2022, 2023, 2024

The reference area for Fourhorn Sculpin is Koluktoo Bay. Magnitudes of effect (spatial comparisons) and relative percent differences (temporal comparisons) are presented in parentheses. **Bold** values indicate magnitudes of effect greater than the CES. Blue shaded values indicate magnitudes of effect exceeding the CES that are potentially indicative of an impairment to fish health.

CES = critical effect size; - = not significantly different; n/a = not applicable.

Table 7-23: Summary of Results of Fish Health Assessment for *Hiatella arctica*, MEEMP 2024

Fish Health Endpoint	CES ^(a)	Spatial Comparisons (Effect Size)	Temporal Comparisons
<i>Hiatella arctica</i>			
Length-frequency analysis	n/a	-	Relatively stable over time 2020 to 2023 ↓ 2024
Whole animal wet weight	n/a	Milne < Reference (-22%)	No consistent trends 2020, 2021 ↑ 2022 ↑ 2023 ↓ 2024
Condition as relative total weight (i.e., whole animal wet weight at total length)	n/a	Milne < Reference (-13%)	No consistent trends 2020 ↓ 2021, 2022 ↑ 2023 ↓ 2024
Relative shell weight (i.e., dry shell weight at total length)	n/a	Milne < Reference (-20%)	No significant trends
Relative gonad weight (i.e., gonad weight at whole animal wet weight)	n/a	-	No consistent trends 2021, 2022 ↑ 2023 ↓ 2024

The reference area for *Hiatella arctica* is Tugaat River Estuary. Magnitudes of effect (spatial comparisons) and relative percent differences (temporal comparisons) are presented in parentheses.

(a) There are no critical effect sizes associated with shellfish health endpoints (Environment Canada 2012).

CES = critical effect size; - = not significantly different; n/a = not applicable.

7.6.2 Tissue Chemistry

Metal concentrations were generally above DLs and variable among species and years. In 2024, concentrations of most COPCs did not differ significantly between Milne Port and the reference areas for Fourhorn Sculpin and *H. arctica*, except for aluminum and selenium in *H. arctica*. Concentrations of aluminum and selenium were significantly lower in *H. arctica* from Milne Port compared to those from Tugaat River Estuary. Concentrations of most COPCs varied significantly over time, but few consistent trends were observed and the measured concentrations of COPCs in 2024 remained within the range of historical variability for all species. The absence of consistent trends suggests observed differences were likely a result of interannual variability, and the magnitude of trends were not considered ecologically relevant.

All tissue samples for Arctic Char, Fourhorn Sculpin and *H. arctica* collected from 2018 to 2024 were below Health Canada's Maximum Levels for Chemical Contaminants in Foods mercury consumption guideline of 0.5 mg/kg ww (Health Canada 2015). All tissue samples for Arctic Char and nearly all samples for Fourhorn Sculpin were also below BC MOE fish tissue guideline of 4 mg/kg dw for selenium (BC MOE 2014). One Fourhorn Sculpin collected in Koluktoo Bay exceeded the selenium guideline (4.20 mg/kg dw selenium).

A summary of results of the fish tissue chemistry assessment for Arctic Char, Fourhorn Sculpin, and *H. arctica* is provided in Table 7-24.

Consistent with previous years, concentrations of most metals were greater in *H. arctica* compared to Arctic Char and Fourhorn Sculpin. Molluscs tend to accumulate metals (from both natural and anthropogenic sources) to a greater degree compared to fish (Bonsignore et al. 2018), and this phenomenon is reflected in the *H. arctica* tissue chemistry results. Metals concentrations in *H. arctica* were consistently greater than those measured in Arctic Char and Fourhorn Sculpin, occasionally by orders of magnitude. Species-specific differences in bioaccumulation processes and the tissue types analyzed (i.e., whole body versus muscle) contribute to the differences observed in tissue metals concentrations among the monitored species. *Hiatella arctica* is a long-lived,

sedentary, filter feeding mollusc closely associated with the sediment; these life-history characteristics increase the potential of *H. arctica* exposure to, and subsequent accumulation of, metals. The concentrations of metals and the observed trends reported herein for *H. arctica* are not considered to reflect ecologically relevant changes.

Tissue concentrations of PAHs were below DL for all Arctic Char and Fourhorn Sculpin analyzed in 2024, consistent with previous monitoring programs. No *H. arctica* were analyzed for PAHs in 2024, but previous years analyses indicated all PAH concentrations were below DL. These results are consistent with water and sediment quality monitoring results, for which concentrations of nearly all PAHs were consistently below DL (Chapters 2.0, 3.0).

In summary, each sentinel fish species provides valuable information for the MEEMP. Arctic Char, a highly mobile and valued subsistence and commercial food fish species, provides ecologically relevant information regarding potential risk to human consumers, as well as large mammals. Fourhorn Sculpin, a benthic-dwelling species with a relatively small range, is an abundant fish species in the Project area, providing information on potential localized effects due to Project activities. Lastly, *H. arctica* have different feeding and life history strategies and, therefore, exposure potential compared to the finfish species. *Hiattella arctica* represent sedentary organisms, spending nearly their entire lives in one place. Their filter-feeding strategy results in continuous exposure to potential Project-related impacts on water quality, providing valuable information concerning potential risk to the benthic invertebrate and shellfish communities.

Table 7-24: Summary of Results of Fish Tissue Chemistry Assessment for Arctic Char, Fourhorn Sculpin, and *Hiattella arctica*, MEEMP 2024

Tissue Chemistry Endpoint	CES ^(a)	Spatial Comparisons	Temporal Comparisons	Overall Trend
Arctic Char				
Aluminum	100%	n/a	2018 ↑ 2019, 2020 ↓ 2021 ↑ 2022, 2023 ↑ 2024	No consistent trends
Iron	100%	n/a	2018, 2029, 2020 ↑ 2021 ↑ 2022 ↑ 2023, 2024	Increasing over time
Magnesium	100%	n/a	2018 ↑ 2019 ↑ 2020 to 2024	Increasing in past years
Mercury	100%	n/a	No significant trends	None
Selenium	100%	n/a	2018 ↑ 2019 ↓ 2020 ↑ 2021 to 2024	No consistent trends
Fourhorn Sculpin				
Aluminum	100%	=	2019 ↓ 2020 ↑ 2021 ↑ 2022, 2023 ↑ 2024	Increasing in recent years
Iron	100%	=	2019 ↓ 2022 to 2024	Decreasing in past years
Magnesium	100%	=	2019 to 2022 ↓ 2023, 2024	Decreasing in recent years
Mercury	100%	=	2019, 2020 ↑ 2021 ↑ 2022 ↓ 2023, 2024	No consistent trends
Selenium	100%	=	2019 ↓ 2020, 2021 ↑ 2022 ↑ 2023, 2024	No consistent trends
<i>Hiattella arctica</i>				
Aluminum	100%	Milne < Tugaat (-49%)	2018 ↑ 2019, 2020, 2021, 2022 ↓ 2023 ↓ 2024	Decreasing in recent years

Tissue Chemistry Endpoint	CES ^(a)	Spatial Comparisons	Temporal Comparisons	Overall Trend
Iron	100%	=	2018 ↑ 2019, 2020, 2021, 2022 ↓ 2023 ↓ 2024	Decreasing in recent years
Magnesium	100%	=	2018 ↑ 2019 ↓ 2020, 2021, 2022 ↓ 2023 ↓ 2024	Decreasing in recent years
Mercury	100%	=	2018 ↑ 2019, 2020, 2021, 2022, 2023, 2024	No consistent trends
Selenium	100%	Milne < Tugaat (-14%)	2018 ↑ 2019, 2020, 2021, 2022, 2023 ↑ 2024	No consistent trends

As Arctic Char are highly mobile pelagic fish, there is no reference area for Arctic Char. The reference area for Fourhorn Sculpin is Koluktoo Bay, and the reference area for *Hiatella arctica* is Tugaat River Estuary. Magnitudes of effect (spatial comparisons) and relative percent differences (temporal comparisons) are presented in parentheses.

(a) The CES is applied to spatial comparisons only.

CES = critical effect size; ‘=’ = not significantly different; n/a = not applicable.

Results of chemical analyses of metals and PAHs in tissues from all species (Arctic Char, Fourhorn Sculpin, *Hiatella arctica*) were within FEIS predictions and subsequent addenda, which indicated the potential for low magnitude increases in fish tissue concentrations of metals and/or PAHs associated with Project activities. Results presented herein do not exceed predicted effects on fish tissue chemistry due to Project activities.

7.7 Conclusions and Recommendations

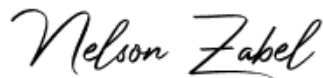
The MEEMP has been designed to meet the objectives of the various conditions associated with PC No. 005 (Chapter 1.0, Table 1-2), and to provide data and results to evaluate whether the marine environment is changing over time as a result of the Project. Original FEIS predictions, and subsequent addenda, indicated the potential for low magnitude changes in some ecological parameters, such as water quality and Arctic Char tissue chemistry, but characterised these changes as not ecologically significant. Monitoring data align with these predictions overall, as observed changes have been small and are consistent with baseline data or established guidelines. Monitoring to date suggests that Project mitigation is functioning as intended and that Project activities are being managed in a way that has not adversely affected marine fish health beyond the scope of the FEIS predictions, including addenda.

Moving forward, if monitoring of fish health and tissue chemistry in 2025 continues to demonstrate that the effects of Project activities are within those predicted by the FEIS and subsequent addenda, it may be recommended to consider periodic monitoring of these MEEMP components on a three-year cycle. Completion of the 2025 monitoring is recommended so that at least three years of data would be available from Koluktoo Bay which was the most-recently selected reference area and has been sampled since 2023 This recommendation aligns with the MDMER EEM requirements for biological monitoring and minimizes potential population-level effects of repeated lethal fish sampling. These efforts will provide an ongoing dataset for use in monitoring effects of the Project to the marine environment into the future.

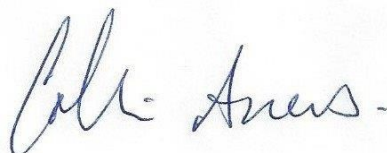
7.8 Closure

We trust this information is sufficient for your needs at this time. Should you have any questions or concerns, please do not hesitate to contact Phil Rouget, on behalf of the undersigned, at +1 250 419 4945.

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APPENDIX 7A

Fish Health Data

Table 7A-1: Fish Health Data for Fourhorn Sculpin Lethally Sampled from the Milne Port Area and Koluktook Bay Reference Area, 2024

Date (dd/mm/yy)	Effort Number	Fish Identification Number	Total Length (mm)	Total Weight (g)	Condition Factor	Sex	Life Stage	Maturity ^(a)	Age (y)	Liver Weight (g)	Gonad Weight (g)
Milne Port											
04/08/24	BAFF24UDPFANJ6	BAFF24UDPFFHSC1001	281	235.7	1.06	F	adult	13	9	10.118	10.459
04/08/24	BAFF24UDPFANJ6	BAFF24UDPFFHSC1003	260	192.0	1.09	F	adult	13	5	7.412	5.940
04/08/24	BAFF24UDPFANJ6	BAFF24UDPFFHSC1004	245	156.3	1.06	F	adult	13	8	7.598	6.740
04/08/24	BAFF24UDPFANJ6	BAFF24UDPFFHSC1012	314	365.5	1.18	F	adult	13	7	16.205	12.149
04/08/24	BAFF24UDPFANJ6	BAFF24UDPFFHSC1015	208	79.9	0.89	F	adult	13	5	2.363	1.988
04/08/24	BAFF24UDPFANJ6	BAFF24UDPFFHSC1017	255	180.6	1.09	F	adult	13	9	5.002	5.016
04/08/24	BAFF24UDPFANJ6	BAFF24UDPFFHSC1018	249	165.2	1.07	F	adult	13	9	7.294	4.577
04/08/24	BAFF24UDPFANJ6	BAFF24UDPFFHSC1019	228	102.7	0.87	F	adult	13	7	2.627	2.467
04/08/24	BAFF24UDPFANJ6	BAFF24UDPFFHSC1020	217	103.3	1.01	F	adult	13	6	4.065	4.121
04/08/24	BAFF24UDPFANJ6	BAFF24UDPFFHSC1022	230	118.3	0.97	F	adult	13	7	4.407	3.242
05/08/24	BAFF24UDPFANJ7	BAFF24UDPFFHSC1024	249	170.3	1.10	F	adult	13	7	8.218	5.769
05/08/24	BAFF24UDPFANJ7	BAFF24UDPFFHSC1025	284	229.5	1.00	F	adult	13	8	10.964	9.459
05/08/24	BAFF24UDPFANJ7	BAFF24UDPFFHSC1026	244	144.4	0.99	F	adult	13	6	5.062	5.890
05/08/24	BAFF24UDPFANJ7	BAFF24UDPFFHSC1027	235	122.7	0.95	F	adult	13	7	4.562	4.154
05/08/24	BAFF24UDPFANJ7	BAFF24UDPFFHSC1028	246	147.5	0.99	F	adult	13	5	5.808	4.827
05/08/24	BAFF24UDPFANJ7	BAFF24UDPFFHSC1029	256	157.7	0.94	F	adult	13	5	7.242	4.964
08/08/24	BAFF24UIPFANJ13	BAFF24UIPFFHSC1037	309	378.7	1.28	F	adult	13	5	17.989	16.055
08/08/24	BAFF24UIPFANJ13	BAFF24UIPFFHSC1038	284	220.1	0.96	F	adult	13	5	10.173	13.501
08/08/24	BAFF24UIPFANJ13	BAFF24UIPFFHSC1039	260	211.9	1.21	F	adult	13	5	15.273	9.888
08/08/24	BAFF24UIPFANJ13	BAFF24UIPFFHSC1040	266	190.8	1.01	F	adult	13	4	11.812	9.884
04/08/24	BAFF24UDPFANJ6	BAFF24UDPFFHSC1002	203	78.1	0.93	M	adult	23	6	1.407	2.237
04/08/24	BAFF24UDPFANJ6	BAFF24UDPFFHSC1005	219	107.7	1.03	M	adult	23	5	3.037	3.875
04/08/24	BAFF24UDPFANJ6	BAFF24UDPFFHSC1006	262	195.7	1.09	M	adult	23	5	4.270	7.074
04/08/24	BAFF24UDPFANJ6	BAFF24UDPFFHSC1007	265	216.3	1.16	M	adult	23	6	4.823	6.163
04/08/24	BAFF24UDPFANJ6	BAFF24UDPFFHSC1008	228	104.8	0.88	M	adult	23	7	2.182	3.155
04/08/24	BAFF24UDPFANJ6	BAFF24UDPFFHSC1009	254	157.7	0.96	M	adult	23	7	3.016	6.340
04/08/24	BAFF24UDPFANJ6	BAFF24UDPFFHSC1010	229	122.1	1.02	M	adult	23	6	3.687	4.519
04/08/24	BAFF24UDPFANJ6	BAFF24UDPFFHSC1011	258	151.5	0.88	M	adult	23	6	3.182	6.986
04/08/24	BAFF24UDPFANJ6	BAFF24UDPFFHSC1013	227	109.7	0.94	M	adult	23	5	3.201	1.869
04/08/24	BAFF24UDPFANJ6	BAFF24UDPFFHSC1014	248	145.0	0.95	M	adult	23	8	2.817	4.970
04/08/24	BAFF24UDPFANJ6	BAFF24UDPFFHSC1016	219	91.6	0.87	M	adult	23	8	2.171	2.147
04/08/24	BAFF24UDPFANJ6	BAFF24UDPFFHSC1021	225	117.1	1.03	M	adult	23	6	3.040	3.234
04/08/24	BAFF24UDPFANJ6	BAFF24UDPFFHSC1023	229	114.9	0.96	M	adult	23	5	3.397	4.042
05/08/24	BAFF24UDPFANJ7	BAFF24UDPFFHSC1030	273	187.2	0.92	M	adult	23	6	5.844	6.727
05/08/24	BAFF24UDPFANJ7	BAFF24UDPFFHSC1031	276	188.7	0.90	M	adult	23	5	6.929	7.552
05/08/24	BAFF24UDPFANJ7	BAFF24UDPFFHSC1032	237	120.1	0.90	M	adult	23	6	4.364	3.553
05/08/24	BAFF24UDPFANJ7	BAFF24UDPFFHSC1033	219	99.1	0.94	M	adult	23	11	2.748	1.690
05/08/24	BAFF24UDPFANJ7	BAFF24UDPFFHSC1034	254	154.8	0.94	M	adult	23	8	4.402	7.526
05/08/24	BAFF24UDPFANJ7	BAFF24UDPFFHSC1035	213	92.6	0.96	M	adult	23	7	2.565	3.203
05/08/24	BAFF24UDPFANJ7	BAFF24UDPFFHSC1036	213	87.6	0.91	M	adult	23	7	1.760	3.246
Koluktook Bay											
03/08/24	BAFF24UREFGN03	BAFF24UKLFHSC2004	296	291.0	1.12	F	adult	13	5	8.201	10.200
03/08/24	BAFF24UREFGN03	BAFF24UKLFHSC2005	229	122.5	1.02	F	adult	13	11	5.810	3.882
03/08/24	BAFF24UREFGN04	BAFF24UKLFHSC2006	250	217.1	1.39	F	adult	13	8	14.045	8.788
03/08/24	BAFF24UREFGN04	BAFF24UKLFHSC2008	252	154.5	0.97	F	adult	13	8	5.629	9.804
03/08/24	BAFF24UREFGN04	BAFF24UKLFHSC2009	210	71.3	0.77	F	adult	13	5	2.999	2.219
03/08/24	BAFF24UREFGN04	BAFF24UKLFHSC2010	186	49.6	0.77	F	adult	13	8	1.213	1.649
03/08/24	BAFF24UREFGN01	BAFF24UKLFHSC2011	283	271.1	1.20	F	adult	13	7	13.295	13.421
03/08/24	BAFF24UREFGN01	BAFF24UKLFHSC2012	298	262.2	0.99	F	adult	13	7	13.131	9.252
09/08/24	BAFF24UREFANJ18	BAFF24UKLFHSC2015	190	60.2	0.88	F	adult	13	5	2.141	2.265
09/08/24	BAFF24UREFANJ16	BAFF24UKLFHSC2024	238	151.3	1.12	F	adult	13	5	8.216	6.810
09/08/24	BAFF24UREFANJ16	BAFF24UKLFHSC2024	220	112.0	1.05	F	adult	13	9	6.292	4.408
09/08/24	BAFF24UREFGN16	BAFF24UKLFHSC2026	256	259.8	1.55	F	adult	13	10	10.094	9.740
09/08/24	BAFF24UREFGN14	BAFF24UKLFHSC2027	254	185.1	1.13	F	adult	13	5	8.357	6.437
09/08/24	BAFF24UREFGN14	BAFF24UKLFHSC2029	224	132.1	1.18	F	adult	13	7	6.060	3.543
09/08/24	BAFF24UREFANJ20	BAFF24UKLFHSC2030	243	156.7	1.09	F	adult	13	5	9.609	7.876
09/08/24	BAFF24UREFANJ19	BAFF24UKLFHSC2033	205	87.3	1.01	F	adult	13	7	3.594	4.090
09/08/24	BAFF24UREFANJ19	BAFF24UKLFHSC2034	209	89.2	0.98	F	adult	13	6	2.940	2.251
16/08/24	BAFF24UREFANJ30	BAFF24UKLFHSC2036	206	74.1	0.85	F	adult	12	4	1.563	3.390
16/08/24	BAFF24UREFANJ30	BAFF24UKLFHSC2037	249	164.9	1.07	F	adult	13	5	11.589	7.460
16/08/24	BAFF24UREFANJ30	BAFF24UKLFHSC2038	225	124.3	1.09	F	adult	13	5	5.308	4.838
03/08/24	BAFF24UREFANJ05	BAFF24UKLFHSC2001	207	84.2	0.95	M	adult	23	4	3.368	3.760
03/08/24	BAFF24UREFGN03	BAFF24UKLFHSC2002	282	225.5	1.01	M	adult	23	5	6.620	6.741
03/08/24	BAFF24UREFGN03	BAFF24UKLFHSC2003	242	127.0	0.90	M	adult	23	8	6.300	3.199
03/08/24	BAFF24UREFGN04	BAFF24UKLFHSC2007	220	99.7	0.94	M	adult	23	7	4.828	3.343
09/08/24	BAFF24UREFANJ18	BAFF24UKLFHSC2013	208	97.7	1.09	M	adult	23	7	2.828	2.950
09/08/24	BAFF24UREFANJ18	BAFF24UKLFHSC2014	230	100.7	0.83	M	adult	23	9	2.952	4.260
09/08/24	BAFF24UREFANJ18	BAFF24UKLFHSC2016	222	103.9	0.95	M	adult	23	8	2.964	3.407
09/08/24	BAFF24UREFANJ18	BAFF24UKLFHSC2017	212	82.5	0.87	M	adult	23	7	2.847	2.249
09/08/24	BAFF24UREFANJ18	BAFF24UKLFHSC2018	184	52.5	0.84	M	adult	23	5	1.141	1.935
09/08/24	BAFF24UREFANJ18	BAFF24UKLFHSC2019	202	72.7	0.88	M	adult	23	8	2.149	3.434
09/08/24	BAFF24UREFANJ18	BAFF24UKLFHSC2020	190	53.7	0.78	M	adult	23	12	0.970	2.650
09/08/24	BAFF24UREFANJ18	BAFF24UKLFHSC2021	198	73.8	0.95	M	adult	23	6	1.985	3.051
09/08/24	BAFF24UREFANJ18	BAFF24UKLFHSC2022	200	72.1	0.90	M	adult	23	4	1.695	3.284
09/08/24	BAFF24UREFGN16	BAFF24UKLFHSC2025	234	114.5	0.89	M	adult	23	7	3.442	3.190
09/08/24	BAFF24UREFGN14	BAFF24UKLFHSC2028	249	151.2	0.98	M	adult	23	6	7.526	4.860
09/08/24	BAFF24UREFANJ20	BAFF24UKLFHSC2031	257	177.9	1.05	M	adult	23	6	4.700	8.458
09/08/24	BAFF24UREFANJ19	BAFF24UKLFHSC2032	219	107.2	1.02	M	adult	23	6	5.171	3.726
09/08/24	BAFF24UREFANJ19	BAFF24UKLFHSC2035	211	90.8	0.97	M	adult	23	7	3.668	3.113
16/08/24	BAFF24UREFANJ31	BAFF24UKLFHSC2039	174	48.4	0.92	M	adult	23	5	0.937	1.788

(a) Refer to Table 7-2 in Report for descriptions of maturity codes.

d = day; m = month; y = year; mm = millimeters; g = grams; F = female; M = male.

Table 7A-2: Internal and External Assessments of Fourhorn Sculpin Lethally Sampled from the Milne Port Area and Koluktoo Bay Reference Area, 2024

Fish Identification Number	External Assessment										Internal Assessment							
	Body Deformity	Eyes	Skin	Thymus	Opercula	Gills	Pseudo-branches	Fins	Vent	Parasites ^(a)	Liver ^(b)	Spleen	Gall Bladder	Gonads	Mesenteric Fat (%)	Parasites ^(a)	Kidney	
Milne Port																		
BAFF24UDPFFHSC1001	N	N	0	0	0	N	N	0	0	1	A	B	0	N	0	0	N	
BAFF24UDPFFHSC1003	N	N	0	0	0	N	N	1	0	0	A	B	0	N	0	0	N	
BAFF24UDPFFHSC1004	N	N	1	0	0	N	N	0	0	0	A	B	0	N	0	0	N	
BAFF24UDPFFHSC1012	N	N	0	0	0	N	N	0	0	1	A	B	0	N	0	0	N	
BAFF24UDPFFHSC1015	N	N	0	0	0	N	N	0	0	0	A	B	0	N	0	0	N	
BAFF24UDPFFHSC1017	N	N	0	0	0	N	N	0	0	0	A	B	0	N	0	0	N	
BAFF24UDPFFHSC1018	N	N	0	0	0	N	N	0	0	0	A	B	0	N	0	0	N	
BAFF24UDPFFHSC1019	N	N	0	0	0	N	N	0	0	0	A	B	0	N	0	0	N	
BAFF24UDPFFHSC1020	N	N	0	0	0	N	N	0	0	0	A	B	0	N	0	0	N	
BAFF24UDPFFHSC1022	N	N	0	0	0	N	N	0	0	0	A	B	0	N	0	0	N	
BAFF24UDPFFHSC1024	N	N	0	0	0	N	N	1	0	2	A	B	0	N	0	0	N	
BAFF24UDPFFHSC1025	N	N	0	0	0	N	N	0	0	1	A	B	0	N	0	0	N	
BAFF24UDPFFHSC1026	N	N	0	0	0	N	N	0	0	1	A	B	0	N	0	0	N	
BAFF24UDPFFHSC1027	N	N	0	0	0	N	N	1	0	1	A	B	0	N	0	0	N	
BAFF24UDPFFHSC1028	N	N	0	0	0	N	N	0	0	0	C	B	0	N	0	0	N	
BAFF24UDPFFHSC1029	N	N	0	0	0	N	N	0	0	1	A	B	0	N	0	0	N	
BAFF24UIPFFHSC1037	N	N	0	0	0	N	N	0	0	3	E	B	0	N	0	2	N	
BAFF24UIPFFHSC1038	N	N	0	0	0	N	N	0	0	1	A	B	0	N	0	0	N	
BAFF24UIPFFHSC1039	N	N	0	0	0	N	N	0	0	1	A	B	0	N	0	0	N	
BAFF24UIPFFHSC1040	N	N	0	0	0	N	N	0	0	3	A	B	0	N	0	0	N	
BAFF24UDPFFHSC1002	N	N	0	0	0	N	N	0	0	1	A	B	0	N	0	0	N	
BAFF24UDPFFHSC1005	N	N	0	0	0	N	N	0	0	0	C	B	0	N	0	0	N	
BAFF24UDPFFHSC1006	N	N	0	0	0	N	N	0	0	0	E	B	0	N	0	0	N	
BAFF24UDPFFHSC1007	N	N	0	0	0	N	N	0	0	1	A	B	0	N	0	0	N	
BAFF24UDPFFHSC1008	N	N	0	0	0	N	N	0	0	0	A	B	0	N	0	0	N	
BAFF24UDPFFHSC1009	N	N	0	0	0	N	N	0	0	0	E	B	0	N	0	0	N	
BAFF24UDPFFHSC1010	N	N	0	0	0	N	N	0	0	1	A	B	0	N	0	0	N	
BAFF24UDPFFHSC1011	N	N	0	0	0	N	N	0	0	0	A	B	0	N	0	0	N	
BAFF24UDPFFHSC1013	N	N	0	0	0	N	N	0	0	0	A	B	0	N	0	0	N	
BAFF24UDPFFHSC1014	N	N	0	0	0	N	N	0	0	0	A	B	0	N	0	0	N	
BAFF24UDPFFHSC1016	N	N	0	0	0	N	N	0	0	0	A	B	0	N	0	0	N	
BAFF24UDPFFHSC1021	N	N	0	0	0	N	N	0	0	1	A	B	0	N	0	0	N	
BAFF24UDPFFHSC1023	N	N	0	0	0	N	N	0	0	2	A	B	0	N	0	0	N	
BAFF24UDPFFHSC1030	N	N	0	0	0	N	N	1	0	2	A	B	0	N	0	2	N	
BAFF24UDPFFHSC1031	N	N	0	0	0	N	N	0	0	2	A	B	0	N	0	2	N	
BAFF24UDPFFHSC1032	N	N	0	0	0	N	N	0	0	0	A	B	0	N	0	0	N	
BAFF24UDPFFHSC1033	N	N	0	0	0	N	N	0	0	1	A	B	0	N	0	0	N	
BAFF24UDPFFHSC1034	N	N	0	0	0	N	N	0	0	0	E	B	0	N	0	0	N	
BAFF24UDPFFHSC1035	N	N	0	0	0	N	N	0	0	0	A	B	0	N	0	0	N	
BAFF24UDPFFHSC1036	N	N	0	0	0	N	N	0	0	1	A	B	0	N	0	0	N	
Koluktoo Bay																		
BAFF24UKLFHSC2004	N	N	0	0	0	N	N	0	0	0	A	B	0	N	0	0	N	
BAFF24UKLFHSC2005	N	N	0	0	0	N	N	0	0	0	A	B	0	N	0	0	N	
BAFF24UKLFHSC2006	N	N	0	0	0	N	N	0	0	0	A	B	0	N	0	0	N	
BAFF24UKLFHSC2008	N	N	0	0	0	N	N	0	0	0	A	B	0	N	0	0	N	
BAFF24UKLFHSC2009	N	N	0	0	0	N	N	0	0	0	A	B	0	N	0	0	N	
BAFF24UKLFHSC2010	N	N	0	0	0	N	N	0	0	0	A	B	0	N	0	0	N	
BAFF24UKLFHSC2011	N	N	0	0	0	N	N	0	0	0	A	B	0	N	0	0	N	
BAFF24UKLFHSC2012	N	N	0	0	0	N	N	0	0	0	A	B	0	N	0	0	N	
BAFF24UKLFHSC2015	N	N	0	0	0	N	N	0	0	0	A	B	0	N	0	0	N	
BAFF24UKLFHSC2024	N	N	0	0	0	N	N	0	0	0	A	B	0	N	0	0	N	
BAFF24UKLFHSC2024	N	N	0	0	0	N	N	0	0	0	A	B	0	N	0	0	N	
BAFF24UKLFHSC2026	N	N	0	0	0	N	N	0	0	1	A	B	0	N	0	0	N	
BAFF24UKLFHSC2027	N	N	0	0	0	N	N	0	0	0	A	B	0	N	0	0	N	
BAFF24UKLFHSC2029	N	N	0	0	0	N	N	0	0	1	A	B	0	N	0	0	N	
BAFF24UKLFHSC2030	N	N	0	0	0	N	N	0	0	1	C	B	0	N	0	0	N	
BAFF24UKLFHSC2033	N	N	0	0	0	N	N	0	0	0	A	B	0	N	0	0	N	
BAFF24UKLFHSC2034	N	N	0	0	0	N	N	0	0	0	C	B	0	N	0	0	N	
BAFF24UKLFHSC2036	N	N	0	0	0	N	N	0	0	0	A	B	0	N	0	0	N	
BAFF24UKLFHSC2037	N	N	0	0	0	N	N	0	0	1	E	B	0	N	0	0	N	
BAFF24UKLFHSC2038	N	N	0	0	0	N	N	0	0	0	A	B	0	N	0	0	N	
BAFF24UKLFHSC2001	N	N	0	0	0	N	N	0	0	0	A	B	0	N	0	0	N	
BAFF24UKLFHSC2002	N	N	0	0	0	N	N	0	0	0	A	B	0	N	0	1	N	
BAFF24UKLFHSC2003	N	N	0	0	0	N	N	0	0	0	E	B	0	N	0	0	N	
BAFF24UKLFHSC2007	N	N	0	0	0	N	N	0	0	0	A	B	0	N	0	0	N	
BAFF24UKLFHSC2013	N	N	0	0	0	N	N	0	0	0	A	B	0	N	0	0	N	
BAFF24UKLFHSC2014	N	N	0	0	0	N	N	0	0	1	A	B	0	N	0	0	N	
BAFF24UKLFHSC2016	N	N	0	0	0	N	N	0	0	0	A	B	0	N	0	0	N	
BAFF24UKLFHSC2017	N	N	0	0	0	N	N	0	0	0	A	B	0	N	0	0	N	
BAFF24UKLFHSC2018	N	N	0	0	0	N	N	0	0	0	A	B	0	N	0	0	N	
BAFF24UKLFHSC2019	N	N	0	0	0	N	N	0	0	0	A	B	0	N	0	0	N	
BAFF24UKLFHSC2020	N	N	0	0	0	N	N	0	0	0	A	B	0	N	0	0	N	
BAFF24UKLFHSC2021	N	N	0	0	0	N	N	0	0	0	A	B	0	N	0	0	N	
BAFF24UKLFHSC2022	N	N	0	0	0	N	N	0	0	0	A	B	0	N	0	0	N	
BAFF24UKLFHSC2025	N	N	0	0	0	N	N	0	0	0	A	B	0	N	0	0	N	
BAFF24UKLFHSC2028	N	N	0	0	0	N	N	0	0	1	A	B	0	N	0	0	N	
BAFF24UKLFHSC2031	N	N	0	0	0	N	N	0	0	1	A	B	0	N	0	0	N	
BAFF24UKLFHSC2032	N	N	0	0	0	N	N	0	0	0	A	B	0	N	0	0	N	
BAFF24UKLFHSC2035	N	N	0	0	0	N	N	0	0	0	A	B	0	N	0	0	N	
BAFF24UKLFHSC2039	N	N	0	0	0	N	N	0	0	0	A	B	0	N	0	0	N	

(a) 0 = No observed parasites; 1 = Few observed parasites; 2 = Several observed parasites; 3 = Many observed parasites.

