Briefing for PWSRCAC Board of Directors – January 2026

ACTION ITEM

Sponsor: Danielle Verna and the Scientific Advisory Committee

Project number and name or topic: 9510 - Long-Term Environmental Monitoring Program

1. **Description of agenda item:** The Board is being asked to accept the 2025 Summary Report and Technical Supplement for the Council's Long-Term Environmental Monitoring Program (LTEMP) by Dr. Morgan Powers of Fjord & Fish Sciences, both dated December 2025. The report and technical supplement provide data and results from the 2025 sampling excursions in Port Valdez for LTEMP, now in its 32nd year.

2. **Why is this item important to PWSRCAC:** The Oil Pollution Act of 1990 directs PWSRCAC to "devise and manage a comprehensive program of monitoring the environmental impacts of the operations of terminal facilities and crude oil tankers while operating in Prince William Sound" – LTEMP is designed to address this directive. LTEMP results are used to assess the environmental impacts of the Valdez Marine Terminal and the crude oil tankers operating in Prince William Sound, including the long-term impacts of the Exxon Valdez oil spill.

3. **Previous actions taken by the Board on this item:** The Long-Term Environmental Monitoring Program has been conducted by PWSRCAC since 1993, and many actions have been taken by the Board on this item since that time. In the interest of providing recent pertinent information, only the last five years of actions related to LTEMP are presented below. All historic actions pertaining to this agenda item are available for review upon request (for more information contact Danielle Verna).

Meeting	Date	Action
Board	1/27/2022	Authorized a budget modification, adding $53,880 to Project 9510-Long-Term Environmental Monitoring Program; and authorized a contract negotiation with Owl Ridge Natural Resource Consultants, to complete the LTEMP scope of work in RFP 951.21.06, and with Payne Environmental Consultants, to support Owl Ridge's work, at a total aggregate cost not to exceed $77,000.
Board	6/21/2022	Approved an FY2023 budget modification, adding $6,478 to project #9510 – Long-Term Environmental Monitoring Program, for contract expenses; and, approved a negotiation of a contract change order, for contract #951.22.06, with Owl Ridge Natural Resource Consultants, adding $6,478 for compensation to archive the 1993-2021 LTLEMP data in the Alaska Ocean Observing System.
Board	1/26/2023	Authorized an FY2023 budget modification from the contingency fund to project #9510 – Long Term Environmental Monitoring Program adding $836 for contract expenses and approval of negotiation of a contract change order, for contract #951.22.06, with Owl Ridge Natural Resource Consultants, adding $5,058 for compensation to archive the 1993-2021 LTEMP data in the Alaska Ocean Observing System and extending the term of the contract to March 31, 2023. [Note: This change order would increase the total contract amount to $68,007.]
Board	5/4/2023	Approved the following: a) authorization of individual contracts with Alpha Analytical and Owl Ridge Natural Resource Consultants, Inc. with the aggregate

		total not to exceed the amount approved in the final FY2024 LTEMP budget (Project #9510) for contract expenses, and b) authorization of contract work to commence prior to the start of the 2024 fiscal year to accommodate timing considerations and purchasing needs. It is estimated that up to $15,000 of the above contract work may be performed before June 30, 2023.
Board	9/19/2024	Authorized a budget modification in the amount of $6,006 from the contingency fund to Project 9510 in the FY2025 budget and authorization for the Executive Director to carry out a corresponding change order to increase Contract 9510.25.06 with Fjord & Fish Sciences in an amount not to exceed $61,731.
Board	1/25/25	Accepted the reports titled "Long-Term Environmental Monitoring Program 2024 Summary Report," "Long-Term Environmental Monitoring Program 2024 Technical Supplement," and "Long-Term Environmental Monitoring Program 2024 Sediment Metals Report" by Morgan Bender of Fjord & Fish Sciences dated December 2024, as meeting the terms and conditions of Contract number 9510.25.06, and for distribution to the public.
Board	5/1/25	Authorized individual contracts with Pace Analytical Services and Fjord & Fish Sciences with the aggregate total not to exceed the amount approved in the final FY2026 LTEMP budget (Project 9510) for contract expenses, and delegation of authority to the Executive Director to enter into individual contracts with the aforementioned consultants; and, authorized a contract work to commence prior to the start of FY26, as approximately $20,000 of these funds will need to be expended in April and May 2025.

4. **Summary of policy, issues, support, or opposition:** None.

5. **Committee Recommendation:** The Scientific Advisory Committee has reviewed the summary report and technical supplement, and recommended the Board accept the material as final via email poll in November 2025.

6. **Relationship to LRP and Budget:** Work associated with this project was included in the FY2026 budget under contract 9510.26.04 in an amount not to exceed $75,100.

7. **Action Requested of the Board of Directors:** Accept the reports titled "Long-Term Environmental Monitoring Program 2025 Summary Report" and "Long-Term Environmental Monitoring Program 2025 Technical Supplement," by Dr. Morgan Powers of Fjord & Fish Sciences dated December 2025, as meeting the terms and conditions of contract number 9510.26.04, and for distribution to the public.

8. **Alternatives:** None.

9. **Attachments:**
   - A) Long-Term Environmental Monitoring Program 2025 Summary Report
   - B) Long-Term Environmental Monitoring Program 2025 Technical Supplement

fjord & fish sciences

December 2025

Final

2025 Summary Report

Long-Term Environmental Monitoring Program

PREPARED FOR

Prince William Sound Regional Citizens' Advisory Council
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"The opinions expressed in this PWSRCAC commissioned report are not necessarily those of PWSRCAC. PWSRCAC Contract #9510.26.04."

Acronyms and Abbreviations

ANS	Alaska North Slope
BWTF	Ballast Water Treatment Facility
EPA.....	U.S. Environmental Protection Agency
EVOS	Exxon Valdez Oil Spill
LTEMP.....	Long-Term Environmental Monitoring Program
NOAA.....	National Oceanic and Atmospheric Administration
PAHs	Polycyclic aromatic hydrocarbons
PPB (or ng/g)....	Parts Per Billion (or nanograms per gram)
PWSRCAC	Prince William Sound Regional Citizens' Advisory Council

1. Abstract

Following the 1989 Exxon Valdez oil spill, concerned citizens and congressional legislation established the Prince William Sound Regional Citizens' Advisory Council (Council). The Council's mission is citizens promoting the environmentally safe operation of the Valdez Marine Terminal and associated oil tanker activities within the spill-affected area. Since 1993, annual monitoring of marine sediments and intertidal blue mussels (*Mytilus trossulus*) has been conducted, focusing on polycyclic aromatic hydrocarbons (PAHs), saturated hydrocarbons, and petroleum geochemical biomarkers essential for oil spill forensics. Sampling sites include areas with current oil tanker activities (e.g., loading, anchoring, transport routes), previously oiled sites from the Exxon Valdez spill, and reference locations with varying hydrocarbon sources.

Over the past 32 years of the Council's Long-Term Environmental Monitoring Program (LTEMP), the data have shown fluctuating hydrocarbon levels in sediments and mussels, with some measurements indicating toxic concentrations. Monitoring in the last two decades has generally recorded low levels of hydrocarbons. However, localized spikes—such as from the 2020 spill at the Valdez Marine Terminal—indicate small-scale oil releases. Low levels of petroleum hydrocarbons, traceable to Alaska North Slope crude oil, have been detected in marine sediments near the Valdez Marine Terminal. However, pyrogenic compounds from combustion processes are also prevalent. In 2025, we see hydrocarbon concentrations in the low parts per trillion in seawater (Total PAHs <20 ng/L), low parts per billion in marine sediments (Total PAHs <250 ng/g dry weight), and low parts per billion in intertidal mussel tissue (<10 ng/g wet weight) in Port Valdez at LTEMP sites. We find that 2025 sediment, tissue, and water concentrations are unlikely to elicit adverse effects when compared with US EPA, international, and independently assessed concentration thresholds that predict toxic effects on marine organisms.

This extensive dataset contains 263,135 chemical data points from sediments, mussels, and seawater (i.e., 249,902 in the sediment/tissue database and 13,233 in the seawater database) collected at numerous remote and rural sites on the traditional lands and waters of the Chugach, Eyak, and Alutiiq/Sugpiaq peoples. This program provides valuable information about temporal trends in petroleum hydrocarbon contamination in the region and baseline data critical for detecting and monitoring lingering contamination, impacts from current activities, and potential future releases. With the breadth and longevity of this dataset, we propose additional analysis and publication in a peer-reviewed scientific manuscript to increase the visibility and utilization of this important work. The LTEMP holds significant potential for further exploration, offering insights into environmental change, hydrocarbon weathering, fate and transport processes, lingering oil, and the biological impacts of hydrocarbons. The utility of the LTEMP in maintaining a robust baseline hydrocarbon database continues to be critical in light of rapid environmental change and continued petroleum pollution risk.

2. Introduction

The Long-Term Environmental Monitoring Program (LTEMP), managed by the Prince William Sound Regional Citizens' Advisory Council (PWSRCAC), is in its 32nd year of monitoring hydrocarbons after the Exxon Valdez oil spill (EVOS) in 1989. Through LTEMP, we aim to determine the sources of hydrocarbons and the potential adverse effects on the ecosystem associated with Alyeska Pipeline Service Company's Valdez Marine Terminal (terminal) and tanker activity. These data have been insightful in understanding the influence of terminal and non-terminal sources of hydrocarbons and environmental factors on hydrocarbon dynamics across Prince William Sound and the Gulf of Alaska.

Hydrocarbons are a highly diverse group of compounds that comprise the bulk of petroleum products, such as crude oil and fuels, and of maritime products, such as hydraulic and motor oils. However, hydrocarbons are also readily created by marine and terrestrial plants, locked up in organic sediments and rocks, and produced by combustion. Hydrocarbons in the environment undergo weathering, including dissolution, evaporation, ultraviolet degradation, and microbial degradation. Weathering changes hydrocarbons' physical and chemical properties, altering their relative abundance, environmental fate, transport, and toxic potential. Polycyclic aromatic hydrocarbons (PAHs) are a group of hydrocarbons in oil with varying numbers of benzene rings that are relatively resistant to degradation and toxic to living organisms. This group of chemicals tends to adsorb rapidly on suspended materials and sediments and accumulate in biological tissues once released into the marine environment.

As a group, PAHs comprise hundreds of compounds, each with its own degree of toxicity, and their mixtures can exhibit a wide range of toxicities. Specific hydrocarbons, patterns, and diagnostic compounds (i.e., (petro-geo) chemical biomarkers) aid in identifying specific hydrocarbon sources and indicate their weathering history (e.g., degree of weathering, degradation, dissolution). PAH profiles are used to identify petrogenic (of crude oil origin) or pyrogenic (of combustion origin) based on well-established pattern changes (e.g., on the ratio of parent and alkylated compounds). Chemical biomarkers, comprising the hopanes, steranes, terpenes, tri-aromatic, and monoaromatic steroids, are much more resistant to degradation in the environment and thus used to confirm sources (e.g., between different crude oils) even when the PAH patterns are heavily weathered. Saturated hydrocarbons (n-alkanes) are used to identify naturally occurring plant hydrocarbons and determine the degree of weathering and biodegradation.

While aquatic vertebrates such as fish can metabolize PAHs, marine invertebrates, such as Pacific blue mussels, are less efficient at processing these compounds. Mussels remain sedentary in one spot and filter particles from their environment, making them effective natural samplers and indicators of overall environmental PAH exposure (Neff & Burns, 1996). Adverse effects of PAH exposure on aquatic organisms include impaired

reproduction, developmental problems, tissue damage, cellular stress, oxidative stress, genetic damage, and death. Although knowledge of the harmful effects of petroleum exposure is extensive, details regarding PAH mixtures, exposure routes, duration, intensity, species and life stages affected, and other environmental factors that may interact are challenging to predict. This underscores the importance of ongoing monitoring efforts by LTEMP.

The ubiquity of hydrocarbons and their sources necessitates the use of multiple matrices to understand their sources, environmental fate, and potential ecotoxicological effects. Marine sediments, which accumulate hydrocarbons, petro-geochemical biomarkers, and saturated hydrocarbons, are appropriate for source analysis and risk assessment. Sources investigated for the present study are those associated with terminal operations, including Alaska North Slope (ANS) crude oil pumped through the trans-Alaska pipeline and loaded into tankers at the terminal. Sessile filter-feeding organisms, such as intertidal blue mussels, reflect chemicals that bioaccumulate in local native biota and can pose ecotoxicological risks. Passive sampling devices measure the dissolved, bioavailable fraction of hydrocarbons, which may pose risks to organisms and ecosystems.

The following study presents the 2025 results from the LTEMP and aims to determine the following:

- The extent, if any, to which the terminal and associated tankers' hydrocarbon fingerprint is present in 2025 samples, with varying ranges from the terminal.
- The potential ecotoxicological risk posed by the measured hydrocarbon contribution from the terminal and tankers.
- The historical trends, ecotoxicological risk, and hydrocarbon fingerprint from mussels collected from extended sampling sites across greater Prince William Sound in 2025.
- The ecotoxicological relevance of these results, given other factors (e.g., environmental or anthropogenic) that may influence the presence and composition of hydrocarbons in 2025 samples.
- Recommendations for future monitoring of petroleum hydrocarbons at the terminal and in Prince William Sound.

3. Briefly, The Methods

Sediment, passive sampling device, and Pacific blue mussel tissue samples were collected in late May of 2025 from annual monitoring stations in Port Valdez. The sampling program investigated three matrices: sediment, Pacific blue mussels, and seawater. Sediments were sampled at Alyeska's Valdez Marine Terminal and Gold Creek (Figure 1). Pacific blue mussel samples were taken from four sites around the Port of Valdez with a focus on the terminal – Alyeska's Valdez Marine Terminal (also referred to as Saw Island), Jackson Point, Gold

Creek, and Valdez Small Boat Harbor entrance (RED - a site that is chemically different from the ANS terminal source signature and currently acts as a high human use, non-ANS reference site). Water was sampled with passive sampling devices at three sites in 2025 — Gold Creek, Jackson Point, and the terminal/Saw Island. Sampling was replicated using triplicates collected from each site across each matrix with three sediment grabs, three composite blue mussel samples, and three composite passive sampling device samples.

Samples were analyzed for PAHs, saturated hydrocarbons, and geochemical petroleum biomarkers using advanced analytical techniques at Pace Analytical Services in Mansfield, Massachusetts (sediments and tissues), and the Oregon State University Food Safety and Environmental Stewardship lab in Corvallis, Oregon (passive sampler, PAHs only). These are the same laboratories that have participated in the LTEMP effort for the last nine years. Briefly, the results continue to be of acceptable precision and accuracy and can be compared to previous years' data. The physical characteristics of sediments were also reported in laboratory results, though they are not presented herein.

Many compounds, especially in the mussel tissues, were below or near the analytical methods detection limit, or were not detected in the sample. Sediment and mussel tissue concentrations are plotted and discussed as a sum of multiple PAHs (sum PAH) either by

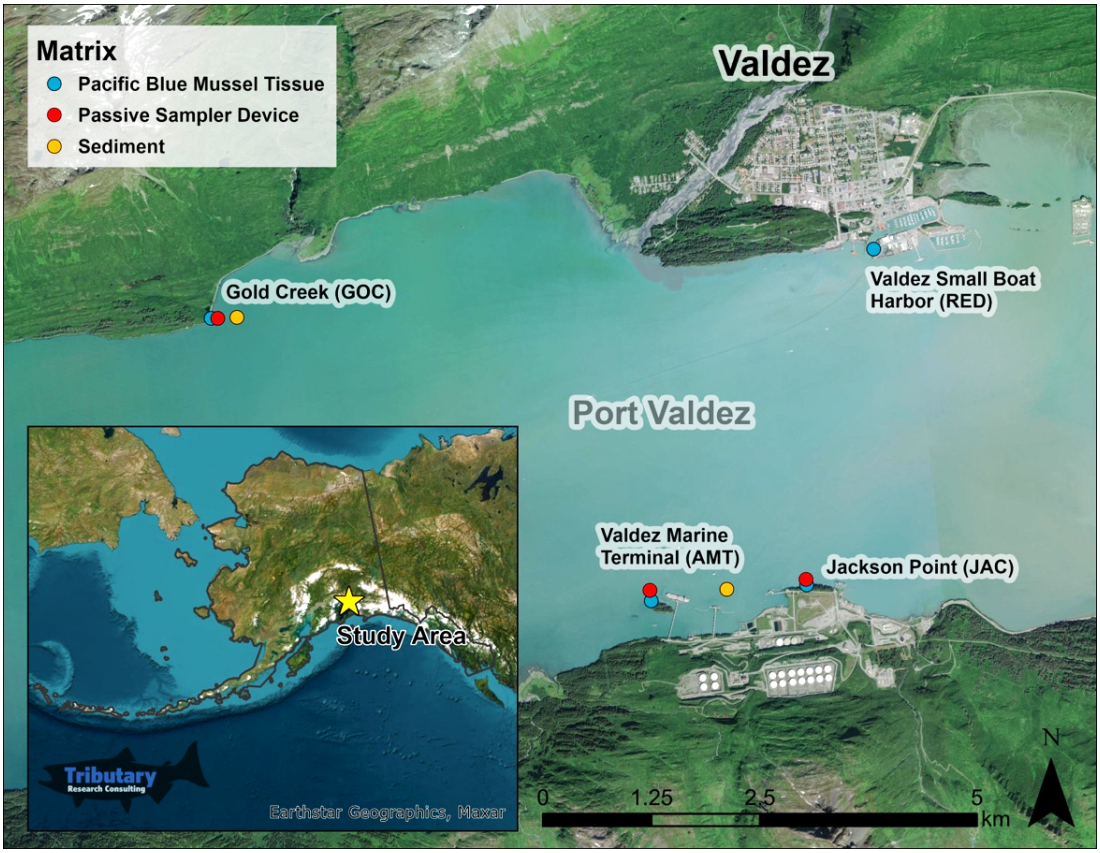

Figure 1. Long-Term Environmental Monitoring Program sites from the 2025 campaign in Port Valdez. The color of the points represents differences in sampling matrices at each site.

dry weight or wet weight, and corrected by factors influencing bioavailability, like total

organic carbon in sediments or lipid content in mussel tissues. Passive sampling device concentrations have been converted by the analytical lab into the dissolved-phase water concentration, C-free concentration. By converting the concentration units, comparisons can be made across other studies, areas, and ecotoxicological effect thresholds. Concentrations below the method level of detection threshold were provided by the lab as an estimate. These estimated concentrations were plotted on PAH profile figures and included in sum calculations; compounds that were not detected in a sample or were biased by laboratory issues (i.e., matrix interference) were not included in the sum calculations. Forensic interpretation was done using analyte profile pattern comparisons for ANS crude for geochemical petroleum biomarkers in sediment samples. Blue mussels and passive sampling devices tentative forensic assertions were made by qualitative ratios of parent to alkylated compounds, and low and high molecular weight PAH compounds. Analytical results and calculations for all samples and all analytes, pattern profiles, forensic ratios, and laboratory blanks are presented in the Technical Summary (Fjord & Fish, 2025) to support the assertions made in this summary report.