(b) A = Normal, solid red or light red colour; C = "Fatty" liver, "coffee with cream" colour; E = focal discolouration.

% = percent; N, 0, or B = normal; - = not collected; < = less than

Table 7A-3: Fish Health Data for *Hiatella arctica* Lethally Sampled from the Milne Port Area and Tugaat River Estuary Reference Area, 2024

Date (dd/mm/yy)	Effort Number	Fish Identification Number	Composite	Field Measurements						Laboratory Measurements						Age (y)
				Total Length (mm)	Whole Animal Wet Weight (g)	Total Length (mm)	Total Height (mm)	Total Width (mm)	Whole Animal Wet Weight (g)	Shell Wet Weight (g)	Tissue Wet Weight (g)	Gonad Wet Weight (g)	Shell Dry Weight (g)			
Milne Port																
06-08-24	BAFF24UMLNHTARVWest-M	BAFF24UMLNHTAR1501	BAFF24-MLN-HTAR-COMP-METALS-3	28.98	2.82	28.25	12.81	11.35	2.045	1.012	0.514	0.404	0.857	9		
06-08-24	BAFF24UMLNHTARVWest-M	BAFF24UMLNHTAR1502	BAFF24-MLN-HTAR-COMP-METALS-1	19.72	1.15	19.73	9.12	7.54	0.826	0.557	0.196	0.014	0.513	5		
06-08-24	BAFF24UMLNHTARVWest-M	BAFF24UMLNHTAR1503	BAFF24-MLN-HTAR-COMP-METALS-8	32.15	3.69	31.27	15.25	10.82	2.025	1.284	0.397	0.028	1.086	7		
06-08-24	BAFF24UMLNHTARVWest-M	BAFF24UMLNHTAR1504	BAFF24-MLN-HTAR-COMP-METALS-2	26.53	2.87	26.44	12.74	10.44	2.455	1.032	1.133	0.031	0.868	11		
06-08-24	BAFF24UMLNHTARVWest-M	BAFF24UMLNHTAR1505	BAFF24-MLN-HTAR-COMP-METALS-1	21.19	1.21	21.03	9.81	8.56	1.004	0.435	0.135	0.006	0.359	-		
06-08-24	BAFF24UMLNHTARVVQ5	BAFF24UMLNHTAR1506	BAFF24-MLN-HTAR-COMP-METALS-7	28.97	3.05	28.81	14.73	11.84	2.596	1.076	0.843	0.047	0.841	18		
06-08-24	BAFF24UMLNHTARVVQ5	BAFF24UMLNHTAR1507	BAFF24-MLN-HTAR-COMP-METALS-4	23.56	2.39	23.59	12.13	11.81	2.141	0.869	0.867	0.179	0.729	21		
06-08-24	BAFF24UMLNHTARVVQ5	BAFF24UMLNHTAR1508	BAFF24-MLN-HTAR-COMP-METALS-6	27.09	3.56	27.17	14.19	11.90	3.113	1.783	0.787	0.037	1.573	37		
06-08-24	BAFF24UMLNHTARVVQ5	BAFF24UMLNHTAR1509	BAFF24-MLN-HTAR-COMP-METALS-3	28.85	3.46	28.67	13.83	12.47	3.159	1.397	1.033	0.043	1.169	14		
06-08-24	BAFF24UMLNHTARVVQ5	BAFF24UMLNHTAR1510	BAFF24-MLN-HTAR-COMP-METALS-5	24.31	1.96	24.18	12.65	9.80	1.823	0.763	0.668	0.026	0.617	10		
06-08-24	BAFF24UMLNHTARVVQ5	BAFF24UMLNHTAR1511	BAFF24-MLN-HTAR-COMP-METALS-3	26.98	2.51	27.20	11.09	13.02	2.260	1.144	0.836	0.032	0.993	10		
06-08-24	BAFF24UMLNHTARVVQ5	BAFF24UMLNHTAR1512	BAFF24-MLN-HTAR-COMP-METALS-5	24.57	2.22	24.62	11.66	10.62	1.815	0.852	0.606	0.040	0.699	14		
06-08-24	BAFF24UMLNHTARVVQ5	BAFF24UMLNHTAR1513	BAFF24-MLN-HTAR-COMP-METALS-2	25.14	2.02	25.24	11.79	10.14	1.806	0.767	0.634	0.587	0.614	6		
06-08-24	BAFF24UMLNHTARVVQ5	BAFF24UMLNHTAR1514	BAFF24-MLN-HTAR-COMP-METALS-6	27.41	2.92	27.42	13.10	10.18	2.499	1.352	0.894	0.021	1.158	15		
06-08-24	BAFF24UMLNHTARVVQ5	BAFF24UMLNHTAR1515	BAFF24-MLN-HTAR-COMP-METALS-7	29.33	2.42	29.22	13.29	9.51	1.725	0.807	0.592	0.010	0.668	-		
06-08-24	BAFF24UMLNHTARVVQ5	BAFF24UMLNHTAR1516	BAFF24-MLN-HTAR-COMP-METALS-2	25.26	2.20	24.70	11.51	10.40	1.806	0.813	0.657	0.042	0.695	11		
06-08-24	BAFF24UMLNHTARVVQ5	BAFF24UMLNHTAR1517	BAFF24-MLN-HTAR-COMP-METALS-1	23.71	1.96	23.94	10.83	10.66	1.849	0.829	0.640	0.011	0.679	13		
06-08-24	BAFF24UMLNHTARVVQ5	BAFF24UMLNHTAR1518	BAFF24-MLN-HTAR-COMP-METALS-4	20.91	1.37	20.87	9.95	8.17	1.103	0.483	0.363	0.009	0.406	6		
06-08-24	BAFF24UMLNHTARVVQ5	BAFF24UMLNHTAR1519	BAFF24-MLN-HTAR-COMP-METALS-4	22.24	2.19	21.99	11.17	8.70	1.410	0.602	0.522	0.029	0.510	9		
06-08-24	BAFF24UMLNHTARVVQ5	BAFF24UMLNHTAR1520	BAFF24-MLN-HTAR-COMP-METALS-5	24.35	2.32	23.87	10.98	9.07	1.365	0.661	0.443	0.024	0.568	5		
06-08-24	BAFF24UMLNHTARVVQ5	BAFF24UMLNHTAR1521	BAFF24-MLN-HTAR-COMP-METALS-4	21.84	1.74	21.66	10.18	8.99	1.182	0.536	0.429	0.017	0.461	9		
06-08-24	BAFF24UMLNHTARVVQ5	BAFF24UMLNHTAR1522	BAFF24-MLN-HTAR-COMP-METALS-1	21.28	2.020	21.97	10.62	10.59	1.712	0.665	0.526	0.016	0.549	5		
10-08-24	BAFF24UMLNHTARVSW3	BAFF24UMLNHTAR1523	BAFF24-MLN-HTAR-COMP-METALS-8	34.34	5.76	34.00	15.58	14.48	4.883	2.877	1.183	0.028	2.511	14		
10-08-24	BAFF24UMLNHTARVSW3	BAFF24UMLNHTAR1524	BAFF24-MLN-HTAR-COMP-METALS-6	25.07	3.93	26.79	13.82	10.96	3.316	1.791	0.926	0.025	1.567	16		
10-08-24	BAFF24UMLNHTARVSW3	BAFF24UMLNHTAR1525	BAFF24-MLN-HTAR-COMP-METALS-8	35.20	6.14	36.31	15.44	13.97	4.355	2.459	1.019	0.035	2.137	21		
10-08-24	BAFF24UMLNHTARVSW3	BAFF24UMLNHTAR1526	BAFF24-MLN-HTAR-COMP-METALS-8	28.43	5.05	30.11	15.57	13.27	4.374	2.261	1.151	0.019	1.984	8		
10-08-24	BAFF24UMLNHTARVSW3	BAFF24UMLNHTAR1527	BAFF24-MLN-HTAR-COMP-METALS-3	25.90	4.86	29.21	14.65	11.87	3.854	1.899	1.198	0.036	1.640	24		
13-08-24	BAFF24UMLNHTARVSCV2	BAFF24UMLNHTAR1528	BAFF24-MLN-HTAR-COMP-METALS-3	27.06	3.57	27.67	14.29	12.31	2.366	1.563	0.513	0.249	1.455	9		
13-08-24	BAFF24UMLNHTARVSCV2	BAFF24UMLNHTAR1529	BAFF24-MLN-HTAR-COMP-METALS-7	29.45	5.67	29.63	15.47	13.52	4.666	3.502	0.834	0.024	3.280	80		
13-08-24	BAFF24UMLNHTARVSCV2	BAFF24UMLNHTAR1530	BAFF24-MLN-HTAR-COMP-METALS-2	26.85	4.10	26.97	14.42	13.64	3.109	2.208	0.521	0.016	2.032	40		
13-08-24	BAFF24UMLNHTARVSCV2	BAFF24UMLNHTAR1531	BAFF24-MLN-HTAR-COMP-METALS-1	23.87	2.00	23.75	11.71	9.97	1.300	0.815	0.361	0.014	0.705	9		
13-08-24	BAFF24UMLNHTARVSCV2	BAFF24UMLNHTAR1532	BAFF24-MLN-HTAR-COMP-METALS-6	27.64	5.26	28.30	15.30	12.58	4.279	3.274	0.660	0.029	3.009	65		
13-08-24	BAFF24UMLNHTARVSCV2	BAFF24UMLNHTAR1533	BAFF24-MLN-HTAR-COMP-METALS-7	29.65	5.57	30.15	16.37	13.94	4.412	3.246	0.665	0.032	2.917	82		
13-08-24	BAFF24UMLNHTARVSCV2	BAFF24UMLNHTAR1534	BAFF24-MLN-HTAR-COMP-METALS-6	26.78	3.25	26.90	13.73	11.42	2.406	1.310	0.730	0.014	1.129	15		
13-08-24	BAFF24UMLNHTARVSCV2	BAFF24UMLNHTAR1535	BAFF24-MLN-HTAR-COMP-METALS-5	24.97	2.75	24.70	13.24	11.20	2.095	1.292	0.534	0.014	1.150	32		
13-08-24	BAFF24UMLNHTARVSCV2	BAFF24UMLNHTAR1536	BAFF24-MLN-HTAR-COMP-METALS-2	26.63	2.29	26.80	12.68	10.04	1.845	1.046	0.556	0.017	0.898	13		
13-08-24	BAFF24UMLNHTARVSCV2	BAFF24UMLNHTAR1537	BAFF24-MLN-HTAR-COMP-METALS-1	23.18	1.94	22.99	11.81	9.72	1.249	0.735	0.381	0.010	0.660	8		
17-08-24	BAFF24UMLNHTARVSNW1	BAFF24UMLNHTAR1538	BAFF24-MLN-HTAR-COMP-METALS-3	27.40	3.78	27.21	14.44	11.87	2.361	1.643	0.412	0.010	1.502	25		
17-08-24	BAFF24UMLNHTARVSNW1	BAFF24UMLNHTAR1539	BAFF24-MLN-HTAR-COMP-METALS-5	25.39	3.170	25.26	13.65	11.45	2.446	1.762	0.439	0.013	1.626	32		
17-08-24	BAFF24UMLNHTARVSNW1	BAFF24UMLNHTAR1540	BAFF24-MLN-HTAR-COMP-METALS-1	24.60	2.40	24.57	11.84	9.93	1.508	1.197	0.157	0.009	1.074	13		
Koluktoo Bay																
03-08-24	BAFF24UREFHTARVVTGT-1	BAFF24UTGTHAR2501	BAFF24-REF-HTAR-COMP-METALS-6	33.22	6.89	33.14	16.71	14.28	4.888	3.259	0.843	0.019	2.944	27		
03-08-24	BAFF24UREFHTARVVTGT-1	BAFF24UTGTHAR2502	BAFF24-REF-HTAR-COMP-METALS-1	25.40	4.42	24.84	15.30	12.70	3.355	2.176	0.793	0.022	1.907	26		
03-08-24	BAFF24UREFHTARVVTGT-1	BAFF24UTGTHAR2503	BAFF24-REF-HTAR-COMP-METALS-2	27.07	3.57	27.24	14.57	10.95	2.074	1.514	0.299	0.016	1.289	48		
03-08-24	BAFF24UREFHTARVVTGT-1	BAFF24UTGTHAR2504	BAFF24-REF-HTAR-COMP-METALS-5	30.83	7.23	30.48	16.45	13.87	4.893	3.648	0.726	0.030	3.106	58		
03-08-24	BAFF24UREFHTARVVTGT-1	BAFF24UTGTHAR2505	BAFF24-REF-HTAR-COMP-METALS-2	24.64	2.90	24.99	12.85	10.62	2.046	1.306	0.420	0.017	1.128	25		
03-08-24	BAFF24UREFHTARVVTGT-1	BAFF24UTGTHAR2506	BAFF24-REF-HTAR-COMP-METALS-3	27.33	3.50	27.99	13.05	10.32	2.164	1.131	0.681	0.009	0.835	-		
03-08-24	BAFF24UREFHTARVVTGT-1	BAFF24UTGTHAR2507	BAFF24-REF-HTAR-COMP-METALS-4	30.81	4.97	29.64	17.01	12.96	3.771	2.684	0.713	0.033	2.284	59		
09-08-24	BAFF24UREFHTARVVTGT-1	BAFF24UTGTHAR2508	BAFF24-REF-HTAR-COMP-METALS-2	25.15	2.870	25.68	12.10	11.85	2.742	1.670	0.704	0.019	1.456	18		
16-08-24	BAFF24UREFHTARVVTGT-1	BAFF24UTGTHAR2509	BAFF24-REF-HTAR-COMP-METALS-6	37.20	10.04	36.65	18.09	15.22	7.595	5.557	1.464	0.050	5.193	50		
16-08-24	BAFF24UREFHTARVVTGT-1	BAFF24UTGTHAR2510	BAFF24-REF-HTAR-COMP-METALS-6	34.71	8.05	34.44	18.92	15.66	5.835	3.498	1.353	0.045	3.047	31		
16-08-24	BAFF24UREFHTARVVTGT-1	BAFF24UTGTHAR2511	BAFF24-REF-HTAR-COMP-METALS-3	29.03	3.78	28.80	14.38	13.09	3.147	1.557	1.114	0.045	1.404	8		
16-08-24	BAFF24UREFHTARVVTGT-1	BAFF24UTGTHAR2512	BAFF24-REF-HTAR-COMP-METALS-4	29.13	4.52	29.44	13.64	12.64	3.956	2.480	0.945	0.037	2.236	31		
16-08-24	BAFF24UREFHTARVVTGT-1	BAFF24UTGTHAR2513	BAFF24-REF-HTAR-COMP-METALS-1	25.48	2.61	24.76	13.00	12.00	2.192	0.972	0.780	0.025	0.832	8		
16-08-24	BAFF24UREFHTARVVTGT-1	BAFF24UTGTHAR2514	BAFF24-REF-HTAR-COMP-METALS-5	30.17	5.47	30.71	16.44	13.72	4.921	2.958	1.200	0.038	2.610	31		
16-08-24	BAFF24UREFHTARVVTGT-1	BAFF24UTGTHAR2515	BAFF24-REF-HTAR-COMP-METALS-2	25.78	2.89	25.80	16.44	11.15	1.821	1.047	0.570	0.012	0.917	8		
16-08-24	BAFF24UREFHTARVVTGT-1	BAFF24UTGTHAR2516	BAFF24-REF-HTAR-COMP-METALS-5	31.48	4.37	31.08	14.90	13.31	2.913	1.871	0.767	0.023	1.659	19		
16-08-24	BAFF24UREFHTARVVTGT-1	BAFF24UTGTHAR2517	BAFF24-REF-HTAR-COMP-METALS-2	27.63	3.42	27.35	13.88	12.81	3.070	1.496	1.016	0.030	1.298	8		
16-08-24	BAFF24UREFHTARVVTGT-1	BAFF24UTGTHAR2518	BAFF24-REF-HTAR-COMP-METALS-1	20.01	2.18	20.34	12.13	10.47	2.062	1.163	0.567	0.023	1.018	26		
16-08-24	BAFF24UREFHTARVVTGT-1	BAFF24UTGTHAR2519	BAFF24-REF-HTAR-COMP-METALS-4	29.87	4.45	29.66	14.87	13.56	3.243	1.993	0.881	0.040	1.780	11		
16-08-24	BAFF24UREFHTARVVTGT-1	BAFF24UTG														

d = day; m = month; y = year; mm = millimeters; g = grams; F = female; M = male; - = not assessed.

Table 7A-4: Fish Health Data for Fourhorn Sculpin Lethally Sampled from the Milne Port Area, 2020 to 2024

Parameter	2020							2021							2022						
	n	Min	Max	Median	Mean	SD	SE	n	Min	Max	Median	Mean	SD	SE	n	Min	Max	Median	Mean	SD	SE
Female																					
Total Length (mm)	22	194	310	216	226	32.5	6.92	20	205	344	249	255	40.3	9.02	20	225	306	253	256	20.1	4.49
Total Weight (g)	22	65.4	380	89.4	124	77.8	16.6	20	78.9	352	138	167	85.0	19.0	20	116	353	186	193	69.0	15.4
Carcass Weight (g)	22	54.3	239	72.7	94.5	50.1	10.7	20	49.7	235	86.2	102	51.0	11.4	20	61.4	203	97.3	104	38.9	8.69
Condition Factor	22	0.75	1.28	0.96	0.97	0.12	0.026	20	0.82	1.14	0.93	0.94	0.077	0.017	20	0.90	1.57	1.07	1.12	0.18	0.040
Liver Weight (g)	22	0.844	16.4	2.37	4.38	4.08	0.870	20	1.96	23.9	5.82	6.84	5.05	1.13	20	3.07	17.3	6.40	8.10	4.66	1.04
LSI	22	1.29	5.09	2.76	3.11	1.2	0.25	20	2.48	7.45	3.88	3.89	1.1	0.24	20	2.15	7.35	3.91	4.09	1.6	0.35
Gonad Weight (g)	22	1.06	16.4	3.26	4.53	3.85	0.821	20	1.40	81.8	4.71	10.3	17.7	3.95	20	2.37	18.2	5.76	6.39	3.58	0.802
GSI	22	1.33	4.99	3.53	3.38	1.1	0.23	20	1.78	24.38	3.67	4.76	4.8	1.1	20	1.83	5.16	3.28	3.22	0.86	0.19
Age (y)	22	4	4	5.0	5.4	1.1	0.22	20	3	10	6.0	6.2	2.0	0.46	20	5	9	7.0	7.0	0.97	0.22
Male																					
Total Length (mm)	21	189	276	215	214	21.1	4.61	20	209	281	229	237	24.4	5.45	20	212	278	236	236	16.7	3.74
Total Weight (g)	21	65.5	230	89.1	98.3	37.8	8.24	20	74.1	197	111	122	38.8	8.68	20	84.1	211	136	132	31.7	7.08
Carcass Weight (g)	21	54.5	169	70.0	78.3	28.0	6.12	20	47.1	147	72.7	80.8	30.0	6.71	20	50.1	129	79.9	77.9	19.6	4.38
Condition Factor	21	0.82	1.19	0.95	0.96	0.099	0.022	20	0.71	1.01	0.90	0.89	0.076	0.017	20	0.78	1.23	0.98	0.99	0.11	0.025
Liver Weight (g)	21	0.607	8.08	2.14	2.54	1.68	0.366	20	1.11	8.75	2.24	2.86	1.78	0.398	20	1.78	7.77	3.95	4.18	1.65	0.370
LSI	21	0.86	4.09	2.56	2.47	0.87	0.19	20	1.49	5.53	2.02	2.27	0.93	0.21	20	1.82	4.87	3.24	3.12	0.78	0.17
Gonad Weight (g)	21	1.43	10.7	3.84	4.07	2.31	0.503	20	2.07	10.2	4.76	5.17	2.19	0.490	20	2.56	9.26	4.48	4.92	1.86	0.415
GSI	21	2.02	5.88	4.09	4.03	1.3	0.28	20	2.51	6.40	4.24	4.23	1.1	0.25	20	2.47	5.04	3.46	3.67	0.79	0.18
Age (y)	21	4	9	5.0	5.6	1.5	0.34	20	3	12	6.0	6.6	2.1	0.48	20	5	10	7.0	6.8	1.1	0.24

LSI = Liver Somatic Index; GSI = Gonadal Somatic Index; n = sample size; mm = millimetres; g = grams; y = year; min = minimum; max = maximum; SD = standard deviation; SE = standard error

Parameter	2023							2024						
	n	Min	Max	Median	Mean	SD	SE	n	Min	Max	Median	Mean	SD	SE
Female														
Total Length (mm)	20	218	323	257	256	23.2	5.19	20	208	314	252	256	27.8	6.22
Total Weight (g)	20	105	329	174	183	57.0	12.7	20	80	379	168	184	77.7	17.4
Carcass Weight (g)	20	52.4	188	94.4	95.5	30.6	6.85	20	41.2	197	90	97	41.1	9.18
Condition Factor	20	0.85	1.42	1.05	1.06	0.13	0.029	20	0.87	1.28	1.01	1.04	0.10	0.023
Liver Weight (g)	20	3.92	16.1	8.66	8.78	3.53	0.789	20	2.363	17.99	7.353	8.210	4.452	0.995
LSI	20	2.88	6.72	4.79	4.78	1.2	0.27	20	2.56	7.21	4.35	4.30	1.08	0.24
Gonad Weight (g)	20	2.35	13.1	5.48	6.08	2.72	0.607	20	1.988	16.06	5.830	7.055	3.867	0.865
GSI	20	2.24	6.77	3.24	3.27	0.93	0.21	20	2.40	6.13	3.39	3.70	0.96	0.22
Age (y)	20	5	9	6.0	6.5	1.1	0.24	20	4	11	6.5	6.6	1.7	0.38
Male														
Total Length (mm)	20	203	281	226	232	24.0	5.37	20	203	276	229	238	21.9	4.89
Total Weight (g)	20	76.4	249	120	134	49.2	11.0	20	78	216	119	132	40.3	9.0
Carcass Weight (g)	20	45.4	140	60.9	77.4	32.2	7.20	20	44.5	115	67	75	22.3	4.99
Condition Factor	20	0.83	1.70	1.00	1.04	0.18	0.040	20	0.87	1.16	0.94	0.96	0.073	0.016
Liver Weight (g)	20	1.60	9.25	4.40	5.18	2.53	0.566	20	1.407	6.929	3.111	3.442	1.353	0.303
LSI	20	2.09	5.64	3.57	3.76	1.0	0.23	20	1.80	3.67	2.68	2.59	0.55	0.124
Gonad Weight (g)	20	1.61	9.53	3.65	4.01	2.05	0.459	20	1.690	7.552	3.959	4.505	2.003	0.448
GSI	20	1.44	5.76	2.80	2.98	1.0	0.23	20	1.70	4.86	3.49	3.32	0.82	0.18
Age (y)	20	4	8	5.5	5.9	1.2	0.27	20	5	9	6	6.4	1.3	0.29

LSI = Liver Somatic Index; GSI = Gonadal Somatic Index; n = sample size; mm = millimetres; g = grams; y = year; min = minimum; max = maximum; SD = standard deviation; SE = standard error

Table 7A-5: Summary of Fish Health Data for *Hiattella arctica* Lethally Sampled from the Milne Port Area, 2020 to 2024

Parameter	2020							2021							2022						
	n	Min	Max	Median	Mean	SD	SE	n	Min	Max	Median	Mean	SD	SE	n	Min	Max	Median	Mean	SD	SE
Total Length (mm)	50	25.4	34.5	29.1	29.2	2.30	0.325	35	17.5	35.1	30.5	29.3	4.25	0.718	40	23.7	38.0	29.5	29.9	4.26	0.674
Whole Animal ww (g)	50	2.76	6.40	4.06	4.33	1.07	0.151	35	0.481	8.13	3.98	4.02	1.76	0.297	40	1.56	6.08	3.09	3.32	1.15	0.182
Condition	50	1.13	2.54	1.70	1.73	0.34	0.047	35	0.90	2.25	1.41	1.48	0.30	0.050	40	0.98	2.68	1.69	1.71	0.37	0.059
Shell ww (g)	50	0.799	3.31	1.52	1.65	0.533	0.0753	35	0.219	5.14	2.06	2.22	1.17	0.197	40	0.673	4.58	1.69	1.87	0.774	0.122
Shell dw (g)	50	0.747	3.18	1.43	1.56	0.516	0.0729	35	0.115	4.73	1.80	1.90	1.03	0.175	40	0.541	4.19	1.54	1.68	0.701	0.111
Tissue ww (g)	50	1.22	4.01	2.57	2.68	0.680	0.0961	35	0.24	2.87	1.91	1.79	0.703	0.119	40	0.62	2.81	1.33	1.37	0.497	0.0786
Gonad ww (g)	-	-	-	-	-	-	-	35	0.00	0.08	0.04	0.04	0.0181	0.00306	40	0.01	0.10	0.02	0.03	0.0208	0.00330
MSI	-	-	-	-	-	-	-	35	0.90	6.13	1.97	2.23	1.2	0.20	40	0.75	3.85	1.84	2.03	0.86	0.14
Age (y)	50	10	49	22.5	24.8	12	1.6	35	1	39	17.0	19.2	8.1	1.4	39	6	34	17.0	17.4	6.4	1.0

ww = wetted weight; dw = dry weight; mm = millimetres; g = grams; n = sample size; min = minimum; max = maximum; SD = standard deviation; SE = standard error; - = not applicable.

Parameter	2023							2024						
	n	Min	Max	Median	Mean	SD	SE	n	Min	Max	Median	Mean	SD	SE
Total Length (mm)	40	24.3	37.8	30.5	30.5	3.15	0.497	40	19.7	36.3	26.8	26.3	3.51	0.555
Whole Animal ww (g)	40	1.14	7.07	3.91	4.02	1.45	0.229	40	0.826	4.88	2.12	2.41	1.10	0.175
Condition	40	1.10	2.79	1.78	1.82	0.40	0.063	40	0.435	3.50	1.11	1.36	0.810	0.128
Shell ww (g)	40	0.588	4.45	2.20	2.30	0.990	0.156	40	0.359	3.28	0.95	1.20	0.750	0.119
Shell dw (g)	40	0.535	4.02	1.95	2.03	0.894	0.141	40	0.135	1.20	0.62	0.65	0.277	0.044
Tissue ww (g)	40	0.55	2.75	1.65	1.66	0.542	0.0857	40	0.97	2.32	1.57	1.62	0.32	0.050
Gonad ww (g)	40	0.03	0.35	0.10	0.10	0.0579	0.00916	40	0.006	0.587	0.024	0.056	0.113	0.0179
MSI	40	2.89	15.43	6.31	6.68	2.6	0.40	40	1.63	1.238	3.96	46.6	202	31.9
Age (y)	40	7	52	21.0	23.0	11	1.8	38	5	82	13	20	19	3.1

MSI = Mantle Somatic Index; ww = wetted weight; dw = dry weight; mm = millimetres; g = grams; n = sample size; min = minimum; max = maximum; SD = standard deviation; SE = standard error; - = not applicable.

Table 7A-6: Stomach Contents Observed in Fishes Sampled from the Milne Port Area and Koluktoo Bay Reference Area, 2024

Phylum	Subphylum	Class	Subclass	Order	Family	Taxon	Proportion of Total Stomach Contents		
							Arctic Char (n = 10)	Fourhorn Sculpin	
								Milne Port (n = 23)	Koluktoo Bay (n = 17)
Annelida	-	Polychaeta	Echiura	-	-	Echiura indet.	-	4%	-
			Sedentaria	Terebellida	Pectinariidae	Pectinariidae indet.	-	36%	-
Arthropoda	Crustacea	Hexanauplia	Copepoda	Calanoida	Calanidae	<i>Calanus hyperboreus</i>	<1%	1%	-
		Malacostraca	Eumalacostraca	Amphipoda		<i>Calanus</i> sp.	-	<1%	<1%
					Atylidae	<i>Atylus</i> sp.	-	4%	-
					Gammaridae	<i>Gammarus</i> sp.	<1%	2%	16%
					Hyperidae	<i>Themisto</i> sp.	40%	-	<1%
					Oedicerotidae	Oedicerotidae indet.	-	<1%	<1%
					Uristidae	<i>Onisimus</i> sp.	2%	<1%	-
					-	Amphipoda indet.	-	<1%	<1%
					-	Hyperiidea indet.	<1%	<1%	1%
					-	Lysianassoidea indet.	<1%	<1%	-
				Mysida	Mysidae	<i>Mysis</i> sp.	3%	<1%	-
					-	Mysida indet.	2%	<1%	2%
		-	-	-	-	Crustacea indet.	49%	4%	16%
	Hexapoda	Insecta	Pterygota	Diptera		Tipuloidea indet.	-	<1%	-
Chordata	Vertebrata	Teleostei	-	Perciformes	Ammodytidae	Ammodytidae indet.	-	15%	-
			-	-	-	Teleostei indet.	2%	12%	5%
Mollusca	-	-	-	-	-	<i>Limacina</i> sp.	-	18%	59%

n = sample size; sp. = species; indet. = indeterminate; - = not identified or not applicable.

Table 7A-7: Stomach Contents of All Fish Captured from Milne Inlet, the Milne Port Area, and Koluktoo Bay Reference Area, 2024

Species	Fish Identification Number	Stomach Fullness (%)	Digested (%)	Full Stomach Weight (g)	Phylum	Subphylum	Class	Subclass	Order	Family	Taxon	Total Abundance (# individuals)	Total Wet Weight (g)	Wet Weight / Individual (g)			
Milne Inlet																	
Arctic Char	BAFF24UDPFARCH4001	25	100	3.60282	Arthropoda	Crustacea	Malacostraca	Eumalacostraca	Amphipoda	Hyperidae	Themisto sp.	2	0.02981	0.01491			
							-	-	-	-	Crustacea indet.	-	0.03441	0.03441			
							Malacostraca	Eumalacostraca	Amphipoda	Hyperidae	Themisto sp.	1	0.01044	0.01044			
	BAFF24UDPFARCH4002	50	50	7.22002	Arthropoda	Crustacea	Hexanauplia	Copepoda	Calanoida	Calanidae	Calanus hyperboreus	3	0.01259	0.01259			
							Malacostraca	Eumalacostraca	Mysida	Mysidae	Mysis sp.	1	0.00577	0.00577			
							-	-	-	-	-	1	0.13752	0.13752			
							-	-	-	-	-	2	0.08720	0.04360			
							-	-	-	-	-	3	0.01386	0.00462			
							-	-	-	-	-	8	0.02704	0.00338			
	BAFF24UDPFARCH4003	25	100	9.91444	Arthropoda	Crustacea	-	-	-	-	Crustacea indet.	-	0.01073	0.01073			
							-	-	-	-	Crustacea indet.	-	0.08308	0.08308			
							-	-	-	-	Crustacea indet.	-	0.13310	0.13310			
	BAFF24UDPFARCH4004	25	75	11.54355	Arthropoda	Crustacea	-	-	-	-	Unidentified tissue	-	0.53173	0.53173			
							Malacostraca	Eumalacostraca	Amphipoda	Hyperidae	Themisto sp.	1	0.01159	0.01159			
							-	-	-	-	Myrsidea indet.	-	0.35202	0.35202			
	BAFF24UDPFARCH4005	75	50	61.15800	Arthropoda	Crustacea	Malacostraca	Eumalacostraca	Amphipoda	Hyperidae	Themisto sp.	19	5.58391	0.29389			
							-	-	-	-	Themisto sp.	148	6.50573	0.04396			
							-	-	-	-	Uristidae	Onisimus sp.	21	0.67294	0.03204		
							-	-	-	-	Mysidae	Mysis sp.	13	0.80171	0.06167		
							-	-	-	-	Crustacea indet.	-	12.53758	12.53758			
							-	-	-	-	Teleostei indet.	-	0.69258	0.69258			
	BAFF24UDPFARCH4006	25	100	10.49591	Arthropoda	Crustacea	-	-	-	-	Unidentified tissue	-	0.05063	0.05063			
							-	-	-	-	-	-	0.03002	0.03002			
							-	-	-	-	-	-	0.02906	0.01453			
							-	-	-	-	-	-	Crustacea indet.	-	0.14814	0.14814	
							-	-	-	-	-	-	Crustacea indet.	-	0.68850	0.68850	
							-	-	-	-	-	-	Unidentified tissue	-	0.35092	0.35092	
	BAFF24UDPFARCH4009	25	100	6.80288	Arthropoda	Crustacea	-	-	-	-	Unidentified tissue	-	0.51862	0.51862			
							Hexanauplia	Copepoda	Calanoida	Calanidae	Calanus hyperboreus	3	0.01965	0.00655			
							Malacostraca	Eumalacostraca	Mysida	-	Myrsidea indet.	8	0.04374	0.00547			
							-	-	-	-	Crustacea indet.	-	0.45257	0.45257			
							-	-	-	-	Unidentified tissue	-	0.64893	0.64893			
							-	-	-	-	-	-	0.01113	0.00557			
	BAFF24UDPFARCH4010	50	75	6.35614	Arthropoda	Crustacea	Malacostraca	Eumalacostraca	Amphipoda	Calanidae	Calanus hyperboreus	2	0.01113	0.00557			
							Hexanauplia	Copepoda	Calanoida	Calanidae	Calanus hyperboreus	12	0.09760	0.00813			
							Malacostraca	Eumalacostraca	Mysida	-	Myrsidea indet.	27	0.17543	0.00650			
							-	-	-	-	Crustacea indet.	-	0.15103	0.15103			
							-	-	-	-	Unidentified tissue	-	0.33127	0.33127			
							-	-	-	-	Crustacea indet.	-	0.43484	0.43484			
	BAFF24UDPFARCH4012	25	100	7.23533	Arthropoda	Crustacea	-	-	-	-	Crustacea indet.	-	0.54652	0.54652			
							-	-	-	-	Unidentified tissue	-	0.54652	0.54652			
	BAFF24UDPFARCH4013	25	100	8.44441	Arthropoda	Crustacea	Malacostraca	Eumalacostraca	Amphipoda	Gammaridae	Gammarus sp.	4	0.08408	0.02102			
	-	-	-	-	-	-	-	-	-	-	Lysianassoidea indet.	1	0.00524	0.00524			
	-	-	-	-	-	-	-	-	-	-	Unidentified tissue	-	0.62088	0.62088			
	Milne Port																
	Arctic Char	BAFF24UDPFHSC1001	100	25	20.55182	Arthropoda	Crustacea	Malacostraca	Eumalacostraca	Amphipoda	Gammaridae	Gammarus sp.	1	0.02727	0.02727		
								-	-	-	-	Uristidae	Onisimus sp.	1	0.09741	0.09741	
								-	-	-	-	-	Amphipoda indet.	-	0.00924	0.00924	
								-	-	-	-	-	Hyperidea indet.	-	0.14721	0.14721	
Hexanauplia								Copepoda	Calanoida	Calanidae	Calanus sp.	30	0.15381	0.00513			
-								-	-	-	-	0.06310	0.06310				
Annelida								-	Polychaeta	Echiura	-	-	Echiura indet.	1	0.72311	0.72311	
Mollusca								-	-	-	-	-	Limacina sp.	53	0.65928	0.01244	
-								-	-	-	-	-	Limacina sp.	204	2.34161	0.01148	
Chordata								Vertebrata	Teleostei	-	-	-	Plant material	-	-	-	
-								-	-	-	-	-	Teleostei indet.	-	2.58451	2.58451	
BAFF24UDPFHSC1002		100	100	3.09678	Arthropoda	Crustacea	Malacostraca	Eumalacostraca	Amphipoda	Gammaridae	Gammarus sp.	2	0.00595	0.00298			
							-	-	-	-	Gammarus sp.	2	0.00595	0.00298			
							Hexanauplia	Copepoda	Calanoida	Calanidae	Gammarus sp.	2	0.07507	0.03754			
							Malacostraca	Eumalacostraca	Mysida	-	Calanus sp.	12	0.08749	0.00735			
							-	-	-	-	Myrsidea indet.	8	0.05830	0.00729			
							-	-	-	-	Crustacea indet.	-	0.75895	0.75895			
							-	-	-	-	Rocks	-	-	-			
							-	-	-	-	-	-	-	-			
							Malacostraca	Eumalacostraca	Amphipoda	Gammaridae	Gammarus sp.	1	0.02570	0.02570			
							-	-	-	-	Gammarus sp.	2	0.11381	0.05691			
							BAFF24UDPFHSC1003	25	75	5.22891	Arthropoda	Crustacea	Hexanauplia	Copepoda	Calanoida	Calanidae	Calanus hyperboreus
-		-	-	-	Calanus hyperboreus	5							0.04977	0.00995			
-		-	-	-	Calanus sp.	-							0.01275	0.01275			
-		-	-	-	Limacina sp.	7							0.05909	0.00844			
-		-	-	-	Limacina sp.	17							0.13128	0.00772			
-		-	-	-	Unidentified tissue	-							0.02939	0.02939			
-		-	-	-	Unidentified tissue	-							0.24898	0.24898			
Arthropoda		Crustacea	Hexanauplia	Copepoda	Calanoida	Calanidae							Calanus hyperboreus	1	0.00643	0.00643	
Annelida		-	Polychaeta	Sedentaria	Terebellida	Pectinariidae							Pectinariidae indet. (tubes only)	-	-	-	
-		-	-	-	-	-							Rocks	-	-		
BAFF24UDPFHSC1004		100	100	12.28651	Arthropoda	Crustacea							Malacostraca	Eumalacostraca	Amphipoda	Gammaridae	Gammarus sp.
							-	-	-	-	Pectinariidae indet.	-	2.36921	2.36921			
							-	-	-	-	Unidentified tissue	-	-	-			
							-	-	-	-	Gammaridae	Gammarus sp.	1	0.04714	0.04714		
							Malacostraca	Eumalacostraca	Amphipoda	Oedicerotidae	Oedicerotidae indet.	1	0.00980	0.00980			
							-	-	-	-	Oedicerotidae indet.	1	0.02665	0.02665			
							-	-	-	-	Amphipoda indet.	1	0.00700	0.00700			
							Hexanauplia	Copepoda	Calanoida	Calanidae	Calanus hyperboreus	3	0.00703	0.00703			
							-	-	-	-	Calanus sp.	2	0.02309	0.01155			
							-	-	-	-	Crustacea indet.	-	0.06751	0.06751			
							-	-	-	-	Crustacea indet.	-	0.08213	0.08213			
BAFF24UDPFHSC1006		25	100	7.11293	Mollusca	-	-	-	-	-	Limacina sp.	43	0.44344	0.01031			
							-	-	-	-	Limacina sp.	156	1.54506	0.00990			
							-	-	-	-	Plant material	-	-	-			
							Chordata	Vertebrata	Teleostei	-	-	Teleostei indet.	-	0.28482	0.28482		
							-	-	-	-	-	Ammodytidae indet.	1	2.68343	2.68343		
							-	-	-	-	-	Unidentified tissue	-	0.01423	0.01423		
							-	-	-	-	-	Unidentified tissue	-	0.23084	0.23084		
							-	-	-	-	-	Amphipoda indet.	1	0.04268	0.04268		
							Arthropoda	Crustacea	Malacostraca	Eumalacostraca	Amphipoda	Calanoida	Calanidae	Calanus hyperboreus	1	0.01287	0.01287
							-	-	-	-	-	Crustacea indet.	-	0.24309	0.24309		
							BAFF24UDPFHSC1011	75	100	9.72847	Mollusca	-	-	-	-	-	Limacina sp.
-		-	-	-	Limacina sp.	264							2.14434	0.00812			
-		-	-	-	Plant material	-							-	-			
-		-	-	-	Unidentified tissue	-							1.06683	1.06683			
Arthropoda		Crustacea	Hexanauplia	Copepoda	Calanoida	Calanidae							Calanus hyperboreus	1	0.01367	0.01367	
Annelida		-	Polychaeta	Echiura	-	-							Echiura indet.	3	1.83334	0.61111	
-		-	-	-	-	Plant material							-	-	-		
-		-	-	-	-	Teleostei indet.							-	0.59125	0.59125		
Chordata		Vertebrata	Teleostei	-	-	Teleostei indet.							-	2.01169	2.01169		
-		-	-	-	-	Ammodytidae indet.							1	5.39547	5.39547		
-		-	-	-	-	Unidentified tissue							-	0.27202	0.27202		
BAFF24UDPFHSC1014		50	100	5.37250	Arthropoda	Crustacea	Hexanauplia	Copepoda	Calanoida	Calanidae	Calanus sp.	1	0.11396	1.11396			
							-	-	-	-	Calanus sp.	1	0.01247	0.01247			
							-	-	-	-	Limacina sp.	2	0.02767	0.01394			
							-	-	-	-	-	-	-	-			
							-	-	-	-	Rocks	-	-	-			
							-	-	-	-	Rocks	-	-	-			
							-	-	-	-	Unidentified tissue	-	0.49490	0.49490			
							-	-	-	-	Unidentified tissue	-	1.35391	1.35391			
							-	-	-	-	Pectinariidae indet.	1	0.00243	0.00243			
							-	-	-	-	Unidentified tissue	-	1.35253	1.35253			
							BAFF24UDPFHSC1015	50	100	4.47916	Arthropoda	Crustacea	Hexanauplia	Copepoda	Calanoida	Calanidae	Calanus sp.
-		-	-	-	Calanus sp.	7							0.03244	0.00463			
-		-	-	-	Limacina sp.	1							0.01247	0.01247			
-		-	-	-	Limacina sp.	5							0.02946	0.00589			
-		-	-	-	Rocks	-							-	-			
-		-	-	-	Rocks	-							-	-			
-		-	-	-	Unidentified tissue	-							0.49490	0.49490			
-		-	-	-	Unidentified tissue	-							1.35391	1.35391			
-		-	-	-	Pectinariidae indet.	1							0.00243	0.00243			
-		-	-	-	Unidentified tissue	-							1.72052	1.72052			
BAFF24UDPFHSC1016		50	100	3.89131	Arthropoda	Crustacea							Malacostraca	Eumalacostraca	Amphipoda	-	-
							-	-	-	-	Unidentified tissue	-	-	-			

Table 7A-7: Stomach Contents of All Fish Captured from Milne Inlet, the Milne Port Area, and Koluktoo Bay Reference Area, 2024

Species	Fish Identification Number	Stomach Fullness (%)	Digested (%)	Full Stomach Weight (g)	Phylum	Subphylum	Class	Subclass	Order	Family	Taxon	Total Abundance (# individuals)	Total Wet Weight (g)	Wet Weight / Individual (g)
Fourhorn Sculpin	BAFF24UREFFHSC2022	25	75	2.40808	Arthropoda	Crustacea	Malacostraca	Eumalacostraca	Amphipoda	Gammaridae	Gammarus sp.	1	0.03430	0.03430
							-	-	-	-	Gammarus sp.	-	0.00711	0.00711
					Mollusca	-	-	-	-	-	Crustacea indet.	-	0.01612	0.01612
							-	-	-	-	Crustacea indet.	-	0.04598	0.04598
	BAFF24UREFFHSC2024	50	100	6.02460	Arthropoda	Crustacea	Malacostraca	Eumalacostraca	Amphipoda	Gammaridae	Limacina sp.	-	0.00570	0.00570
											Gammarus sp.	1	0.00417	0.00417
											Gammarus sp.	3	0.03284	0.01095
									Mysida	Oedicerotidae	Gammarus sp.	3	0.19941	0.06647
											Oedicerotidae indet.	1	0.00754	0.00754
							-	-	-	-	Mysida indet.	1	0.00389	0.00389
					Mollusca	-	-	-	-	-	Crustacea indet.	-	0.02296	0.02296
							-	-	-	-	Crustacea indet.	-	0.03657	0.03657
							-	-	-	-	Limacina sp.	14	0.18541	0.01324
							-	-	-	-	Limacina sp.	69	0.71132	0.01031
							-	-	-	-	Limacina sp.	-	0.07382	0.07382
							-	-	-	-	Cestoda indet.	2	0.00037	0.00019
					Platyhelminthes	-	-	-	-	-	Unidentified tissue	-	0.12769	0.12769
							-	-	-	-	Unidentified tissue	-	0.81825	0.81825
	BAFF24UREFFHSC2025	100	75	12.85457	Arthropoda	Crustacea	Malacostraca	Eumalacostraca	Amphipoda	Gammaridae	Gammarus sp.	1	0.05481	0.05481
											Gammarus sp.	3	0.03583	0.01194
									Mysida	-	Gammarus sp.	9	0.39149	0.04350
											Gammarus sp.	15	0.22166	0.01478
							-	-	-	-	Hyperidea indet.	1	0.11193	0.11193
							-	-	-	-	Mysida indet.	1	0.00496	0.00496
							-	-	-	-	Mysida indet.	18	0.06464	0.00359
							-	-	-	-	Crustacea indet.	-	0.06745	0.06745
					Mollusca	-	-	-	-	-	Crustacea indet.	-	0.66094	0.66094
							-	-	-	-	Limacina sp.	34	0.22113	0.00650
							-	-	-	-	Limacina sp.	170	1.33074	0.00783
							-	-	-	-	Plant material	-	-	-
					Platyhelminthes	-	-	-	-	-	Cestoda indet.	6	0.00574	0.00096
							-	-	-	-	Unidentified tissue	-	0.14484	0.14484
					-	-	-	-	-	-	Unidentified tissue	-	3.29996	3.29996
							-	-	-	-	Unidentified tissue	-	3.29996	0.01332
	BAFF24UREFFHSC2030	50	75	7.13678	Arthropoda	Crustacea	Malacostraca	Eumalacostraca	Amphipoda	Gammaridae	Gammarus sp.	3	0.03996	0.01332
							-	-	-	-	Mysida indet.	2	0.00824	0.00412
					Mollusca	-	-	-	-	-	Crustacea indet.	-	0.01692	0.01692
							-	-	-	-	Limacina sp.	71	0.43167	0.00608
	BAFF24UREFFHSC2031	50	50	6.49754	Arthropoda	Crustacea	Malacostraca	Eumalacostraca	Amphipoda	Gammaridae	Gammarus sp.	3	0.03153	0.01051
											Mysida indet.	4	0.01035	0.00259
							-	-	-	-	Crustacea indet.	-	0.01001	0.01001
							-	-	-	-	Limacina sp.	49	0.52681	0.01075
					Mollusca	-	-	-	-	-	Limacina sp.	-	0.23724	0.23724
							-	-	-	-	Plant material	-	-	-
							-	-	-	-	Rocks	-	-	-
					Platyhelminthes	-	-	-	-	-	Cestoda indet.	2	0.00047	0.00024
	BAFF24UREFFHSC2032	0	100	4.61607	-	-	-	-	-	-	Empty Stomach	-	-	-
	BAFF24UREFFHSC2033	0	100	1.67066	-	-	-	-	-	-	Empty Stomach	-	-	-
	BAFF24UREFFHSC2035	75	25	4.66901	Arthropoda	Crustacea	Malacostraca	Eumalacostraca	Amphipoda	Gammaridae	Gammarus sp.	2	0.10272	0.05136
							-	-	-	-	Mysida indet.	1	0.00262	0.00262
					Mollusca	-	-	-	-	-	Crustacea indet.	-	0.00553	0.00553
							-	-	-	-	Limacina sp.	121	0.54841	0.00453
	BAFF24UREFFHSC2037	25	25	7.20518	Arthropoda	Crustacea	Malacostraca	Eumalacostraca	Amphipoda	Gammaridae	Limacina sp.	-	0.05121	0.05121
							-	-	-	-	Gammarus sp.	1	0.04173	0.04173
					Mollusca	-	-	-	-	-	Theristo sp.	1	0.00748	0.00748
							-	-	-	-	Crustacea indet.	-	0.00150	0.00150
	BAFF24UREFFHSC2038	25	50	6.06110	Arthropoda	Crustacea	Malacostraca	Eumalacostraca	Amphipoda	Gammaridae	Limacina sp.	28	0.20931	0.00748
							-	-	-	-	Gammarus sp.	3	0.02670	0.00890
					Mollusca	-	-	-	-	-	Mysida indet.	-	0.00520	0.00520
							-	-	-	-	Crustacea indet.	-	0.00711	0.00711
	BAFF24UREFFHSC2039	50	50	2.15468	Arthropoda	Crustacea	Malacostraca	Eumalacostraca	Amphipoda	Gammaridae	Limacina sp.	19	0.11851	0.00624
							-	-	-	-	Unidentified tissue	-	0.06011	0.06011
					Mollusca	-	-	-	-	-	Gammarus sp.	5	0.34700	0.06940
							-	-	-	-	Crustacea indet.	-	0.06312	0.06312
							-	-	-	-	Limacina sp.	28	0.16975	0.00606
							-	-	-	-	Rocks	-	-	-
					-	-	-	-	-	-	Unidentified tissue	-	0.02933	0.02933

g = grams; indet. = indeterminate; sp. = species; - = not available or not applicable.

Table 7A-8: Supporting Information for Statistical Comparisons Between the Milne Port Area and the Koluktoo Bay Reference Area for Fourhorn Sculpin, 2024

Effect Indicator	Endpoint ^(a)	Covariate	Statistical Test	n Outlier	n		LSM		MSE	Coefficient of Determination (R ²)		Interaction <i>P</i> -value	Levene's Test	Shapiro-Wilk	<i>P</i> -value	Magnitude of Effect (%)	Critical Effect Size (%) ^(b)	Direction of Effect	Power Analysis ^(c)		
					Milne Port	Koluktoo Bay	Milne Port	Koluktoo Bay		Full Model	Reduced Model								Power to Detect CES	Minimum Detectable Difference ^(d)	Sensitivity ^(e)
Female																					
Survival	Age	-	ANOVA	0	20	20	7	7	2.829	0.008	-	-	1.000	0.144	0.576	-	25%	-	100%	1.83	27%
Growth	Size-at-Age	Age	ANCOVA _{log10}	0	20	20	2.25	2.11	0.0157	0.655	0.646	0.330	0.105	0.555	0.002	36%	25%	Milne > Ref	93% / 77%	19.44 / 77.1	15% / 59%
Condition (Energy Storage)	Relative Total Weight	Total Length	ANCOVA _{log10}	0	20	20	2.16	2.20	0.0024	0.945	0.945	0.618	0.096	0.221	0.067	-7%	10%	Milne < Ref	89% / 83%	23.13 / 14.4	15% / 9%
	Relative Liver Weight	Total Weight	ANCOVA _{log10}	0	20	20	0.785	0.823	0.012	0.859	0.858	0.717	0.227	0.679	0.295	-	25%	-	97% / 87%	1.803 / 1.713	27% / 26%
Reproduction	Relative Gonad Weight	Total Weight	ANCOVA _{log10}	0	20	20	0.725	0.776	0.010	0.864	0.858	0.184	0.802	0.336	0.120	-	25%	-	99% / 92%	1.576 / 1.235	26% / 21%
Male																					
Survival	Age	-	ANOVA _{rank}	0	20	19	6 ^(f)	6 ^(f)	125.43	0.007	-	-	0.265	0.013^(g)	0.610	-	25%	-	100%	1.67	27%
Growth	Size-at-Age	Age	ANCOVA	0	20	19	132	102	436.39	0.809	0.791	0.077	0.579	0.543	<0.001	30%	25%	Milne > Ref	100%	23.35	20%
Condition (Energy Storage)	Relative Total Weight	Total Length	ANCOVA _{log10}	0	20	19	2.04	2.04	0.0011	0.963	0.962	0.539	0.906	0.715	0.751	-	10%	-	100% / 99%	8.38 / 10.1	8% / 9%
	Relative Liver Weight	Total Weight	ANCOVA _{log10}	0	20	19	0.425	0.555	0.012	0.784	0.774	0.213	0.449	0.062	0.002	-26%	25%	Milne < Ref	97% / 85%	1.249 / 0.495	35% / 14%
Reproduction	Relative Gonad Weight	Total Weight	ANCOVA _{log10}	0	20	19	0.545	0.599	0.012	0.743	0.692	0.013	0.724	0.123	0.163	-	25%	-	97% / 85%	1.143 / 0.957	29% / 24%

Notes:

Statistically significant values and magnitudes of effect greater than the CES are indicated in **bold**.

(a) For model components, please see Table 7-3 in Chapter 7.

(b) Critical Effect Size (CES) expressed as a percentage of the Koluktoo Bay mean.

(c) Power Analysis values presented on measurement scale. Log₁₀-transformed models include values for differences below and above the Koluktoo Bay mean.

(d) Minimum Detectable Difference expressed as unit difference from the Koluktoo Bay mean.

(e) Sensitivity is the minimum detectable difference expressed as a percent change in the Koluktoo Bay mean.

(f) Medians used for rank ANOVA.

(g) Rank ANOVA proceeded despite significant Shapiro-Wilk test based on visual inspection of the data.

n = sample size; LSM = least squares mean; P-value = probability value; log₁₀ = log₁₀-transformed data; rank = rank-transformed data; ANOVA = analysis of variance; ANCOVA = analysis of covariance; n/a = not applicable.

Table 7A-9: Supporting Information for Statistical Comparisons from 2020 to 2024 for Fourhorn Sculpin, Milne Port Area

Effect Indicator	Endpoint ^(a)	Statistical Test	n	Outlier	Sample Size				Assumptions		Coefficient of Determination (R ²)	MSE	Year P-value	Least Squares Mean					Year Trend P-value					Year Trend Slope Estimate					Trend Direction					
					2020	2021	2022	2024	2024	Breusch-Pagan				Shapiro-Wilk	2020	2021	2022	2024	2024	2020	2021	2022	2024	2024	2020	2021	2022	2024	2024	2020	2021	2022	2024	2024
Female																																		
Survival	Age	GAM _{log10} ^(b)	0	22	20	20	20	20	0.773	0.048	0.135	0.0089	0.003	0.730	0.780	0.815	0.817	0.807	0.030	0.001	0.154	0.579	0.605	0.052	0.046	0.019	-0.0078	-0.012	↑	↑	-	-	-	-
Growth	Size-at-Age	GAM _{log10} ^(b)	1	21	16	20	20	19	0.151	0.800	0.055	0.011	0.021	2.13	2.15	2.17	2.19	2.21	0.021	0.021	0.021	0.021	0.021	0.018	0.018	0.018	0.018	0.018	↑	↑	↑	↑	↑	
Condition (Energy Storage)	Relative Total Weight	GAM _{log10}	0	22	20	20	20	20	0.737	0.077	0.190	0.0021	0.001	2.19	2.16	2.22	2.21	2.20	0.011	0.002	0.004	0.009	0.959	-0.054	0.034	0.033	-0.028	-0.0011	↓	↑	↑	↓	-	
	Relative Liver Weight	GAM _{log10}	0	22	20	20	20	20	0.413	0.645	0.080	0.015	0.004	0.735	0.761	0.786	0.812	0.838	0.004	0.004	0.004	0.004	0.004	0.026	0.026	0.026	0.026	0.026	↑	↑	↑	↑	↑	
Reproduction	Relative Gonad Weight	GAM _{log10}	1	22	19	20	20	20	0.117	0.571	0.091	0.013	0.053	0.770	0.740	0.691	0.692	0.739	0.564	0.020	0.129	0.126	0.141	-0.0214	-0.046	-0.032	0.030	0.055	-	↓	-	-	-	
Male																																		
Survival	Age	GAM _{log10}	0	21	20	20	20	20	0.051	0.359	0.092	0.010	0.079	0.734	0.796	0.814	0.775	0.792	0.078	0.013	0.279	0.321	0.35	0.068	0.049	-0.0233	-0.019	0.036	↑	↑	-	-	-	
Growth	Size-at-Age	GAM _{log10} ^(b)	0	21	18	19	20	20	0.702	0.245	0.105	0.0094	0.005	2.02	2.04	2.07	2.09	2.11	0.055	0.011	0.007	0.086	0.33	0.027	0.026	0.023	0.018	0.014	↑	↑	↑	↑	-	
Condition (Energy Storage)	Relative Total Weight	GAM _{log10}	1	21	20	20	19	20	0.234	0.602	0.160	0.0016	0.006	2.05	2.02	2.06	2.07	2.05	0.005	0.343	0.000	0.254	0.16	-0.050	0.0081	0.035	-0.010	-0.025	↓	-	↑	-	-	
	Relative Liver Weight	GAM _{log10}	0	21	20	20	20	20	0.235	0.746	0.265	0.015	<0.001	0.425	0.385	0.507	0.578	0.440	0.115	0.067	<0.001	0.121	0.001	-0.0829	0.047	0.14	-0.040	-0.19	-	↑	↑	-	↓	
Reproduction	Relative Gonad Weight	GAM _{log10}	0	21	20	20	20	20	0.746	0.101	0.200	0.015	<0.001	0.646	0.645	0.580	0.504	0.531	0.785	0.203	0.001	0.246	0.248	0.013	-0.030	-0.0911	-0.027	0.055	-	-	↓	-	-	

Notes:
Statistically significant values are indicated **in bold**. Statistical outliers are provided in Appendix 7A, Table 7A-12. Detailed statistical results for size-adjustment are provided in Appendix 7A, Table 7A-13.
(a) For model components, please see Table 7-2 in Chapter 7.
(b) Temporal trends assessed over range of overlapping covariate values (i.e., Ages 4 to 9 years).
n = sample size; P-value = probability value; GAM = Gaussian additive model; log₁₀ = log₁₀-transformed data; ↑ = increasing; ↓ = decreasing.

Table 7A-10: Supporting Information for Statistical Comparisons Between Milne Port and Tugaat River Estuary for *Hiatella arctica*, 2024

Effect Indicator	Endpoint ^(a)	Dependent Variable	Covariate	Statistical Test	n Outliers	n		LSM		MSE	Coefficient of Determination (R ²)		Interaction P-value	Levene's Test	Shapiro-Wilk	Area P-value	Magnitude of Effect (%)	Power Analysis ^(b)	
						Milne Port	Tugaat River Estuary	Milne Port	Tugaat River Estuary		Full Model	Reduced Model						Minimum Detectable Difference ^(c)	Sensitivity ^(d)
Hiatella arctica																			
Survival	Length Frequency	Total Length	n/a	K-S Test	-	40	23	-	-	-	-	-	-	-	-	0.196	-	-	-
Growth	Total Wet Weight	Whole Animal Wet Weight	n/a	ANOVA _{log10}	0	40	23	0.451	0.560	0.04	0.062	-	-	0.412	0.205	0.048	-22%	0.975 / 1.401	30% / 44%
Condition (Energy Storage)	Relative Total Weight	Whole Animal Wet Weight	Total Length	ANCOVA _{log10}	0	40	23	0.469	0.529	0.0074	0.840	0.840	0.949	0.489	0.795	0.011	-13%	0.443 / 0.515	14% / 16%
	Relative Shell Weight	Dry Shell Weight	Total Length	ANCOVA _{log10}	0	40	23	0.025	0.121	0.0232	0.692	0.691	0.565	0.705	0.506	0.021	-20%	0.278 / 0.363	23% / 31%
Reproduction	Mantle Somatic Index	Gonad Weight	Tissue Wet Weight	ANCOVA _{log10}	4	36	23	-1.67	-1.69	0.0261	0.581	0.562	0.120	0.270	0.540	0.594	-	0.001 / 0.001	25% / 33%

Notes:
Statistically significant values are indicated in **bold**. Power analysis was completed assuming normality. Statistical outliers are provided in Appendix 7A, Table 7A-12.
(a) For model components, please see Table 7-4 in Chapter 7.
(b) Power Analysis values presented on measurement scale. Log₁₀-transformed models include values for differences below and above the Tugaat River Estuary mean.
(c) Minimum Detectable Difference expressed as unit difference from the Tugaat River Estuary mean.
(d) Sensitivity is the minimum detectable difference expressed as a percent change in the Tugaat River Estuary mean.
n = sample size; LSM = Least Squares Mean; MSE = Mean Squared Error; P-value = probability value; log₁₀ = log₁₀-transformed data; K-S Test = Kolmogorov-Smirnov test; ANOVA = analysis of variance; ANCOVA = analysis of covariance; - = not applicable.

Table 7A-11: Supporting Information for Statistical Comparisons from 2020 to 2024 for *Hiatella arctica*, Milne Port

Effect Indicator	Endpoint ^(a)	Dependent Variable	Covariate	Statistical Test	n	Outlier	Sample Size					Assumptions		Coefficient of Determination (R ²)	MSE	Year P-value	Least Squares Mean					Year Trend P-value					Year Trend Slope Estimate					Trend Direction				
							2020	2021	2022	2023	2024	Breusch-Pagan	Shapiro-Wilk				2020	2021	2022	2023	2024	2020	2021	2022	2023	2024	2020	2021	2022	2023	2024	2020	2021	2022	2023	2024
<i>Hiatella arctica</i>																																				
Survival	Length Frequency ^(b)	Total Length	n/a	K-S Test	-		50	35	44	40	40	-	-	-	-	-	29.09	30.45	29.53	30.47	26.80	-	0.234	0.797	0.797	<0.001	-	1.360	-0.925	0.940	-3.670	-	-	-	-	↓
Growth	Whole Animal Wet Weight	Whole Animal Wet Weight	n/a	GAM _{log10}	1		50	35	44	40	40	0.018	0.005^(c)	0.186	2.142	<0.001	4.32	4.14	4.66	5.17	3.14	0.479	0.613	<0.001	0.001	<0.001	-0.3229	0.11	0.92	-0.70	-2.69	-	-	↑	↓	↓
Condition (Energy Storage)	Relative Total Weight ^(d)	Whole Animal Wet Weight	Total Length	GAM _{log10}	0		49	34	44	40	39	0.077	0.696	0.083	0.0081	0.004	0.62	0.58	0.63	0.65	0.59	0.020	0.479	0.001	0.052	0.006	-0.0627	0.0088	-0.052	-0.074	↓	-	↑	↓	↓	
	Relative Shell Weight ^(e)	Dry Shell Weight	Total Length	GAM _{log10}	0		50	27	27	36	23	0.018	0.892	0.051	0.018	0.106	0.194	0.262	0.193	0.245	0.201	-	-	-	-	-	-	-	-	-	-	-	-	-	-	
Reproduction	Mantle Somatic Index ^(f)	Gonad Weight	Tissue Wet Weight	GAM _{log10}	5	-	35	40	39	36		0.520	0.227	0.578	0.031	<0.001	-	-1.77	-1.80	-1.30	-1.54	-	<0.001	<0.001	<0.001	<0.001	-	-0.22	0.35	0.22	-0.47	-	↓	↑	↑	↓

Notes:

Statistically significant values are indicated in **bold**. Statistical outliers are provided in Appendix 7A, Table 7A-12. Statistical outliers are provided in Appendix 7A, Table 7A-12. Detailed statistical results for size-adjustment are provided in Appendix 7A, Table 7A-13.

(a) For model components, please see Table 7-4 in Chapter 7.

(b) Least squares mean values are median total lengths. P-values adjusted using Holm's correction for multiple comparisons (Holm 1979). Trend slopes are sequential pairwise differences between years (e.g., between 2020 and 2021).

(c) GAM analysis using log₁₀-transformation proceeded despite significant Shapiro-Wilk test result as inspection of residuals did not suggest severe deviation from normality.

(d) Evaluated over the range of overlapping covariate values (i.e., total lengths ranging from 20.00 to 37.40 mm).

(e) Evaluated over the range of overlapping covariate values (i.e., whole animal wet weights ranging from 1.004 to 4.934 g).

(f) Evaluated over the range of overlapping covariate values (i.e., tissue wet weights ranging from 1.000 to 4.934 g).

n = sample size; P-value = probability value; ↑ = increasing; ↓ = decreasing.

Table 7A-12: Outliers Omitted from Statistical Comparisons of Fish Health Endpoints, 2020 to 2024

Species	Sex	Parameter	Grouping	FIN	Total Length (mm)	Total Weight (g)	SR
Spatial							
Hiatella arctica	-	Mantle Somatic Index	Milne Port	BAFF24UMLNHTAR1501	28.25	2.045	_(a)
				BAFF24UMLNHTAR1507	23.59	2.141	_(a)
				BAFF24UMLNHTAR1513	25.24	1.806	_(a)
				BAFF24UMLNHTAR1528	27.67	2.366	_(a)
Temporal							
Fourhorn Sculpin	Female	Size-at-Age	2020	BAFF20UMLNFHSC1023	310	380	3.57
		Relative Gonad Weight	2021	BAFF21UMLNFRSC1019	309	336	5.96
	Male	Condition	2024	BAFF23UDPFFHSC1007	210	158	5.55
Hiatella arctica	-	Whole Animal Wet Weight	2021	BAFF21UMLNHTAR1530	17.47	0.481	-5.52
		Mantle Somatic Index	2023	BAFF23UMLNHTAR1506	34.44	7.066	_(a)
			2024	BAFF24UMLNHTAR1501	28.25	2.045	_(a)
				BAFF24UMLNHTAR1507	23.59	2.141	_(a)
				BAFF24UMLNHTAR1513	25.24	1.806	_(a)
				BAFF24UMLNHTAR1528	27.67	2.366	_(a)

(a) Five *Hiatella arctica* removed prior to ANCOVA analysis due to anomalously high gonad weights, based on visual inspection of scatterplots.