4. Results & Discussion

4.1. Subtidal Marine Sediments

Hydrocarbons were detected in all sediments sampled at the terminal and Gold Creek sites in the low parts per billion range (ppb or ng/g). One (1) ng/g or one ppb can be visualized as the concentration of 50 drops in an Olympic-sized swimming pool. In 2025, the highest sum (∑) PAH concentrations were found at the terminal (250 ± 212 ng/g dry weight) compared to Gold Creek sediment (36 ± 10 ng/g dry weight; Figure 2). Parent and alkylated 2 ring dibenzothiophenes, 3-ring naphthalenes, phenanthrenes/anthracenes, 4-ring fluoranthenes/pyrenes made up the bulk of PAHs at the terminal in 2025 (Figure 3). At Gold Creek, similar compounds made up the bulk of detectable PAHs but with greater contribution from naphthalenes and parent PAHs generally. Greater variability in PAH analytes from the terminal sediments indicates a heterogeneous distribution, likely reflecting the distance of grab samples from the outfall pipe. For comparison, PAH concentrations across both Port Valdez sites are lower than those reported in Norwegian fjords, Novia Scotia small boat harbors, and the Baltic Sea (Oen et al., 2006; Davis et al., 2018; Pikkarainen, 2010). Present Port Valdez concentrations were more similar to those reported from sediments of Cook Inlet and St. Paul Island, Alaska (Nesvacil et al., 2016).

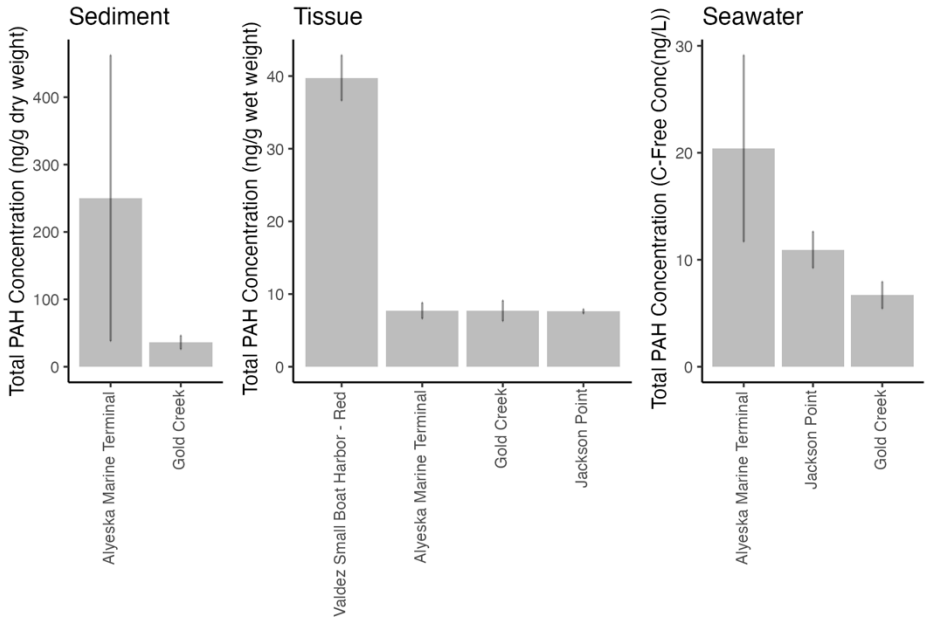

Figure 2. Sum PAH concentrations for 2025 sediments, Pacific blue mussel tissues, and water sampled via passive sampling devices by site plotted at the mean ± 1 standard deviation. Note the unit difference between matrices (i.e., parts per billion for sediments and mussel tissues, and parts per trillion for passive sampling devices).

4.1.1. Sediments - Ecotoxicological Interpretation

In 2025, individual and total PAH concentrations in sediment at the terminal and Gold Creek sites pose little to no risk, either acute or chronic, for marine organisms, with all concentrations at least ten times lower than U.S. Environmental Protection Agency (EPA) sediment quality PAH benchmarks for aquatic life. Specifically, this assessment used the Equilibrium Partitioning Sediment Benchmarks for PAH Mixtures (EPA, 2003) with organic carbon–corrected concentrations. Measured concentrations are also below protective regulatory thresholds in other countries, such as Norway (Bakke et al., 2010). While these benchmarks might not fully reflect the benthic communities adapted to Port Valdez's cold, sediment-rich waters, previous monitoring around the terminal has shown little to no change in benthic communities despite varying PAH concentrations (Shaw & Blanchard, 2021). The sediment's total organic carbon content is low (0.4–0.5%), indicating higher bioavailability of PAHs to marine life. Though high molecular weight PAHs are detected—particularly at the terminal—their concentrations do not surpass any protective benchmarks. Carcinogenic PAHs are present at low levels at both sites.

4.1.2. Sediments - Site-Specific Source Identification

The hydrocarbons in the 2025 terminal sediments are determined to be derived from ANS crude oil. Biomarker patterns closely match ANS crude oil; however, PAH profiles indicated ANS crude with other sources, as high molecular weight PAHs with greater than four rings were overrepresented compared to the ANS standard. The diagnostic biomarkers and their ratios confirm ANS crude oil as the source of hydrocarbons at the terminal. Additional hydrocarbons from non-ANS sources are present in the Ballast Water Treatment Facility (BWTF) effluent, contributing to the PAH profile and the elevated sum PAH concentration. The ratios of several PAHs differed between the terminal and Gold Creek, suggesting some petrogenic sources at the terminal compared to more pyrogenic and weathered sources at Gold Creek.

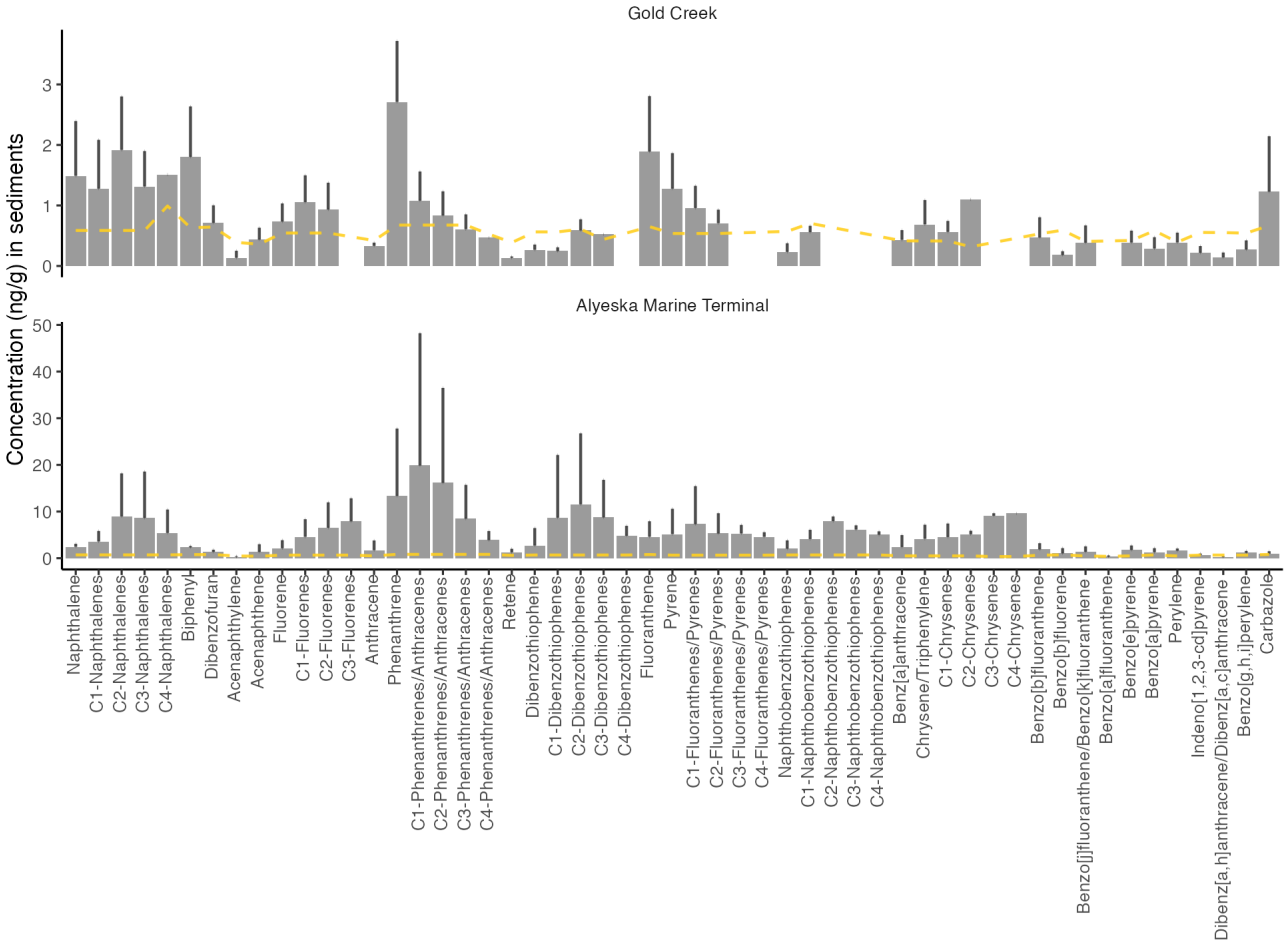

Figure 3. 2025 PAH profiles from sediments sampled at Gold Creek and the Valdez Marine Terminal site plotted as the mean ± 1 standard deviation for the three replicate samples. A dashed, yellow line indicated the analyte-specific method detection limit. Note the difference in scale between the two panels.

Diagnostic ratios point to wood combustion and petrol emissions sources. Saturated hydrocarbons at both sites reveal strong microbial degradation and weathering of the

hydrocarbons, leaving the higher molecular weight saturated compounds (and, in some cases, terrestrial plant wax compounds).

At Gold Creek, chemical biomarkers were sparse compared to those at the terminal; still, petrogenic biomarker traces confirm the oil signal as a distant source. However, the PAH patterns are mixed petrogenic and pyrogenic. Gold Creek sediments are moderately weathered with a near-complete loss of saturated hydrocarbons, except those contributed by terrestrial plants. In summary, hydrocarbon concentrations in the terminal sediments are linked to the terminal activities and are similar to incidents and activities reported in previous LTEMP reports (e.g., BWTF effluent, spills, and combustion) with residues that have undergone environmental degradation and accumulated over time. Gold Creek sediments show lower hydrocarbon levels and fewer constituents, likely indicative of less recent sources.

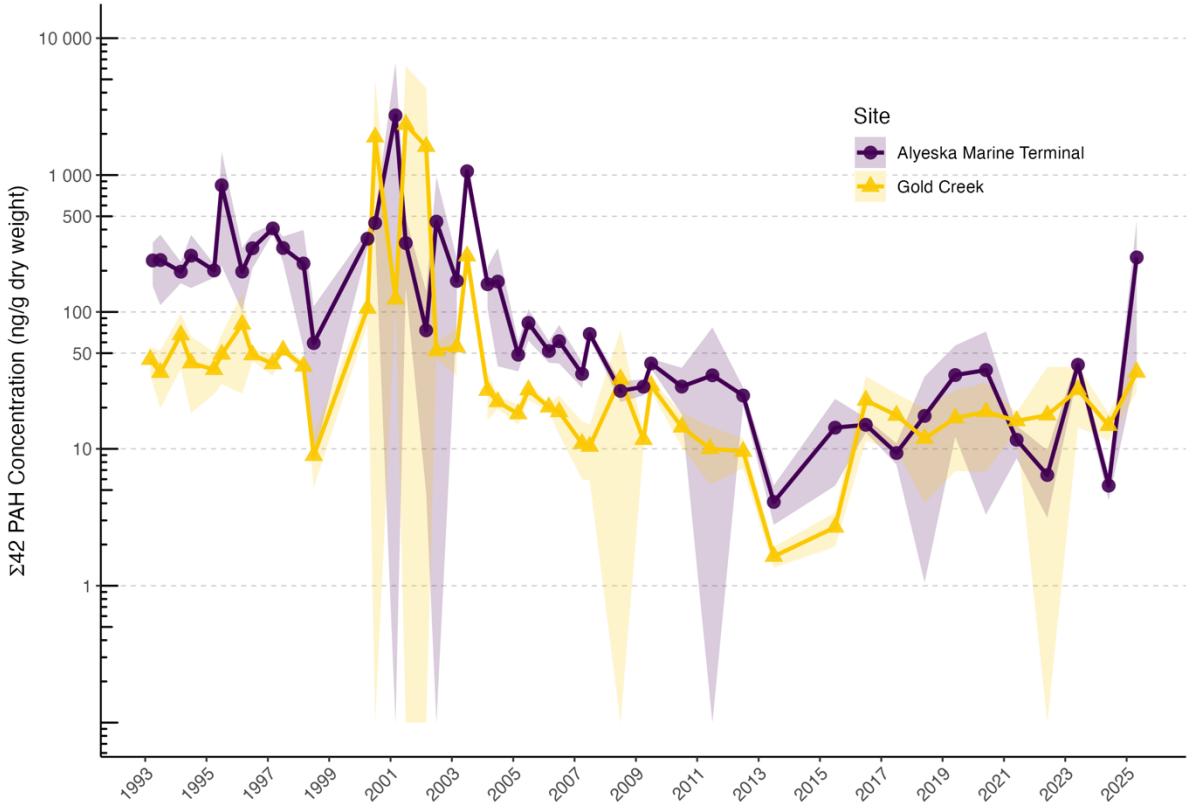

Figure 4. Sum PAH concentrations in sediments over the duration of LTEMP. Colors and shapes indicate the sampling site; mean values ± 1 standard deviation are plotted for each sampling event.

4.1.3. Sediments - Historical Perspective

Hydrocarbon concentrations have varied widely throughout the LTEMP monitoring period from 1993 to the present (Figure 4). The highest sediment PAH concentrations were measured in the early 2000s. Since 2005, hydrocarbon concentrations have remained low. While recent years have seen similar hydrocarbon concentrations between the two sites,

the 2025 terminal concentrations were substantially higher than values at Gold Creek or any site in the last 19 years. Terminal sediments have generally contained higher, more variable PAH loads than Gold Creek, although considerable overlap in PAH concentration ranges between the two stations has persisted from 2008-2024.

4.2. Pacific Blue Mussels

PAHs were detected in Pacific blue mussels at low concentrations at all LTEMP sites in 2025 (Figure 2), with low to moderate concentrations measured at the non-ANS positive control site Valdez Small Boat Harbor site (39.7 ± 3.1 ng/g wet weight). Valdez Marine Terminal (i.e., Saw Island), Jackson Point (terminal downstream), and Gold Creek had indistinguishable PAH tissue levels in 2025 (7.6-7.7 ng/g wet weight).

Phenanthrene was the most abundant PAH at LTEMP sites (Figure 5). Most PAHs were at or under detection limits (<1.0 ng/g) at LTEMP sites. When compared to other Alaska marine species in a recent meta-analysis, hydrocarbon tissue concentrations in 2025 mussel measurements are greater than average values in non-mussel invertebrates and seaweed but less than the average values of fish, seals, and whales (Fjord & Fish, 2025b). The 2025 tissue PAH concentrations in Port Valdez are comparable to those found in relatively pristine locations in national parks, national forests, and National Oceanic and Atmospheric Administration (NOAA) Mussel Watch sites around southcentral and southeast Alaska, and well below the high concentrations (>1000 ng/g dry weight (138 ng/g wet weight when using mean conversion factor from LTEMP mussel data)) found in the harbor at Skagway, Alaska (Rider, 2020). Additionally, mussel tissue PAH concentrations were comparable to those measured in pelagic zooplankton in Valdez Arm (Carls et al., 2006) and to mussels caged two kilometers or greater from an oil rig in the North Sea (Sundt et al., 2011). Mussels from the Valdez Small Boat Harbor exceeded NOAA's national long-term monitoring status "Low Concentration" range (0–173 ng/g dry weight (0–24 ng/g wet weight)). At the Valdez Small Boat Harbor, larger PAHs, such as fluoranthene, were more prevalent than at LTEMP standard sites (i.e., terminal upstream and downstream, and Gold Creek). Like the Valdez Small Boat Harbor location, fluoranthene was also the most abundant PAH in mussels in a Norwegian fjord with moderate human activity, where the sum PAH concentrations were comparable to this study (Schøyen et al., 2017).

4.2.1. Mussels - Ecotoxicological Interpretations

At the 2025 tissue concentrations, no adverse biological effects are predicted at the low exposure levels (Bowen et al., 2018). Similar mussel tissue concentrations did not elicit early warning signs for genotoxicity or cellular toxicity in laboratory and field studies (Hylland et al., 2008; Sundt et al., 2011). Sampled mussels did not approach the calculated food safety threshold for bivalves in the European Union nor the U.S. Food and Drug Administration risk criteria levels for vulnerable populations developed after the BP Deepwater Horizon oil spill (Rotkin-Ellman et al., 2012; Shen et al., 2020).