FIN = Fish Identification Number; SR = Studentized Residual

Table 7A-13 Results of Size-Adjustment of Biometrics for Temporal Trend Assessment of Fish Health Endpoints for Fourhorn Sculpin and Hiatella arctica, 2024

Sex	Dependent Variable	Covariate	Statistical Model	Number of Outliers	Assumptions			Coefficient of Determination (R ²)	ANOVA Table								
					Homogeneity of Variance	Shapiro-Wilk	Interaction <i>P</i> -value		Intercept			Covariate			Year		
									F-Value	df	<i>P</i> -value	F-Value	df	<i>P</i> -value	F-Value	df	<i>P</i> -value
Fourhorn Sculpin																	
Female	Total Weight	Age	GLM _{log10} ^(a)	0	0.561	0.758	0.234	0.640	73.6	1,91	<0.001	120.2	1,91	<0.001	1.88	4,91	0.121
	Total Weight	Total Length	GLM _{log10}	0	0.650	0.097	0.017	0.941	668.1	1,96	<0.001	1215.1	1,96	<0.001	5.60	4,96	<0.001
	Liver Weight	Total Weight	GLM _{log10}	0	0.046	0.663	0.197	0.835	219.4	1,96	<0.001	339.6	1,96	<0.001	3.07	4,96	0.020
	Gonad Weight	Total Weight	GLM _{log10}	1	0.189	0.657	0.440	0.824	241.6	1,95	<0.001	383.8	1,95	<0.001	2.43	4,95	0.053
Male	Total Weight	Age	GLM _{log10}	0	0.545	0.762	0.554	0.501	251.5	1,92	<0.001	64.8	1,92	<0.001	3.51	4,92	0.010
	Total Weight	Total Length	GLM _{log10}	1	0.549	0.630	0.644	0.916	457.9	1,94	<0.001	867.0	1,94	<0.001	4.57	4,94	0.002
	Liver Weight	Total Weight	GLM _{log10}	0	0.235	0.489	0.903	0.728	120.3	1,95	<0.001	163.5	1,95	<0.001	8.44	4,95	<0.001
	Gonad Weight	Total Weight	GLM _{log10}	0	0.137	0.104	0.737	0.630	82.6	1,95	<0.001	143.9	1,95	<0.001	5.79	4,95	<0.001
Hiatella arctica																	
-	Whole Animal Wet Weight	Total Length	GLM _{log10}	0	0.304	0.690	0.015	0.737	286.4	1,200	<0.001	411.0	1,200	<0.001	4.34	4,200	0.002
	Dry Shell Weight	Total Length	GLM _{log10} ^(a)	0	0.880	0.676	0.674	0.367	83.9	1,161	<0.001	93.2	1,161	<0.001	1.71	4,157	0.150
	Gonad Weight	Tissue Wet Weight	GLM _{log10}	5	0.046	0.221	0.026	0.762	2524.6	1,145	<0.001	158.6	1,145	<0.001	66.08	3,145	<0.001

Note: **Bold** values indicate statistically significant results. Statistical outliers are presented in Appendix 7A, Table 7A-12.

(a) A reduced linear model, including the covariate only, was used as Year was not significant ($p > 0.05$).

(b) The reduced model (i.e., no interaction term) was used as slopes could be considered practically parallel ($\Delta r^2 = 0.948 - 0.941 = 0.007 < 0.020$; Barrett et al. 2010).

P-value = probability value; df = degrees of freedom; GLM = general linear model; log₁₀ = log₁₀-transformed dependent and covariate values.

APPENDIX 7B

Fish Tissue Data

Table 7B-1: Sample Counts for Fish Tissue Chemistry Analyses from the Milne Port Area, 2010 to 2024

Species	Year	Number of Samples	
		Metals	Polycyclic Aromatic Hydrocarbons
Arctic Char	2010	22 ^(a)	0
	2013	17	14
	2015	5	0
	2016	13	0
	2017	2	0
	2018	26	0
	2019	47	0
	2020	8	8
	2021	8	8
	2022	8	26
	2024	8	8
	2024	8	8
	Total	164	72
Arctic Staghorn Sculpin	2013	1	0
Fourhorn Sculpin	2013	2	1
	2019	30	0
	2020	8	8
	2021	8	8
	2022	8	8
	2024	8	8
	2024	8	8
	Total	64	41
<i>Hiatella arctica</i>	2018	24	0
	2019	80	0
	2020	8	8
	2021	8	8
	2022	8	4 ^(b)
	2024	8	2 ^(b)
	2024	8	0 ^(b)
	Total	144	22
Unknown Sculpin	2019	30	0
Unknown Fish	2015	10	0
Grand Total	-	413	135

(a) Includes 11 muscle samples and 11 liver samples.

(b) Sample sizes were reduced due to compositing samples to meet laboratory sample volume requirements.

Table 7B-2: Summary of *Hiatella arctica* Samples Sent to Bureau Veritas Laboratory for Tissue Chemistry Analysis, 2024

Chemistry	Area	Composite Sample	Fish Identification Numbers	Number of Individuals
Metals	Milne Port	BAFF24-MLN-HTAR-COMP-METALS-1	BAFF24UMLNHTAR1502	7
			BAFF24UMLNHTAR1505	
			BAFF24UMLNHTAR1517	
			BAFF24UMLNHTAR1522	
			BAFF24UMLNHTAR1531	
			BAFF24UMLNHTAR1537	
		BAFF24-MLN-HTAR-COMP-METALS-2	BAFF24UMLNHTAR1540	5
			BAFF24UMLNHTAR1504	
			BAFF24UMLNHTAR1513	
			BAFF24UMLNHTAR1516	
		BAFF24-MLN-HTAR-COMP-METALS-3	BAFF24UMLNHTAR1530	6
			BAFF24UMLNHTAR1536	
			BAFF24UMLNHTAR1501	
			BAFF24UMLNHTAR1509	
			BAFF24UMLNHTAR1511	
		BAFF24-MLN-HTAR-COMP-METALS-4	BAFF24UMLNHTAR1527	4
			BAFF24UMLNHTAR1528	
			BAFF24UMLNHTAR1538	
		BAFF24-MLN-HTAR-COMP-METALS-5	BAFF24UMLNHTAR1507	6
			BAFF24UMLNHTAR1518	
			BAFF24UMLNHTAR1519	
			BAFF24UMLNHTAR1521	
		BAFF24-MLN-HTAR-COMP-METALS-6	BAFF24UMLNHTAR1510	5
			BAFF24UMLNHTAR1512	
			BAFF24UMLNHTAR1520	
			BAFF24UMLNHTAR1535	
		BAFF24-MLN-HTAR-COMP-METALS-7	BAFF24UMLNHTAR1539	4
			BAFF24UMLNHTAR1508	
			BAFF24UMLNHTAR1514	
			BAFF24UMLNHTAR1524	
		BAFF24-MLN-HTAR-COMP-METALS-8	BAFF24UMLNHTAR1532	4
			BAFF24UMLNHTAR1534	
			BAFF24UMLNHTAR1506	
			BAFF24UMLNHTAR1515	
	Tugaat River Estuary	BAFF24-REF-HTAR-COMP-METALS-1	BAFF24UTGHTAR2502	5
			BAFF24UTGHTAR2513	
			BAFF24UTGHTAR2518	
			BAFF24UTGHTAR2520	
		BAFF24-REF-HTAR-COMP-METALS-2	BAFF24UTGHTAR2522	6
			BAFF24UTGHTAR2503	
			BAFF24UTGHTAR2505	
			BAFF24UTGHTAR2508	
			BAFF24UTGHTAR2515	
		BAFF24-REF-HTAR-COMP-METALS-3	BAFF24UTGHTAR2517	3
			BAFF24UTGHTAR2523	
			BAFF24UTGHTAR2506	
		BAFF24-REF-HTAR-COMP-METALS-4	BAFF24UTGHTAR2511	3
			BAFF24UTGHTAR2521	
			BAFF24UTGHTAR2507	
		BAFF24-REF-HTAR-COMP-METALS-5	BAFF24UTGHTAR2512	3
			BAFF24UTGHTAR2519	
			BAFF24UTGHTAR2504	
		BAFF24-REF-HTAR-COMP-METALS-6	BAFF24UTGHTAR2514	3
			BAFF24UTGHTAR2516	
			BAFF24UTGHTAR2501	
		BAFF24-REF-HTAR-COMP-METALS-6	BAFF24UTGHTAR2509	3
			BAFF24UTGHTAR2510	

Note: No samples were analyzed for polycyclic aromatic hydrocarbons in 2024.

Table 7B-3: Concentrations of Metals in Arctic Char Muscle Tissue Collected from the Milne Inlet Area, 2024

Parameter	DL	Fish Identification Number							
		BAFF23UDPF ARCH4001	BAFF24UDPF ARCH4002	BAFF24UIPFA RCH4003	BAFF24UIPFA RCH4004	BAFF24UIPF ARCH4005	BAFF24UIPF ARCH4008	BAFF24UIPFA RCH4010	BAFF24UIPFA RCH4012
Moisture (%)	0.30	73	70	72	66	64	71	73	73
Total Metals (mg/kg ww)									
Aluminum	0.50	0.60	1.61	0.82	0.84	0.58	1.20	32.4	1.43
Antimony	0.0020	0.0022	0.0068	0.0041	0.0028	0.0031	0.0038	<0.0020	0.0045
Arsenic	0.0050	0.992	0.953	1.00	1.71	1.19	0.886	0.515	0.764
Barium	0.010	0.012	0.033	0.087	<0.010	<0.010	<0.010	<0.010	0.013
Beryllium	0.0020	<0.0020	<0.0020	<0.0020	<0.0020	<0.0020	<0.0020	<0.0020	<0.0020
Bismuth	0.0013	<0.0013	<0.0013	<0.0013	<0.0013	<0.0013	<0.0013	<0.0013	<0.0013
Boron	0.20	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20
Cadmium	0.0013	0.0069	0.0056	0.0053	0.0055	0.0047	0.0033	0.0025	0.0228
Calcium	4.0	251	252	110	79.2	75.2	83.0	80.9	111
Chromium	0.025	<0.025	<0.025	<0.025	<0.025	<0.025	0.233	<0.025	<0.025
Cobalt	0.0013	0.0067	0.0070	0.0056	0.0059	0.0047	0.0039	0.0047	0.0058
Copper	0.013	0.225	0.752	0.393	0.958	0.536	0.306	0.486	0.282
Iron	0.25	4.25	32.9	5.06	7.29	4.06	5.69	2.35	5.99
Lead	0.0013	0.0029	0.0239	0.0044	0.0039	0.0017	0.0028	0.0137	0.0063
Magnesium	0.40	339	282	318	287	264	297	337	317
Manganese	0.010	0.095	0.108	0.107	0.114	0.068	0.087	0.125	0.096
Mercury	0.0010 - 0.0020	0.0699	0.0531	0.0419	0.0541	0.0483	0.0423	0.0335	0.142
Molybdenum	0.0080	<0.0080	<0.0080	<0.0080	<0.0080	<0.0080	0.0093	<0.0080	<0.0080
Nickel	0.010	0.049	0.049	0.065	0.051	<0.010	0.075	<0.010	0.012
Phosphorus	2.0	3360	3290	3170	2930	2740	2900	3150	3050
Potassium	2.5	4990	4550	4720	4150	3910	4590	4960	4650
Selenium	0.010	0.483	0.433	0.369	0.468	0.308	0.358	0.304	0.448
Silver	0.0013	<0.0013	<0.0013	<0.0013	<0.0013	<0.0013	<0.0013	<0.0013	<0.0013
Sodium	2.5	305	455	419	401	431	386	315	394
Strontium	0.013	0.261	0.366	0.285	0.148	0.129	0.134	0.145	0.137
Thallium	0.00040	0.00347	0.00310	0.00195	0.00237	0.00147	0.00187	0.00192	0.00476
Tin	0.020	<0.020	<0.020	<0.020	<0.020	<0.020	<0.020	<0.020	<0.020
Titanium	0.13	0.44	0.48	0.41	0.41	0.37	0.37	0.36	0.51
Uranium	0.00040	<0.00040	<0.00040	<0.00040	<0.00040	<0.00040	<0.00040	<0.00040	<0.00040
Vanadium	0.020	<0.020	<0.020	<0.020	<0.020	<0.020	<0.020	<0.020	<0.020
Zinc	0.20	5.74	6.28	6.91	6.88	4.19	4.02	5.00	4.54

% = percent; mg/kg ww = milligram per kilogram wet weight; DL = Detection Limit; < = less than.

Table 7B-4: Concentrations of Metals in Fourhorn Sculpin Muscle Tissue Collected from the Milne Port Area and Koluktoo Bay Reference Area, 2024

Parameter	DL	Fish Identification Number															
		Milne Port								Koluktoo Bay							
		BAFF24UDPFF HSC1004	BAFF24UDPFF HSC1012	BAFF24UDPFF HSC1015	BAFF24UDPFF HSC1016 ^(a)	BAFF24UDPFF HSC1023	BAFF24UDPFF HSC1034	BAFF24UIPFF HSC1038	BAFF24UIPFF HSC1040	BAFF24UKLKF HSC2002	BAFF24UKLKF HSC2004	BAFF24UKLKF HSC2005	BAFF24UKLKF HSC2015	BAFF24UKLKF HSC2019	BAFF24UKLKF HSC2031	BAFF24UKLKF HSC2035	BAFF24UKLKF HSC2037
Moisture (%)	0.30	77	80	78	77	73	79	81	76	79	88	79	76	76	75	74	75
Total Metals (mg/kg ww)																	
Aluminum	0.50	1.24	1.32	1.77	1.36	1.89	1.53	1.59	0.57	1.85	1.67	1.39	1.26	0.71	0.62	0.77	1.21
Antimony	0.0020	0.0034	0.0069	0.0021	0.03	0.0044	0.0080	0.0020	0.0054	0.0039	0.0085	0.0048	0.0063	0.0030	0.0025	0.0070	0.0066
Arsenic	0.0050	2.15	3.25	3.84	3.24	2.79	3.61	2.59	6.03	8.42	5.78	1.91	1.98	2.87	5.46	3.99	3.02
Barium	0.010	0.017	0.030	0.016	0.07	0.185	0.021	0.034	0.028	0.031	0.042	0.051	0.099	0.016	0.041	0.093	0.022
Beryllium	0.0020	<0.0020	<0.0020	<0.0020	0.00	<0.0020	<0.0020	<0.0020	<0.0020	<0.0020	<0.0020	<0.0020	<0.0020	<0.0020	<0.0020	<0.0020	<0.0020
Bismuth	0.0013	0.0020	0.0026	<0.0013	0.01	0.0028	<0.0013	0.0041	0.0048	<0.0013	<0.0013	<0.0013	<0.0013	<0.0013	<0.0013	<0.0013	<0.0013
Boron	0.20	<0.20	<0.20	<0.20	0.22	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20
Cadmium	0.0013	0.0069	0.0077	0.0042	0.01	0.0118	0.0163	0.0035	0.0054	0.0051	0.0044	0.0037	0.0086	0.0082	0.0122	0.0089	0.0072
Calcium	4.0	129	111	138	518.00	3540	168	261	125	236	104	108	306	141	117	111	129
Chromium	0.025	<0.025	0.055	<0.025	0.08	0.050	0.260	<0.025	<0.025	<0.025	0.051	<0.025	0.034	<0.025	<0.025	<0.025	0.148
Cobalt	0.0013	0.0140	0.0162	0.0075	0.01	0.0128	0.0144	0.0089	0.0052	0.0116	0.0221	0.0094	0.0164	0.0128	0.0154	0.0146	0.0068
Copper	0.013	0.499	0.638	0.316	0.44	0.596	0.680	0.431	0.388	0.463	0.722	0.367	0.441	0.374	0.393	0.384	0.315
Iron	0.25	5.69	8.30	5.72	19.20	10.3	14.5	6.04	5.69	5.22	12.7	42.5	11.8	5.48	5.97	6.47	7.06
Lead	0.0013	0.0085	0.0093	0.0072	0.02	0.0114	0.0078	0.0034	0.0022	0.0046	0.0087	0.0077	0.0098	0.0042	0.0040	0.0123	0.0056
Magnesium	0.40	199	205	291	272.00	299	188	239	196	255	205	230	219	309	234	272	225
Manganese	0.010	0.154	0.170	0.153	0.43	0.636	0.271	0.183	0.110	0.513	0.159	0.275	0.357	0.210	0.193	0.265	0.174
Mercury	0.0020 - 0.010	0.204	0.320	0.105	0.14	0.127	0.144	0.147	0.218	0.363	0.156	0.104	0.0928	0.0983	0.332	0.0667	0.135
Molybdenum	0.0080	<0.0080	<0.0080	<0.0080	<0.0080	<0.0080	<0.0080	<0.0080	<0.0080	<0.0080	<0.0080	<0.0080	<0.0080	<0.0080	<0.0080	<0.0080	<0.0080
Nickel	0.010	0.014	0.060	0.010	0.37	0.048	0.027	0.041	0.021	0.028	0.032	0.258	0.088	0.027	0.030	0.011	0.013
Phosphorus	2.0	2070	1990	2190	2730.00	4260	2210	2170	2100	2350	2000	2130	2270	2200	2220	2220	2070
Potassium	2.5	3620	3320	3870	3780.00	3890	3600	3760	3760	3820	3660	3620	3850	3810	3720	3550	3490
Selenium	0.010	0.489	0.450	0.485	0.59	0.717	0.614	0.446	0.570	0.782	0.504	0.445	0.509	0.703	0.642	0.741	0.567
Silver	0.0013	<0.0013	<0.0013	<0.0013	0.01	<0.0013	0.0016	<0.0013	<0.0013	<0.0013	<0.0013	<0.0013	<0.0013	<0.0013	<0.0013	<0.0013	<0.0013
Sodium	2.5	679	894	586	798.00	710	647	726	731	923	1150	829	781	705	739	709	675
Strontium	0.013	0.442	0.585	0.337	2.43	17.9	0.493	1.45	0.520	1.71	0.623	0.402	1.31	0.424	0.682	0.419	0.534
Thallium	0.00040	0.00106	0.00062	0.00055	0.00	0.00126	0.00131	0.00077	0.00097	0.00058	0.00107	0.00084	0.00079	0.00050	0.00117	0.00058	0.00070
Tin	0.020	<0.020	0.021	0.021	0.05	0.025	0.035	0.023	<0.020	0.036	0.044	0.024	<0.020	<0.020	<0.020	<0.020	<0.020
Titanium	0.13	0.32	0.28	0.33	0.31	0.57	0.31	0.28	0.29	0.39	0.31	0.27	0.31	0.29	0.27	0.27	0.28
Uranium	0.00040	<0.00040	0.00203	0.00048	0.00	0.00418	<0.00040	<0.00040	<0.00040	0.00056	<0.00040	<0.00040	0.00049	<0.00040	<0.00040	<0.00040	<0.00040
Vanadium	0.020	<0.020	<0.020	<0.020	<0.020	<0.020	<0.020	<0.020	<0.020	0.026	<0.020	<0.020	<0.020	<0.020	<0.020	<0.020	<0.020
Zinc	0.20	12.2	15.7	10.1	20.40	30.6	20.3	11.4	13.0	32.1	17.3	11.0	15.6	20.1	34.3	13.4	12.2

% = percent; mg/kg ww = milligram per kilogram wet weight; DL = Detection Limit; < = less than; - not measured.

Table 7B-5: Concentrations of Metals in *Hiatella arctica* Tissue Collected from the Milne Port Area and Tugaat River Estuary Reference Area, 2024

Parameter	DL	Fish Identification Number														
		Milne Port								Tugaat River Estuary						
		BAFF24-MLN- HTAR-COMP- METAL-1	BAFF24-MLN- HTAR-COMP- METAL-2	BAFF24-MLN- HTAR-COMP- METAL-3	BAFF24-MLN- HTAR-COMP- METAL-4	BAFF24-MLN- HTAR-COMP- METAL-5	BAFF24-MLN- HTAR-COMP- METAL-6	BAFF24-MLN- HTAR-COMP- METAL-7	BAFF24-MLN- HTAR-COMP- METAL-8	BAFF24-REF- HTAR-COMP- METAL-1 ^(a)	BAFF24-REF- HTAR-COMP- METAL-2	BAFF24-REF- HTAR-COMP- METAL-2 REPEAT	BAFF24-REF- HTAR-COMP- METAL-3	BAFF24-REF- HTAR-COMP- METAL-4	BAFF24-REF- HTAR-COMP- METAL-5	BAFF24-REF- HTAR-COMP- METAL-6
79	82	81	79	82	80	83	81	78	76		75	78	82	79		
Total Metals (mg/kg ww)																
Aluminum	0.50	63.5	64.9	123	67.6	21.1	29.3	47.7	25.3	112	304	253	140	133	71.0	90.7
Antimony	0.0020	0.0045	0.0129	0.0036	0.0064	0.0051	0.0038	0.0234	0.0027	0.0046	0.0140	N/A	0.0042	0.0050	0.0038	0.0056
Arsenic	0.0050	1.72	1.75	2.16	1.97	1.75	1.52	2.18	2.05	1.78	2.57	N/A	2.25	2.21	1.83	2.18
Barium	0.010	3.71	20.3	4.35	3.90	53.1	4.63	31.8	5.29	15.9	38.3	N/A	2.93	56.4	142	8.61
Beryllium	0.0020	0.0045	0.0035	0.0077	0.0044	0.0020	0.0023	0.0067	0.0021	0.0058	0.0196	N/A	0.0068	0.0114	0.0058	0.0065
Bismuth	0.0013	0.0078	0.0023	0.0027	0.0028	0.0023	0.0016	0.0027	0.0018	0.0024	0.0049	N/A	0.0036	0.0043	0.0022	0.0020
Boron	0.20	2.36	3.03	3.08	2.88	2.09	2.43	2.81	2.78	2.98	4.43	N/A	5.20	3.57	2.72	2.73
Cadmium	0.0013	0.816	0.931	1.04	0.804	0.801	1.28	0.817	0.902	1.11	1.30	N/A	0.857	1.12	0.732	1.27
Calcium	4.0	1220	1130	1430	1340	684	877	988	939	1140	2260	1880	1510	1270	863	892
Chromium	0.025	0.189	0.251	0.389	0.251	0.187	0.153	0.375	0.167	0.233	0.719	0.679	0.288	0.436	0.319	0.362
Cobalt	0.0013	0.244	0.331	0.295	0.257	0.255	0.264	0.302	0.199	0.240	0.485	N/A	0.250	0.358	0.309	0.266
Copper	0.013	1.65	1.70	1.60	1.49	1.58	1.25	1.44	1.16	1.67	2.09	N/A	2.03	1.66	1.24	1.07
Iron	0.25	151	146	256	164	82.5	79.8	132	85.7	177	528	445	216	253	141	159
Lead	0.0013	0.0953	0.0908	0.132	0.0932	0.0510	0.0503	0.0772	0.0435	0.224	0.352	N/A	0.209	0.190	0.112	0.119
Magnesium	0.40	825	1000	1040	647	841	911	1050	851	980	1310	N/A	852	1180	883	1040
Manganese	0.010	21.9	30.9	18.0	17.8	20.5	27.3	18.6	14.3	15.7	42.1	31.2	20.3	19.0	22.1	17.7
Mercury	0.0010-0.0020	0.0302	0.0368	0.0460	0.0296	0.0493	0.0487	0.0504	0.0397	0.0203	0.0432	N/A	0.0271	0.0484	0.0289	0.0264
Molybdenum	0.0080	0.190	0.191	0.168	0.122	0.173	0.157	0.171	0.153	0.290	0.196	N/A	0.143	0.184	0.159	0.112
Nickel	0.010	0.426	0.662	0.634	0.447	0.597	0.565	0.727	0.505	0.414	0.846	N/A	0.453	0.805	0.619	0.695
Phosphorus	2.0	1480	1250	1150	2030	1330	1310	952	1210	1530	1340	N/A	1500	1550	1210	1190
Potassium	2.5	959	1090	834	1070	993	1190	882	1080	1450	1230	N/A	1500	1160	1170	1210
Selenium	0.010	1.66	1.66	1.58	1.32	1.71	1.55	1.83	1.75	1.97	N/A	N/A	2.18	1.96	1.51	1.02
Silver	0.0013	0.0087	0.0072	0.0065	0.0046	0.0107	0.0051	0.0067	0.0030	0.0328	0.0097	N/A	0.0105	0.0094	0.0136	0.0110
Sodium	2.5	2800	5000	3980	2190	4300	5190	5620	4940	4770	4750	N/A	4590	4890	4910	5620
Strontium	0.013	9.48	11.2	12.3	9.64	9.99	8.17	12.6	9.96	10.1	16.7	N/A	12.3	12.2	14.1	8.13
Thallium	0.00040	0.00289	0.00481	0.00393	0.00404	0.00213	0.00213	0.00448	0.00205	0.00349	0.00829	0.00755	0.00412	0.00449	0.00345	0.00416
Tin	0.020	<0.020	<0.020	<0.020	<0.020	<0.020	<0.020	<0.020	<0.020	<0.020	<0.020	N/A	<0.020	<0.020	<0.020	<0.020
Titanium	0.13	2.25	1.94	3.66	2.24	0.66	0.83	1.35	0.98	3.98	13.3	10.5	4.62	5.09	2.52	3.11
Uranium	0.00040	0.0555	0.0910	0.0870	0.0712	0.0757	0.0570	0.114	0.0659	0.0608	0.161	N/A	0.0706	0.125	0.104	0.119
Vanadium	0.020	0.697	0.717	0.820	0.910	0.516	0.446	0.767	0.510	0.602	1.18	N/A	0.755	0.874	0.562	0.829
Zinc	0.20	17.2	16.7	16.1	13.1	13.1	17.4	16.8	13.8	14.0	19.9	N/A	16.4	17.4	11.4	10.3

% = percent; mg/kg ww = milligram per kilogram wet weight; DL = Detection Limit; < = less than; n/a = not applicable.

Table 7B-6: Concentrations of Polycyclic Aromatic Hydrocarbons in Arctic Char Muscle Tissue Collected from the Milne Port Area, 2024

Parameter	DL	Fish Identification Number							
		BAFF23UDPFA RCH4001	BAFF24UDPF ARCH4002	BAFF24UIPFA RCH4003	BAFF24UIPFA RCH4004	BAFF24UIPFA RCH4005	BAFF24UIPFA RCH4008	BAFF24UIPFA RCH4010	BAFF24UIPFA RCH4012
Polycyclic Aromatic Hydrocarbons (mg/kg ww)									
1-Methylnaphthalene	0.050	<0.050	<0.050	<0.050	<0.050	<0.050	<0.050	<0.050	<0.050
2-Methylnaphthalene	0.050	<0.050	<0.050	<0.050	<0.050	<0.050	<0.050	<0.050	<0.050
Benzo(j)fluoranthene	0.050	<0.050	<0.050	<0.050	<0.050	<0.050	<0.050	<0.050	<0.050
Perylene	0.050	<0.050	<0.050	<0.050	<0.050	<0.050	<0.050	<0.050	<0.050
Naphthalene	0.050	<0.050	<0.050	<0.050	<0.050	<0.050	<0.050	<0.050	<0.050
Acenaphthylene	0.050	<0.050	<0.050	<0.050	<0.050	<0.050	<0.050	<0.050	<0.050
Acenaphthene	0.050	<0.050	<0.050	<0.050	<0.050	<0.050	<0.050	<0.050	<0.050
Fluorene	0.050	<0.050	<0.050	<0.050	<0.050	<0.050	<0.050	<0.050	<0.050
Phenanthrene	0.050	<0.050	<0.050	<0.050	<0.050	<0.050	<0.050	<0.050	<0.050
Anthracene	0.050	<0.050	<0.050	<0.050	<0.050	<0.050	<0.050	<0.050	<0.050
Fluoranthene	0.050	<0.050	<0.050	<0.050	<0.050	<0.050	<0.050	<0.050	<0.050
Pyrene	0.050	<0.050	<0.050	<0.050	<0.050	<0.050	<0.050	<0.050	<0.050
Benzo(a)anthracene	0.050	<0.050	<0.050	<0.050	<0.050	<0.050	<0.050	<0.050	<0.050
Chrysene	0.050	<0.050	<0.050	<0.050	<0.050	<0.050	<0.050	<0.050	<0.050
Benzo(b)fluoranthene	0.050	<0.050	<0.050	<0.050	<0.050	<0.050	<0.050	<0.050	<0.050
Benzo(k)fluoranthene	0.050	<0.050	<0.050	<0.050	<0.050	<0.050	<0.050	<0.050	<0.050
Benzo(a)pyrene	0.050	<0.050	<0.050	<0.050	<0.050	<0.050	<0.050	<0.050	<0.050
Indeno(1,2,3-cd)pyrene	0.050	<0.050	<0.050	<0.050	<0.050	<0.050	<0.050	<0.050	<0.050
Dibenz(a,h)anthracene	0.050	<0.050	<0.050	<0.050	<0.050	<0.050	<0.050	<0.050	<0.050
Benzo(g,h,i)perylene	0.050	<0.050	<0.050	<0.050	<0.050	<0.050	<0.050	<0.050	<0.050
Surrogate Recovery (%)									
Anthracene-D ₁₀	-	94	94	89	91	84	93	83	83
Acenaphthylene-D ₈	-	93	92	89	90	82	92	82	81
Terphenyl-D ₁₄	-	97	96	94	94	88	95	97	97

Table 7B-7: Concentrations of Polycyclic Aromatic Hydrocarbons in Fourhorn Sculpin Muscle Tissue Collected from the Milne Port Area and Koluktoo Bay Reference Area, 2024

Parameter	DL	Fish Identification Number															
		Milne Port								Koluktoo Bay							
		BAFF24UDPFF HSC1004	BAFF24UDPFF HSC1012	BAFF24UDPFF HSC1015	BAFF24UDPFF HSC1016	BAFF24UDPFF HSC1023	BAFF24UDPFF HSC1034	BAFF24UIPFF HSC1038	BAFF24UIPFF HSC1040	BAFF24UKLK FHSC2002	BAFF24UKLK FHSC2004	BAFF24UKLK FHSC2005	BAFF24UKLK FHSC2015	BAFF24UKLK FHSC2019	BAFF24UKLK FHSC2031	BAFF24UKLK FHSC2035	BAFF24UKLK FHSC2037
Polycyclic Aromatic Hydrocarbons (mg/kg ww)																	
1-Methylnaphthalene	0.050 – 0.053	<0.050	<0.050	<0.050	<0.050	<0.050	<0.050	<0.050	<0.050	<0.050	<0.050	<0.050	<0.053	<0.050	<0.050	<0.050	<0.050
2-Methylnaphthalene	0.050 – 0.053	<0.050	<0.050	<0.050	<0.050	<0.050	<0.050	<0.050	<0.050	<0.050	<0.050	<0.050	<0.053	<0.050	<0.050	<0.050	<0.050
Benzo(j)fluoranthene	0.050 – 0.053	<0.050	<0.050	<0.050	<0.050	<0.050	<0.050	<0.050	<0.050	<0.050	<0.050	<0.050	<0.053	<0.050	<0.050	<0.050	<0.050
Perylene	0.050 – 0.053	<0.050	<0.050	<0.050	<0.050	<0.050	<0.050	<0.050	<0.050	<0.050	<0.050	<0.050	<0.053	<0.050	<0.050	<0.050	<0.050
Naphthalene	0.050 – 0.053	<0.050	<0.050	<0.050	<0.050	<0.050	<0.050	<0.050	<0.050	<0.050	<0.050	<0.050	<0.053	<0.050	<0.050	<0.050	<0.050
Acenaphthylene	0.050 – 0.053	<0.050	<0.050	<0.050	<0.050	<0.050	<0.050	<0.050	<0.050	<0.050	<0.050	<0.050	<0.053	<0.050	<0.050	<0.050	<0.050
Acenaphthene	0.050 – 0.053	<0.050	<0.050	<0.050	<0.050	<0.050	<0.050	<0.050	<0.050	<0.050	<0.050	<0.050	<0.053	<0.050	<0.050	<0.050	<0.050
Fluorene	0.050 – 0.053	<0.050	<0.050	<0.050	<0.050	<0.050	<0.050	<0.050	<0.050	<0.050	<0.050	<0.050	<0.053	<0.050	<0.050	<0.050	<0.050
Phenanthrene	0.050 – 0.053	<0.050	<0.050	<0.050	<0.050	<0.050	<0.050	<0.050	<0.050	<0.050	<0.050	<0.050	<0.053	<0.050	<0.050	<0.050	<0.050
Anthracene	0.050 – 0.053	<0.050	<0.050	<0.050	<0.050	<0.050	<0.050	<0.050	<0.050	<0.050	<0.050	<0.050	<0.053	<0.050	<0.050	<0.050	<0.050
Fluoranthene	0.050 – 0.053	<0.050	<0.050	<0.050	<0.050	<0.050	<0.050	<0.050	<0.050	<0.050	<0.050	<0.050	<0.053	<0.050	<0.050	<0.050	<0.050
Pyrene	0.050 – 0.053	<0.050	<0.050	<0.050	<0.050	<0.050	<0.050	<0.050	<0.050	<0.050	<0.050	<0.050	<0.053	<0.050	<0.050	<0.050	<0.050
Benzo(a)anthracene	0.050 – 0.053	<0.050	<0.050	<0.050	<0.050	<0.050	<0.050	<0.050	<0.050	<0.050	<0.050	<0.050	<0.053	<0.050	<0.050	<0.050	<0.050
Chrysene	0.050 – 0.053	<0.050	<0.050	<0.050	<0.050	<0.050	<0.050	<0.050	<0.050	<0.050	<0.050	<0.050	<0.053	<0.050	<0.050	<0.050	<0.050
Benzo(b)fluoranthene	0.050 – 0.053	<0.050	<0.050	<0.050	<0.050	<0.050	<0.050	<0.050	<0.050	<0.050	<0.050	<0.050	<0.053	<0.050	<0.050	<0.050	<0.050
Benzo(k)fluoranthene	0.050 – 0.053	<0.050	<0.050	<0.050	<0.050	<0.050	<0.050	<0.050	<0.050	<0.050	<0.050	<0.050	<0.053	<0.050	<0.050	<0.050	<0.050
Benzo(a)pyrene	0.050 – 0.053	<0.050	<0.050	<0.050	<0.050	<0.050	<0.050	<0.050	<0.050	<0.050	<0.050	<0.050	<0.053	<0.050	<0.050	<0.050	<0.050
Indeno(1,2,3-cd)pyrene	0.050 – 0.053	<0.050	<0.050	<0.050	<0.050	<0.050	<0.050	<0.050	<0.050	<0.050	<0.050	<0.050	<0.053	<0.050	<0.050	<0.050	<0.050
Dibenz(a,h)anthracene	0.050 – 0.053	<0.050	<0.050	<0.050	<0.050	<0.050	<0.050	<0.050	<0.050	<0.050	<0.050	<0.050	<0.053	<0.050	<0.050	<0.050	<0.050
Benzo(g,h,i)perylene	0.050 – 0.053	<0.050	<0.050	<0.050	<0.050	<0.050	<0.050	<0.050	<0.050	<0.050	<0.050	<0.050	<0.053	<0.050	<0.050	<0.050	<0.050
Surrogate Recovery (%)																	
Anthracene-D ₁₀	-	91	88	91	94	95	93	92	94	92	94	95	95	96	96	93	91
Acenaphthylene-D ₈	-	90	89	89	92	94	92	91	93	92	93	94	92	95	93	92	92
Terphenyl-D ₁₄	-	98	104	98	99	100	96	96	97	95	96	96	97	98	100	95	95

Table 7B-8: Concentrations of Polycyclic Aromatic Hydrocarbons in *Hiatella arctica* Tissues Collected from the Milne Port Area and Tugaat River Estuary Reference Area, 2024

No samples were analyzed for PAHs in *Hiatella arctica* in 2024. Appendix included as a placeholder.

Table 7B-9: Tissue Chemistry Summary Statistics for Fourhorn Sculpin from the Milne Port Area, 2019 to 2024

Parameter (mg / kg ww)	2019										2020										2021										2022									
	N>DL / N Total	Min	Max	Median	Mean	SD	SE	N>DL / N Total	Min	Max	Median	Mean	SD	SE	N>DL / N Total	Min	Max	Median	Mean	SD	SE	N>DL / N Total	Min	Max	Median	Mean	SD	SE												
Aluminum	30 / 30	0.75	11	1.9	2.9	2.4	0.44	7 / 8	<0.20	1.2	0.29	0.40	0.35	0.12	8 / 8	0.28	1.3	0.53	0.56	0.31	0.11	7 / 8	<0.50	1.4	0.75	0.78	0.33	0.12												
Antimony	15 / 30	<0.0020	0.0030	<0.0020	<0.0020	0.00074	0.00014	0 / 8	<0.0010	<0.0010	<0.20	<0.0010	-	-	7 / 8	<0.0010	0.0028	0.0013	0.0014	0.00071	0.00025	7 / 8	<0.0020	0.0044	0.0028	0.0027	0.00094	0.00033												
Arsenic	30 / 30	0.51	6.6	1.8	1.8	1.1	0.20	8 / 8	1.7	3.3	2.2	2.4	0.62	0.22	8 / 8	2.1	4.9	3.6	3.4	1.0	0.36	8 / 8	1.8	5.9	3.3	1.4	0.49													
Barium	30 / 30	0.030	0.40	0.15	0.15	0.087	0.016	8 / 8	0.027	0.086	0.057	0.054	0.021	0.0075	7 / 8	<0.0010	0.060	0.031	0.031	0.021	0.0074	6 / 8	<0.010	0.019	0.012	0.012	0.0050	0.001												
Beryllium	0 / 30	<0.0020	<0.0020	<0.0020	<0.0020	-	-	0 / 8	<0.0010	<0.0010	<0.0010	<0.0010	-	-	7 / 8	<0.0010	<0.0010	<0.0010	<0.0010	0.00049	0.00063	0 / 8	<0.0020	<0.020	<0.020	<0.020	<0.009													
Bismuth	26 / 30	<0.0013	0.0052	0.0029	0.0027	0.0012	0.00022	5 / 8	<0.0010	0.0052	0.0014	0.0018	0.0017	0.00059	8 / 8	<0.0010	0.0031	0.0019	0.0019	0.00079	0.00028	8 / 8	0.0016	0.0029	0.0022	0.0022	0.00041	0.00015												
Boron	23 / 30	<0.20	0.60	0.24	0.23	0.10	0.016	0 / 8	<0.20	<0.20	<0.20	<0.20	-	-	2 / 8	<0.20	0.54	<0.20	0.16	0.058	0 / 8	<0.20	<0.20	<0.20	<0.20	<0.20														
Cadmium	30 / 30	0.0050	0.13	0.025	0.037	0.034	0.0062	7 / 8	<0.0010	0.0088	0.0023	0.0028	0.0026	0.00092	8 / 8	0.0041	0.0095	0.0055	0.0058	0.0017	0.00062	8 / 8	0.0027	0.012	0.0059	0.0057	0.00210	0.00010												
Calcium	30 / 30	470	4300	2200	2200	1200	220	8 / 8	610	910	710	760	110	40	8 / 8	190	1200	490	540	370	130	8 / 8	100	140	120	120	15	5.4												
Cesium	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-												
Chromium	21 / 30	<0.025	0.16	0.031	0.040	0.035	0.0063	8 / 8	0.023	0.50	0.16	0.20	0.17	0.060	7 / 8	<0.010	0.038	0.020	0.021	0.011	0.0038	3 / 8	<0.025	0.030	<0.025	<0.025	0.0084	0.0030												
Cobalt	30 / 30	0.0045	0.024	0.012	0.012	0.041	0.00074	8 / 8	0.0048	0.0080	0.0062	0.0061	0.0010	0.00036	8 / 8	0.0065	0.012	0.0078	0.0083	0.0019	0.00066	8 / 8	0.0094	0.021	0.012	0.037	0.070	0.025												
Copper	30 / 30	0.28	1.0	0.56	0.59	0.21	0.038	8 / 8	0.32	1.0	0.43	0.50	0.23	0.080	8 / 8	0.45	0.71	0.47	0.51	0.089	0.031	8 / 8	0.29	0.54	0.35	0.36	0.080	0.028												
Iron	30 / 30	3.6	24	9.0	9.9	4.6	0.84	8 / 8	3.7	10	6.3	6.6	2.1	0.73	8 / 8	5.4	92	6.7	6.9	1.4	0.48	8 / 8	3.5	8.1	6.5	6.3	1.4	0.51												
Lead	30 / 30	0.0055	0.054	0.015	0.019	0.012	0.0021	8 / 8	0.0013	0.0047	0.0018	0.0022	0.0011	0.00041	8 / 8	0.0037	0.013	0.0054	0.0063	0.0031	0.0011	8 / 8	0.0054	0.032	0.0065	0.011	0.0090	0.0032												
Lithium	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-												
Magnesium	30 / 30	190	410	270	280	45	8.2	8 / 8	260	300	300	290	14	4.8	8 / 8	240	310	280	280	28	9.8	8 / 8	250	320	270	280	23	8.1												
Manganese	30 / 30	0.15	0.87	0.34	0.36	0.16	0.029	8 / 8	0.26	0.41	0.30	0.32	0.049	0.017	8 / 8	0.18	0.35	0.26	0.27	0.053	0.019	8 / 8	0.12	0.26	0.18	0.19	0.055	0.020												
Mercury	30 / 30	0.055	0.28	0.15	0.14	0.053	0.0096	8 / 8	0.069	0.15	0.11	0.11	0.029	0.010	8 / 8	0.10	0.42	0.20	0.23	0.11	0.040	8 / 8	0.15	0.43	0.25	0.26	0.089	0.032												
Molybdenum	4 / 30	<0.0080	0.012	<0.0080	0.0021	0.00038	5 / 8	<0.0040	0.010	0.0053	0.0049	0.0029	0.010	0 / 8	<0.0040	<0.0040	<0.0040	<0.0040	0.00071	0.00025	0 / 8	<0.0080	<0.0080	<0.0080	<0.0080	-	-	-												
Nickel	30 / 30	0.014	0.054	0.030	0.031	0.010	0.0018	6 / 8	<0.010	0.020	0.015	0.013	0.0057	0.020	8 / 8	0.015	0.079	0.023	0.028	0.021	0.0074	8 / 8	0.017	0.042	0.022	0.025	0.0084	0.0030												
Phosphorus	30 / 30	1800	4300	2600	2600	700	130	8 / 8	2600	2900	2600	2700	130	46	8 / 8	2000	2700	2500	2400	210	76	8 / 8	1900	2300	2200	2100	120	42												
Potassium	30 / 30	2200	3600	2900	2900	340	63	8 / 8	3900	4300	4100	4000	120	44	8 / 8	3400	3900	3700	3600	160	57	8 / 8	3400	3900	3600	3600	180	62												
Rubidium	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-												
Selenium	30 / 30	0.34	0.64	0.52	0.51	0.080	0.015	8 / 8	0.37	0.48	0.41	0.42	0.037	0.013	8 / 8	0.41	0.57	0.50	0.49	0.061	0.021	8 / 8	0.44	0.63	0.53	0.53	0.062	0.022												
Silver	3 / 30	<0.0013	0.0023	<0.0013	0.00034	0.000062	0 / 8	<0.0010	<0.0010	<0.0010	<0.0010	-	-	1 / 8	<0.0010	0.0015	<0.0010	<0.0010	-	-	1 / 8	<0.0013	0.0017	<0.0013	<0.0013	-	-	-												
Sodium	30 / 30	890	1700	1300	1300	200	36	8 / 8	480	740	550	570	89	32	8 / 8	550	1000	750	750	160	56	8 / 8	500	770	580	600	94	33												
Strontium	30 / 30	2.4	30	14	14	8.2	1.5	8 / 8	2.4	5.0	3.5	3.6	0.88	0.31	8 / 8	0.91	7.3	2.4	2.9	2.3	0.80	8 / 8	0.34	0.75	0.50	0.52	0.13	0.046												
Tellurium	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-												
Thallium	29 / 30	<0.00040	0.0023	0.00087	0.00095	0.00043	0.000078	8 / 8	<0.020	<0.020	<0.020	<0.020	0.00024	0.000087	8 / 8	0.00050	0.0010	0.00076	0.00075	0.00015	0.000054	8 / 8	0.00059	0.0011	0.00077	0.00083	0.00018	0.000065												
Tin	19 / 30	<0.020	1.4	0.027	0.10	0.26	0.047	0 / 8	<0.020	<0.020	<0.020	<0.020	-	-	5 / 8	<0.020	0.19	0.025	0.042	0.061	0.021	5 / 8	<0.020	0.042	0.023	0.023	0.013	0.0045												
Titanium	30 / 30	0.27	1.0	0.45	0.48	0.16	0.029	8 / 8	0.17	0.22	0.21	0.21	0.018	0.0065	8 / 8	0.30	0.52	0.37	0.37	0.065	0.023	8 / 8	0.42	0.50	0.46	0.46	0.030	0.011												
Uranium	30 / 30	0.00045	0.020	0.0035	0.0045	0.0041	0.00074	6 / 8	<0.00040	0.0014	0.00072	0.00067	0.00039	0.00014	5 / 8	<0.00040	0.0014	0.00077	0.00067	0.00044	0.00016	8 / 8	0.00075	0.0027	0.00099	0.0012	0.00065	0.00023												
Vanadium	0 / 30	<0.020	<0.020	<0.020	<0.020	-	-	0 / 8	<0.020	<0.020	<0.020	<0.020	-	-	1 / 8	<0.020	0.056	<0.020	<0.020	-	-	0 / 8	<0.020	<0.020	<0.020	<0.020	-	-												
Zinc	30 / 30	12	27	17	18	3.9	0.72	8 / 8	9.6	18	12	13	3.3	1.2	8 / 8	9.6	26	18	17	5.9	2.1	8 / 8	9.7	18	14	14	3.1	1.1												
Zirconium	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-												

mg / kg = milligram per kilogram wet weight; > = greater than; < = less than; DL = detection limit; n = sample size; min = minimum; max = maximum; SD = standard deviation; SE = standard error; - = not applicable.

Parameter (mg / kg ww)	2023							2024						
	N >DL / N Total	Min	Max	Median	Mean	SD	SE	N >DL / N Total	Min	Max	Median	Mean	SD	SE
Aluminum	7 / 8	<0.20	0.87	0.45	0.53	0.27	0.095	8 / 8	0.57	1.9	1.4	1.47	0.41	0.14
Antimony	5 / 8	<0.0010	0.0015	<0.0010	<0.0010	0.00041	0.00015	8 / 8	<0.0020	0.025	0.0049	0.007	0.0078	0.0027
Arsenic	8 / 8	2.2	6.2	3.4	3.4	1.3	0.45	8 / 8	3.2	6.1	3.2	3.4	1.2	0.42
Barium	8 / 8	0.015	0.62	0.32	0.11	0.21	0.074	8 / 8	0.016	0.19	0.029	0.050	0.057	0.021
Beryllium	0 / 8	<0.0010	<0.0010	<0.0010	<0.0010	-	-	1 / 8	<0.0020	<0.0020	<0.0020	<0.0020	-	-
Bismuth	8 / 8	0.0012	0.0037	0.0020	0.0023	0.00095	0.00034	8 / 8	<0.0013	0.0063	0.0027	0.0031	0.0018	0.00064
Boron	0 / 8	<0.20	<0.20	<0.20	<0.20	-	-	1 / 8	<0.20	<0.20	<0.20	<0.20	-	-
Calcium	8 / 8	0.0021	0.0093	0.0054	0.0056	0.0027	0.00097	8 / 8	0.0035	0.016	0.0073	0.0088	0.0049	0.0017
Cesium	8 / 8	300	1300	600	630	310	110	8 / 8	110	3500	150	620	1200	420
Chromium	3 / 8	<0.010	0.026	<0.010	0.011	0.0091	0.0032	4 / 8	<0.025	0.26	0.034	0.061	0.085	0.030
Cobalt	8 / 8	0.0060	0.011	0.0078	0.0079	0.0017	0.00060	8 / 8	0.0052	0.016	0.013	0.011	0.0038	0.0013
Copper	8 / 8	0.35	0.52	0.47	0.45	0.060	0.021	8 / 8	0.32	0.65	0.47	0.50	0.13	0.045
Iron	8 / 8	4.7	12	6.9	7.7	2.3	0.82	8 / 8	5.7	19	7.2	9.4	5.0	1.8
Lead	8 / 8	0.0035	0.030	0.0095	0.012	0.0095	0.0034	8 / 8	0.0022	0.017	0.0082	0.0083	0.0046	0.0016
Lithium	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Magnesium	8 / 8	220	280	260	260	19	6.8	8 / 8	190	300	220	240	46	16
Manganese	8 / 8	0.20	0.33	0.25	0.26	0.045	0.016	8 / 8	0.11	0.64	0.18	0.26	0.18	0.064
Mercury	8 / 8	0.064	0.30	0.13	0.16	0.082	0.029	8 / 8	0.11	0.32	0.15	0.18	0.069	0.025
Molybdenum	0 / 8	<0.0040	<0.0040	<0.0040	<0.0040	-	-	0 / 8	<0.0080	<0.0080	<0.0080	<0.0080	-	-
Nickel	8 / 8	0.012	0.019	0.015	0.015	0.0027	0.00095	8 / 8	<0.010	0.37	0.034	0.074	0.12	0.043
Phosphorus	8 / 8	2300	2800	2600	2600	180	64	8 / 8	2000	4300	2200	2500	760	270
Potassium	8 / 8	3500	4100	3700	3800	210	73	8 / 8	3300	3900	3800	3700	180	65
Rubidium	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Selenium	8 / 8	0.47	0.71	0.60	0.59	0.084	0.030	8 / 8	0.45	0.72	0.53	0.55	0.095	0.033
Silver	0 / 8	<0.0010	<0.0010	<0.0010	<0.0010	-	-	2 / 8	<0.0013	0.0056	<0.0013	0.0013	0.0020	0.00069
Sodium	8 / 8	480	670	520	550	73	26	8 / 8	590	890	720	720	94	33
Strontium	8 / 8	1.5	7.5	3.1	3.4	2.1	0.73	8 / 8	0.34	1.8	0.55	0.30	6.1	2.1
Tellurium	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Thallium	8 / 8	0.00088	0.0022	0.0013	0.0014	0.00042	0.00015	8 / 8	0.00055	0.0019	0.0010	0.0011	0.00043	0.00015
Tin	3 / 8	<0.020	0.023	<0.020	<0.020	0.0059	0.0021	6 / 8	<0.020	0.047	0.022	0.025	0.012	0.0041
Titanium	8 / 8	0.067	0.13	0.091	0.091	0.020	0.0071	8 / 8	0.28	0.57	0.31	0.34	0.096	0.034
Uranium	8 / 8	0.00074	0.0013	0.0011	0.0010	0.00021	0.000074	4 / 8	<0.00040	0.0042	<0.00040	0.0014	0.0018	0.00064
Vanadium	0 / 8	<0.020	<0.020	<0.020	<0.020	-	-	0 / 8	<0.020	<0.020	<0.020	<0.020	-	-
Zinc	8 / 8	11	17	15	15	2.1	0.74	8 / 8	10	31	14	17	6.8	2.4
Zirconium	-	-	-	-	-	-	-	-	-	-	-	-	-	-

mg / kg = milligram per kilogram wet weight; > = greater than; < = less than; DL = detection limit; n = sample size; min = minimum; max = maximum; SD = standard deviation; SE = standard error; - = not applicable.

Table 7B-10: Tissue Chemistry Summary Statistics for *Hiatella arctica* from the Milne Port Area, 2018 to 2024

Parameter (mg/kg ww)	2018										2019										2020									
	N>DLN Total	Min	Max	Median	Mean	SD	SE	N>DLN Total	Min	Max	Median	Mean	SD	SE	N>DLN Total	Min	Max	Median	Mean	SD	SE	N>DLN Total	Min	Max	Median	Mean	SD	SE		
Aluminum	24/24	170	920	520	520	200	40	80/80	110	2400	890	910	360	40	8/8	330	1800	690	760	440	160	8/8	330	1800	690	760	440	160		
Antimony	24/24	0.0039	0.0094	0.0066	0.0064	0.0016	0.00033	80/80	0.0043	0.042	0.018	0.018	0.0060	0.00067	8/8	0.0085	0.035	0.020	0.019	0.0082	0.0029	8/8	0.0085	0.035	0.020	0.019	0.0082	0.0029		
Arsenic	24/24	1.4	4.1	2.4	2.4	0.68	0.14	80/80	1.6	6.3	2.8	2.9	1.0	0.12	8/8	2.4	3.4	2.6	2.7	0.33	0.12	8/8	2.4	3.4	2.6	2.7	0.33	0.12		
Barium	24/24	2.1	21	7.9	9.2	5.2	1.1	80/80	3.3	33	8.5	11	6.3	0.71	8/8	5.3	20	8.8	11	5.0	1.8	8/8	5.3	20	8.8	11	5.0	1.8		
Beryllium	24/24	0.012	0.053	0.033	0.033	0.011	0.0023	80/80	0.0072	0.15	0.050	0.051	0.020	0.0022	8/8	0.021	0.097	0.041	0.044	0.024	0.0021	8/8	0.021	0.097	0.041	0.044	0.024	0.0021		
Bismuth	24/24	0.0029	0.012	0.0068	0.0069	0.0022	0.00045	80/80	0.0032	0.025	0.012	0.012	0.0035	0.00039	8/8	0.0050	0.024	0.0088	0.0099	0.0059	0.0021	8/8	0.0050	0.024	0.0088	0.0099	0.0059	0.0021		
Boron	24/24	3.3	9.0	6.1	6.0	1.4	0.29	80/80	3.1	17	8.5	8.9	2.7	0.30	8/8	4.4	13	6.6	7.0	2.8	0.98	8/8	4.4	13	6.6	7.0	2.8	0.98		
Cadmium	24/24	0.27	2.5	0.56	0.68	0.47	0.097	80/80	0.16	1.3	0.45	0.50	0.22	0.024	8/8	0.43	0.76	0.61	0.62	0.10	0.036	8/8	0.43	0.76	0.61	0.62	0.10	0.036		
Calcium	24/24	2000	12000	5100	5600	2500	520	80/80	1400	27000	7000	7900	4300	480	8/8	4000	11000	5400	6000	2300	810	8/8	4000	11000	5400	6000	2300	810		
Cesium	24/24	0.027	0.17	0.091	0.091	0.035	0.0072	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-		
Chromium	24/24	0.61	2.6	1.5	1.5	0.55	0.11	80/80	0.41	7.3	2.5	2.7	1.0	0.12	8/8	5.9	64	31	28	18	6.4	8/8	5.9	64	31	28	18	6.4		
Cobalt	24/24	0.22	1.7	0.71	0.78	0.39	0.080	80/80	0.29	4.0	1.0	1.2	0.75	0.083	8/8	0.76	2.5	1.4	1.5	0.54	0.19	8/8	0.76	2.5	1.4	1.5	0.54	0.19		
Copper	24/24	1.5	3.3	2.0	2.1	0.40	0.082	80/80	1.4	4.5	2.2	2.3	0.55	0.062	8/8	1.8	4.0	2.8	2.9	0.82	0.29	8/8	1.8	4.0	2.8	2.9	0.82	0.29		
Iron	24/24	510	2300	1300	1300	510	100	80/80	370	7000	2200	2300	1000	120	8/8	900	3900	2000	2100	960	340	8/8	900	3900	2000	2100	960	340		
Lead	24/24	0.20	1.8	0.69	0.74	0.35	0.071	80/80	0.15	3.4	1.2	1.3	0.49	0.055	8/8	0.43	4.3	0.99	1.4	1.3	0.45	8/8	0.43	4.3	0.99	1.4	1.3	0.45		
Lithium	24/24	0.71	3.9	2.3	2.3	0.83	0.17	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-		
Magnesium	24/24	1200	5500	2600	2600	1100	220	80/80	1200	12000	3900	4100	1600	180	8/8	2400	5000	3000	3200	950	340	8/8	2400	5000	3000	3200	950	340		
Manganese	24/24	4.8	330	71	90	75	15	80/80	14	630	88	140	140	15	8/8	74	270	140	160	72	26	8/8	74	270	140	160	72	26		
Mercury	24/24	0.011	0.070	0.023	0.027	0.015	0.0030	80/80	0.015	0.078	0.030	0.033	0.014	0.0015	8/8	0.022	0.047	0.031	0.032	0.0087	0.0031	8/8	0.022	0.047	0.031	0.032	0.0087	0.0031		
Molybdenum	24/24	0.13	0.52	0.26	0.26	0.10	0.021	80/80	0.13	1.3	0.29	0.37	0.19	0.021	8/8	0.28	1.3	0.72	0.71	0.31	0.11	8/8	0.28	1.3	0.72	0.71	0.31	0.11		
Nickel	24/24	0.79	2.7	1.5	1.5	0.50	0.10	80/80	0.74	4.3	2.0	2.1	0.65	0.073	8/8	3.5	30	14	13	8.2	2.9	8/8	3.5	30	14	13	8.2	2.9		
Phosphorus	24/24	730	2000	1200	1200	260	53	80/80	710	3200	1200	1400	550	61	8/8	1000	1600	1300	1300	200	72	8/8	1000	1600	1300	1300	200	72		
Potassium	24/24	800	2100	1400	1400	270	55	80/80	870	2000	1200	1200	240	27	8/8	1300	1700	1400	1500	130	45	8/8	1300	1700	1400	1500	130	45		
Rubidium	24/24	0.95	3.2	2.0	2.0	0.57	0.12	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-		
Selenium	24/24	0.65	1.4	1.2	1.2	0.17	0.034	80/80	0.74	2.0	1.4	1.4	0.27	0.030	8/8	1.1	1.6	1.2	1.3	0.17	0.058	8/8	1.1	1.6	1.2	1.3	0.17	0.058		
Silver	-	-	-	-	-	-	-	80/80	0.0019	0.022	0.0049	0.0058	0.0036	0.00041	8/8	0.0035	0.0083	0.0047	0.0048	0.0016	0.00055	8/8	0.0035	0.0083	0.0047	0.0048	0.0016	0.00055		
Sodium	24/24	1900	6500	4000	4100	1200	250	80/80	1700	5700	4200	4200	870	97	8/8	3300	4500	3800	3800	460	160	8/8	3300	4500	3800	3800	460	160		
Strontium	24/24	46	20	22	22	9.2	1.9	80/80	7.4	90	16	20	13	1.5	8/8	10	30	15	16	6.2	2.2	8/8	10	30	15	16	6.2	2.2		
Tellurium	6/24	<0.0040	0.0052	<0.0040	<0.0040	0.0011	0.00023	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-		
Thallium	24/24	0.0047	0.038	0.013	0.014	0.0075	0.0015	80/80	0.0037	0.064	0.021	0.023	0.011	0.0012	8/8	<0.020	0.042	<0.020	<0.020	0.010	0.0036	8/8	<0.020	0.042	<0.020	<0.020	0.010	0.0036		
Tin	20/24	<0.020	0.35	0.033	0.046	0.067	0.014	79/80	<0.020	0.53	0.060	0.071	0.059	0.0066	8/8	0.086	0.36	0.16	0.18	0.086	0.030	8/8	0.086	0.36	0.16	0.18	0.086	0.030		
Titanium	-	-	-	-	-	-	-	80/80	4.6	110	34	34	15	1.6	8/8	14	63	25	28	16	5.5	8/8	14	63	25	28	16	5.5		
Uranium	24/24	0.082	0.19	0.12	0.13	0.030	0.0062	80/80	0.090	0.44	0.20	0.20	0.072	0.0081	8/8	0.087	0.28	0.14	0.15	0.056	0.020	8/8	0.087	0.28	0.14	0.15	0.056	0.020		
Vanadium	24/24	0.80	4.0	2.4	2.4	0.90	0.18	80/80	0.83	7.5	3.8	3.9	1.3	0.15	8/8	1.9	6.9	3.4	3.4	1.6	0.55	8/8	1.9	6.9	3.4	3.4	1.6	0.55		
Zinc	24/24	7.1	14	12	11	1.8	0.37	80/80	8.6	21	14	14	2.3	0.26	8/8	12	18	13	13	2.1	0.73	8/8	12	18	13	13	2.1	0.73		
Zirconium	24/24	0.22	1.2	0.71	0.72	0.27	0.055	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-		

mg/kg = milligram per kilogram wet weight; > = greater than; DL = detection limit; n = sample size; min = minimum; max = maximum; SD = Standard deviation; SE = standard error.

parameter (mg/kg ww)	2021										2022										2023									
	N>DLN Total	Min	Max	Median	Mean	SD	SE	N>DLN Total	Min	Max	Median	Mean	SD	SE	N>DLN Total	Min	Max	Median	Mean	SD	SE	N>DLN Total	Min	Max	Median	Mean	SD	SE		
Aluminum	8/8	390	1500	830	850	410	150	8/8	410	1200	710	700	230	81	8/8	160	1800	540	690	500	180	8/8	160	1800	540	690	500	180		
Antimony	8/8	0.011	0.032	0.017	0.018	0.0077	0.0027	8/8	0.015	0.030	0.026	0.024	0.0055	0.0020	8/8	0.0097	0.044	0.014	0.021	0.015	0.0052	8/8	0.0097	0.044	0.014	0.021	0.015	0.0052		
Arsenic	8/8	2.2	6.2	3.1	3.6	1.5	0.52	8/8	2.2	3.4	3.0	2.9	0.52	0.19	8/8	1.5	5.3	2.8	3.1	1.5	0.53	8/8	1.5	5.3	2.8	3.1	1.5	0.53		
Barium	8/8	5.2	14	9.2	9.8	3.1	1.1	8/8	3.5	33	9.1	12	10	3.5	8/8	2.3	15	7.3	8.5	5.1	1.8	8/8	2.3	15	7.3	8.5	5.1	1.8		
Beryllium	8/8	0.021	0.081	0.043	0.045	0.022	0.0077	8/8	0.021	0.065	0.038	0.038	0.013	0.0046	8/8	0.0070	0.085	0.027	0.035	0.023	0.0083	8/8	0.0070	0.085	0.027	0.035	0.023	0.0083		
Bismuth	8/8	0.0055	0.017	0.0095	0.0099	0.0040	0.0014	8/8	0.0051	0.017	0.0090	0.0099	0.0035	0.0012	8/8	0.0028	0.027	0.0069	0.0095	0.0078	0.0027	8/8	0.0028	0.027	0.0069	0.0095	0.0078	0.0027		
Boron	8/8	4.8	12	7.5	7.7	2.8	1.0	8/8	4.6	13	8.8	9.1	2.9	1.0	8/8	3.0	14	6.3	7.3	3.5	1.2	8/8	3.0	14	6.3	7.3	3.5	1.2		
Cadmium	8/8	0.52	1.0	0.90	0.79	0.20	0.070	8/8	0.58	1.1	0.84	0.83	0.17	0.060	8/8	0.42	1.1	0.74	0.75	0.25	0.089	8/8	0.42	1.1	0.74	0.75	0.25	0.089		
Calcium	8/8	4100	12000	6600	7600	3400	1200	8/8	4700	9500	6000	6400	1500	530	8/8	2000	10000	5000	6100	2900	1000	8/8	2000	10000	5000	6100	2900	1000		
Chromium	8/8	1.2	4.5	2.3	2.5	1.3	0.45	8/8	1.5	3.1	1.9	2.0	0.51	0.18	8/8	0.41	4.5	1.5	1.9	1.2	0.43	8/8	0.41	4.5	1.5	1.9	1.2	0.43		
Cobalt	8/8	0.57	3.3	1.2	1.4	0.90	0.32	8/8	0.56	2.0	1.3	1.3	0.50	0.18	8/8	0.29	4.1	1.1	1.5	1.2	0.42	8/8	0.29	4.1	1.1	1.5	1.2	0.42		
Copper	8/8	1.6	3.9	2.4	2.5	0.79	0.28	8/8	2.1	4.6	2.6	2.8	0.79	0.28	8/8	1.4	4.0	2.0	2.3	0.91	0.32	8/8	1.4	4.0	2.0	2.3	0.91	0.32		
Iron	8/8	970	5200	2000	2500	1400	500	8/8	1500	3000	1900	2000	550	200	8/8	400	5100	2000	2400	1700	600	8/8	400	5100	2000	2400	1700	600		
Lead	8/8	0.56	2.1	1.2	1.2	0.57	0.20	8/8	0.45	2.5	1.2	1.4	0.71	0.25	8/8	0.051	1.6	0.73	0.73	0.51	0.18	8/8	0.051	1.6	0.73	0.73	0.51	0.18		
Lithium	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-		
Magnesium	8/8	2000	5700	3400	3600	1500	530	8/8	2000	3400	2900	2800	460	160	8/8	1100	5000	2600	2900	1200	440	8/8	1100	5000	2600	2900	1200	440		
Manganese	8/8	55	610	160	190	180	63	8/8	59	280	170	160	78	28	8/8	20	440	130	180	140	49	8/8	20	440	130	180	140	49		
Mercury	8/8	0.023	0.036	0.031	0.031	0.0039	0.0014	8/8	0.024	0.061	0.030	0.034	0.013	0.0045	8/8	0.014	0.044	0.029	0.028	0.011	0.0039	8/8	0.014	0.044	0.029	0.028	0.011	0.0039		
Molybdenum	8/8	0.22	0.68	0.31	0.36	0.16	0.056	8/8	0.27	0.44	0.35	0.36	0.051	0.018	8/8	0.13	0.65	0.28	0.36	0.18	0.063	8/8	0.13	0.65	0.28	0.36	0.18	0.063		
Nickel	8/8	1.2	2.9	1.9	2.0	0.81	0.29	8/8	1.3	2.8	1.9	1.9	0.49	0.17	8/8	0.54	4.0	1.5	1.9	1.1	0.38	8/8	0.54	4.0	1.5	1.9	1.1	0.38		
Phosphorus	8/8	1100	1700	1500	1500	200	70	8/8	1100	1900	1500	1500	290	100	8/8	1000	1500	1300	1300	190	67	8/8	1000	1500	1300	1300	190	67		
Potassium	8/8	1300	2100	1600	1600	250	88	8/8	1200	2100	1600	1600	250	88	8/8	1100	1700	1400	1400	240	86	8/8	1100	1700	1400	1400	240	86		
Rubidium	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-		
Selenium	8/8	1.2	1.7	1.4	1.4	0.16	0.055	8/8	1.2	1.5	1.4	1.3	0.10	0.036	8/8	0.67	1.8	1.1	1.4	0.43	0.15	8/8	0.67	1.8	1.1	1.4	0.43	0.15		
Silver	8/8	0.0039	0.041	0.0075	0.012	0.0044	0.0014	8/8	0.0046	0.020	0.010	0.009	0.0040	0.0013	8/8	0.0022	0.091	0.0097	0.0097	0.0030	0.0020	8/8	0.0022	0.091	0.0097	0.0097	0.0030	0.0020		
Sodium	8/8	2800	3900	3300	3300	410	140	8/8	3400	6300	5300	5200	1100	380	8/8	3300	6300	4500	4700	980	350	8/8	3300	6300	4500	4700	980	350		
Strontium	8/8	-	11	45	25	26	12	4.1	8/8	19	49	27	31	9.9	3.5	8/8	10	45	21	24	12	4.2	8/8	10	45	21	24	12	4.2	
Tellurium	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-		
Thallium	8/8	0.010	0.055	0.020	0.024	0.016	0.0056	8/8	0.0078	0.028	0.017	0.017	0.0063	0.0022	8/8	0.0039	0.045	0.013	0.018	0.013	0.0046	8/8	0.0039	0.045	0.013	0.018	0.013	0.0046		
Tin	8/8	0.053	0.12	0.074	0.079	0.026	0.0094	8/8	0.038	0.070	0.047	0.048	0.010	0.0036	7/8	<0.020	0.10	0.040	0.045	0.029	0.010	8/8	<0.020	0.10	0.040	0.045	0.029	0.010		
Titanium	8/8	14	68	30	33	19	6.7	8/8	17	38	24	25	6.7	2.4	8/8	5.1	53	19	23	15	5.4	8/8	5.1	53	19	23	15	5.4		
Vanadium	8/8	0.11	0.28	0.15	0.18	0.068	0.024	8/8	0.13	0.22	0.16	0.16	0.029	0.010	8/8	0.013	0.27	0.10	0.12	0.079	0.028	8/8	0.013	0.27	0.10	0.12	0.079	0.028		
Uranium	8/8	1.8	5.4	3.3	3.5	1.5	0.55	8/8	1.5	4.8	3.1	3.2	1.1	0.38	8/8	0.78	7.8	2.4	3.2	2.2	0.77	8/8	0.78	7.8	2.4	3.2	2.2	0.77		
Zinc	8/8	12	17	14	14	1.9	0.66	8/8	14	20	17	17	2.3	0.81	8/8	7.3	20	18	16	4.5	1.6	8/8	7.3	20	18	16	4.5	1.6		
Zirconium	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-		