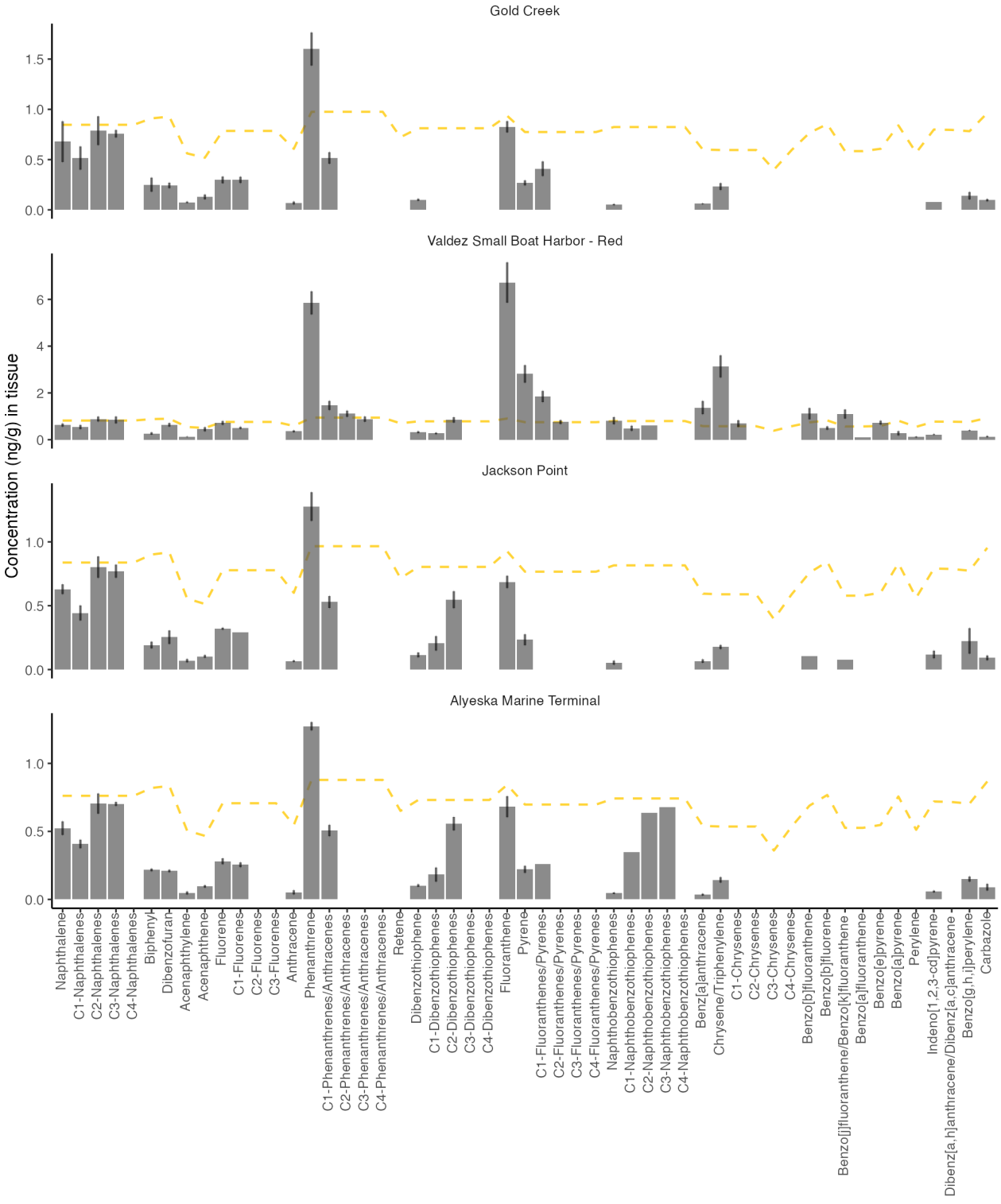

Figure 5. 2025 PAH profiles from Pacific blue mussels plotted as the mean ± 1 standard deviation for the three replicate samples. A dashed, yellow line indicates the analyte-specific method detection limit. Note the difference in y-axis scale between the panels.

4.2.2. Mussels - Site-Specific Source Identification

As tissue hydrocarbon concentrations and chemical compositions are driven by the bioavailability of compounds, environmental conditions, and physiological, cellular, and molecular processes in the mussels, which govern exposure, uptake, metabolism, and elimination, source identification analysis should be performed cautiously.

In 2025, Gold Creek, Jackson Point, and Valdez Marine Terminal (i.e., Saw Island) mussels exhibited similar PAH profiles with very few PAHs and petroleum biomarkers detected, indicating low bioavailability of petroleum hydrocarbons. A general comparison of low molecular weight to high molecular weight PAHs reveals petrogenic sources for these sites across all samples, although not specifically ANS origin. Petro-geochemical biomarkers show oil-derived material and microbial degradation of straight-chain alkanes at these sites (Technical Supplement Table 10). Diagnostic ratios of PAHs strongly support pyrogenic, non-ANS sources of hydrocarbons at the Valdez Small Boat Harbor; this site also had the least weathered hydrocarbon input as interpreted by higher saturated hydrocarbon levels compared to other sites.

4.2.3. Mussels - Historical Perspective

Historical trends in Pacific blue mussel tissue PAH concentrations are variable, reflecting known oil spill incidents in 2004 at Gold Creek, and 2017 and April 2020 at the terminal (Figure 7). Within the broader trend, PAH variability and mean tissue concentrations have remained stable since 2003, in the absence of known spills. In non-spill conditions, mussel tissue concentrations have remained below <100 ng/g dry weight, indicating the mussels are likely not under PAH exposure-induced stress. However, high values have been recorded following spill incidents (e.g., 244,000 ng/g wet weight after the April 2020 terminal spill, not shown in Figure 7). The 2025 PAH concentrations in Port Valdez mussel tissues are within the historical range of locations with limited human use and not oiled during the Exxon Valdez oil spill (Boehm et al., 2004). Positive control non-ANS site at the Valdez Small Boat Harbor continues to have elevated PAH levels compared to the standard LTEMP sites.

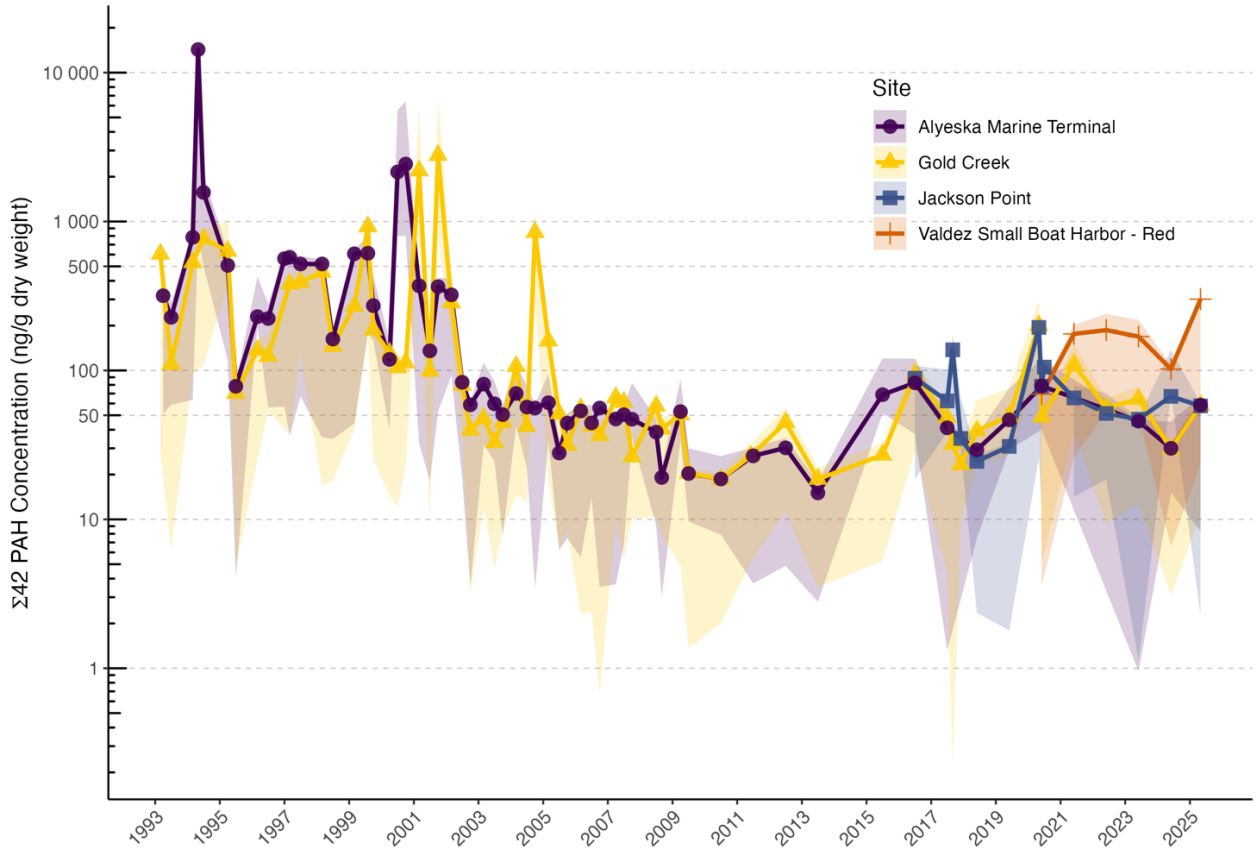

Figure 7. Sum PAH concentrations in Pacific blue mussel tissue over the entire duration of the LTEMP. Colors distinguish sampling sites and mean values are plotted for each sampling event. Values greater than 15,000 ng/g are excluded for clarity.

4.3. Seawater

In 2025, petroleum hydrocarbons were found at low parts per trillion concentrations in all Port Valdez seawater samples (Figure 2, Valdez Marine Terminal/Saw Island (20.4 ± 8.7 ng/L), Gold Creek (6.7 ±1.26 ng/L), and Jackson Point (10.9 ± 1.7 ng/L)). These hydrocarbon concentrations represent the dissolved constituents (C-free) in the subsurface waters where the samplers were deployed for 30 days in the spring. They are not traditional total water concentrations, but in this report, the passive sampling device C-free concentrations are used as a proxy for seawater concentrations of PAHs. These dissolved concentrations represent the bioavailable fraction and can be directly associated with exposure levels for organisms in the water. Passive sampling devices have been successful at predicting the hydrocarbon bioaccumulation in edible tissue of clams (Minick et al 2019).

The typical LTEMP dissolved hydrocarbon pattern of dominating and heavily water-washed naphthalenes was present at all sites and in most replicates (Figure 8). Smaller, 2–3 ring PAHs comprised 97-99% of the sum concentrations, indicating the more readily water-

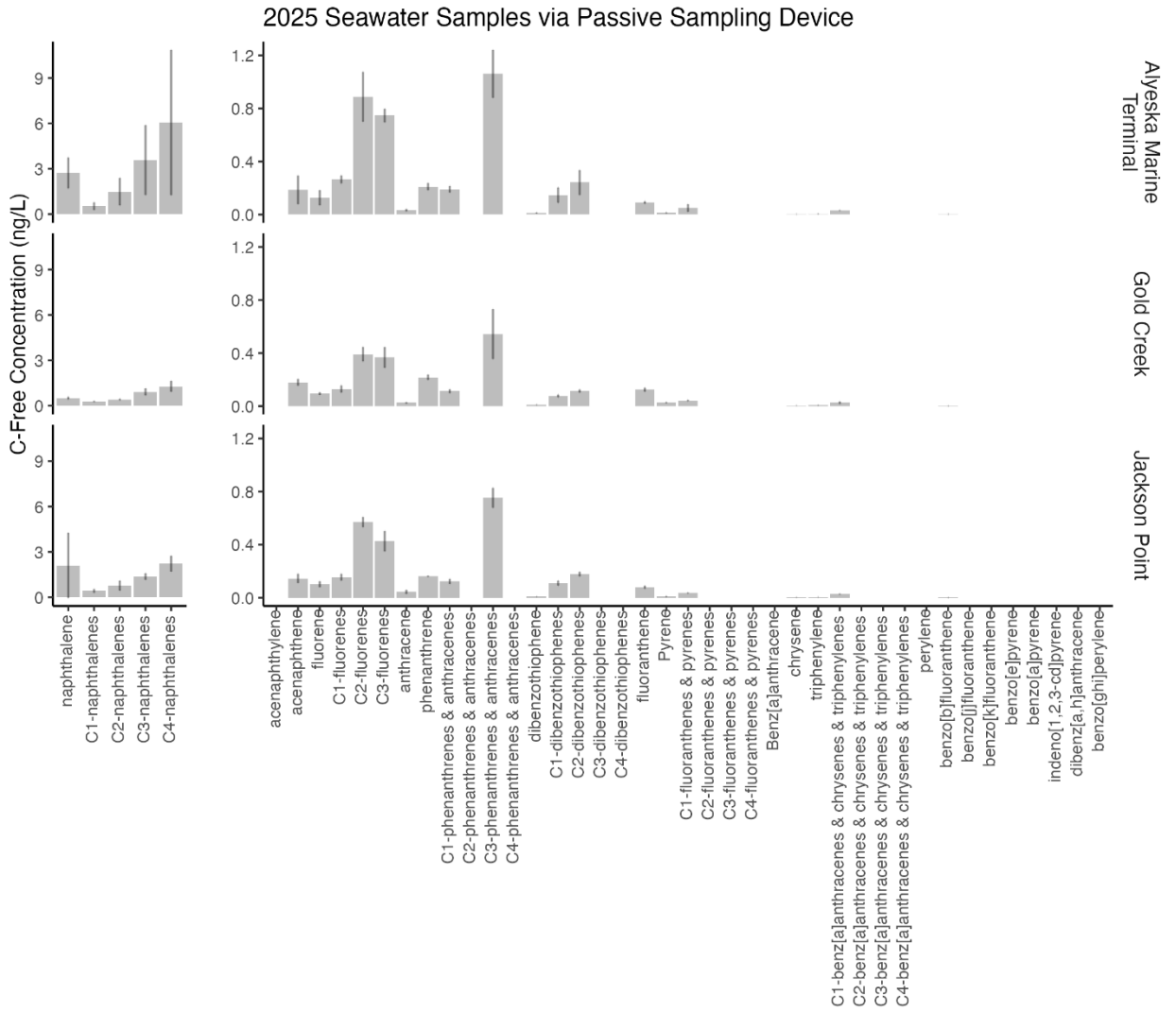

Figure 8. PAH profiles in seawater sampled via passive sampling devices placed at Valdez Marine Terminal, Gold Creek, and Jackson Point in 2025. Values represent mean ± standard deviation for the three replicates. Note the changes in scale between the Naphthalenes on the left and the other PAHs.

soluble fraction. Other PAHs detected at lower concentrations at all sites were fluorenes, fluoranthenes, dibenzothiophenes, phenanthrenes, and anthracenes.

Present dissolved PAH concentrations from the passive sampling devices are comparable to water concentrations at unoiled sites and sites with medium human activity around Prince William Sound (Short et al., 2008; Lindeberg et al., 2017). The present passive sampling device-derived water concentrations in Port Valdez were all at least two to three orders of magnitude below published water quality standards and those of polluted areas across the United States (EPA, 2002).

4.3.1. Seawater - Ecotoxicological Interpretations

Concentrations reported in the Port Valdez subsurface seawater derived by passive sampling devices are below those reported to cause adverse effects even in marine organisms' most sensitive life stages. The 2025 PAH concentrations in the parts per trillion range (i.e., one drop in 20 Olympic-sized swimming pools) are an order of magnitude lower than those reported to cause developmental and delayed effects in herring and salmon early life stages (Incardona et al., 2015). However, no analytical lower limit measured from water or tissues has been identified for developmental cardiac effects in herring (Incardona et al., 2023). Naphthalene, while present at greater concentrations than other PAHs, is of low toxicological concern at present concentrations.

Water quality guidelines set by the U.S. and Canada to represent the lowest observed acute effect concentration are not exceeded by any individual PAH or the sum PAHs (set at 300 ug/L). In 2025, water concentrations did not exceed conservative, protective individual PAH threshold concentrations set for Brazil, British Columbia, Canada, or the United Kingdom (Lourenço et al., 2023), nor the national seawater PAH benchmark comparison performed by Baldwin and colleagues (2024).

4.3.2. Seawater - Site-Specific Source Identification

Seawater primarily reflects petrogenic sources of hydrocarbons with few higher molecular weight PAHs as evidenced using diagnostic ratios. One observation is the prominent naphthalene peak with ascending alkylation, indicative of a water-washed and weathered petrogenic source in all samples. Several samples were also relatively high in the parent naphthalene compound, indicating a fresh hydrocarbon source. Weak pyrogenic signals are present and ratios indicate diesel emissions sources across all sites. Jackson Point seawater does have a slight signature of some pyrogenic sources compared to the other sites.

4.3.3. Seawater - Historical Perspective

2025 marked one of the lowest years on record for seawater hydrocarbon concentrations around the Valdez Marine Terminal and Gold Creek. Differences observed between 2024 and 2025 at the Gold Creek site suggest that a minor hydrocarbon release may have occurred in 2024, such as a small fuel spill from an anchored vessel, as uncharacteristically high concentrations were observed in 2024 and were not sustained. PAH concentrations in passive samplers have remained low since the 2016 inclusion of passive sampling device-derived water concentrations in LTEMP (Figure 9). A peak in PAH levels is observed at the terminal-adjacent site, Jackson Point, following the 2020 terminal spill, supporting the reactivity and reliability of the passive sampling devices. Passive sampler PAH profiles have also remained consistent, with high naphthalene spikes dominating, as noted in previous LTEMP reports (Payne & Driskell, 2021).

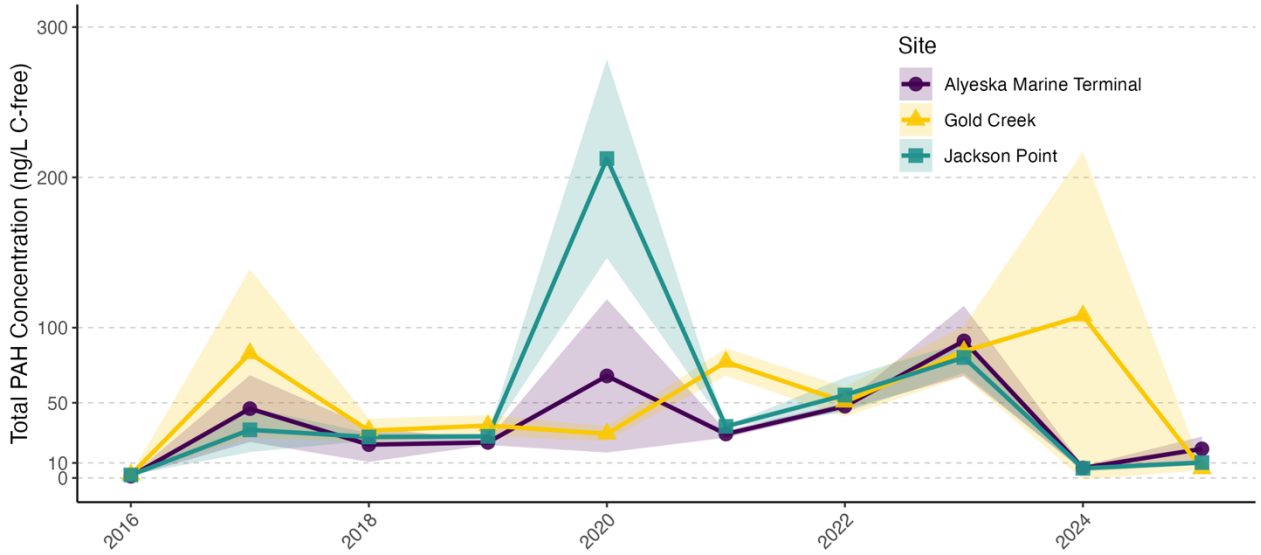

Figure 9. Sum PAH concentrations in seawater derived by passive sampling device at five sites for 2016–2025. Sites are distinguished by color and shape and plotted by mean ± 1 standard deviation. Note that 2016 values only include parent PAHs, no alkylated PAHs were quantified in 2016.