Table 7B-11: Tissue Chemistry Summary Statistics for Arctic Char from the Milne Inlet Area, 2018 to 2024

Parameter (mg/kg ww)	2018							2019							2020						
	N >DLN Total	Min	Max	Median	Mean	SD	SE	N >DLN Total	Min	Max	Median	Mean	SD	SE	N >DLN Total	Min	Max	Median	Mean	SD	SE
Aluminum	8 / 26	<-0.20	0.81	<-0.20	<-0.20	0.18	0.036	45 / 47	<-0.20	0.81	0.66	0.66	1.4	0.20	8 / 8	0.28	0.62	0.43	0.42	0.11	0.040
Antimony	0 / 26	<-0.0010	<-0.0010	<-0.0010	<-0.0010	-	-	0 / 47	<-0.0010	<-0.0010	<-0.0010	<-0.0010	-	-	1 / 8	<-0.0010	0.0094	<-0.0010	0.0016	-	-
Arsenic	26 / 26	0.31	1.2	0.46	0.53	0.22	0.043	47 / 47	0.33	2.9	0.81	0.80	0.37	0.055	8 / 8	0.39	33	0.83	4.9	11	4.0
Barium	1 / 26	<-0.010	0.013	<-0.010	<-0.010	-	-	16 / 47	<-0.010	0.036	<-0.010	<-0.010	0.0066	0.00097	5 / 8	<-0.010	0.068	0.017	0.024	0.024	0.0084
Beryllium	0 / 26	<-0.0010	<-0.0010	<-0.0010	<-0.0010	-	-	0 / 47	<-0.0010	<-0.0010	<-0.0010	<-0.0010	-	-	0 / 8	<-0.0010	<-0.0010	<-0.0010	<-0.0010	-	-
Bismuth	0 / 26	<-0.0010	<-0.0010	<-0.0010	<-0.0010	-	-	0 / 47	<-0.0010	<-0.0010	<-0.0010	<-0.0010	-	-	0 / 8	<-0.0010	<-0.0010	<-0.0010	<-0.0010	-	-
Boron	0 / 26	<-0.20	0.21	<-0.20	<-0.20	-	-	0 / 47	<-0.20	<-0.20	<-0.20	<-0.20	-	-	0 / 8	<-0.20	<-0.20	<-0.20	<-0.20	-	-
Cadmium	25 / 26	<-0.0010	0.021	0.0030	0.0062	0.0059	0.0012	45 / 47	<-0.0010	0.024	0.0052	0.0062	0.0052	0.00076	8 / 8	0.0012	0.017	0.0032	0.0062	0.0061	0.0021
Calcium	26 / 26	43	250	76	87	45	8.8	47 / 47	57	790	150	160	120	17	8 / 8	39	510	110	220	190	68
Cesium	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Chromium	12 / 26	<-0.010	0.050	<-0.010	0.014	0.013	0.0025	33 / 47	<-0.010	0.043	0.012	0.014	0.0088	0.0013	6 / 8	<-0.010	1.5	0.030	0.22	0.53	0.19
Cobalt	26 / 26	0.0030	0.011	0.0047	0.0049	0.0015	0.00029	47 / 47	0.0024	0.013	0.0043	0.0049	0.0022	0.00031	8 / 8	0.0029	0.0057	0.0035	0.0038	0.0010	0.00035
Copper	26 / 26	0.35	0.69	0.50	0.51	0.088	0.017	47 / 47	0.29	0.74	0.39	0.41	0.090	0.013	8 / 8	0.17	0.35	0.33	0.30	0.059	0.021
Iron	26 / 26	3.0	5.8	4.4	4.4	0.74	0.14	47 / 47	2.3	21	4.0	4.5	2.7	0.40	8 / 8	2.4	17	4.7	5.9	4.5	1.6
Lead	10 / 26	<-0.0010	0.0026	<-0.0010	<-0.0010	0.00070	0.00014	40 / 47	<-0.0010	0.0054	0.0016	0.0018	0.00098	0.00014	8 / 8	0.0012	0.0052	0.0023	0.0024	0.0013	0.00046
Lithium	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Magnesium	26 / 26	260	310	280	280	12	2.3	47 / 47	260	370	300	300	22	3.3	8 / 8	220	350	300	300	37	13
Manganese	26 / 26	0.067	0.13	0.090	0.093	0.015	0.0030	47 / 47	0.060	0.32	0.092	0.10	0.038	0.0056	8 / 8	0.056	0.18	0.12	0.12	0.045	0.016
Mercury	26 / 26	0.027	0.10	0.038	0.043	0.016	0.0031	47 / 47	0.026	0.13	0.042	0.052	0.025	0.0036	8 / 8	0.023	0.30	0.043	0.073	0.092	0.032
Molybdenum	0 / 26	<-0.0040	<-0.0040	<-0.0040	<-0.0040	-	-	0 / 47	<-0.0040	<-0.0040	<-0.0040	<-0.0040	-	-	1 / 8	<-0.0040	0.011	<-0.0040	<-0.0040	-	-
Nickel	21 / 26	<-0.010	0.037	0.014	0.015	0.0073	0.0014	37 / 47	<-0.010	0.024	0.013	0.013	0.0052	0.00076	5 / 8	<-0.010	0.029	0.014	0.015	0.010	0.0036
Phosphorus	26 / 26	2800	3200	3000	3000	110	21	47 / 47	2500	3300	2900	2900	190	27	8 / 8	2400	4000	3100	3200	470	170
Potassium	26 / 26	4000	4700	4400	4400	160	31	47 / 47	3000	4900	4100	4000	440	64	8 / 8	4200	5400	4700	4700	430	150
Rubidium	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Selenium	26 / 26	0.30	0.46	0.33	0.34	0.037	0.0073	47 / 47	0.23	0.64	0.38	0.40	0.080	0.012	8 / 8	0.29	0.39	0.31	0.32	0.031	0.011
Silver	2 / 26	<-0.0010	0.0018	<-0.0010	<-0.0010	0.00027	0.00053	0 / 47	<-0.0010	<-0.0010	<-0.0010	<-0.0010	-	-	0 / 8	<-0.0010	<-0.0010	<-0.0010	<-0.0010	-	-
Sodium	26 / 26	360	600	490	500	96	19	47 / 47	310	1200	700	710	230	34	8 / 8	240	630	330	370	120	42
Strontium	26 / 26	0.079	0.64	0.18	0.20	0.11	0.022	47 / 47	0.14	1.7	0.43	0.48	0.26	0.039	8 / 8	0.088	1.6	0.34	0.59	0.55	0.20
Tellurium	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Thallium	26 / 26	0.0021	0.0064	0.0029	0.0031	0.00082	0.00016	47 / 47	0.0012	0.0060	0.0022	0.0025	0.0010	0.00015	6 / 8	0.00071	0.0032	0.0020	0.0020	0.00072	0.00025
Tin	1 / 26	<-0.020	0.036	<-0.020	<-0.020	-	-	4 / 47	<-0.020	0.032	<-0.020	<-0.020	0.0047	0.00068	8 / 8	<-0.020	0.038	0.028	0.026	0.011	0.0038
Titanium	26 / 26	0.085	0.15	0.12	0.12	0.016	0.0031	47 / 47	0.42	0.57	0.49	0.49	0.034	0.0050	8 / 8	0.12	0.17	0.14	0.14	0.018	0.0065
Uranium	1 / 26	<-0.0040	0.00058	<-0.0040	<-0.0040	-	-	6 / 47	<-0.0040	0.00091	<-0.0040	<-0.0040	0.000040	0.000020	2 / 8	<-0.0040	0.0011	<-0.0040	<-0.0040	0.00034	0.00012
Vanadium	0 / 26	<-0.020	<-0.020	<-0.020	<-0.020	-	-	0 / 47	<-0.020	<-0.020	<-0.020	<-0.020	-	-	0 / 8	<-0.020	<-0.020	<-0.020	<-0.020	-	-
Zinc	26 / 26	4.5	7.7	5.5	5.7	0.91	0.18	47 / 47	4.4	15	7.0	7.6	2.8	0.41	8 / 8	3.8	5.5	4.6	4.6	0.70	0.25
Zirconium	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-

mg/kg = milligram per kilogram wet weight; > = greater than; < = less than; DL = detection limit; n = sample size; min = minimum; max = maximum; SD = standard deviation; SE = standard error; - = not applicable.

Parameter (mg/kg ww)	2021							2022							2023							
	N>DLN Total	Min	Max	Median	Mean	SD	SE	N>DLN Total	Min	Max	Median	Mean	SD	SE	N>DLN Total	Min	Max	Median	Mean	SD	SE	
Aluminum	3 / 8	<-0.20	8.1	<-0.20	1.1	2.8	0.99	3 / 8	<-0.50	1.3	<-0.50	<-0.50	0.39	0.14	6 / 8	<-0.20	0.87	0.33	0.37	0.26	0.092	
Antimony	4 / 8	<-0.0010	0.0045	<-0.0010	0.0013	0.0014	0.00048	6 / 8	<-0.0020	0.019	0.0031	0.0046	0.0059	0.0021	0 / 8	<-0.0010	<-0.0010	<-0.0010	<-0.0010	-	-	
Arsenic	8 / 8	0.10	5.5	2.8	2.6	2.0	0.70	8 / 8	0.37	0.72	0.53	0.52	0.12	0.043	8 / 8	0.45	1.3	0.77	0.85	0.31	0.11	
Barium	1 / 8	<-0.010	0.12	<-0.010	0.020	-	-	5 / 8	<-0.010	0.041	0.020	0.019	0.012	0.0043	5 / 8	<-0.010	0.018	0.011	0.011	0.0052	0.0019	
Beryllium	0 / 8	<-0.0010	<-0.0010	<-0.0010	<-0.0010	-	-	0 / 8	<-0.0020	<-0.0020	<-0.0020	<-0.0020	-	-	0 / 8	<-0.0010	<-0.0010	<-0.0010	<-0.0010	-	-	
Bismuth	0 / 8	<-0.0010	<-0.0010	<-0.0010	<-0.0010	-	-	0 / 8	<-0.0013	<-0.0013	<-0.0013	<-0.0013	-	-	0 / 8	<-0.0010	<-0.0010	<-0.0010	<-0.0010	-	-	
Boron	1 / 8	<-0.20	0.27	<-0.20	<-0.20	-	-	0 / 8	<-0.20	<-0.20	<-0.20	<-0.20	-	-	0 / 8	<-0.20	<-0.20	<-0.20	<-0.20	-	-	
Cadmium	5 / 8	<-0.0010	0.0020	0.0015	0.0013	0.00065	0.00023	7 / 8	<-0.0013	0.021	0.0028	0.0048	0.0065	0.0023	8 / 8	0.0015	0.012	0.0024	0.0040	0.0036	0.0013	
Calcium	8 / 8	60	430	150	200	140	49	8 / 8	87	1400	130	360	460	160	8 / 8	70	530	180	210	140	50	
Cesium	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	
Chromium	3 / 8	<-0.010	0.11	<-0.010	0.020	0.037	0.013	1 / 8	<-0.025	0.033	<-0.025	<-0.025	-	-	2 / 8	<-0.010	0.029	<-0.010	<-0.010	0.0086	0.0030	
Cobalt	8 / 8	0.0030	0.017	0.0039	0.0059	0.0048	0.0017	8 / 8	0.0037	0.050	0.0071	0.012	0.015	0.0054	8 / 8	0.0020	0.0075	0.0047	0.0045	0.0017	0.00062	
Copper	8 / 8	0.30	0.61	0.40	0.42	0.097	0.034	8 / 8	0.27	0.58	0.32	0.36	0.098	0.035	8 / 8	0.29	0.63	0.33	0.38	0.13	0.045	
Iron	8 / 8	3.1	87	4.0	15	29	10	8 / 8	3.5	10	4.2	5.4	2.4	0.84	8 / 8	3.6	13	6.6	6.8	2.8	1.0	
Lead	6 / 8	<-0.0010	0.062	0.0029	0.011	0.021	0.0074	8 / 8	0.0025	0.013	0.0044	0.0054	0.0035	0.0012	7 / 8	<-0.0010	0.0055	0.0027	0.0030	0.0017	0.00058	
Lithium	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	
Magnesium	8 / 8	270	380	310	310	32	11	8 / 8	260	360	320	310	30	11	8 / 8	260	350	300	300	32	11	
Manganese	8 / 8	0.060	0.58	0.084	0.15	0.18	0.062	8 / 8	0.059	0.26	0.10	0.13	0.076	0.027	8 / 8	0.080	0.19	0.11	0.12	0.038	0.013	
Mercury	8 / 8	0.025	0.060	0.041	0.042	0.013	0.0046	8 / 8	0.034	0.10	0.062	0.064	0.023	0.0081	8 / 8	0.012	0.059	0.024	0.029	0.015	0.0054	
Molybdenum	1 / 8	<-0.0040	0.012	<-0.0040	<-0.0040	-	-	0 / 8	<-0.0080	<-0.0080	<-0.0080	<-0.0080	-	-	1 / 8	<-0.0040	<-0.0040	<-0.0040	<-0.0040	-	-	
Nickel	2 / 8	<-0.010	0.052	<-0.010	0.013	0.017	0.0060	6 / 8	<-0.010	0.041	0.013	0.018	0.014	0.0049	5 / 8	<-0.010	0.024	0.012	0.012	0.0067	0.0024	
Phosphorus	8 / 8	3000	3400	3100	3100	150	54	8 / 8	2600	3500	3100	3100	340	120	8 / 8	2700	3600	3200	3100	280	100	
Potassium	8 / 8	4000	5000	4500	4600	290	100	8 / 8	4100	5200	4400	4500	410	140	8 / 8	3800	5200	4700	4600	480	170	
Rubidium	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	
Selenium	8 / 8	0.18	0.48	0.42	0.40	0.096	0.034	8 / 8	0.34	0.48	0.40	0.40	0.045	0.016	8 / 8	0.32	0.43	0.34	0.37	0.046	0.016	
Silver	0 / 8	<-0.0010	<-0.0010	<-0.0010	<-0.0010	-	-	2 / 8	<-0.0013	0.0014	<-0.0013	<-0.0013	0.00035	0.00012	3 / 8	<-0.0010	0.0036	<-0.0010	0.0013	0.0013	0.00047	
Sodium	8 / 8	240	420	280	300	59	21	8 / 8	270	460	320	340	68	24	8 / 8	260	430	350	350	51	18	
Strontium	8 / 8	0.10	1.1	0.26	0.35	0.12	0.038	8 / 8	0.17	0.30	0.22	0.80	1.1	0.37	8 / 8	0.12	1.4	0.29	0.41	0.40	0.14	
Tellurium	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	
Thallium	8 / 8	0.0015	0.0067	0.0024	0.0032	0.0023	0.00082	8 / 8	0.0016	0.0037	0.0020	0.0023	0.00077	0.00027	8 / 8	0.0020	0.0048	0.0022	0.0026	0.00098	0.00035	
Tin	1 / 8	<-0.020	0.069	<-0.020	<-0.020	-	-	0 / 8	<-0.020	<-0.020	<-0.020	<-0.020	-	-	0 / 8	<-0.020	<-0.020	<-0.020	<-0.020	-	-	
Titanium	8 / 8	0.1	0.42	0.1	0.50	0.22	0.076	8 / 8	0.50	0.74	0.50	0.62	0.23	0.080	0.028	8 / 8	0.065	0.12	0.10	0.10	0.014	0.0049
Uranium	0 / 8	<-0.0040	0.0077	<-0.0040	0.0011	-	-	6 / 8	<-0.0040	0.0018	0.00081	0.00095	0.00064	0.00023	4 / 8	<-0.0040	<-0.0040	<-0.0040	<-0.0040	0.00018	0.000085	
Vanadium	8 / 8	<-0.020	<-0.020	<-0.020	<-0.020	-	-	0 / 8	<-0.020	<-0.020	<-0.020	<-0.020	-	-	0 / 8	<-0.020	<-0.020	<-0.020	<-0.020	-	-	
Zinc	8 / 8	4.4	9.8	4.8	5.6	1.8	0.65	8 / 8	3.9	8.1	5.0	5.2	1.3	0.46	8 / 8	3.6	6.1	5.0	4.8	0.79	0.28	
Zirconium	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	

Table 7B-12: Supporting Information for Spatial Analysis of Chemicals of Potential Concern in Fourhorn Sculpin and *Hiatella arctica* Tissue Samples Collected from the Milne Port Area and Reference Area, 2024

Parameter	Test	Sample Size		<i>n</i> Outliers	MSE	Coefficient of Determination (R ²)		Interaction <i>P</i> -value	Covariate <i>P</i> -value	Levene's Test	Shapiro-Wilk Test	Area <i>P</i> -value	Least Squares Means		Magnitude of Effect (%)	Power Analysis ^(a)	
		Milne Port	Reference			Full Model	Reduced Model						Milne Port	Reference		Minimum Detectable Difference ^(b)	Sensitivity ^(c)
Fourhorn Sculpin																	
Aluminum	ANOVA	8	8	0	0.185	0.071	-	-	-	0.594	0.896	0.317	1.408	1.19	-	0.766	59%
Iron	ANOVA _{rank}	8	8	0	24.2	0.001	-	-	-	0.840	0.651	0.921	7.17 ^(d)	6.47 ^(d)	-	7.6	111%
Magnesium	ANOVA	8	8	0	1,605	0.010	-	-	-	0.232	0.096	0.714	236	244	-	71.2	30%
Mercury	ANCOVA _{log} ^(e)	8	8	0	0.0224	0.581	0.569	0.570	0.001	0.106	0.591	0.909	-0.810	-0.819	-	3.00 / 5.56	46% / 85%
Selenium	ANOVA ^(f)	8	8	0	0.0121	0.093	-	-	0.524	0.290	0.325	0.250	0.546	0.612	-	0.196	34%
Hiatella arctica																	
Aluminum	ANOVA	8	5	1	1,002	0.449	-	-	-	0.840	0.466	0.012	55	109	-49%	86	105%
Iron	ANOVA	8	5	1	2,931	0.206	-	-	-	0.680	0.195	0.120	137	189	-	147	90%
Magnesium	ANOVA	8	6	0	23,639	0.203	-	-	-	0.524	0.874	0.106	896	1041	-	418	43%
Mercury	ANOVA	8	6	0	0.000092	0.200	-	-	-	0.877	0.299	0.109	0.0413	0.0324	-	0.0261	71%
Selenium	ANOVA	8	5	1	0.038	0.346	-	-	-	0.380	0.724	0.035	1.61	1.87	-14%	0.527	30%

Note: Significant differences indicated in **bold**. The reference area for Fourhorn Sculpin is Koluktoo Bay, while the reference area for *Hiatella arctica* is Tugaat River Estuary.

(a) Power Analysis values presented on measurement scale. Log₁₀-transformed models include values for differences below and above the grand mean.

(b) Minimum Detectable Difference expressed as difference from the overall mean.

(c) Sensitivity is the minimum detectable difference expressed as a percent change in the overall mean.

(d) Medians used for rank ANOVA.

(e) Length was included as a covariate for ANCOVA.

(f) Length was not significantly related to selenium concentrations; therefore, ANOVA was used.

n = sample size; MSE = mean squared error; *P*-value = probability value; ANOVA = analysis of variance; ANCOVA = analysis of covariance; log = log₁₀-transformed data; rank = rank-transformed data; - = not calculated or not applicable.

Table 7B-13: Supporting Information for Trend Analysis of Chemicals of Potential Concern in Arctic Char, Fourhorn Sculpin and Hiatella arctica Tissue Samples Collected from the Milne Port Area from 2018 to 2024.

Parameter	Statistical Test	n	Outliers	Sample Size				Assumptions		Coefficient of Determination (R ²)	MSE	Trend P-value	Least Squares Means										Year Trend P-value										Year Trend Slope Estimate										Trend Direction									
				2018	2019	2020	2021	2022	2024				Breusch-Pagan	Shapiro-Wilk	2018	2019	2020	2021	2022	2024	2024	2018	2019	2020	2021	2022	2024	2024	2018	2019	2020	2021	2022	2024	2024	2018	2019	2020	2021	2022	2024	2024										
Arctic Char																																																				
Aluminum	GAM _{rank}	0	26	47	8	8	8	8	0.334	0.004 ^(a)	0.400	639	<0.001	30	67	65	30	57	58	102	<0.001	0.006	<0.001	0.872	0.078	0.093	0.002	44	23	-33	-2	18	15	58	↑	↑	↓	-	↑	↑	↑	↑	↑	↑								
Iron	GAM _{rank}	0	26	47	8	8	8	8	0.221	0.002 ^(a)	0.075	984	0.014	50	53	56	61	66	72	78	0.480	0.255	0.060	0.021	0.027	0.078	0.163	3	3	4	5	6	6	6	-	-	↑	↑	↑	↑	↑	↑	-									
Magnesium	GAM	1	26	47	7	8	8	8	0.021	0.085	0.178	497	<0.001	285	301	311	314	311	306	302	0.001	<0.001	0.071	0.916	0.225	0.300	0.626	17.8	13.6	5.8	-0.4	-4.5	-4.6	-3.3	↑	↑	↑	-	-	-	-	-	-	-								
Length-Adjusted Mercury	GAM _{log10}	0	26	47	7	8	8	8	0.008 ^(b)	0.709	<0.001	0.033	0.977	-1.35	-1.35	-1.35	-1.35	-1.35	-1.35	-1.35	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-									
Length-Adjusted Selenium	GAM _{log10}	1	26	46	8	8	8	8	0.830	0.085	0.279	0.0037	<0.001	-0.473	-0.400	-0.478	-0.401	-0.374	-0.421	-0.409	<0.001	0.100	0.435	<0.001	0.191	0.222	0.469	0.125	-0.032	-0.015	0.089	-0.031	-0.026	0.031	↑	↓	-	↑	-	-	-	-	-	-								
Fourhorn Sculpin																																																				
Aluminum	GAM _{log10}	0	-	30	8	8	8	8	0.270	0.797	0.601	0.067	<0.001	-	0.329	-0.469	-0.319	-0.152	-0.268	0.114	-	<0.001	<0.001	0.002	0.509	0.347	0.005	-	-1.04	-0.30	0.33	-0.067	0.085	0.53	-	↓	↓	↑	-	-	-	-	↑									
Iron	GAM _{log10}	0	-	30	8	8	8	8	0.496	0.656	0.127	0.026	0.039	-	0.940	0.860	0.819	0.819	0.858	0.913	-	<0.040	0.015	0.442	0.433	0.126	0.252	-	-0.088	-0.064	-0.020	0.021	0.050	0.058	-	↓	↓	-	-	-	-	-	-									
Magnesium	GAM _{log10}	0	-	30	8	8	8	8	0.798	0.525	0.182	0.0031	0.003	-	2.45	2.45	2.44	2.43	2.41	2.38	-	0.783	0.937	0.228	0.021	0.008	0.044	-	0.004	-0.001	-0.009	-0.019	-0.028	-0.031	-	-	-	-	↓	↓	↓	↓	↓	↓								
Length-Adjusted Mercury	GAM _{log10}	0	-	30	8	8	8	8	0.458	0.192	0.272	0.012	0.002	-	-0.837	-0.848	-0.738	-0.659	-0.846	-0.805	-	0.570	0.192	0.001	0.039	0.004	0.134	-	-0.038	0.046	0.15	-0.091	-0.12	0.12	-	-	-	-	↑	↓	↓	-	-	-								
Length-Adjusted Selenium	GAM _{log10}	0	-	30	8	8	8	8	0.298	0.701	0.238	0.0031	0.003	-	-0.292	-0.341	-0.325	-0.279	-0.246	-0.265	-	0.016	0.166	0.025	0.007	0.697	0.311	-	-0.065	-0.018	0.039	0.048	0.006	-0.032	-	↓	-	↑	↑	-	-	-	-									
Hiatella arctica																																																				
Aluminum	GAM _{rank}	0	24	78	8	8	8	7	8	0.111	0.200	0.370	1044	<0.001	44	88	78	76	67	43	6	<0.001	0.096	0.132	0.892	0.121	0.001	0.040	59	14	-12	-1	-17	-32	-40	↑	↑	-	-	-	-	↓	↓	-	-							
Iron	GAM _{rank}	0	24	78	8	8	8	7	8	0.115	0.013	0.316	1132	<0.001	41	83	80	80	82	77	8	<0.001	0.067	0.402	0.890	0.590	0.001	<0.001	55	17	-7	2	6	-35	-86	↑	↑	-	-	-	-	↓	↓	-	-							
Magnesium	GAM _{log10}	0	24	79	8	8	8	8	8	0.166	0.570	0.506	0.022	<0.001	3.39	3.58	3.51	3.51	3.47	3.40	2.96	<0.001	0.348	0.146	0.771	0.787	<0.001	<0.001	0.257	0.041	-0.060	-0.016	-0.015	-0.244	-0.536	↑	-	-	-	-	-	-	-	-	-							
Mercury	GAM _{log10}	0	24	78	8	8	8	8	8	0.315	0.171	0.076	0.023	0.044	-1.60	-1.53	-1.51	-1.51	-1.52	-1.50	-1.43	0.046	0.069	0.824	0.764	0.938	0.208	0.147	0.076	0.048	0.005	-0.008	-0.002	0.042	0.080	↑	↑	-	-	-	-	-	-	-								
Selenium	GAM	0	24	80	8	8	8	8	8	0.706	0.804	0.146	0.057	0.001	1.19	1.38	1.35	1.35	1.34	1.39	1.58	0.001	0.193	0.446	0.989	0.984	0.053	0.073	0.256	0.070	-0.040	0.001	-0.001	0.126	0.222	↑	-	-	-	-	-	↑	↑	-	-							

Note: Significant differences indicated in **bold**.
(a) Rank GAM proceeded despite violation of normality. See Section 7.3.4.3.
(b) Log₁₀ GAM proceeded despite minor violation of homoscedasticity as residual plots indicated assumptions were not severely violated.
n = sample size; MSE = mean squared error; P-value = probability value; GAM = Gaussian additive model; log = log₁₀-transformed data; rank = rank-transformed data; - = not calculated, no data available; ↑ = increasing; ↓ = decreasing.

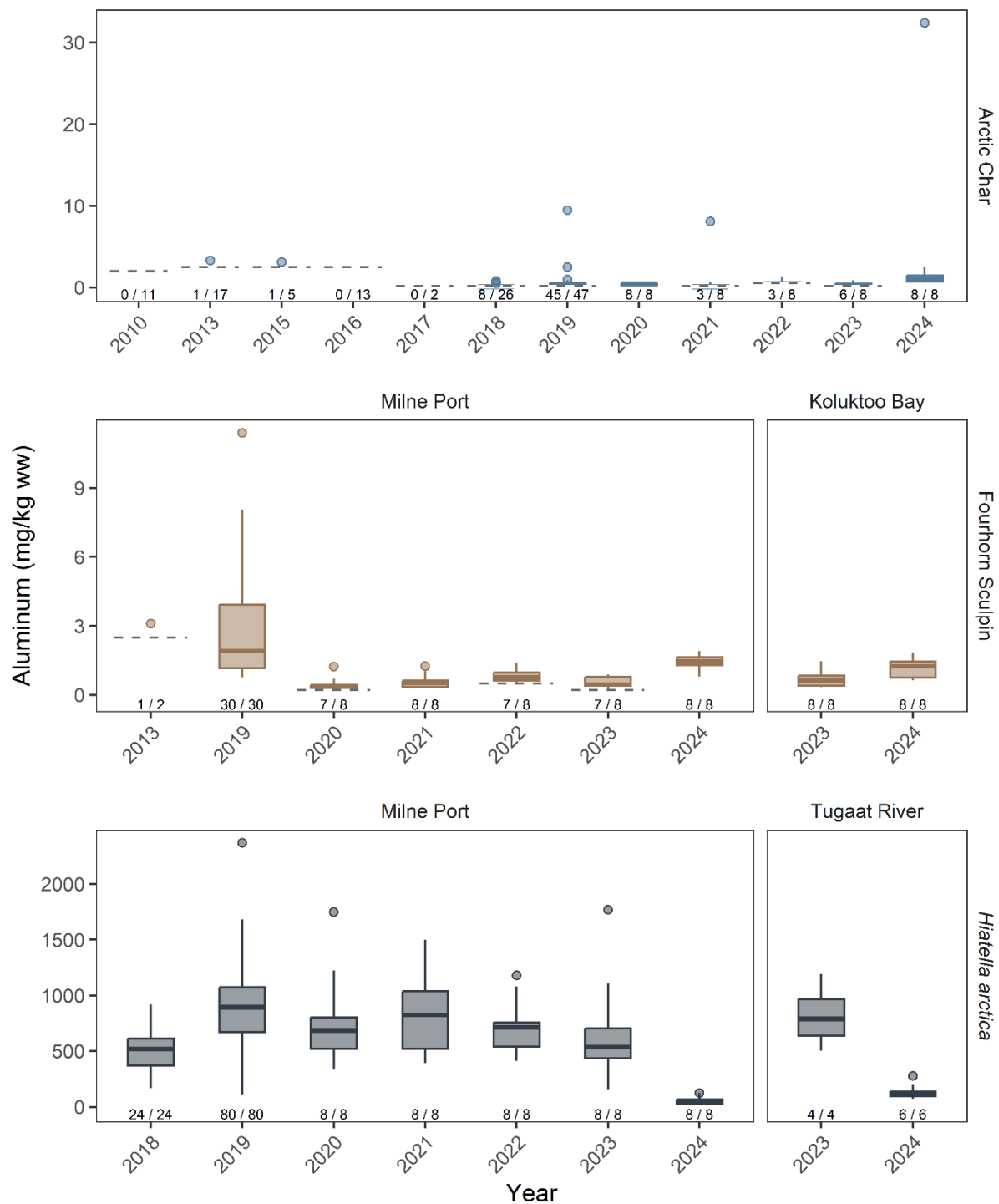
Table 7B-14 Results of Size-Adjustment of Metals Concentrations for Temporal Trend Assessment of Fish Tissue Chemistry for Arctic Char and Fourhorn Sculpin, 2024

Species	Dependent Variable	Covariate	Statistical Model	n Outliers	Assumptions			Coefficient of Determination (R ²)	ANOVA Table								
					Homogeneity of Variance	Shapiro-Wilk	Interaction P-value		Intercept			Covariate			Year		
									F-Value	df	P-value	F-Value	df	P-value	F-Value	df	P-value
Arctic Char	Mercury	Total Length (mm)	GLM _{log10}	1	0.508	0.069	0.831	0.227	3.1	1,104	0.080	4.3	1,104	0.040	4.45	6,104	<0.001
	Selenium	Total Length (mm)	GLM _{log10}	1	0.016	0.195	<0.001^(a)	0.404	0.045	1,98	0.833	1.5	1,98	0.219	5.17	6,98	<0.001
Fourhorn Sculpin	Mercury	Total Length (mm)	GLM _{log10}	0	0.878	0.473	0.030	0.707	126.5	1,63	<0.001	90.2	1,63	<0.001	4.54	5,63	0.001
	Selenium	Total Length (mm)	GLM _{log10}	0	0.125	0.377	0.085	0.409	24.1	1,63	<0.001	13.9	1,63	<0.001	4.13	5,63	0.003

Note: **Bold** values indicate statistically significant results.
(a) The reduced model (i.e., no interaction term) was used as slopes were considered practically parallel (Barrett et al. 2010).
n = sample size; df = degrees of freedom; mm = millimeters; GLM = general linear model; log₁₀ = log₁₀-transformed dependent and covariate values.

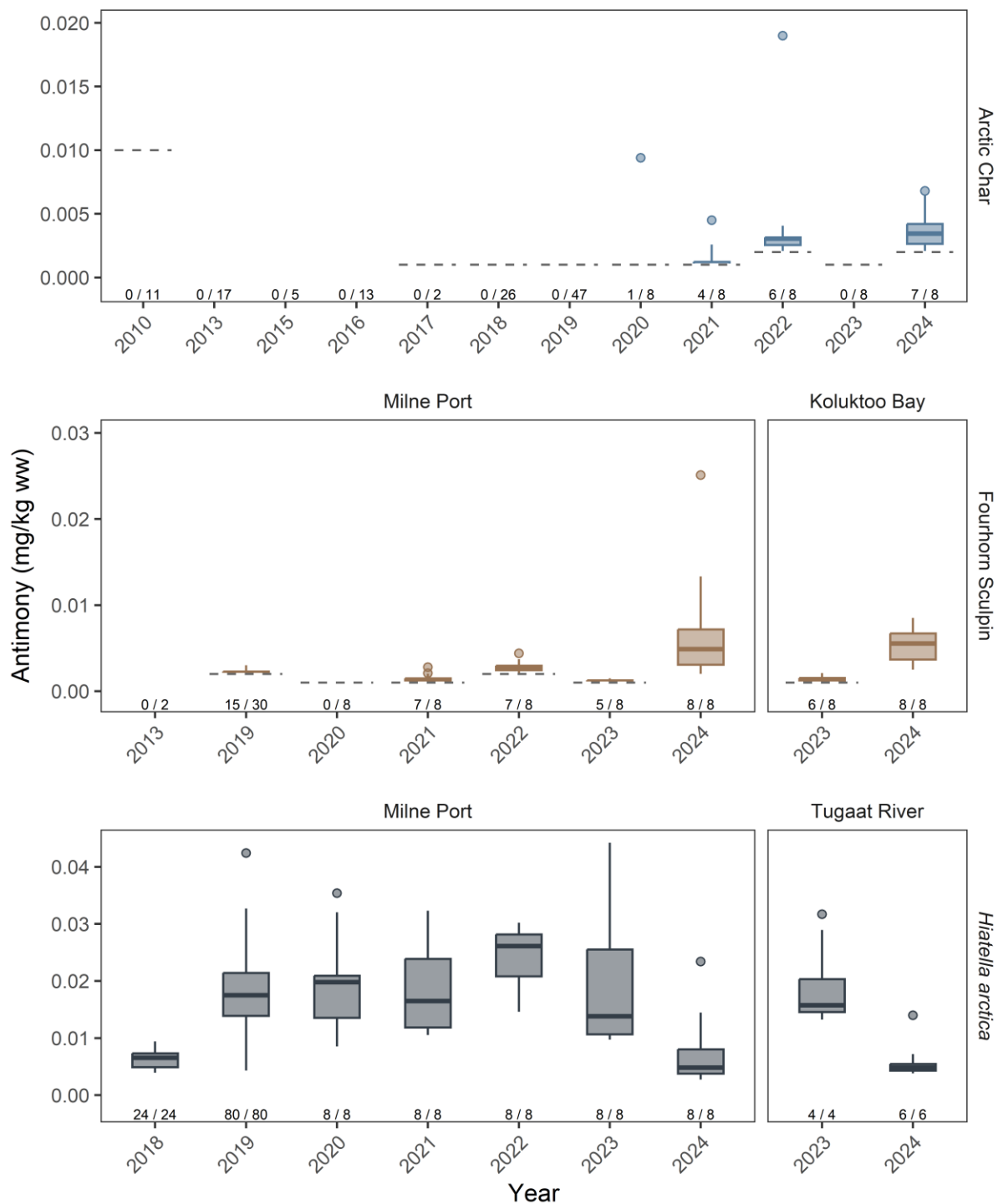
APPENDIX 7C

Fish Tissue Boxplots



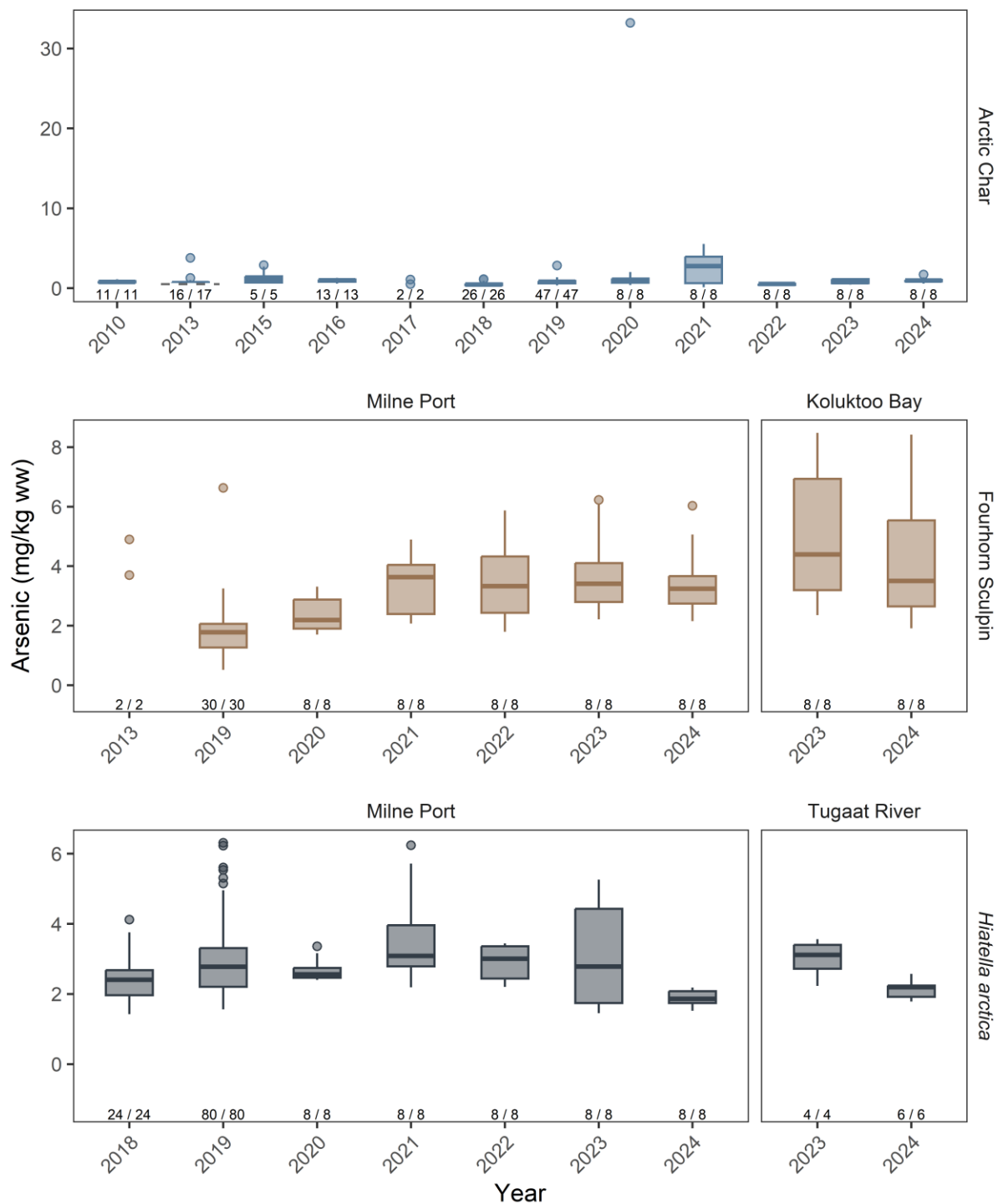
Total sample size (n) and number of samples above detection limits (n>DL) are shown above the x-axis as “n>DL/n”. Values below DL are not shown in the plots. Dashed lines indicate detection limits.

Figure 7C-1: Concentrations of Aluminum for Arctic Char, Fourhorn Sculpin and *Hiatella arctica* Tissue Sampled from the Milne Port Area and Reference Areas, 2010 to 2024



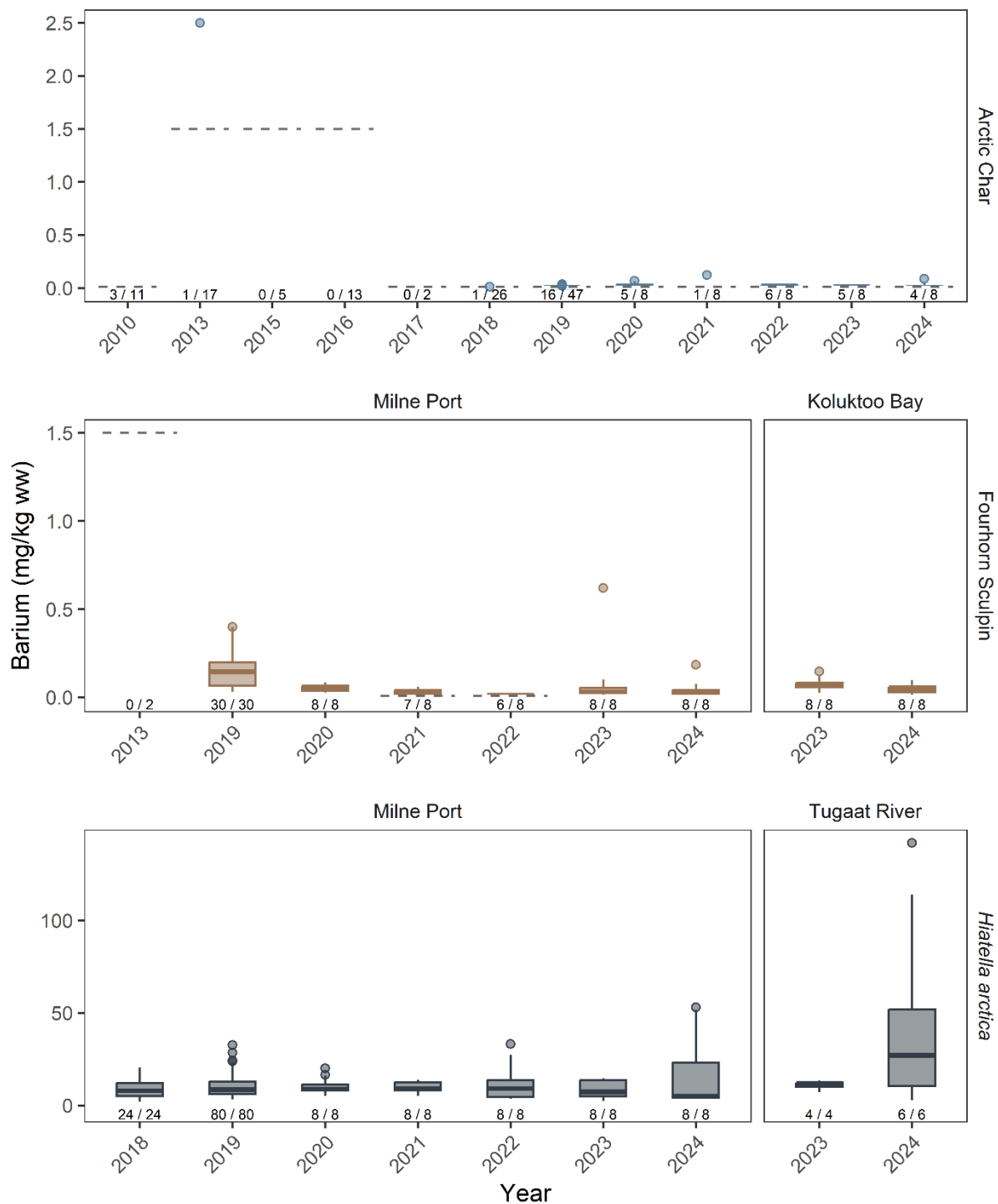
Total sample size (n) and number of samples above detection limits (n>DL) are shown above the x-axis as “n>DL/n”. Values below DL are not shown in the plots. Dashed lines indicate detection limits. Values truncated at 0.020 mg/kg ww and 0.030 mg/kg ww for Arctic Char and Fourhorn Sculpin, respectively, to improve interpretability.

Figure 7C-2: Concentrations of Antimony for Arctic Char, Fourhorn Sculpin and *Hiatella arctica* Tissue Sampled from the Milne Port Area and Reference Areas, 2010 to 2024



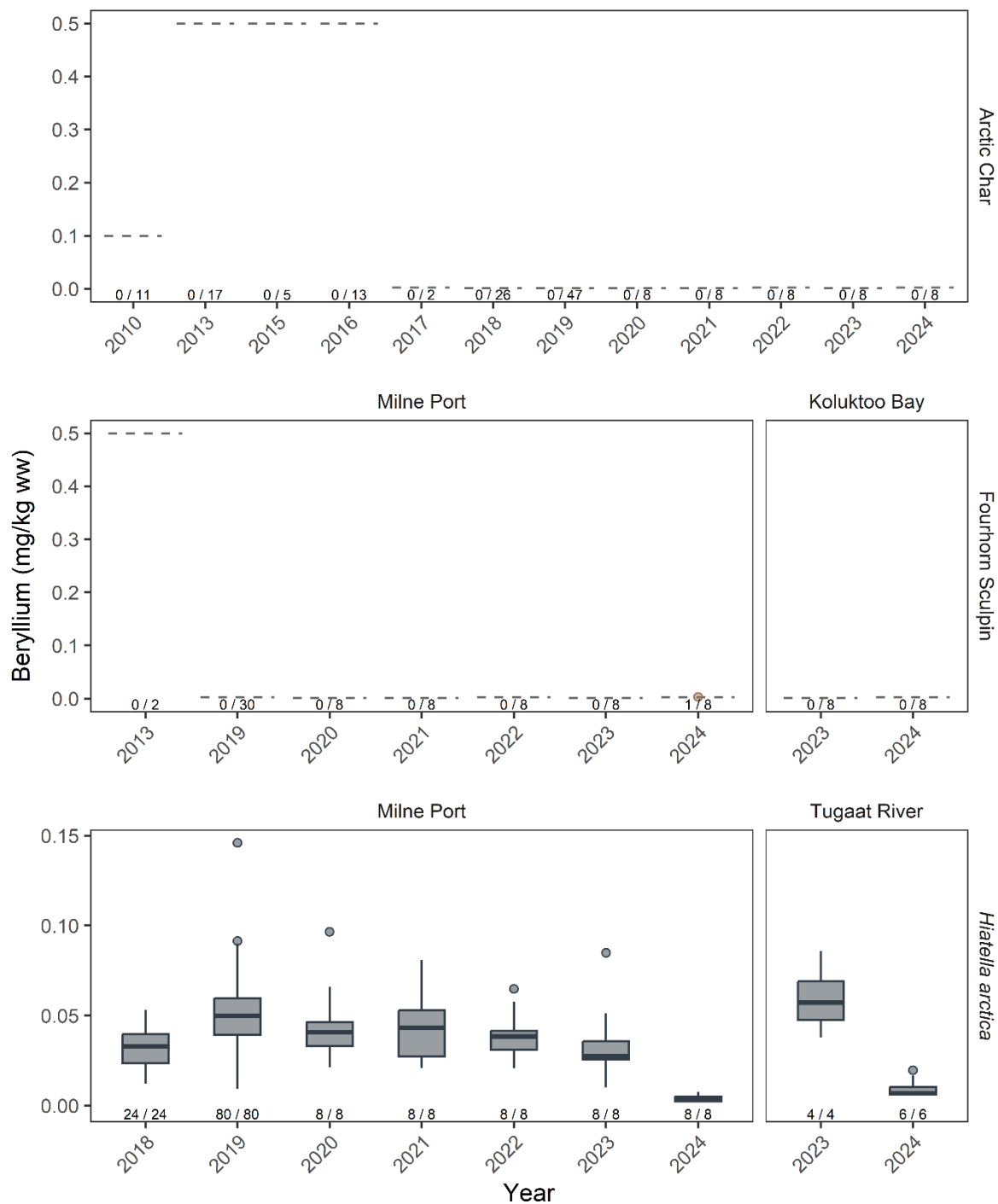
Total sample size (n) and number of samples above detection limits (n>DL) are shown above the x-axis as “n>DL/n”. Values below DL are not shown in the plots. Dashed lines indicate detection limits.

Figure 7C-3: Concentrations of Arsenic for Arctic Char, Fourhorn Sculpin and *Hiatella arctica* Tissue Sampled from the Milne Port Area and Reference Areas, 2010 to 2024



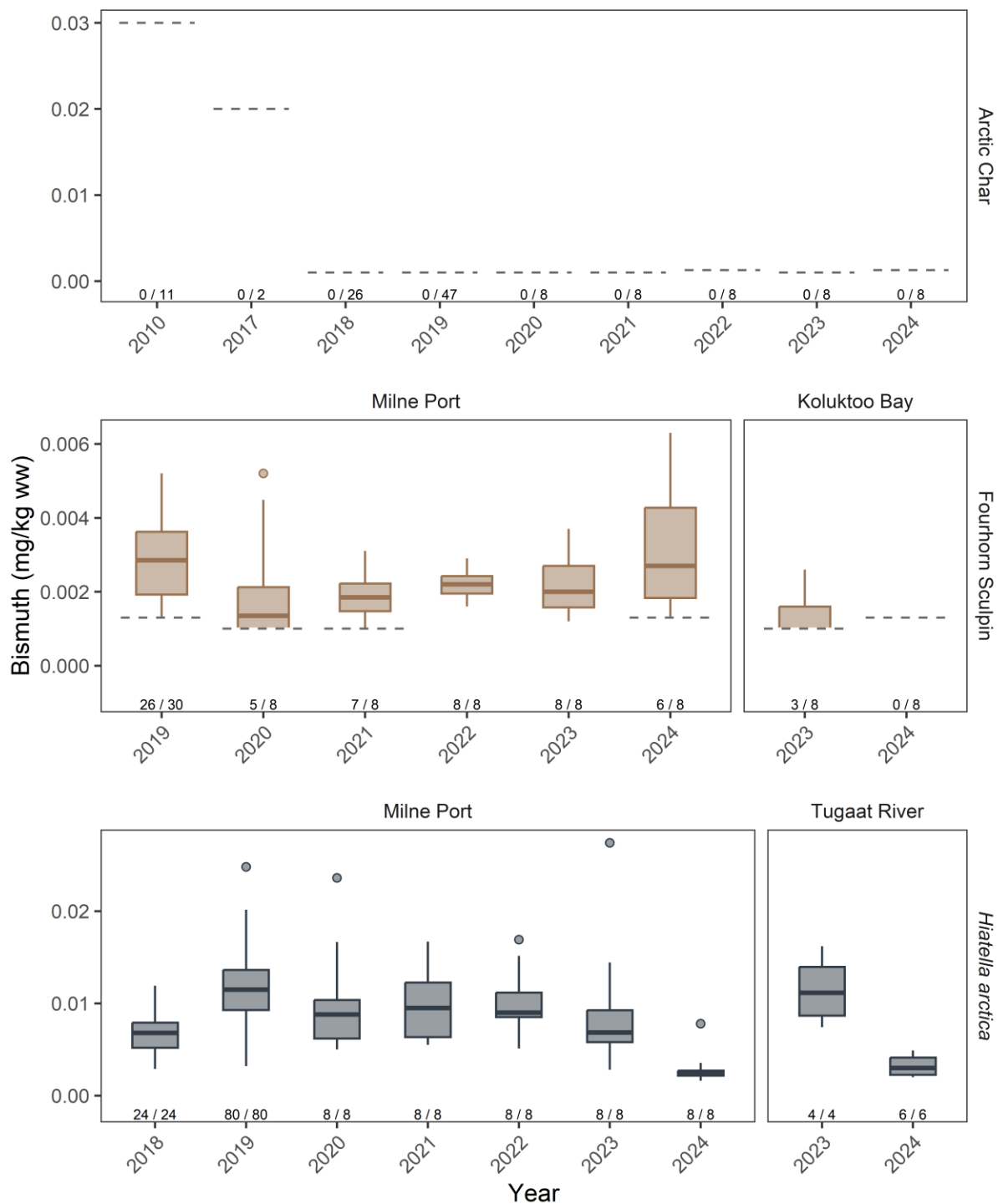
Total sample size (n) and number of samples above detection limits (n>DL) are shown above the x-axis as “n>DL/n”. Values below DL are not shown in the plots. Dashed lines indicate detection limits.

Figure 7C-4: Concentrations of Barium for Arctic Char, Fourhorn Sculpin and *Hiatella arctica* Tissue Sampled from the Milne Port Area and Reference Areas, 2010 to 2024



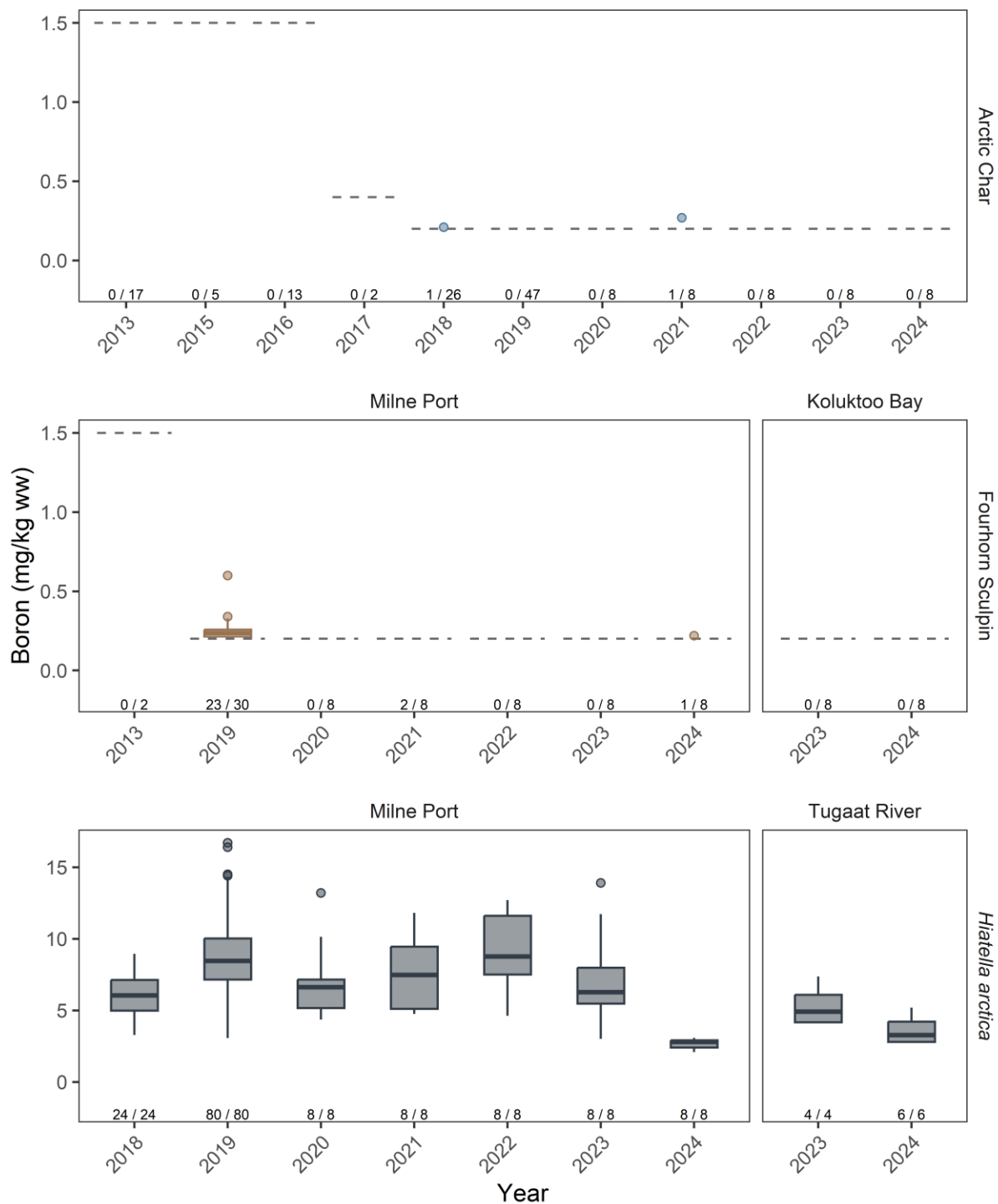
Total sample size (n) and number of samples above detection limits (n>DL) are shown above the x-axis as “n>DL/n”. Values below DL are not shown in the plots. Dashed lines indicate detection limits.

Figure 7C-5: Concentrations of Beryllium for Arctic Char, Fourhorn Sculpin and *Hiatella arctica* Tissue Sampled from the Milne Port Area and Reference Areas, 2010 to 2024



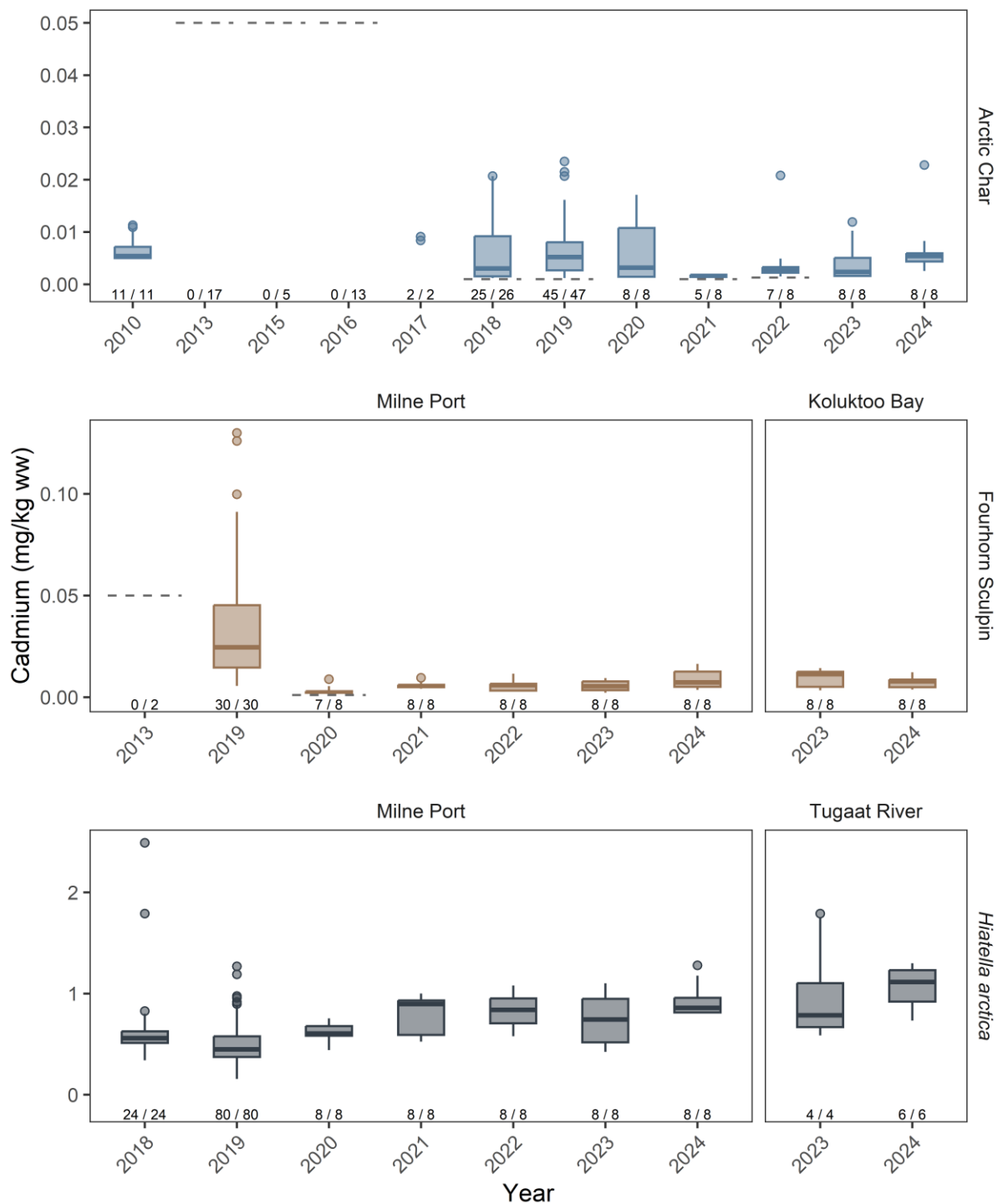
Total sample size (n) and number of samples above detection limits (n>DL) are shown above the x-axis as “n>DL/n”. Values below DL are not shown in the plots. Dashed lines indicate detection limits.