5. Holistic Interpretation

In 2025, we saw agreement on low-level PAHs at similar concentrations across the three standard LTEMP stations in Port Valdez (i.e., Gold Creek, Valdez Marine Terminal, and Jackson Point). While an increase in sum PAH concentrations in sediments was seen at the terminal, which was determined to be of ANS origin, levels are still predicted not to cause adverse effects to marine life. Mussel tissue and seawater PAH concentrations were similar across sites and consistently low at all LTEMP sites in 2025, whereas sediment PAH concentrations were higher and more variable at the terminal. Mussel PAH levels found at the Valdez Small Boat Harbor were higher than those of other stations, confirming this station's status as a pyrogenic, non-ANS positive control site. As each matrix measures a different section of the environmental hydrocarbon load, the differences between matrices likely reflect differences in the accumulation, degradation, elimination, and dispersion of hydrocarbons across the sites.

The ubiquity of hydrocarbons in the environment complicates tracing sources, understanding ecotoxic thresholds, and following dynamics over time and space. Environmental samples, like sediments, can accumulate multiple hydrocarbon sources over

time, resulting in a mixed or unresolved profile. Organisms such as blue mussels can accumulate, eliminate, or alter hydrocarbon compounds, complicating the identification of the sources. Passive sampling devices are designed to complement the biological and toxicological interpretations by measuring just the dissolved compounds available to aquatic organisms (i.e., the bioavailable fraction) but are not well suited for hydrocarbon forensics. The forensic agreement between the 2025 samples is a mixed source, largely petrogenic signal. This is consistent with the forensic determinations made in the last 5 years. Again, strong pyrogenic and mixed sources contribute to blue mussel hydrocarbon profiles at the Valdez Small Boat Harbor.

The ecotoxicological risk to organisms from the hydrocarbon levels present in the sediments, mussel tissue, and dissolved in the water from 2025 was low. Previous work focusing on how low levels of hydrocarbon exposure can influence ecologically and commercially important fish species in Prince William Sound has found profound effects on heart development (Incardona et al., 2021). Recent herring research reveals that analytical chemistry with detection levels in the sub parts per billion level (ng/g) is not sensitive enough to distinguish between exposure and background concentrations in water or embryo tissue even when crude oil-induced effects on heart development and PAH-induced enzymatic response were detected (Incardona et al., 2023). Instead, enzymatic induction related to nominal crude oil exposure (e.g., CYP1A induction) is directly related to cardiac deformities in herring. It may provide a more sensitive assessment of injury at the low end of PAH exposure levels (Incardona et al., 2023).

6. Future Perspective

Frequent reanalysis of LTEMP's aims and methodology is necessary to maintain the utility of such a robust monitoring program even in its 32nd year. While maintaining the program's integrity with the three matrix approaches, efforts must be taken to ensure that future monitoring and reporting are conducted to guarantee comparability to previous analyses and utility for future projects. A review of contemporary hydrocarbon biomonitoring study designs confirms the validity of using multiple matrices, including intertidal mussels (Kasiotis & Emmanouil, 2015), sediments, and passive sampling devices with a suite of hydrocarbon (e.g., beyond the 16 EPA parent PAHs), petro-geochemical markers for more definitive forensic determination. These matrices are suitable for trend- and problem-oriented monitoring, the two main objectives of LTEMP (Beyer et al., 2017).

The following represents a list of potential future directions recommended to increase the reach, longevity, and importance of LTEMP work. Note that the 2025 suggestions do not directly address monitoring study design but rather invite comments from the wider public and scientific audience through increased dissemination.

Increase project visibility

1. **Draft a scientific manuscript**

Pursue scientific publishing for greater visibility and utilization of LTEMP data; following the January 2025 poster presentation at the Alaska Marine Science Symposium. Additional analysis would be included in this peer-reviewed manuscript, including investigating contaminant trends using environmental data and size and lipid content of mussels (Ek et al 2021).

2. **Archive data**

Continue to work with data librarians at the National Center for Ecological Analysis & Synthesis (NCEAS) and the Alaska Ocean Observing System (AOOS) for external data management and archival.

3. **Improve program dissemination**

Address broader community concern for local pollution issues using alternative dissemination methods (e.g., short explainer video, updates to the PWSRCAC LTEMP website, popular science articles, participating at community events like the Prince William Sound Natural History Symposium, attending and presenting at relevant conferences, creating educational content). Community needs identified through these outreach projects could be integrated with LTEMP data interpretation and future sampling programs.

7. Conclusion

In the 32nd year of the LTEMP run by PWSRCAC, concentration, source, and potential ecotoxicological effects of hydrocarbons were assessed in bulk marine subtidal sediments, Pacific blue mussels, and dissolved in the nearshore waters via passive sampling devices. The hydrocarbon fingerprints in the 2025 samples vary by site, with those at or near the Valdez Marine Terminal revealing ANS crude and its associated products as the primary hydrocarbon source. Hydrocarbons found in Pacific blue mussels from Gold Creek, and the Valdez Small Boat Harbor cannot be linked directly to the terminal operations. However, these samples revealed various sources, including petroleum and combusted petroleum products. Low potential environmental and toxicological risk is posed by hydrocarbons contributed by the terminal and tankers in 2025. Passive sampling devices continue to report low levels of bioavailable hydrocarbons in the water column within Port Valdez.

Since 1993, hydrocarbon concentrations in Prince William Sound have been generally low, with localized spikes corresponding to events like the April 2020 oil spill at the terminal. Following an all-time low in the mid-2010s, hydrocarbon concentrations in sediments and mussels have slowly increased across all sites. However, they are still below any threshold for adverse effects on aquatic life. The utility of the LTEMP in maintaining a robust baseline hydrocarbon database continues to be critical in light of rapid environmental change and continued petroleum pollution risk.

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"The opinions expressed in this PWSRCAC commissioned report are not necessarily those of PWSRCAC. PWSRCAC Contract #9510.26.04."

LIST OF TABLES

LIST OF FIGURES

ACRONYMS AND ABBREVIATIONS

°C	Degrees Celsius
AMT	Alyeska Marine Terminal [officially known as the Valdez Marine Terminal]
ANS	Alaska North Slope [Crude Oil]
cm	Centimeter
CV	Calibration Verification
DQO	Data Quality Objective
EPA	U.S. Environmental Protection Agency
ESBs	Equilibrium Partitioning Sediment Benchmarks
FSES	Food Safety and Environmental Stewardship [Oregon State University lab]
GC/MS	Gas Chromatography/Mass Spectrometry
GOC	Gold Creek
HMW	High Molecular Weight [PAH]
JAC	Jackson Point
LMW	Low Molecular Weight [PAH]
LTEMP	Long-Term Environmental Monitoring Program
m	meters
mL	Milliliter
MDL	Method Detection Limit
ng/g	Nanogram per Gram (parts per billion)
ng/L	Nanogram/ Liter (parts per trillion)
OSU	Oregon State University
PAH	Polycyclic Aromatic Hydrocarbons
pg/µL	Picogram per Microliter
PSD	Passive Sampling Device
PWSRCAC	Prince William Sound Regional Citizens' Advisory Council
QC	Quality Control
RED	Positive control Site - Valdez Small Boat Harbor Entrance [red light]
RPD%	Relative Percent Difference
SAW	Saw Island
SHC	Saturated Hydrocarbons
SIM	Specific Ion Monitoring
SOP	Standard Operating Procedure

Executive Summary

This technical supplement contains information on field sampling and analytical and data analysis methods used to monitor and assess environmental hydrocarbons and their potential environmental risk in Prince William Sound Regional Citizens' Advisory Council's (PWSRCAC) Long-Term Environmental Monitoring Program (LTEMP). Here, we have plotted and summarized all sediment, Pacific blue mussel tissue (*Mytilus trossulus*), and passive samples collected in the 2025 campaign in Port Valdez. This document should aid in the assertions made in the 2025 Long-Term Environmental Monitoring Program Summary Report (fjord & fish sciences, 2025).

1. Methods

1.1. Field Methods

1.1.1. Sediments and Mussel Tissue

In 2025, sediment sampling at Valdez Marine Terminal (Alyeska Marine Terminal (AMT)) and Gold Creek (GOC) took place on May 28 (Figure 1; Table 1). Samples were collected using a modified Van Veen grab and deployed to a depth of 65–67 meters (m) at AMT and 26–27 m at GOC from the salmon seining/fishing vessel, Equinox, contracted as a research vessel and fitted with an aluminum davit. For each replicate, a ~250 milliliter (mL) sample of the surface 1–5 centimeters (cm) was collected at each site, placed in three hydrocarbon-free jars, and frozen for hydrocarbons, total organic carbon, and particle grain size analysis. Three replicates were taken at each site. Samples were frozen at the end of the sampling day and sent to the lab for analysis within a week of sampling.

The 2025 Port Valdez Pacific blue mussel (*Mytilus trossulus*) sampling was performed at Jackson Point (JAC) and Saw Island (AMT/SAW) on May 28 and at the positive control reference station at the Valdez Small Boat Harbor – RED (RED) and LTEMP reference site at GOC on May 29. Three replicates of ~30 large mussels were collected by hand at each site. Sample replicates are usually taken from multiple locations spaced along 30 m of shoreline. Mussel samples were wrapped in aluminum foil and double bagged in plastic zip-locks, frozen, and shipped to the laboratory, where they remained frozen until analysis. The analytical lab performed dissections of a whole mussel, including all internal organs.

1.1.2. Passive Sampling Devices

In 2025, the passive sampling devices (PSDs) were collected on May 28 at sites JAC and AMT/SAW, and on May 29 from GOC after an April 26 deployment. The PSDs are low-density polyethylene membranes submerged in shallow water to absorb passing hydrocarbons. The PSD is intended to sample only a fraction of the total hydrocarbon analytes present, namely, freely dissolved compounds and labile complexes that diffuse into the membrane that are the most bioavailable hydrocarbons for aquatic organisms. As a critical part of the method, various deuterated surrogate compounds are pre-infused into the membrane before deployment. This known starting concentration allows the time-integrated back calculation of dissolved chemical concentrations specific to the environmental conditions experienced by the PSDs. The PSDs were deployed in 4–7 m of water, attached to new polypropylene rope with hydrocarbon-free steel cables and shackles, anchored to a concrete cinder block at each location. At each site, three replicates of 5 PSDs were deployed such that they floated approximately 1 m above the seafloor. The PSDs were collected from stations, transferred to hydrocarbon-free Teflon bags, sealed, and stored at room temperature following LTEMP field protocols (2019 LTEMP PSD standard operating procedure (SOP)). A deployment field blank and a retrieval field blank were included in each annual analysis. Samples were sent to the Oregon State University

(OSU) Food Safety and Environmental Stewardship (FSES) lab in Corvallis, Oregon, for analysis and frozen at -20°C upon arrival.

1.2. Analytical Methods

1.2.1. Sediments and Mussel Tissue

Tissue and sediment samples were analyzed for semi-volatiles, biomarkers, and saturated hydrocarbon analytes at Pace Analytical Services (previously Alpha Analytical and NewFields) lab in Mansfield, Massachusetts. Extractions used the ALPHA OP-018 method for tissues and the ALPHA OP-013 method for sediments. Polycyclic aromatic hydrocarbons (PAH), sterane/triterpene petro-geochemical markers, and saturated hydrocarbons (SHC) are quantified as concentrations in the extracted sediments and mussel tissues. Parent PAHs, alkylated PAHs, and petrochemical markers are analyzed using selected ion monitoring gas chromatography/mass spectrometry (SIM GC/MS) via a modified U.S. Environmental Protection Agency (EPA) Method 8270 (aka 8270M). This analysis provides the concentration of 1) approximately 80 PAH, alkylated PAH homologs, individual PAH isomers, and sulfur-containing aromatics, and 2) approximately 78 tricyclic and pentacyclic triterpenes, regular and rearranged steranes, and tri-aromatic and monoaromatic steroids. Using a modified EPA 8015D(M), 37 SHC in sediments are quantified as total extractable materials (C9-C44) and as concentrations of n-alkanes (C9-C40) and selected (C15-C20) acyclic isoprenoids (e.g., pristane and phytane). The complete lists of PAH, SHC, and petro-geochemical markers are presented in Tables 2-4.

Surrogates are novel or deuterated compounds added in known amounts to each raw sample to assess the efficiency of extraction and analysis by their final percent recovery. Surrogate recoveries are considered acceptable if they are between 50% and 130%. Surrogate percent recovery concentrations are acceptable across all but one analyses performed in 2025 with a range of 62%-99% recovery. In the instance of this one sample (biomarkers in GOC-S-25-3-DUP), additional integrations and calculations were reviewed and verified to be due to the native sample heterogeneity. Another lab-performance quality control (QC) measure is the EPA-formulated, statistically derived, analyte-specific Method Detection Limit (MDL) that EPA defines as “the minimum measured concentration of a substance that can be reported with 99 percent confidence that the measured concentration is distinguishable from method blank results.” Pace Analytics Laboratory’s method detection limits (MDLs) for hydrocarbons exceed the performance of most commercial labs and are within the lower detection limits needed for forensic purposes. Duplicate sediment and tissue samples were run for method QC and precision assessment. Several samples have analytes that are reported as estimated values below the reporting limit and as such “J” flagged in the dataset. Some sample results are "B" qualified if the concentrations are less than 10x the concentrations in the blank. Both J and B flagged samples are plotted in the figures and included in the calculation; flags are retained in the LTEMP Master dataset. A diluted Alaska North Slope (ANS) crude standard sample, collected in 2020, was run in parallel to sediment samples.

1.2.2. Seawater Sampled by Passive Sampling Device

To remove any biofouling (e.g., periphyton or particulates), the PSD strips were cleaned in the laboratory by light scrubbing and sequential washing in 1 N HCl, 18 MΩ*cm water, and twice with isopropanol, then dried. PSDs were extracted twice at room temperature with 200 mL n-hexane before the volume was reduced. 82 PAHs were quantified on a modified Agilent 7890 gas chromatograph (GC) and Agilent 7000 triple quadrupole mass spectrometer. The internal standard, Perylene-D12, was added to each sample or parallel aliquots of bioassay samples immediately before analyses. Calculating freely dissolved water concentration of organic compounds was done following the lab-specific SOP. Continuing calibration verification (CV) analysis was performed at the start and end of every analytical batch (maximum of 15 samples). CVs met FSES data quality objectives (DQOs) with an average of 83% of the target analytes within 30% of the known value. Instrument blanks were analyzed after each CV, and in all cases, FSES DQOs were met for all target analytes. To demonstrate instrument precision, a duplicate analysis was performed. Average relative percent difference (RPD %) was 9%, meeting FSES DQO's.Perylene-D12, the method internal standard, had less than 11% variation across the entire project.

1.3. Data Analysis

Data analysis and management were done using the R statistical program (R Core Team 2021). Briefly, data were reformatted to allow for individual locations and analytes to be accessed, and analysis nomenclature was reconciled against the historical dataset. All data with concentrations reported as "non-detect" by Pace Analytical were removed for summary purposes. However, detected values under the method detection concentration were retained if no other issues were reported with the value. Any sample with matrix interference (i.e., "G" lab flag) was removed from the analysis for matrix interference. For sediment analysis, samples with negative detection and matrix interference were plotted for forensic determination. A select group of commonly used analytes was plotted to ease interpretation at the author's discretion and ordered using previously used LTEMP standards when possible. Method detection limits were plotted for sediment (Figures 2-7) and tissue samples (Figures 8-15). Corrections for dry weight, total organic carbon, and lipid content are reported in the tables and text when appropriate. Data from multiple labs were merged to compare historical data (Auke Bay Lab, NewFields/Alpha Analytical, and GERG).

Passive sampling device data were extracted and merged into a single dataset. Common lab flags were "B" for background correction applied broadly to Naphthalene and Fluorene and "J", which is close to the detection level and therefore estimated. For summary purposes, all data with concentrations reported as "non-detect" by FSES were not included in summary calculations and figures, though the qualitative data was included in tables for transparency purposes. PAH profiles were plotted for individual replicates for all sites (Figures 16-18).

1.4. Toxicological Interpretations

Multiple avenues were used to investigate the possibility of toxicological effects as no single standard exists, and development in the field of ecotoxicology is rapid. The most commonly accepted method is summing a select group of PAHs. This includes 53, 44, 42, 16, and other specific sum calculations PAHs. Calculations were made of the relative proportion on low (2–3 ring) and high (4–6 ring) molecular weight PAHs as well as sum totals of known carcinogenic PAHs (i.e., benzo(a)pyrene, benz(a)anthracene, chrysene, benzo(b)fluoranthene, benzo(k)fluoranthene, dibenzo(a,h)anthracene, and indeno(1,2,3-c,d)pyrene).

Furthermore, these values were adjusted for dry and lipid weights for mussel tissues to aid in cross-study comparisons. Sediment values were compared to *Equilibrium Partitioning Sediment Benchmarks (ESBs) for PAH Mixtures* (EPA-2003) using 34 PAHs, including some alkylated compounds (Table 6). Tissue concentrations were compared against the most recently available published literature and concentration-of-concern guidelines, as appropriate (Table 7). Seawater samples are treated similarly using a comparison for water column based water quality benchmarks for individual PAHs used to calculate toxicity quotients (Table 8, Baldwin et al 2024). Concentrations were compared to other field measurements across similar environments (sub-arctic, temperate fjord systems), areas with moderate human activity converted for wet or dry weight in tissues as appropriate, other lab studies with analogous aims as LTEMP (e.g., monitoring of ongoing petroleum operations, sublethal effects, chronic exposure) as explained in the 2025 summary report (fjord & fish 2025).