Figure 7C-6: Concentrations of Bismuth for Arctic Char, Fourhorn Sculpin and *Hiatella arctica* Tissue Sampled from the Milne Port Area and Reference Areas, 2010 to 2024



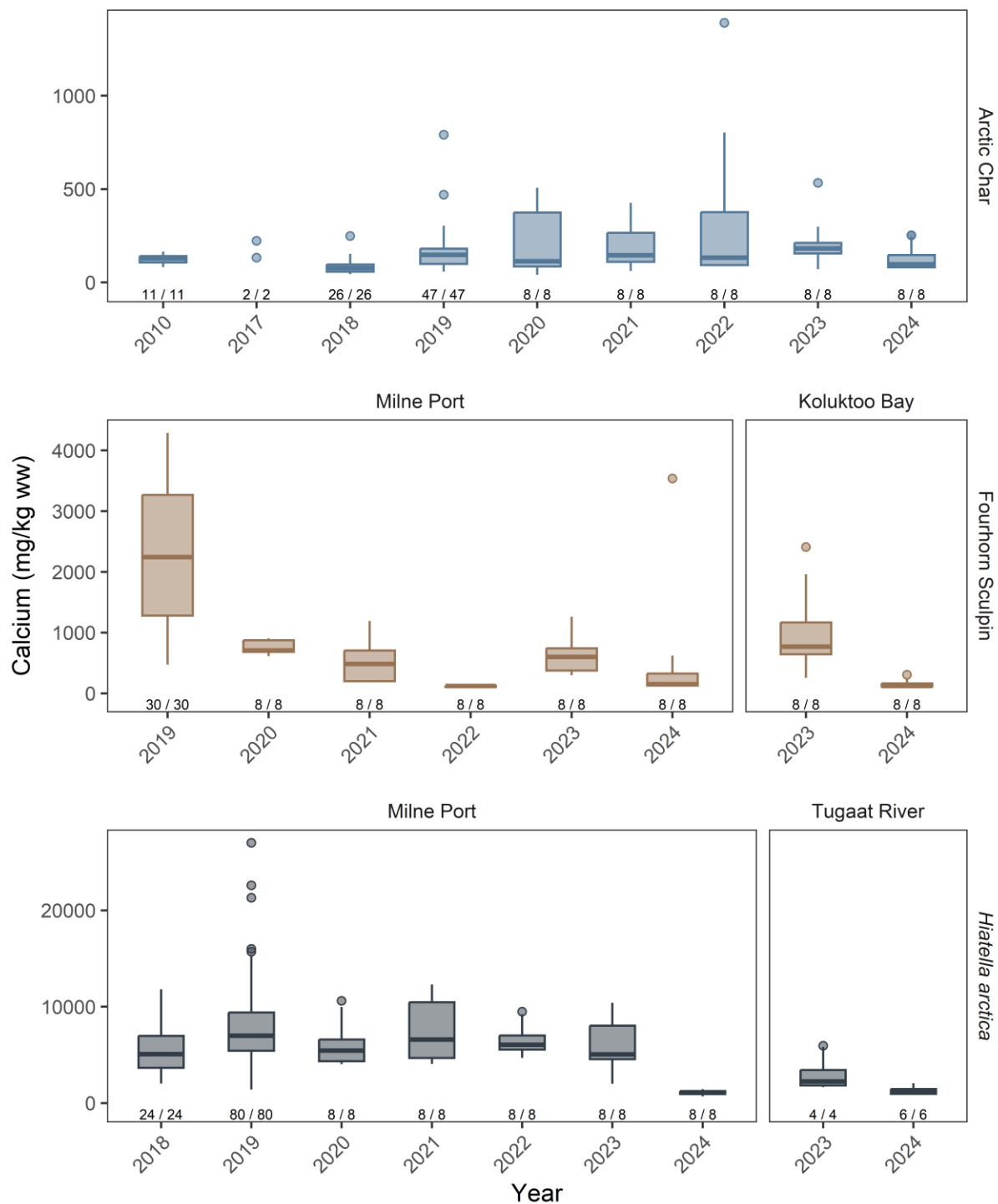
Total sample size (n) and number of samples above detection limits (n>DL) are shown above the x-axis as “n>DL/n”. Values below DL are not shown in the plots. Dashed lines indicate detection limits.

Figure 7C-7: Concentrations of Boron for Arctic Char, Fourhorn Sculpin and *Hiatella arctica* Tissue Sampled from the Milne Port Area and Reference Areas, 2013 to 2024



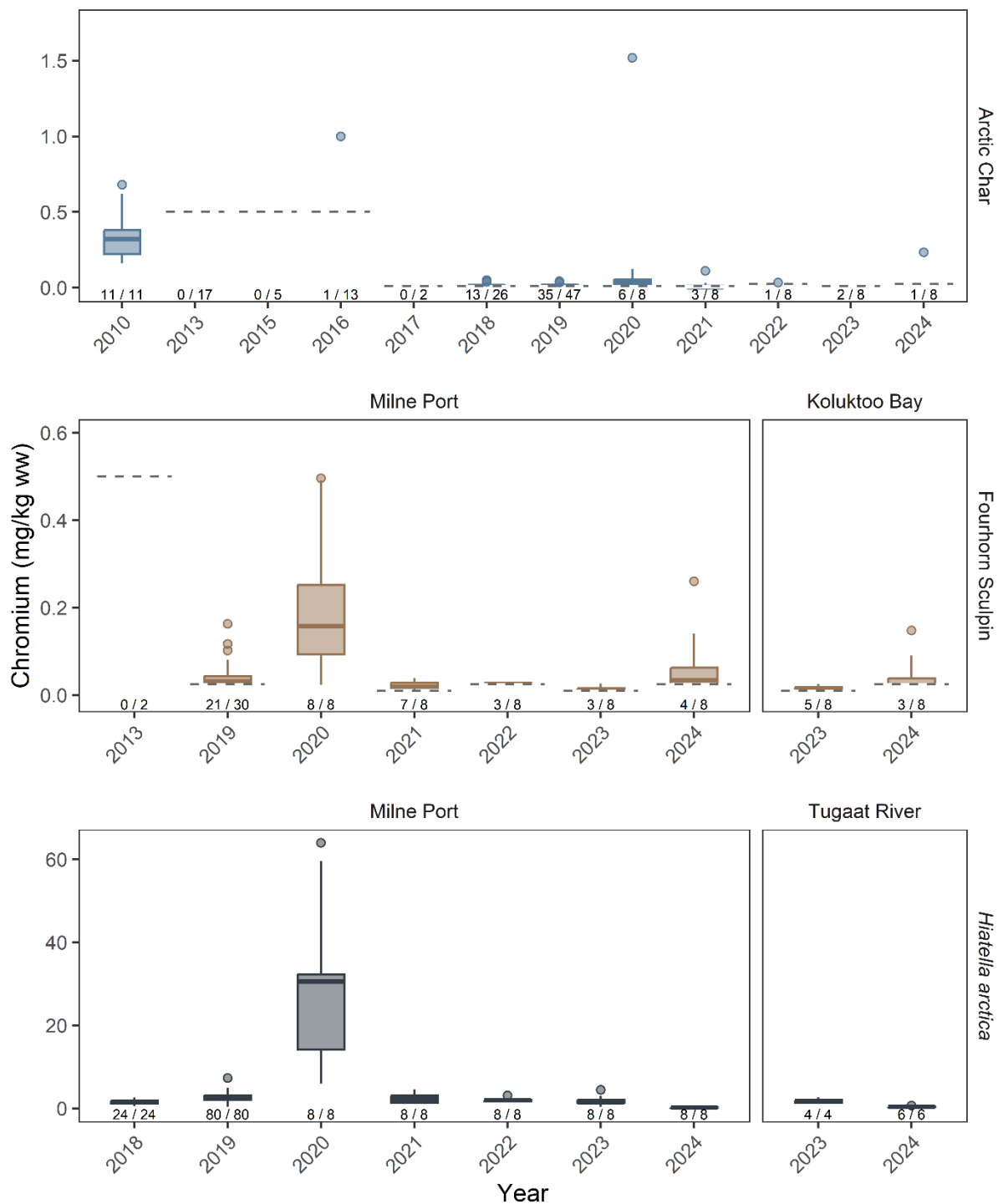
Total sample size (n) and number of samples above detection limits (n>DL) are shown above the x-axis as “n>DL/n”. Values below DL are not shown in the plots. Dashed lines indicate detection limits.

Figure 7C-8: Concentrations of Cadmium for Arctic Char, Fourhorn Sculpin and *Hiatella arctica* Tissue Sampled from the Milne Port Area and Reference Areas, 2010 to 2024



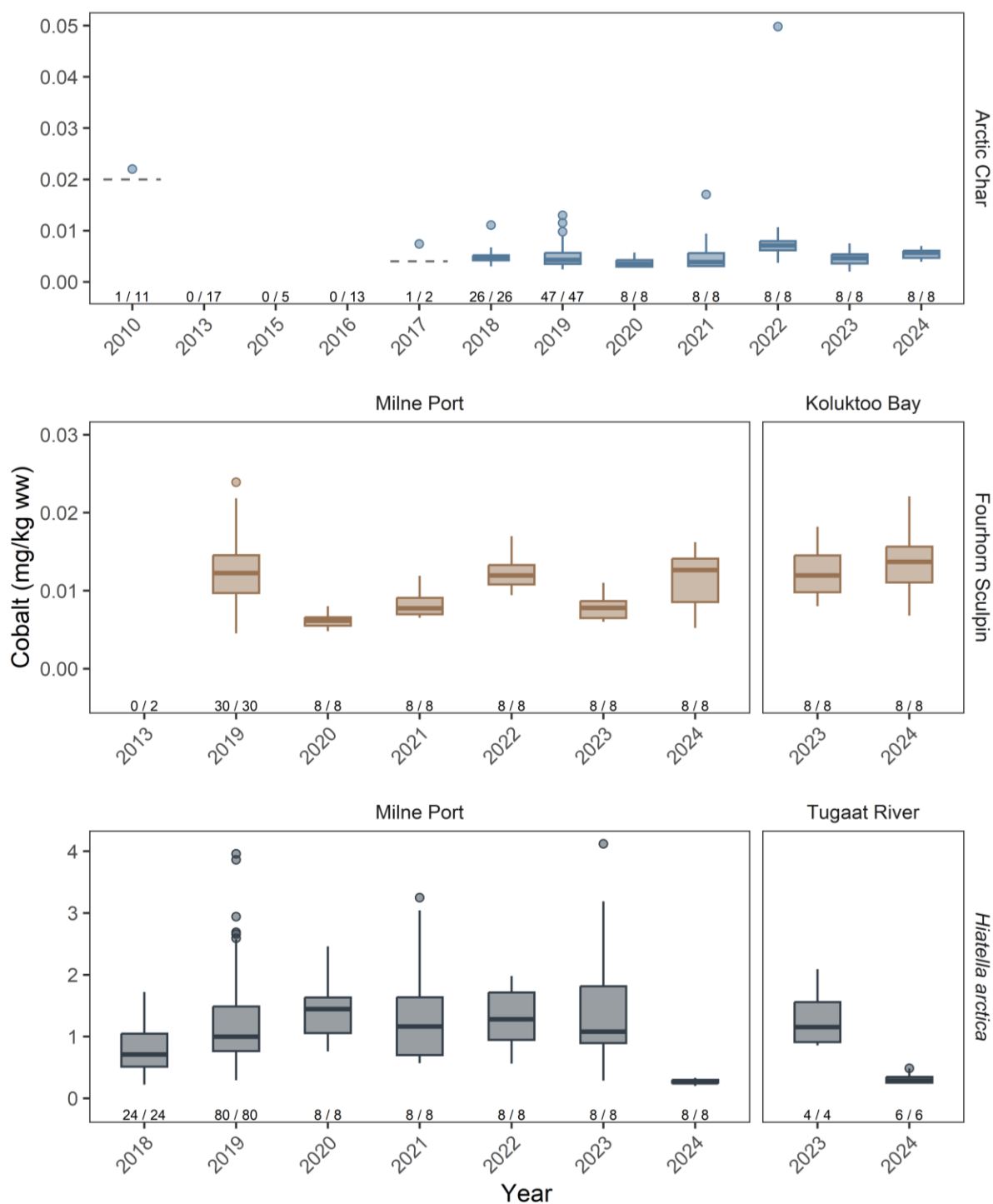
Total sample size (n) and number of samples above detection limits (n>DL) are shown above the x-axis as “n>DL/n”. Values below DL are not shown in the plots.

Figure 7C-9: Concentrations of Calcium for Arctic Char, Fourhorn Sculpin and *Hiatella arctica* Tissue Sampled from the Milne Port Area and Reference Areas, 2010 to 2024



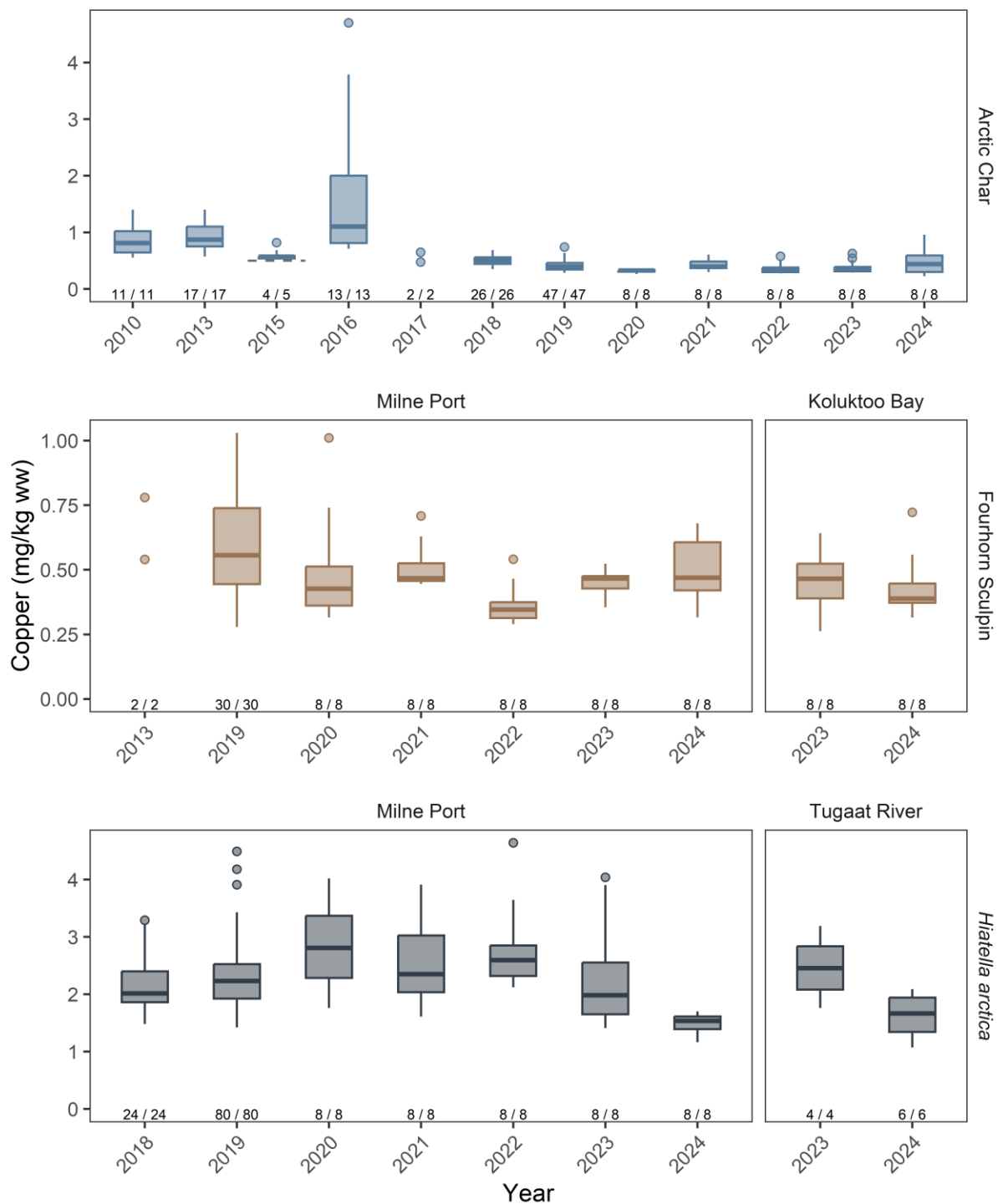
Total sample size (n) and number of samples above detection limits (n>DL) are shown above the x-axis as “n>DL/n”. Values below DL are not shown in the plots. Dashed lines indicate detection limits. Values truncated at 1.75 mg/kg ww and 0.60 mg/kg ww for Arctic Char and Fourhorn Sculpin, respectively, to improve interpretability.

Figure 7C-10: Concentrations of Chromium for Arctic Char, Fourhorn Sculpin and *Hiatella arctica* Tissue Sampled from the Milne Port Area and Reference Areas, 2010 to 2024



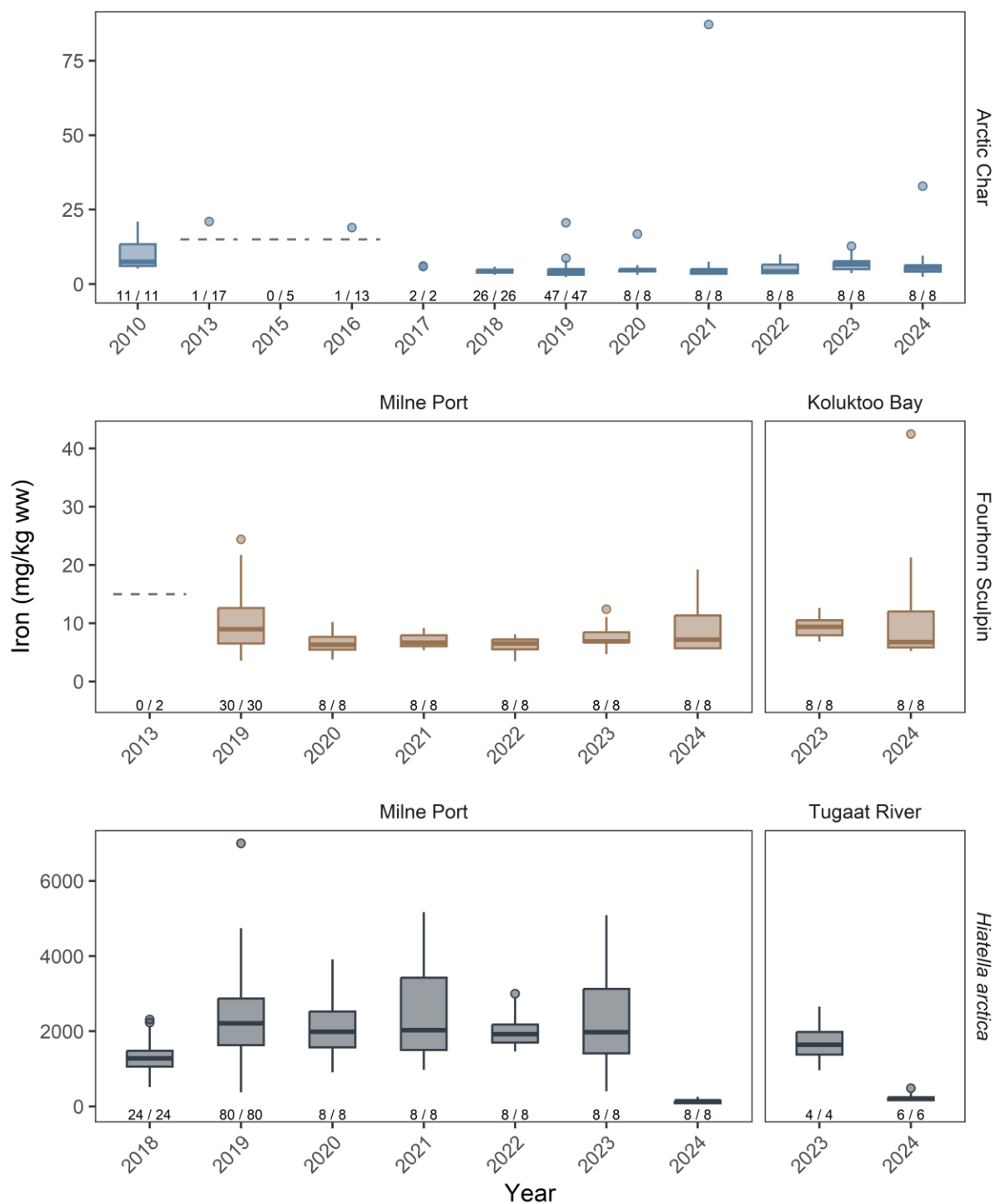
Total sample size (n) and number of samples above detection limits (n>DL) are shown above the x-axis as “n>DL/n”. Values below DL are not shown in the plots. Dashed lines indicate detection limits. Detection limit of 0.2 mg/kg for Arctic Char (2013, 2015, 2016) and Fourhorn Sculpin (2013) not shown to improve interpretability.

Figure 7C-11: Concentrations of Cobalt for Arctic Char, Fourhorn Sculpin and *Hiatella arctica* Tissue Sampled from the Milne Port Area and Reference Areas, 2010 to 2024



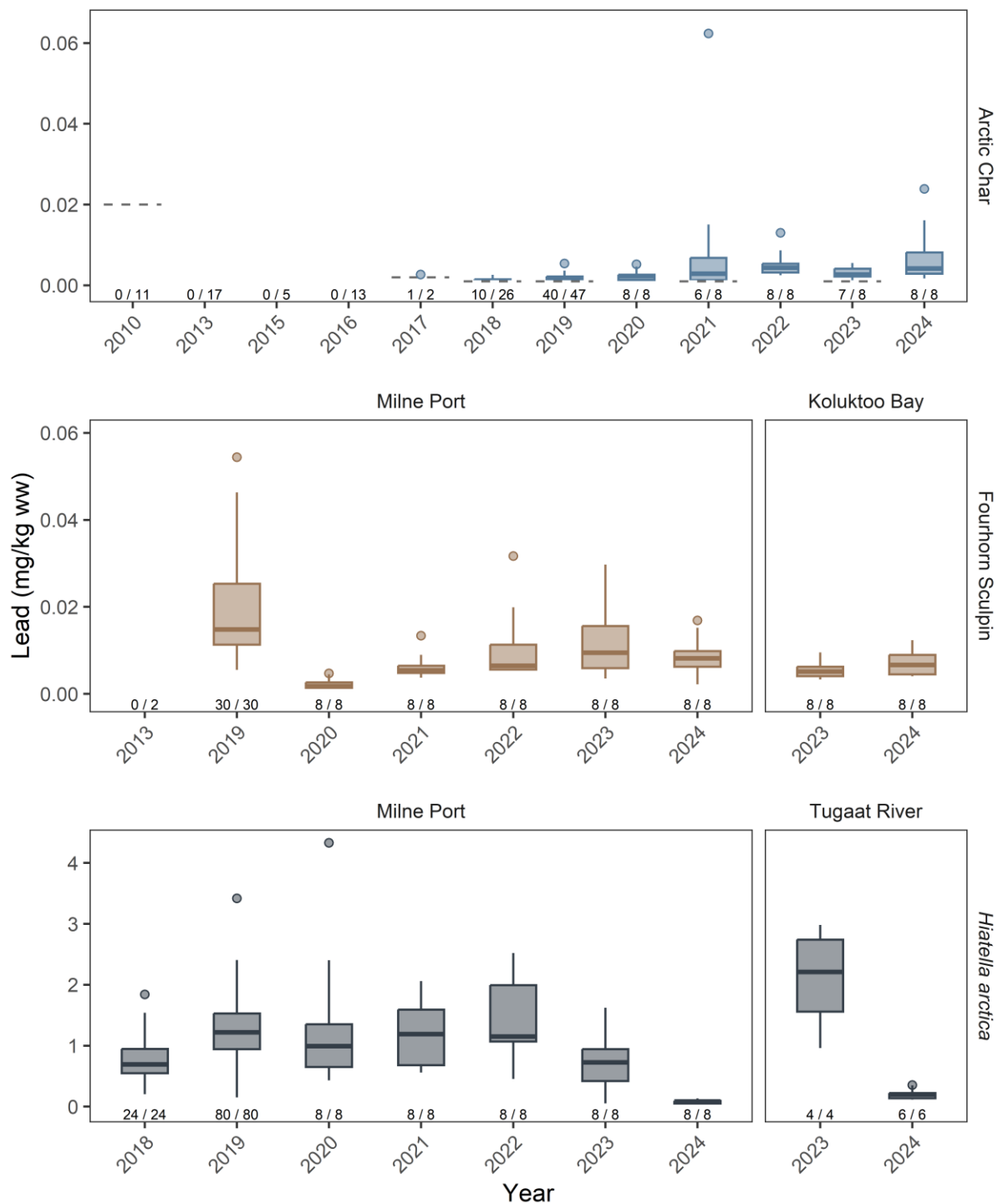
Total sample size (n) and number of samples above detection limits (n>DL) are shown above the x-axis as “n>DL/n”. Values below DL are not shown in the plots. Dashed lines indicate detection limits.

Figure 7C-12: Concentrations of Copper for Arctic Char, Fourhorn Sculpin and *Hiatella arctica* Tissue Sampled from the Milne Port Area and Reference Areas, 2010 to 2024



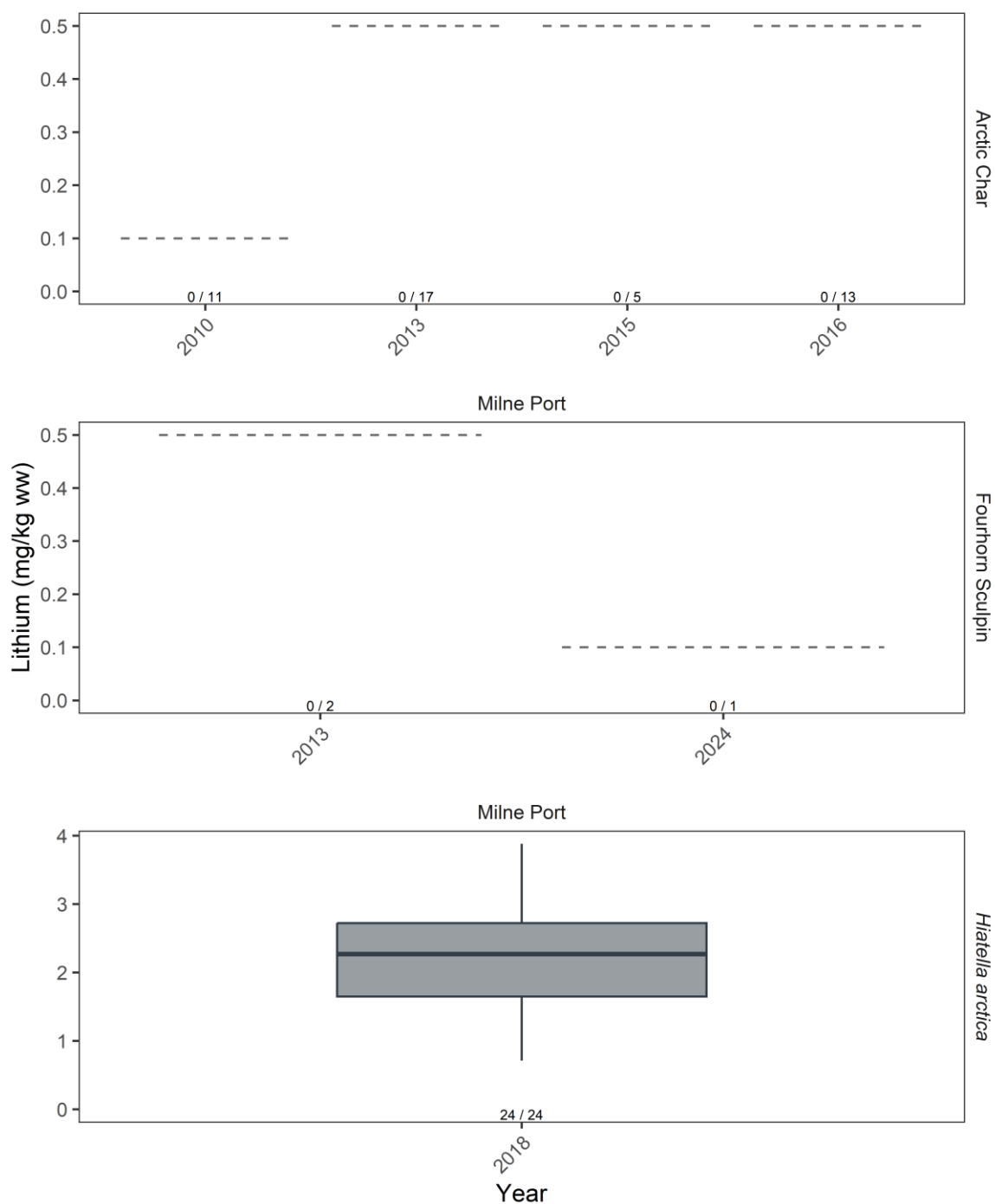
Total sample size (n) and number of samples above detection limits (n>DL) are shown above the x-axis as “n>DL/n”. Values below DL are not shown in the plots. Dashed lines indicate detection limits.

Figure 7C-13: Concentrations of Iron for Arctic Char, Fourhorn Sculpin and *Hiatella arctica* Tissue Sampled from the Milne Port Area and Reference Areas, 2010 to 2024



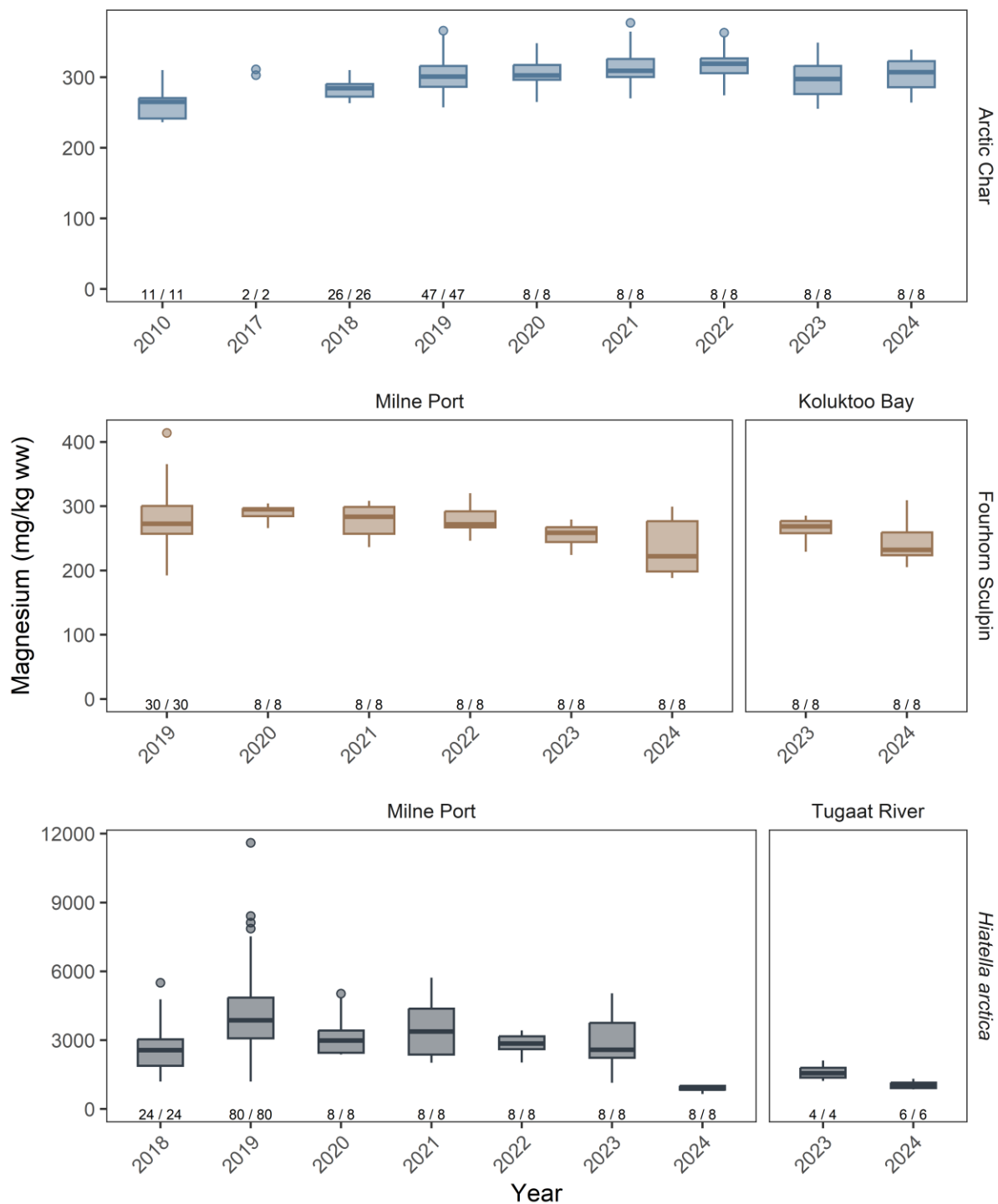
Total sample size (n) and number of samples above detection limits (n>DL) are shown above the x-axis as “n>DL/n”. Values below DL are not shown in the plots. Dashed lines indicate detection limits. Values truncated at 0.065 mg/kg ww and 0.060 mg/kg ww for Arctic Char and Fourhorn Sculpin, respectively, to improve interpretability.

Figure 7C-14: Concentrations of Lead for Arctic Char, Fourhorn Sculpin and *Hiatella arctica* Tissue Sampled from the Milne Port Area and Reference Areas, 2010 to 2024



Total sample size (n) and number of samples above detection limits (n>DL) are shown above the x-axis as "n>DL/n". Values below DL are not shown in the plots. Dashed lines indicate detection limits.

Figure 7C-15: Concentrations of Lithium for Arctic Char, Fourhorn Sculpin and *Hiatella arctica* Tissue Sampled from the Milne Port Area and Reference Areas, 2010 to 2024



Total sample size (n) and number of samples above detection limits (n>DL) are shown above the x-axis as "n>DL/n". Values below DL are not shown in the plots.

Figure 7C-16: Concentrations of Magnesium for Arctic Char, Fourhorn Sculpin and *Hiatella arctica* Tissue Sampled from the Milne Port Area and Reference Areas, 2010 to 2024