Saturated hydrocarbons and petro-geochemical biomarkers were not a focus of toxicological interpretations as they are not known to have specific modes of toxic action.

1.5. Source Identification, Petroleum Fingerprinting, and Biomarker Analysis

Source identification through petroleum fingerprinting and petro-geochemical markers analysis was performed using ANS whole crude oil collected in 2020, and was run as laboratory standard with 2025 samples. For accurate comparisons, the ANS chemical profile is displayed petro-geochemical biomarkers for each replicate sediment sample (Figure 4 and 5). Profiles were scaled to T19-hopane for petro-geochemical markers to aid in interpretation. Profiles were qualitatively evaluated for the best match between individual replicates and potential ANS source using practices outlined in previous LTEMP reports (Payne and Driskell 2020; Stout and Wang 2016). Biomarkers in tissues were displayed in tabular form as few analytes were detected (Table 9). Common hydrocarbon diagnostic ratios of low- and high-molecular weight PAHs and petro-geochemical biomarkers were calculated for sediments, tissue samples, and seawater for quantitative source identification (Table 10).

1.6. References

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2. TABLES

Table 1. Long-Term Monitoring Program sites sampled in 2025 for subtidal marine sediments, Pacific blue mussels and deployment/retrieval of the passive sampling devices. Coordinates are displayed in the WGS84 datum.

Site	Latitude	Longitude	Matrix
AMT-S	61.0906	-146.3928	Sediment
GOC-S	61.1242	-146.4906	Sediment
AMT-B	61.0903	-146.4092	Pacific Blue Mussel Tissue
JAC-B	61.0901	-146.3757	Pacific Blue Mussel Tissue
GOC-B	61.1244	-146.4961	Pacific Blue Mussel Tissue
RED-B	61.1237	-146.3532	Pacific Blue Mussel Tissue
GOC-PSD	61.1243	-146.4947	Water via Passive Sampler Device
JAC-PSD	61.0907	-146.3757	Water via Passive Sampler Device
AMT-PSD	61.0914	-146.4092	Water via Passive Sampler Device

Table 2. Analytes quantified in marine subtidal sediments of the 2025 Long-Term Environmental Monitoring Program.

	EPA 8015D(M)		EPA 8015D(M)		8270E-SIM(M) cont.
1	Nonane (C9)	**40**	o-terphenyl	**78**	3-Methylphenanthrene
2	Decane (C10)	**41**	d50-Tetracosane	**79**	2-Methylphenanthrene (2MP)
3	Undecane		**8270E-SIM(M)**	**80**	2-Methylanthracene (2MA)
4	Dodecane (C12)	**42**	cis/trans-Decalin	**81**	9/4-Methylphenanthrene (9MP)
5	Tridecane	**43**	C1-Decalins	**82**	1-Methylphenanthrene
6	2,6,10 Trimethyldodecane (1380)	**44**	C2-Decalins	**83**	C1-Phenanthrenes/Anthracenes
7	n-Tetradecane (C14)	45	C3-Decalins	**84**	C2-Phenanthrenes/Anthracenes
8	2,6,10-Trimethyltridecane (1470)	46	C4-Decalins	**85**	C3-Phenanthrenes/Anthracenes
9	n-Pentadecane (C15)	47	Naphthalene	**86**	C4-Phenanthrenes/Anthracenes
10	n-Hexadecane (C16)	48	C1-Naphthalenes	**87**	Retene
11	Norpristane (1650)	49	C2-Naphthalenes	**88**	Anthracene
12	n-Heptadecane (C17)	50	C3-Naphthalenes	**89**	Carbazole
13	Pristane	51	C4-Naphthalenes	**90**	Fluoranthene
14	n-Octadecane (C18)	52	2-Methylnaphthalene	**91**	Benzo[b]fluorene
15	Phytane	53	1-Methylnaphthalene	**92**	Pyrene
16	n-Nonadecane (C19)	54	Benzothiophene	**93**	C1-Fluoranthenes/Pyrenes
17	n-Eicosane (C20)	55	C1-Benzo(b)thiophenes	**94**	C2-Fluoranthenes/Pyrenes
18	n-Heneicosane (C21)	56	C2-Benzo(b)thiophenes	**95**	C3-Fluoranthenes/Pyrenes
19	n-Docosane (C22)	57	C3-Benzo(b)thiophenes	**96**	C4-Fluoranthenes/Pyrenes
20	n-Tricosane (C23)	58	C4-Benzo(b)thiophenes	**97**	Naphthobenzothiophenes
21	n-Tetracosane (C24)	59	Biphenyl	**98**	C1-Naphthobenzothiophenes
22	n-Pentacosane (C25)	60	2,6-Dimethylnaphthalene	**99**	C2-Naphthobenzothiophenes
23	n-Hexacosane (C26)	61	Dibenzofuran	**100**	C3-Naphthobenzothiophenes
24	n-Heptacosane (C27)	62	Acenaphthylene	**101**	C4-Naphthobenzothiophenes
25	n-Octacosane (C28)	63	Acenaphthene	**102**	Benz[a]anthracene
26	n-Nonacosane (C29)	64	2,3,5-Trimethylnaphthalene	**103**	Chrysene/Triphenylene
27	n-Triacontane (C30)	65	Fluorene	**104**	C1-Chrysenes
28	n-Hentriacontane (C31)	66	C1-Fluorenes	**105**	C2-Chrysenes
29	n-Dotriacontane (C32)	67	C2-Fluorenes	**106**	C3-Chrysenes
30	n-Tritriacontane (C33)	68	C3-Fluorenes	**107**	C4-Chrysenes
31	n-Tetratriacontane (C34)	**69**	Dibenzothiophene	**108**	Benzo[b]fluoranthene
32	n-Pentatriacontane (C35)	**70**	4-Methyldibenzothiophene(4MDT)	**109**	Benzo[j]fluoranthene/Benzo[k]fluoranthene
33	n-Hexatriacontane (C36)	**71**	2/3-Methyldibenzothiophene(2MDT)	**110**	Benzo[a]fluoranthene
34	n-Heptatriacontane (C37)	**72**	1-Methyldibenzothiophene(1MDT)	**111**	Benzo[e]pyrene
35	n-Octatriacontane (C38)	**73**	C1-Dibenzothiophenes	**112**	Benzo[a]pyrene
36	n-Nonatriacontane (C39)	**74**	C2-Dibenzothiophenes	**113**	Perylene
37	n-Tetracontane (C40)	**75**	C3-Dibenzothiophenes	**114**	Indeno[1,2,3-cd]pyrene
38	Total Petroleum Hydrocarbons (C9-C44)	**76**	C4-Dibenzothiophenes	**115**	Dibenz[a,h]anthracene/Dibenz[a,c]anthracene
39	Total Saturated Hydrocarbons	**77**	Phenanthrene	**116**	Benzo[g,h,i]perylene

Table 2. Analytes quantified in marine subtidal sediments of the 2025 Long-Term Environmental Monitoring Program.

	8270E-SIM(M) contin.		8270E-SIM(M) contin.
117	Hopane (T19)	**156**	Unknown Sterane (S18)
118	C23 Tricyclic Terpane (T4)	**157**	13a,17b-20S-Ethyldiacholestane (S19)
119	C24 Tricyclic Terpane (T5)	**158**	14a,17a-20S-Methylcholestane (S20)
120	C25 Tricyclic Terpane (T6)	**159**	14a,17a-20R-Methylcholestane (S24)
121	C24 Tetracyclic Terpane (T6a)	**160**	14a(H),17a(H)-20S-Ethylcholestane (S25)
122	C26 Tricyclic Terpane-22S (T6b)	**161**	14a(H),17a(H)-20R-Ethylcholestane (S28)
123	C26 Tricyclic Terpane-22R (T6c)	**162**	14b(H),17b(H)-20R-Cholestane (S14)
124	C28 Tricyclic Terpane-22S (T7)	**163**	14b(H),17b(H)-20S-Cholestane (S15)
125	C28 Tricyclic Terpane-22R (T8)	**164**	14b,17b-20R-Methylcholestane (S22)
126	C29 Tricyclic Terpane-22S (T9)	**165**	14b,17b-20S-Methylcholestane (S23)
127	C29 Tricyclic Terpane-22R (T10)	**166**	14b(H),17b(H)-20R-Ethylcholestane (S26)
128	18a-22,29,30-Trisnorneohopane-TS (T11)	**167**	14b(H),17b(H)-20S-Ethylcholestane (S27)
129	C30 Tricyclic Terpane-22S	**168**	C26,20R+C27,20S TAS
130	C30 Tricyclic Terpane-22R	**169**	C28,20S TAS
131	17a(H)-22,29,30-Trisnorhopane-TM	**170**	C27,20R TAS
132	17a/b,21b/a 28,30-Bisnorhopane (T14a)	**171**	C28,20R TAS
133	17a(H),21b(H)-25-Norhopane (T14b)	**172**	Naphthalene-d8
134	30-Norhopane (T15)	**173**	Phenanthrene-d10
135	18a(H)-30-Norneohopane-C29Ts (T16)	**174**	Benzo[a]pyrene-d12
136	17a(H)-Diahopane (X)	**175**	5B(H)Cholane
137	30-Normoretane (T17)		
138	18a(H)&18b(H)-Oleananes (T18)		**D6913/D7928**
139	Moretane (T20)	176	Cobbles
140	30-Homohopane-22S (T21)	177	% Coarse Gravel
141	30-Homohopane-22R (T22)	178	% Fine Gravel
142	Gammacerane/C32-Diahopane	179	Gravel
143	30,31-Bishomohopane-22S (T26)	180	% Coarse Sand
144	30,31-Bishomohopane-22R (T27)	181	% Medium Sand
145	30,31-Trishomohopane-22S (T30)	182	% Fine Sand
146	30,31-Trishomohopane-22R (T31)	183	Sand
147	Tetrakishomohopane-22S (T32)	184	% Silt Fine
148	Tetrakishomohopane-22R (T33)	185	% Clay Fine
149	Pentakishomohopane-22S (T34)	186	Fines
150	Pentakishomohopane-22R (T35)		**9060A(M)**
151	13b(H),17a(H)-20S-Diacholestane (S4)	187	Total Organic Carbon (Rep1)
152	13b(H),17a(H)-20R-Diacholestane (S5)	188	Total Organic Carbon (Rep2)
153	13b,17a-20S-Methyldiacholestane (S8)	189	Total Organic Carbon (Average)
154	17a(H)20SC27/C29dia		
155	17a(H)20rc27/C29dia		

Table 3. Analytes quantified in intertidal mussels of the 2025 Long-Term Environmental Monitoring Program.

	EPA 8015D(M)		8270E-SIM(M)		
1	Nonane (C9)	**41**	Hopane (T19)	**83**	14a,17a-20R-Methylcholestane (S24)
2	Decane (C10)	**42**	C23 Tricyclic Terpane (T4)	**84**	14a(H),17a(H)-20S-Ethylcholestane (S25)
3	Undecane	**43**	C24 Tricyclic Terpane (T5)	**85**	14a(H),17a(H)-20R-Ethylcholestane (S28)
4	Dodecane (C12)	**44**	C25 Tricyclic Terpane (T6)	**86**	14b(H),17b(H)-20R-Cholestane (S14)
5	Tridecane	**45**	C24 Tetracyclic Terpane (T6a)	**87**	14b(H),17b(H)-20S-Cholestane (S15)
6	2,6,10 Trimethyldodecane (1380)	**46**	C26 Tricyclic Terpane-22S (T6b)	**88**	14b,17b-20R-Methylcholestane (S22)
7	n-Tetradecane (C14)	**47**	C26 Tricyclic Terpane-22R (T6c)	**89**	14b,17b-20S-Methylcholestane (S23)
8	2,6,10-Trimethyltridecane (1470)	**48**	C28 Tricyclic Terpane-22S (T7)	**90**	14b(H),17b(H)-20R-Ethylcholestane (S26)
9	n-Pentadecane (C15)	**49**	C28 Tricyclic Terpane-22R (T8)	**91**	14b(H),17b(H)-20S-Ethylcholestane (S27)
10	n-Hexadecane (C16)	**50**	C29 Tricyclic Terpane-22S (T9)	**92**	5B(H)Cholane
11	Norpristane (1650)	**51**	C29 Tricyclic Terpane-22R (T10)	**93**	cis/trans-Decalin
12	n-Heptadecane (C17)	**52**	18a-22,29,30-Trisnorneohopane-TS (T11)	**94**	C1-Decalins
13	Pristane	**53**	C30 Tricyclic Terpane-22S	**95**	C2-Decalins
14	n-Octadecane (C18)	**54**	C30 Tricyclic Terpane-22R	**96**	C3-Decalins
15	Phytane	**55**	17a(H)-22,29,30-Trisnorhopane-TM	**97**	C4-Decalins
16	n-Nonadecane (C19)	**56**	17a/b,21b/a 28,30-Bisnorhopane (T14a)	**98**	Naphthalene
17	n-Eicosane (C20)	**57**	17a(H),21b(H)-25-Norhopane (T14b)	**99**	C1-Naphthalenes
18	n-Heneicosane (C21)	**58**	30-Norhopane (T15)	**100**	C2-Naphthalenes
19	n-Docosane (C22)	**59**	18a(H)-30-Norneohopane-C29Ts (T16)	**101**	C3-Naphthalenes
20	n-Tricosane (C23)	**60**	17a(H)-Diahopane (X)	**102**	C4-Naphthalenes
21	n-Tetracosane (C24)	**61**	30-Normoretane (T17)	**103**	2-Methylnaphthalene
22	n-Pentacosane (C25)	**62**	18a(H)&18b(H)-Oleananes (T18)	**104**	1-Methylnaphthalene
23	n-Hexacosane (C26)	**63**	Moretane (T20)	**105**	Benzothiophene
24	n-Heptacosane (C27)	**64**	30-Homohopane-22S (T21)	**106**	C1-Benzo(b)thiophenes
25	n-Octacosane (C28)	**65**	30-Homohopane-22R (T22)	**107**	C2-Benzo(b)thiophenes
26	n-Nonacosane (C29)	**66**	Gammacerane/C32-Diahopane	**108**	C3-Benzo(b)thiophenes
27	n-Triacontane (C30)	**67**	30,31-Bishomohopane-22S (T26)	**109**	C4-Benzo(b)thiophenes
28	n-Hentriacontane (C31)	**68**	30,31-Bishomohopane-22R (T27)	**110**	Biphenyl
29	n-Dotriacontane (C32)	**69**	30,31-Trishomohopane-22S (T30)	**111**	2,6-Dimethylnaphthalene
30	n-Tritriacontane (C33)	**70**	30,31-Trishomohopane-22R (T31)	**112**	Dibenzofuran
31	n-Tetratriacontane (C34)	**71**	Tetrakishomohopane-22S (T32)	**113**	Acenaphthylene
32	n-Pentatriacontane (C35)	**72**	Tetrakishomohopane-22R (T33)	**114**	Acenaphthene
33	n-Hexatriacontane (C36)	**73**	Pentakishomohopane-22S (T34)	**115**	2,3,5-Trimethylnaphthalene
34	n-Heptatriacontane (C37)	**74**	Pentakishomohopane-22R (T35)	**116**	Fluorene
35	n-Octatriacontane (C38)	**75**	13b(H),17a(H)-20S-Diacholestane (S4)	**117**	C1-Fluorenes
36	n-Nonatriacontane (C39)	**76**	13b(H),17a(H)-20R-Diacholestane (S5)	**118**	C2-Fluorenes
37	n-Tetracontane (C40)	**77**	13b,17a-20S-Methyldiacholestane (S8)	**119**	C3-Fluorenes
38	Total Petroleum Hydrocarbons (C9-C44)	**78**	17a(H)20SC27/C29dia	**120**	Dibenzothiophene
39	Total Saturated Hydrocarbons	**79**	17a(H)20rc27/C29dia	**121**	4-Methyldibenzothiophene(4MDT)
40	d50-Tetracosane	**80**	Unknown Sterane (S18)	**122**	2/3-Methyldibenzothiophene(2MDT)
		81	13a,17b-20S-Ethyldiacholestane (S19)	**123**	1-Methyldibenzothiophene(1MDT)
		82	14a,17a-20S-Methylcholestane (S20)	**124**	C1-Dibenzothiophenes

Table 3. Analytes quantified in intertidal mussels of the 2025 Long-Term Environmental Monitoring Program.

	8270E-SIM(M)
125	C2-Dibenzothiophenes
126	C3-Dibenzothiophenes
127	C4-Dibenzothiophenes
128	Phenanthrene
129	3-Methylphenanthrene
130	2-Methylphenanthrene (2MP)
131	2-Methylanthracene (2MA)
132	9/4-Methylphenanthrene (9MP)
133	1-Methylphenanthrene
134	C1-Phenanthrenes/Anthracenes
135	C2-Phenanthrenes/Anthracenes
136	C3-Phenanthrenes/Anthracenes
137	C4-Phenanthrenes/Anthracenes
138	Retene
139	Anthracene
140	Carbazole
141	Fluoranthene
142	Benzo[b]fluorene
143	Pyrene
144	C1-Fluoranthenes/Pyrenes
145	C2-Fluoranthenes/Pyrenes
146	C3-Fluoranthenes/Pyrenes
147	C4-Fluoranthenes/Pyrenes
148	Naphthobenzothiophenes
149	C1-Naphthobenzothiophenes
150	C2-Naphthobenzothiophenes
151	C3-Naphthobenzothiophenes
152	C4-Naphthobenzothiophenes
153	Benz[a]anthracene
154	Chrysene/Triphenylene
155	C1-Chrysenes
156	C2-Chrysenes
157	C3-Chrysenes
158	C4-Chrysenes
159	Benzo[b]fluoranthene
160	Benzo[j]fluoranthene/Benzo[k]fluoranthene
161	Benzo[a]fluoranthene
162	Benzo[e]pyrene
163	Benzo[a]pyrene
164	Perylene
165	Indeno[1,2,3-cd]pyrene
166	Dibenz[a,h]anthracene/Dibenz[a,c]anthracene
167	Benzo[g,h,i]perylene
168	Naphthalene-d8
169	Phenanthrene-d10
170	Benzo[a]pyrene-d12
	NOAA NOS ORCA 130
171	Percent Lipids
	2540G
172	Moisture

Table 4. Analytes quantified in seawater by passive sampling device in the 2025 Long-Term Environmental Monitoring Program.

Parent and Alkyl Substituted PAHs by GC-MS/MS (ng/L)				Determination of Forensic Alkyl PAHs using GC-QQQ (ng/L)	
Count	Analytes	Count.	Analytes.	Count..	Analytes..
1	1,2-dimethylnaphthalene	34	benzo[b]fluoranthene	65	C1-benz[a]anthracenes & chrysenes & triphenylenes
2	1,4-dimethylnaphthalene	35	benzo[b]fluorene	66	C1-dibenzothiophenes
3	1,5-dimethylnaphthalene	36	benzo[b]perylene	67	C1-fluoranthenes & pyrenes
4	1,6 and 1,3-Dimethylnaphthalene	37	benzo[c]fluorene	68	C1-fluorenes
5	1,8-dimethylnaphthalene	38	benzo[e]pyrene	69	C1-naphthalenes
6	1-methylnaphthalene	39	benzo[ghi]perylene	70	C1-phenanthrenes & anthracenes
7	1-methylphenanthrene	40	benzo[j]fluoranthene	71	C2-benz[a]anthracenes & chrysenes & triphenylenes
8	1-methylpyrene	41	benzo[k]fluoranthene	72	C2-dibenzothiophenes
9	2,3-dimethylanthracene	42	chrysene	73	C2-fluoranthenes & pyrenes
10	2,6-diethylnaphthalene	43	coronene	74	C2-fluorenes
11	2,6-dimethylnaphthalene	44	cyclopenta[cd]pyrene	75	C2-naphthalenes
12	2-ethylnaphthalene	45	dibenzo[a,e]fluoranthene	76	C2-phenanthrenes & C2-anthracenes
13	2-methylanthracene	46	dibenzo[a,e]pyrene	77	C3-dibenzothiophenes
14	2-methylnaphthalene	47	dibenzo[a,h]anthracene	78	C3-fluorenes
15	2-methylphenanthrene	48	dibenzo[a,h]pyrene	79	C3-naphthalenes
16	3,6-dimethylphenanthrene	49	dibenzo[a,i]pyrene	80	C3-phenanthrenes & anthracenes
17	5-methylchrysene	50	dibenzo[a,l]pyrene	81	C4-naphthalenes
18	6-methylchrysene	51	dibenzo[e,l]pyrene	82	C4-phenanthrenes & C4-anthracenes
19	7,12-dimethylbenz[a]anthracene	52	dibenzothiophene		
20	9,10-dimethylanthracene	53	fluoranthene		
21	9-methylanthracene	54	fluorene		
22	Naphtho[2,3-b]fluoranthene	55	indeno[1,2,3-cd]pyrene		
23	Naphtho[2,3-j] and [1,2-k]fluoranthene	56	naphthalene		
24	Pyrene	57	naphtho[1,2-b]fluoranthene		
25	acenaphthene	58	naphtho[2,3-a]pyrene		
26	acenaphthylene	59	naphtho[2,3-e]pyrene		
27	anthanthrene	60	naphtho[2,3-k]fluoranthene		
28	anthracene	61	perylene		
29	benz[a]anthracene	62	phenanthrene		
30	benz[j] and [e]aceanthrylene	63	retene		
31	benzo[a]chrysene	64	triphenylene		
32	benzo[a]fluorene				
33	benzo[a]pyrene				

Table 5. Sediment PAH loads from 2025 samples.

Count	Analyte (ng/g dry weight)	AMT-S-25-1	AMT-S-25-2	AMT-S-25-3	GOC-S-25-1	GOC-S-25-2	GOC-S-25-3	GOC-S-25-3-DUP
1	Naphthalene	2.140	3.170	2.010	2.720	1.620	0.791	0.826
2	C1-Naphthalenes	6.180	2.120	2.410	2.170	1.750	0.587	0.602
3	C2-Naphthalenes	19.600	3.550	3.700	3.120	2.040	1.280	1.230
4	C3-Naphthalenes	20.100	2.980	2.820	2.080	1.460	0.886	0.823
5	C4-Naphthalenes	11.200	2.530	2.480	1.510	1.860	-	-
6	Biphenyl	2.640	2.210	2.150	3.040	1.330	1.280	1.560
7	Dibenzofuran	1.870	1.190	0.978	1.080	0.808	0.493	0.469
8	Acenaphthylene	0.459	0.207	0.188	0.304	0.119	0.046	0.068
9	Acenaphthene	3.250	0.402	0.380	0.698	0.467	0.255	0.325
10	Fluorene	4.130	1.160	1.090	1.160	0.722	0.549	0.507
11	C1-Fluorenes	8.900	2.900	1.920	1.710	0.940	0.773	0.797
12	C2-Fluorenes	12.700	4.460	2.400	1.590	0.804	0.675	0.663
13	C3-Fluorenes	13.600	4.950	5.160	-	-	-	-
14	Dibenzothiophene	7.040	0.589	0.463	0.385	0.278	0.200	0.204
15	C1-Dibenzothiophenes	24.200	1.120	0.697	0.339	0.214	0.210	0.223
16	C2-Dibenzothiophenes	29.100	3.090	2.440	0.792	0.535	-	0.440
17	C3-Dibenzothiophenes	18.000	4.780	3.460	-	0.524	-	-
18	C4-Dibenzothiophenes	7.200	4.080	3.120	-	-	-	-
19	Phenanthrene	30.000	5.510	4.530	4.200	2.420	2.000	2.220
20	C1-Phenanthrenes/Anthracenes	52.600	3.960	3.040	1.770	0.920	0.650	0.973
21	C2-Phenanthrenes/Anthracenes	39.600	5.640	3.250	1.420	0.742	0.541	0.633
22	C3-Phenanthrenes/Anthracenes	16.800	4.920	3.700	0.966	0.430	0.478	0.557
23	C4-Phenanthrenes/Anthracenes	6.110	2.910	2.650	-	0.469	-	-
24	Retene	2.030	1.220	0.523	-	0.119	-	0.150
25	Anthracene	4.120	0.546	0.447	0.400	0.269	0.334	0.323
26	Carbazole	1.570	0.625	0.662	0.374	0.499	2.020	2.020
27	Fluoranthene	8.380	3.210	2.150	3.130	1.830	0.923	1.680
28	Benzo[b]fluorene	2.330	0.466	0.322	0.275	0.145	0.158	0.145
29	Pyrene	11.400	2.520	1.560	2.060	1.010	0.688	1.350
30	C1-Fluoranthenes/Pyrenes	16.700	2.760	2.460	1.500	0.693	0.797	0.840
31	C2-Fluoranthenes/Pyrenes	10.300	2.940	2.680	0.996	0.480	0.594	0.756
32	C3-Fluoranthenes/Pyrenes	7.350	4.710	3.790	-	-	-	-
33	C4-Fluoranthenes/Pyrenes	5.680	4.280	3.760	-	-	-	-
34	Naphthobenzothiophenes	4.090	1.110	0.928	0.443	0.196	0.127	0.161
35	C1-Naphthobenzothiophenes	6.370	3.210	2.720	0.633	0.485	-	-
36	C2-Naphthobenzothiophenes	8.760	8.240	6.830	-	-	-	-
37	C3-Naphthobenzothiophenes	6.550	6.750	5.090	-	-	-	-
38	C4-Naphthobenzothiophenes	5.850	4.750	4.500	-	-	-	-
39	Benz[a]anthracene	5.320	1.290	0.556	0.633	0.255	0.367	0.471
40	Chrysene/Triphenylene	7.580	2.960	1.900	1.280	0.414	0.457	0.594
41	C1-Chrysenes	7.860	3.110	2.620	0.769	0.364	0.465	0.651
42	C2-Chrysenes	6.000	4.650	4.720	-	-	-	1.100
43	C3-Chrysenes	9.030	8.580	9.660	-	-	-	-
44	C4-Chrysenes	9.600	-	-	-	-	-	-
45	Benzo[b]fluoranthene	3.340	1.570	0.774	0.950	0.271	0.214	0.445
46	Benzo[j]fluoranthene/Benzo[k]fluoranthene	2.690	0.916	0.485	0.796	0.164	0.222	0.354
47	Benzo[a]fluoranthene	0.516	0.193	-	-	-	-	-
48	Benzo[e]pyrene	2.840	1.440	1.030	0.658	0.246	0.235	0.406
49	Benzo[a]pyrene	2.240	1.060	0.520	0.505	0.127	0.135	0.385
50	Perylene	2.080	1.610	1.160	0.626	0.304	0.268	0.352
51	Indeno[1,2,3-cd]pyrene	1.020	0.637	0.401	0.338	0.103	0.144	0.284

Table 5. Sediment PAH loads from 2025 samples.

Count	Analyte (ng/g dry weight)	AMT-S-25-1	AMT-S-25-2	AMT-S-25-3	GOC-S-25-1	GOC-S-25-2	GOC-S-25-3	GOC-S-25-3-DUP
52	Dibenz[a,h]anthracene/Dibenz[a,c]anthracene	0.417	0.197	0.178	0.174	0.079	0.074	0.240
53	Benzo[g,h,i]perylene	1.570	1.140	0.823	0.479	0.171	0.151	0.287
	Total Organic Carbon (Average)	0.549	0.623	0.528	0.544	0.48	0.474	0.551
	Sum 53 PAH (ng/g dry weight)	501.00	145.12	118.29	48.07	28.68	20.07	26.11
	Sum 53 PAH (ng/g TOC corrected)	912.57	232.93	224.02	88.37	59.74	42.34	47.39
	Sum 16 PAH[1] (ng/g dry weight)	88.06	26.50	17.99	19.83	10.04	7.35	10.36
	Sum low molecular weight PAH[2]	343.57	70.19	56.01	31.45	20.84	12.03	13.59
	Sum high molecular weight PAH[3]	155.86	74.30	61.62	16.25	7.34	6.02	10.50
	% low molecular weight PAH	69%	49%	48%	66%	74%	67%	56%
	% high molecular weight PAH	31%	51%	52%	34%	26%	33%	44%
	Sum of Carcinogenic PAH[4]	22.607	8.630	4.814	4.676	1.413	1.613	2.773

1- 16 EPA Priority PAHs - naphthalene, acenaphthylene, acenaphthene, fluorene, phenanthrene, anthracene, fluoranthene, pyrene, benzo[a]anthracene, chrysene, benzo[b]fluoranthene, benzo[k]fluoranthene , benzo[a]pyrene, benzo[g,h,i]perylene, indeno[1,2,3-c,d]pyrene,

2- Low molecular weight PAHs : napthalenes - phenanthrenes (2-3-ring PAH)

3- High molecular weight PAHs: fluoranthene - benzo (g,h,i)perylene (3-6 ring PAH)

4 - Carcinogenic PAHs: benzo[a]pyrene, benz[a]anthracene, benzo[b]fluoranthene, benzo[k]fluoranthene, chrysene, dibenz[a,h]anthracene, indeno[1,2,3-cd]pyrene

Table 6. Sediment PAH toxicity comparisons from 2025 samples.

	EPA 2003	Sample Organic carbon corrected levels (ng/g)						Sample Equlibrium Partioning concentration-of-concern values					
PAH Analyte	Sediment Benchmarks (ng/goc)	AMT-S-25-1	AMT-S-25-2	AMT-S-25-3	GOC-S-25-1	GOC-S-25-2	GOC-S-25-3	AMT-S-25-1	AMT-S-25-2	AMT-S-25-3	GOC-S-25-1	GOC-S-25-2	GOC-S-25-3
Naphthalene	385000	389.80	508.83	380.68	500.00	337.50	166.88	1.01E-03	1.32E-03	9.89E-04	1.30E-03	8.77E-04	4.33E-04
C1-Naphthalenes	444000	1125.68	340.29	456.44	398.90	364.58	123.84	2.54E-03	7.66E-04	1.03E-03	8.98E-04	8.21E-04	2.79E-04
Acenaphthylene	452000	83.61	33.23	35.61	55.88	24.79	9.70	1.85E-04	7.35E-05	7.88E-05	1.24E-04	5.48E-05	2.15E-05
Acenaphthene	491000	591.99	64.53	71.97	128.31	97.29	53.80	1.21E-03	1.31E-04	1.47E-04	2.61E-04	1.98E-04	1.10E-04
C2-Naphthalenes	510000	3570.13	569.82	700.76	573.53	425.00	270.04	7.00E-03	1.12E-03	1.37E-03	1.12E-03	8.33E-04	5.29E-04
Fluorene	538000	752.28	186.20	206.44	213.24	150.42	115.82	1.40E-03	3.46E-04	3.84E-04	3.96E-04	2.80E-04	2.15E-04
C3-Naphthalenes	581000	3661.20	478.33	534.09	382.35	304.17	186.92	6.30E-03	8.23E-04	9.19E-04	6.58E-04	5.24E-04	3.22E-04
Anthracene	594000	750.46	87.64	84.66	73.53	56.04	70.46	1.26E-03	1.48E-04	1.43E-04	1.24E-04	9.43E-05	1.19E-04
Phenanthrene	596000	5464.48	884.43	857.95	772.06	504.17	421.94	9.17E-03	1.48E-03	1.44E-03	1.30E-03	8.46E-04	7.08E-04
C1-Fluorenes	611000	1621.13	465.49	363.64	314.34	195.83	163.08	2.65E-03	7.62E-04	5.95E-04	5.14E-04	3.21E-04	2.67E-04
C4-Naphthalenes	657000	2040.07	406.10	469.70	277.57	387.50	ND	3.11E-03	6.18E-04	7.15E-04	4.22E-04	5.90E-04	0.00E+00
C1-Phenanthrenes/Anthracenes	670000	9581.06	635.63	575.76	325.37	191.67	137.13	1.43E-02	9.49E-04	8.59E-04	4.86E-04	2.86E-04	2.05E-04
C2-Fluorenes	686000	2313.30	715.89	454.55	292.28	167.50	142.41	3.37E-03	1.04E-03	6.63E-04	4.26E-04	2.44E-04	2.08E-04
Pyrene	697000	2076.50	404.49	295.45	378.68	210.42	145.15	2.98E-03	5.80E-04	4.24E-04	5.43E-04	3.02E-04	2.08E-04
Fluoranthene	707000	1526.41	515.25	407.20	575.37	381.25	194.73	2.16E-03	7.29E-04	5.76E-04	8.14E-04	5.39E-04	2.75E-04
C2-Phenanthrenes/Anthracenes	746000	7213.11	905.30	615.53	261.03	154.58	114.14	9.67E-03	1.21E-03	8.25E-04	3.50E-04	2.07E-04	1.53E-04
C3-Fluorenes	769000	2477.23	794.54	977.27	ND	ND	ND	3.22E-03	1.03E-03	1.27E-03	0.00E+00	0.00E+00	0.00E+00
C1-Fluoranthenes/Pyrenes	770000	3041.89	443.02	465.91	275.74	144.38	168.14	3.95E-03	5.75E-04	6.05E-04	3.58E-04	1.88E-04	2.18E-04
C3-Phenanthrenes/Anthracenes	829000	3060.11	789.73	700.76	177.57	89.58	100.84	3.69E-03	9.53E-04	8.45E-04	2.14E-04	1.08E-04	1.22E-04
Benz[a]anthracene	841000	969.03	207.06	105.30	116.36	53.13	77.43	1.15E-03	2.46E-04	1.25E-04	1.38E-04	6.32E-05	9.21E-05
Chrysene/Triphenylene	844000	1380.69	475.12	359.85	235.29	86.25	96.41	1.64E-03	5.63E-04	4.26E-04	2.79E-04	1.02E-04	1.14E-04
C4-Phenanthrenes/Anthracenes	913000	1112.93	467.09	501.89	ND	97.71	ND	1.22E-03	5.12E-04	5.50E-04	0.00E+00	1.07E-04	0.00E+00
C1-Chrysenes	929000	1431.69	499.20	496.21	141.36	75.83	98.10	1.54E-03	5.37E-04	5.34E-04	1.52E-04	8.16E-05	1.06E-04
Benzo[a]pyrene	965000	408.01	170.14	98.48	92.83	26.46	28.48	4.23E-04	1.76E-04	1.02E-04	9.62E-05	2.74E-05	2.95E-05
Perylene	967000	378.87	258.43	219.70	115.07	63.33	56.54	3.92E-04	2.67E-04	2.27E-04	1.19E-04	6.55E-05	5.85E-05
Benzo[e]pyrene	967000	517.30	231.14	195.08	120.96	51.25	49.58	5.35E-04	2.39E-04	2.02E-04	1.25E-04	5.30E-05	5.13E-05
Benzo[b]fluoranthene	979000	608.38	252.01	146.59	174.63	56.46	45.15	6.21E-04	2.57E-04	1.50E-04	1.78E-04	5.77E-05	4.61E-05
Benzo[j]fluoranthene/Benzo[k]fluoranthene	981000	489.98	147.03	91.86	146.32	34.17	46.84	4.99E-04	1.50E-04	9.36E-05	1.49E-04	3.48E-05	4.77E-05
C2-Chrysenes	1008000	1092.90	746.39	893.94	ND	ND	ND	1.08E-03	7.40E-04	8.87E-04	0.00E+00	0.00E+00	0.00E+00
Benzo[g,h,i]perylene	1095000	285.97	182.99	155.87	88.05	35.63	31.86	2.61E-04	1.67E-04	1.42E-04	8.04E-05	3.25E-05	2.91E-05
C3-Chrysenes	1112000	1644.81	1377.21	1829.55	ND	ND	ND	1.48E-03	1.24E-03	1.65E-03	0.00E+00	0.00E+00	0.00E+00
Indeno[1,2,3-cd]pyrene	1115000	185.79	102.25	75.95	62.13	21.46	30.38	1.67E-04	9.17E-05	6.81E-05	5.57E-05	1.92E-05	2.72E-05
Dibenz[a,h]anthracene/Dibenz[a,c]ant	1123000	75.96	31.62	33.71	31.99	16.46	15.61	6.76E-05	2.82E-05	3.00E-05	2.85E-05	1.47E-05	1.39E-05
C4-Chrysenes	1214000	1748.63	ND	ND	ND	ND	ND	1.44E-03	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
Sample Equlibrium Partioning concentration-of-concern values for PAH Mixtures (% of benchmark)								**0.091689**	**0.019881**	**0.019062**	**0.01171**	**0.0079708**	**0.0050076**

Table 7. Mussel Tissue PAH loads from 2025 LTEMP samples.

Count	ANALYTE	JAC-B-25-1	JAC-B-25-2	JAC-B-25-3	AMT-B-25-1	AMT-B-25-2	AMT-B-25-3	RED-B-25-1	RED-B-25-2	RED-B-25-3	GOC-B-25-1	GOC-B-25-2	GOC-B-25-3
1	Naphthalene	0.653	0.65	0.585	0.472	0.527	0.572	0.679	0.644	0.55	0.457	0.855	0.724
2	C1-Naphthalenes	0.463	0.49	0.377	0.435	0.373	0.414	0.611	0.574	0.441	0.402	0.633	0.511
3	C2-Naphthalenes	0.738	0.772	0.897	0.658	0.665	0.79	0.988	0.887	0.777	0.64	0.926	0.797
4	C3-Naphthalenes	0.757	0.727	0.827	0.715	0.705	0.686	0.931	0.929	0.674	-	0.784	0.731
5	Biphenyl	0.221	0.185	0.17	0.212	0.21	0.228	0.292	0.298	0.208	0.331	0.206	0.214
6	Dibenzofuran	0.313	0.212	0.235	0.22	0.204	0.204	0.622	0.721	0.57	0.211	0.258	0.259
7	Acenaphthylene	0.085	0.062	0.062	0.048	0.058	0.036	0.125	0.134	0.121	-	0.08	0.07
8	Acenaphthene	0.116	0.098	0.096	0.1	0.085	0.102	0.458	0.531	0.354	0.123	0.155	0.108
9	Fluorene	0.321	0.328	0.312	0.303	0.259	0.279	0.701	0.808	0.645	0.262	0.329	0.302
10	Dibenzothiophene	0.136	0.11	0.099	0.107	0.108	0.091	0.3	0.369	0.292	0.088	0.105	0.107
11	C1-Dibenzothiophenes	0.156	0.267	0.193	0.183	0.234	0.13	0.294	0.23	0.282	-	-	-
12	C2-Dibenzothiophenes	0.5	-	0.594	0.592	0.578	0.5	0.917	0.712	0.91	-	-	-
13	Phenanthrene	1.18	1.4	1.25	1.3	1.28	1.24	5.58	6.42	5.55	1.41	1.7	1.69
14	C1-Phenanthrenes/Anthracenes	0.57	0.478	0.539	0.552	0.497	0.47	1.46	1.66	1.27	0.468	0.58	0.5
15	Anthracene	0.072	0.068	0.059	0.063	-	0.041	0.375	0.389	0.315	0.065	0.056	0.084
16	Carbazole	0.087	0.112	0.075	0.072	0.118	0.079	0.164	0.128	0.108	0.084	0.106	0.1
17	Fluoranthene	0.699	0.727	0.633	0.638	0.771	0.636	6.8	7.54	5.82	0.81	0.78	0.889
18	Pyrene	0.222	0.281	0.197	0.207	0.251	0.205	2.74	3.22	2.48	0.249	0.297	0.259
19	Naphthobenzothiophenes	0.07	0.054	0.038	0.042	-	0.05	0.992	0.721	0.726	0.045	0.055	0.057
20	Benz[a]anthracene	0.082	0.061	0.056	0.04	-	0.03	1.7	1.2	1.22	0.057	0.064	0.061
21	Chrysene/Triphenylene	0.167	0.195	0.168	0.132	0.167	0.132	3.68	2.86	2.86	0.218	0.207	0.271
22	Benzo[b]fluoranthene	0.104	-	-	-	-	-	1.39	1.01	0.938	-	-	-
23	Benzo[j]fluoranthene/Benzo[k]fluoranthene	0.079	-	-	-	-	-	1.32	1.01	0.962	-	-	-
24	Indeno[1,2,3-cd]pyrene	0.139	0.097	-	0.063	-	0.053	0.243	0.212	0.212	0.079	-	-
25	Benzo[g,h,i]perylene	0.309	0.25	0.114	0.13	0.168	0.15	0.396	0.412	0.385	0.164	0.16	0.098
26	C1-Fluorenes	-	0.29	-	0.267	-	0.242	0.454	0.536	0.529	-	0.276	0.32
27	C1-Fluoranthenes/Pyrenes	-	-	-	-	-	0.261	2	1.97	1.57	0.356	0.492	0.38
28	C1-Naphthobenzothiophenes	-	-	-	-	-	0.347	0.508	0.371	0.587	-	-	-
29	C2-Naphthobenzothiophenes	-	-	-	-	-	0.637	-	-	0.607	-	-	-
30	C3-Naphthobenzothiophenes	-	-	-	-	-	0.678	-	-	-	-	-	-
31	C2-Phenanthrenes/Anthracenes	-	-	-	-	-	-	1.2	0.958	1.17	-	-	-
32	C3-Phenanthrenes/Anthracenes	-	-	-	-	-	-	1.01	0.824	0.805	-	-	-
33	Benzo[b]fluorene	-	-	-	-	-	-	0.542	0.54	0.414	-	-	-

Table 7. Mussel Tissue PAH loads from 2025 LTEMP samples.

Count	ANALYTE	JAC-B-25-1	JAC-B-25-2	JAC-B-25-3	AMT-B-25-1	AMT-B-25-2	AMT-B-25-3	RED-B-25-1	RED-B-25-2	RED-B-25-3	GOC-B-25-1	GOC-B-25-2	GOC-B-25-3
34	C2-Fluoranthenes/Pyrenes	-	-	-	-	-	-	0.826	0.78	0.66	-	-	-
35	C1-Chrysenes	-	-	-	-	-	-	0.838	0.682	0.554	-	-	-
36	Benzo[a]fluoranthene	-	-	-	-	-	-	0.093	-	-	-	-	-
37	Benzo[e]pyrene	-	-	-	-	-	-	0.797	0.755	0.636	-	-	-
38	Benzo[a]pyrene	-	-	-	-	-	-	0.379	0.242	0.205	-	-	-
39	Perylene	-	-	-	-	-	-	0.119	0.134	0.098	-	-	-
	Percent Lipids	1.56	1.43	1.44	1.6	1.42	1.28	1.51	1.62	1.12	1.9	1.69	2.13
	Moisture	85.9	85.7	87.2	87.6	87.9	88.3	87.7	84.7	88.5	86	86.9	85
Total PAH (ng/g wet weight)		8.24	7.91	7.58	7.55	7.26	9.28	42.52	41.41	36.51	6.52	9.10	8.53
Total PAH (ng/g dry weight)		58.43	55.34	59.19	60.90	59.98	79.34	345.72	270.66	317.43	46.56	69.50	56.88
Total PAH (ng/g lipid corrected)		528.14	553.43	526.11	471.94	511.13	725.23	2816.16	2556.23	3259.38	343.11	538.70	400.56
Sum 16 PAH[1] (ng/g wet weight)		4.23	4.22	3.53	3.50	3.57	3.48	26.57	26.63	22.62	3.89	4.68	4.56
Sum 16 PAH[1] (ng/g dry weight)		0.60	0.60	0.45	0.43	0.43	0.41	3.27	4.07	2.60	0.55	0.61	0.68
Sum low molecular weight PAH[2] (ng/g wet weight)		6.28	5.85	6.30	5.96	5.78	5.78	14.33	15.31	12.96	4.46	6.67	6.10
Sum high molecular weight PAH[3] (ng/g wet weight)		1.87	1.96	1.21	1.52	1.36	3.42	28.03	25.98	23.44	1.98	2.33	2.34
% low molecular weight PAH		77%	75%	84%	80%	81%	63%	34%	37%	36%	69%	74%	72%
% high molecular weight PAH		23%	25%	16%	20%	19%	37%	66%	63%	64%	31%	26%	28%
Sum of Carcinogenic PAH[4] (ng/g wet weight)		0.571	0.353	0.224	0.235	0.167	0.215	8.712	6.534	6.397	0.354	0.271	0.332

1 16 EPA Priority PAHs - See Table 5

2 Low molecular weight PAHs : napthalenes - phenanthrenes (2-3-ring PAH)

3 High molecular weight PAHs: fluoranthene - benzo (g,h,i)perylene (3-6 ring PAH)

4 Carcinogenic PAHs: benzo[a]pyrene, benz[a]anthracene, benzo[b]fluoranthene, benzo[k]fluoranthene, chrysene, dibenz[a,h]anthracene, indeno[1,2,3-cd]pyrene

Table 8. 2025 Water PAH concentrations quantified via passive sampling device (ng/L C free)

.	Analyte	JAC-PSD-25-1	JAC-PSD-25-2	JAC-PSD-25-3	AMT-PSD-25-1	AMT-PSD-25-2	AMT-PSD-25-3	GOC-PSD-25-1	GOC-PSD-25-2	GOC-PSD-25-3
1	naphthalene	0.842	4.58	0.905	3.12	1.58	3.47	0.471	0.591	0.456
2	C1-naphthalenes	0.312	0.543	0.408	0.809	0.34	0.44	0.256	0.312	0.276
3	C2-naphthalenes	0.391	1.03	0.866	2.53	0.861	1.07	0.39	0.456	0.37
4	C3-naphthalenes	1.55	1.14	1.44	6.24	2.1	2.4	0.761	1.17	0.801
5	C4-naphthalenes	2.7	1.67	2.27	11.6	3.29	3.28	1.01	1.68	1.16
6	acenaphthylene	< 0.00955	< 0.00945	< 0.00947	< 0.00993	< 0.0104	< 0.0104	< 0.00940	< 0.00961	< 0.00945
7	acenaphthene	0.159	0.106	0.171	0.306	9.69E-02	0.156	0.161	0.209	0.17
8	fluorene	8.60E-02	0.127	9.24E-02	0.185	7.19E-02	0.124	8.58E-02	0.105	9.06E-02
9	C1-fluorenes	0.129	0.178	0.156	0.232	0.28	0.283	0.148	0.14	9.89E-02
10	C2-fluorenes	0.597	0.528	0.586	0.688	0.915	1.06	0.342	0.448	0.384
11	C3-fluorenes	0.514	0.376	0.389	0.701	0.738	0.8	0.316	0.456	0.327
12	anthracene	2.74E-02	5.42E-02	5.10E-02	2.42E-02	3.91E-02	3.74E-02	2.92E-02	2.60E-02	2.04E-02
13	phenanthrene	0.166	0.161	0.158	0.181	0.219	0.233	0.201	0.239	0.214
14	C1-phenanthrenes & anthracenes	0.141	0.106	0.121	0.173	0.181	0.218	0.101	0.128	0.11
15	C3-phenanthrenes & anthracenes	0.831	0.683	0.746	0.853	1.16	1.17	0.349	0.725	0.557
16	dibenzothiophene	9.75E-03	8.88E-03	9.10E-03	9.90E-03	1.19E-02	1.66E-02	1.02E-02	1.21E-02	1.02E-02
17	C1-dibenzothiophenes	0.123	8.90E-02	0.117	0.115	0.113	0.212	6.97E-02	8.75E-02	7.56E-02
18	C2-dibenzothiophenes	0.191	0.16	0.185	0.159	0.223	0.343	0.105	0.126	0.109
19	C3-dibenzothiophenes	< 0.0324	< 0.0294	< 0.0303	< 0.0388	< 0.0440	< 0.0440	< 0.0311	< 0.0352	< 0.0324
20	fluoranthene	9.06E-02	7.11E-02	7.72E-02	8.24E-02	9.72E-02	9.38E-02	0.113	0.14	0.121
21	Pyrene	1.17E-02	7.81E-03	9.56E-03	1.65E-02	1.39E-02	1.24E-02	2.45E-02	3.03E-02	2.75E-02
22	C1-fluoranthenes & pyrenes	3.44E-02	3.94E-02	3.33E-02	2.87E-02	3.56E-02	8.22E-02	3.86E-02	4.67E-02	4.21E-02
23	C2-fluoranthenes & pyrenes	< 0.00193	< 0.00148	< 0.00163	< 0.00277	< 0.00338	< 0.00338	< 0.00178	< 0.00233	< 0.00195
24	chrysene	3.63E-03	2.72E-03	3.51E-03	3.26E-03	3.84E-03	3.21E-03	4.50E-03	5.13E-03	4.79E-03
25	triphenylene	4.96E-03	4.19E-03	4.32E-03	5.13E-03	6.72E-03	6.08E-03	5.41E-03	6.52E-03	6.02E-03
26	C1-benz[a]anthracenes & chrysenes & triphenylenes	0.026	0.030	0.028	0.033	0.031	0.031	0.025	0.035	1.77E-02
27	perylene	< 0.000750	< 0.000555	< 0.000621	< 0.00112	< 0.00138	< 0.00138	< 0.000686	< 0.000929	< 0.000759
28	benzo[b]fluoranthene	1.47E-03	1.51E-03	1.10E-03	2.84E-03	3.82E-03	3.88E-03	1.98E-03	2.42E-03	2.25E-03
29	benzo[j]fluoranthene	< 0.000396	< 0.000293	< 0.000328	< 0.000590	< 0.000728	< 0.000729	< 0.000363	< 0.000490	< 0.000401
30	benzo[k]fluoranthene	< 0.000375	< 0.000278	< 0.000310	< 0.000558	< 0.000689	< 0.000690	< 0.000343	< 0.000464	< 0.000379
31	benzo[e]pyrene	< 0.000584	< 0.000431	< 0.000483	< 0.000869	< 0.00107	< 0.00107	< 0.000534	< 0.000723	< 0.000590
32	benzo[a]pyrene	< 0.000842	< 0.000623	< 0.000697	< 0.00125	< 0.00155	< 0.00155	< 0.000770	< 0.00104	< 0.000851
33	indeno[1,2,3-cd]pyrene	< 0.000247	< 0.000182	< 0.000204	< 0.000368	< 0.000454	< 0.000454	< 0.000226	< 0.000306	< 0.000249
34	benzo[ghi]perylene	< 0.000310	< 0.000229	< 0.000256	< 0.000462	< 0.000570	< 0.000571	< 0.000283	< 0.000384	< 0.000313
	Total PAHs	8.94201	11.69701	8.82749	28.09793	12.41178	15.54527	5.01879	7.17687	5.45106
	Total PAH w/o Naphthalene	3.147	2.734	2.938	3.799	4.241	4.885	2.131	2.968	2.388
	Sum 16 PAHs[1]	1.419	5.146	1.501	3.959	2.163	4.170	1.122	1.390	1.130
	Sum low molecular weight PAH[2]	8.769	11.540	8.671	27.926	12.220	15.313	4.806	6.911	5.230
	Sum high molecular weight PAH[3]	0.173	0.157	0.157	0.172	0.192	0.232	0.213	0.266	0.221
	Percent low molecular weight PAH	98%	99%	98%	99%	98%	99%	96%	96%	96%
	Sum of Carcinogenic PAHs[4]	0.004	0.003	0.004	0.003	0.004	0.003	0.005	0.005	0.005
	Percent Naphthalene	65%	77%	67%	86%	66%	69%	58%	59%	56%

[1-4]: See Tables 5 6

Table 9. Mussel tissue biomarkers from 2025 LTEMP samples. All positive analyte detections are reported for every sample with positive detections (i.e., not all samples had positive detections).

Count	ANALYTE	JAC-B-25-1	JAC-B-25-2	JAC-B-25-3	AMT-B-25-1	AMT-B-25-2	AMT-B-25-3	RED-B-25-1	RED-B-25-2	RED-B-25-3	GOC-B-25-1	GOC-B-25-2	GOC-B-25-3
1	Hopane (T19)	0.706	0.957	1.080	0.612	3.460	0.652	2.470	1.710	2.030	0.944	0.420	0.745
2	30-Norhopane (T15)	0.930	0.772	0.573	0.686	0.652	0.862	1.610	1.400	1.530	0.702	0.633	0.565
3	30,31-Bishomohopane-22S (T26)	5.130	5.190	4.760	4.770	5.190	5.420	5.950	4.990	4.870	4.220	3.690	4.100
4	13b(H),17a(H)-20S-Diacholestane (S4)	0.176	0.191	0.181	-	-	0.132	0.378	0.293	0.309	-	-	0.134
5	17a(H)20SC27/C29dia	0.517	0.689	0.299	0.452	0.437	0.554	0.914	0.541	0.583	0.470	0.469	0.453
6	17a(H)20rc27/C29dia	0.508	1.040	0.400	0.698	0.593	0.676	1.360	0.914	0.750	0.773	0.725	0.699
7	14b(H),17b(H)-20R-Cholestane (S14)	0.199	0.212	0.160	0.228	0.171	0.172	0.434	0.377	0.368	0.204	0.139	0.190
8	14b(H),17b(H)-20S-Cholestane (S15)	0.180	0.208	0.185	0.198	0.221	0.220	0.439	0.373	0.392	0.166	0.181	0.235
9	14b,17b-20S-Methylcholestane (S23)	0.180	0.247	0.270	0.220	0.226	0.230	0.562	0.586	0.470	0.249	-	-
10	14b(H),17b(H)-20R-Ethylcholestane (S26)	0.361	0.325	0.253	0.237	0.332	0.289	0.434	0.448	0.691	0.243	0.224	0.313
11	14b(H),17b(H)-20S-Ethylcholestane (S27)	0.218	0.260	0.249	0.353	0.166	0.186	0.720	0.635	0.416	0.260	0.176	0.145
12	30-Homohopane-22S (T21)	-	0.599	0.582	-	-	-	1.050	0.862	1.020	-	-	-
13	14a,17a-20R-Methylcholestane (S24)	-	0.559	0.257	0.284	0.286	0.245	0.557	0.532	0.368	0.315	0.240	0.397
14	14a(H),17a(H)-20R-Ethylcholestane (S28)	-	0.347	0.219	0.272	0.271	0.377	0.643	0.524	0.510	0.271	0.245	0.296
15	14b,17b-20R-Methylcholestane (S22)	-	0.234	0.160	0.177	0.171	0.142	0.439	0.501	0.343	0.166	-	-
16	14a(H),17a(H)-20S-Ethylcholestane (S25)	-	-	-	-	-	0.172	0.322	0.257	0.245	-	-	-
17	C23 Tricyclic Terpane (T4)	-	-	-	-	-	-	1.020	1.450	1.100	-	-	-
18	C24 Tricyclic Terpane (T5)	-	-	-	-	-	-	0.377	0.322	0.332	-	-	-
19	C24 Tetracyclic Terpane (T6a)	-	-	-	-	-	-	0.547	0.310	0.348	-	-	-
20	C26 Tricyclic Terpane-22S (T6b)	-	-	-	-	-	-	0.184	-	-	-	-	-
21	C28 Tricyclic Terpane-22R (T8)	-	-	-	-	-	-	0.227	-	-	-	-	-
22	18a-22,29,30-Trisnorneohopane-TS (T11)	-	-	-	-	-	-	0.552	0.638	0.702	-	-	-
23	17a(H)-22,29,30-Trisnorhopane-TM	-	-	-	-	-	-	0.533	0.431	0.547	-	-	-
24	18a(H)-30-Norneohopane-C29Ts (T16)	-	-	-	-	-	-	0.360	0.416	-	-	-	-
25	30-Homohopane-22R (T22)	-	-	-	-	-	-	0.728	0.803	0.889	-	-	-
26	13b(H),17a(H)-20R-Diacholestane (S5)	-	-	-	-	-	-	0.194	0.204	0.181	-	-	-
27	13b,17a-20S-Methyldiacholestane (S8)	-	-	-	-	-	-	0.260	0.248	0.240	-	-	-
28	14a,17a-20S-Methylcholestane (S20)	-	-	-	-	-	-	0.296	-	0.382	-	-	-
29	C25 Tricyclic Terpane (T6)	-	-	-	-	-	-	-	0.350	-	-	-	-
Count		11	15	15	13	13	15	28	26	25	13	11	12

Table 10. Diagonistic Ratios for petroleum fingerprinting in marine sediment, intertidal mussel tissue, and seawater sampled by PSD for all replicates of the 2025 LTEMP campaign.

n	SAMPID	Matrix	Total Petroleum Hydrocarbons (C9-C44 ng/g)	Total Saturated Hydrocarbons (µg/g)	Ratio of T15/T19[1]	Ratio of Pristane/ Phytane[2]	Ratio of Pristane/ C17[3]	Ratio of Phytane/ C18[4]	ANT/(ANT+PHE)[5]	ΣLMW/ΣHMW[6]	FL/(FL + PYR)[7]	FLA/(FLA + PYR)[8]
Whole ANS Crude Oil			563000	77351.80	0.557	1.729	0.863	0.578	0.000	-	0.848	0.213
Cutoff Value (s)									0.100	1.00	0.500	0.400
1	AMT-S-25-1	Sediment	37.10	1.70	0.600	3.495	0.645	0.371	0.121	2.204	0.266	0.424
2	AMT-S-25-2	Sediment	38.70	2.02	0.600	1.407	0.415	0.072	0.090	0.945	0.320	0.560
3	AMT-S-25-3	Sediment	33.00	2.12	0.687	1.526	0.484	0.365	0.090	0.909	0.410	0.580
4	GOC-S-25-1	Sediment	28.60	2.35	1.076	0.043	0.507	11.616	0.100	1.936	0.360	0.600
5	GOC-S-25-2	Sediment	13.20	0.99	0.790	3.645	0.886	0.199	0.100	2.840	0.417	0.640
6	GOC-S-25-3	Sediment	10.60	0.88	0.611	1.683	0.411	0.289	0.143	1.998	0.444	0.573
7	JAC-B-25-1	Tissue	1.35	2.70	1.317	0.175	0.315	12.308	0.058	3.357	0.591	0.759
8	JAC-B-25-2	Tissue	5.04	1.76	0.807	0.196	0.380	7.650	0.046	2.991	0.539	0.721
9	JAC-B-25-3	Tissue	1.25	1.84	0.531	0.169	0.433	9.625	0.045	5.220	0.613	0.763
10	AMT-B-25-1	Tissue	4.79	2.18	1.121	0.317	0.657	11.154	0.046	3.924	0.594	0.755
11	AMT-B-25-2	Tissue	4.74	2.01	0.188	0.167	0.308	12.000	0.584	4.262	0.508	0.754
12	AMT-B-25-3	Tissue	4.47	2.17	1.322	0.244	0.423	9.643	0.032	1.690	0.576	0.756
13	RED-B-25-1	Tissue	7.86	3.42	0.650	2.000	0.420	1.235	0.063	0.511	0.204	0.713
14	RED-B-25-2	Tissue	14.30	2.06	0.819	2.267	0.453	1.250	0.057	0.589	0.201	0.700
15	RED-B-25-3	Tissue	15.70	3.01	0.750	2.000	0.400	1.600	0.054	0.553	0.206	0.700
16	GOC-B-25-1	Tissue	8.40	3.03	0.744	0.197	0.449	15.700	0.044	2.253	0.513	0.765
17	GOC-B-25-2	Tissue	6.89	1.84	1.507	0.222	0.593	12.154	0.032	2.860	0.526	0.724
18	GOC-B-25-3	Tissue	7.75	2.63	0.758	0.224	0.455	12.000	0.047	2.611	0.538	0.774
19	JAC-PSD-25-1	Seawater	8.92	-	-	-	-	-	0.142	59.752	0.880	0.886
20	JAC-PSD-25-2	Seawater	11.67	-	-	-	-	-	0.252	91.060	0.942	0.901
21	JAC-PSD-25-3	Seawater	8.80	-	-	-	-	-	0.244	67.218	0.906	0.890
22	AMT-PSD-25-1	Seawater	28.06	-	-	-	-	-	0.118	201.153	0.918	0.833
23	AMT-PSD-25-2	Seawater	12.38	-	-	-	-	-	0.151	75.862	0.838	0.875
24	AMT-PSD-25-3	Seawater	15.51	-	-	-	-	-	0.138	75.969	0.909	0.883
25	GOC-PSD-25-1	Seawater	4.99	-	-	-	-	-	0.127	25.565	0.778	0.822
26	GOC-PSD-25-2	Seawater	7.14	-	-	-	-	-	0.098	29.907	0.776	0.822
27	GOC-PSD-25-3	Seawater	5.43	-	-	-	-	-	0.087	25.679	0.767	0.815

[1] T15-Norhopane to T19-Hopane is a diagnostic ratio that identifies crude oil presence

[2] Higher values are indicative of greater marine biogenic sources over oil

[3] Higher values are indicative of greater weathering for oil and biogenic mixtures

[4] Higher values are indicative of oil-derived material and microbial degradation of the straight-chain alkanes

[5] Ratio of Anthracene to Anthracene+ Phenanthrene is indicative of petrogenic sources with values <0.1 and pyrogenic with values > 0.1 (Pies et al 2008)

[6] ΣLMW/ΣHMW; A higher prevelance of low molecular weight PAHs compared to high molecular weight PAHs (e.g., values >1) indicates petrogenic sources (Zang et al 2008)

[7] FL/(FL + PYR); Flourene and pyrene ratios indicate types of emissions with values <0.5 suggesting petrol while values >0.5 diesel (Ravindra et al. 2008b)

[8] FLA/(FLA + PYR); Flouranthene and Pyrene ratios indicate types of combustion with values >0.4 indicating wood and coal combustion (De La Torre-Roche et al., 2009)

3. FIGURES

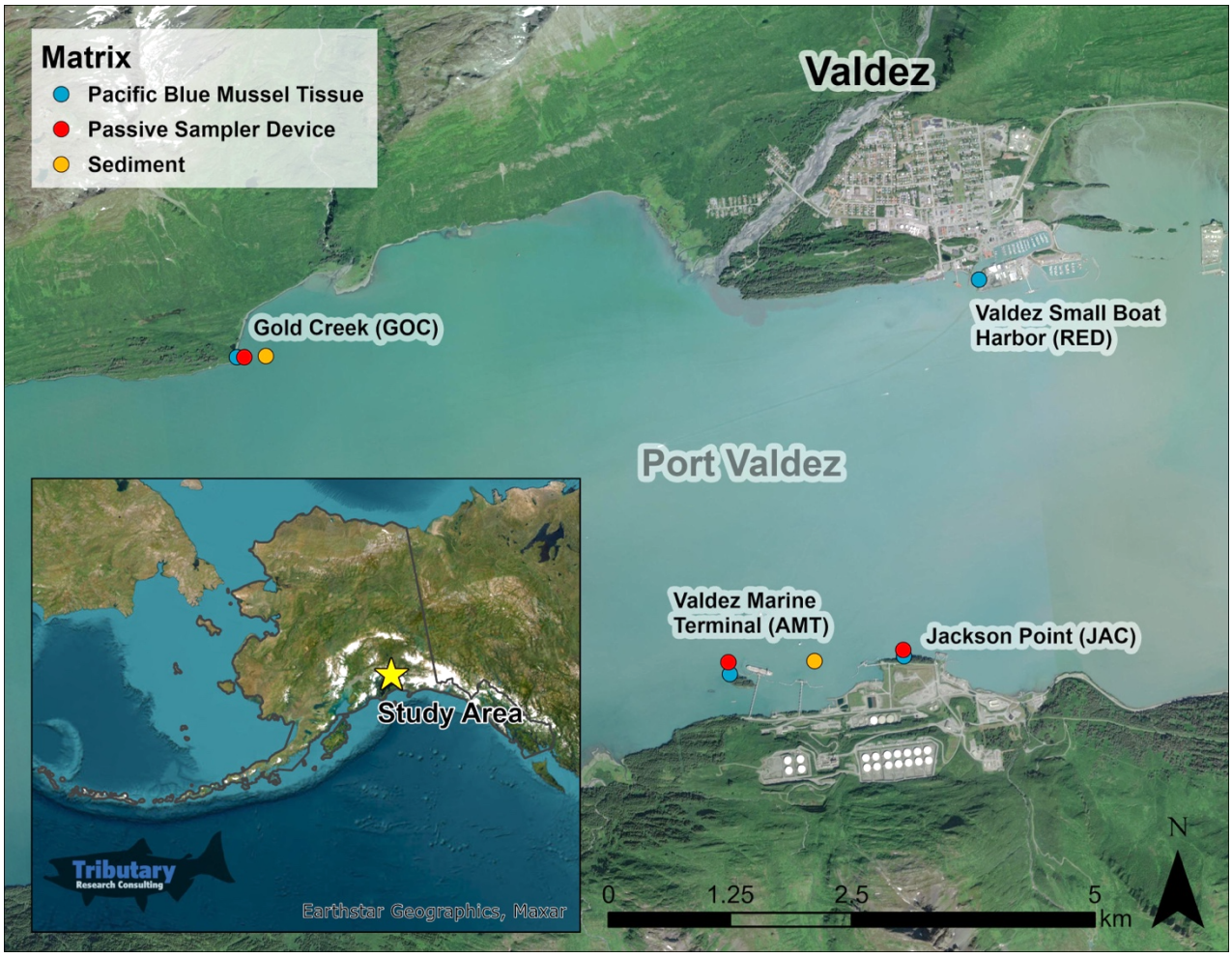

Figure 1. Long-Term Environmental Monitoring Program sites from the 2025 campaign. Mapping by Tributary Research Consulting.

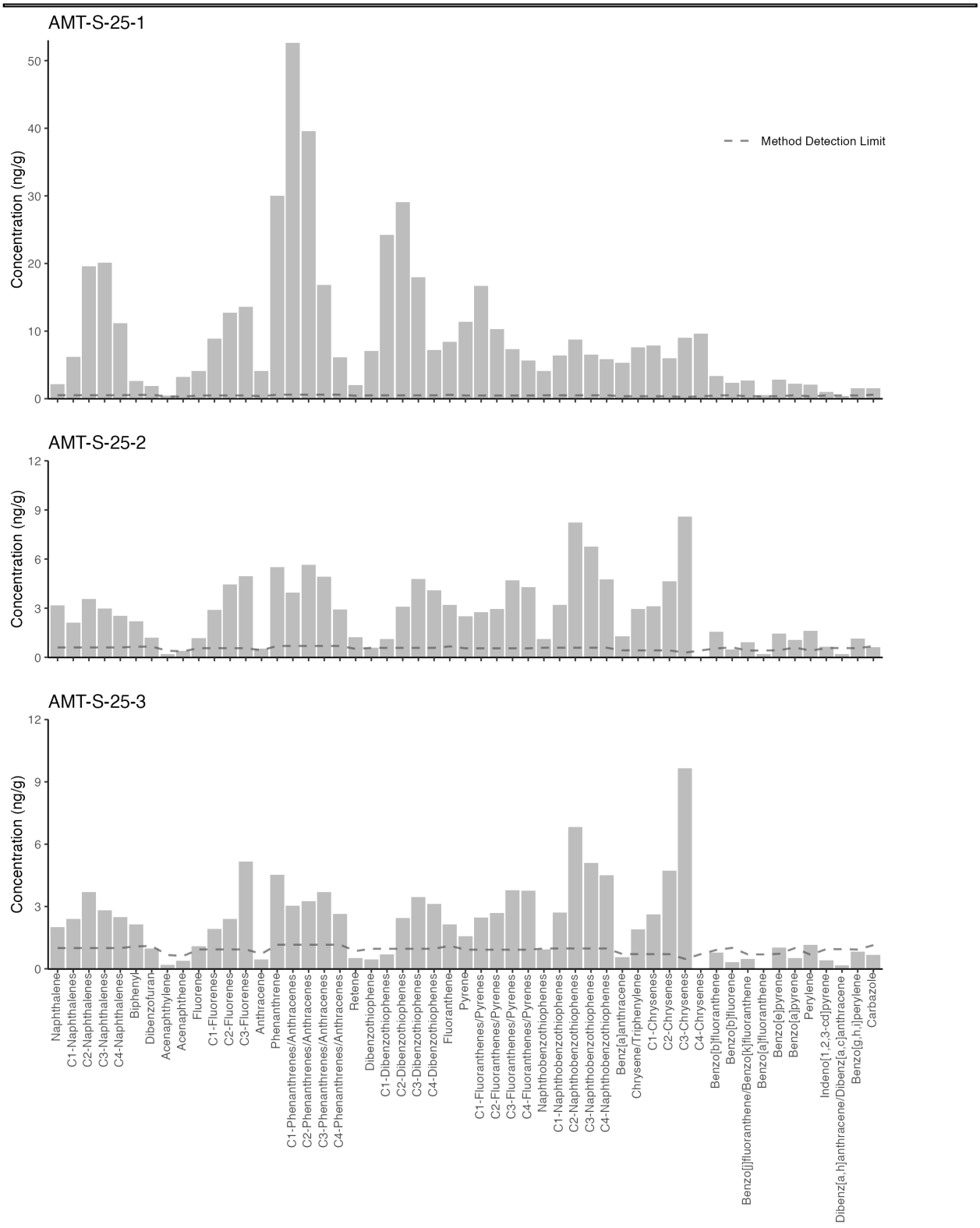

Figure 2. 2025 PAH profiles from individual sediment samples at the Valdez Marine Terminal (AMT) with the analyte-specific method detection limit superimposed as dashed lines. Note that the top panel has a different y-axis compared to the other two plots.

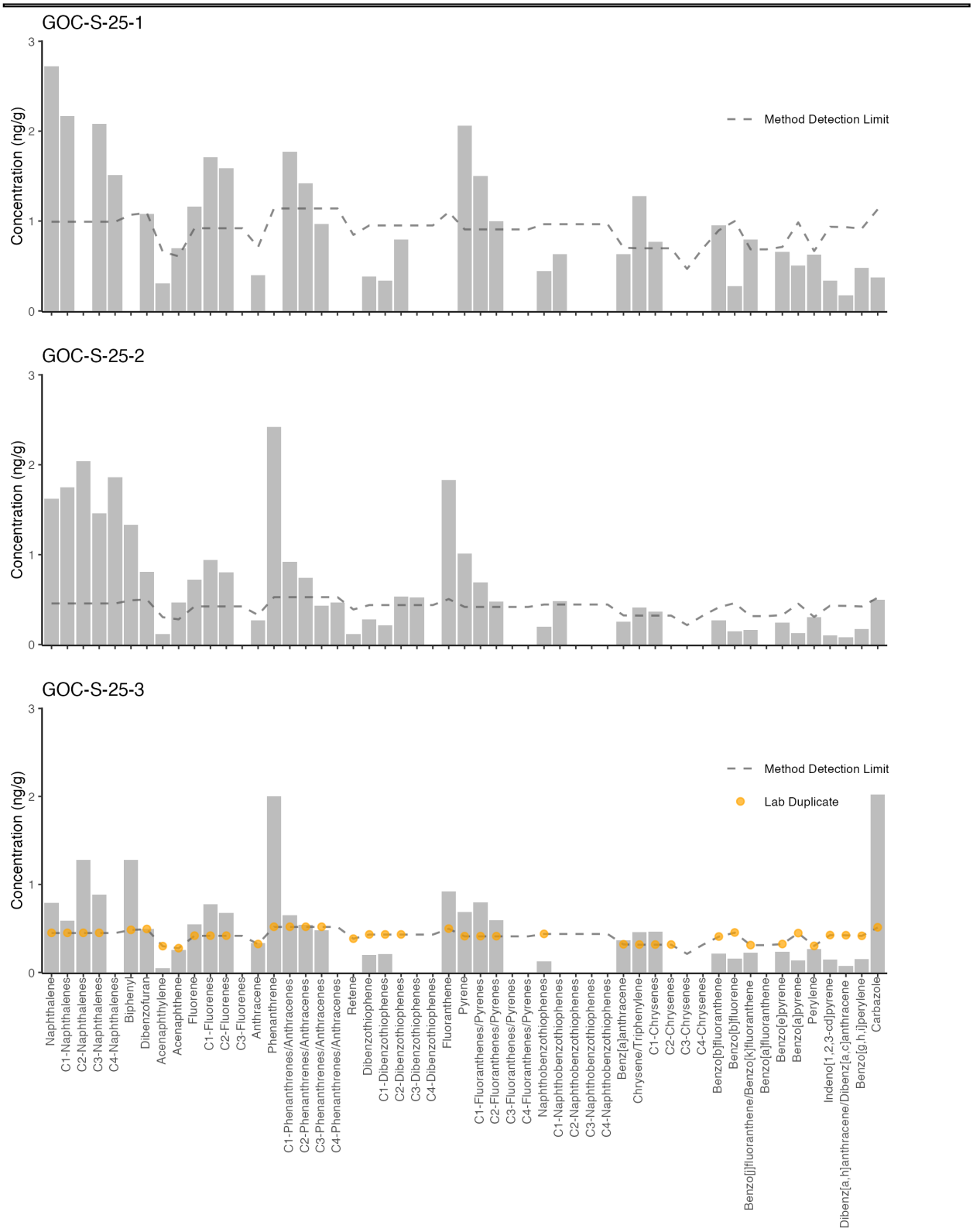

Figure 3. 2025 PAH profiles from individual sediment samples at the Gold Creek (GOC) reference site with the sample duplicate overlaid as orange points and the analyte-specific method detection limit superimposed as a dashed line.

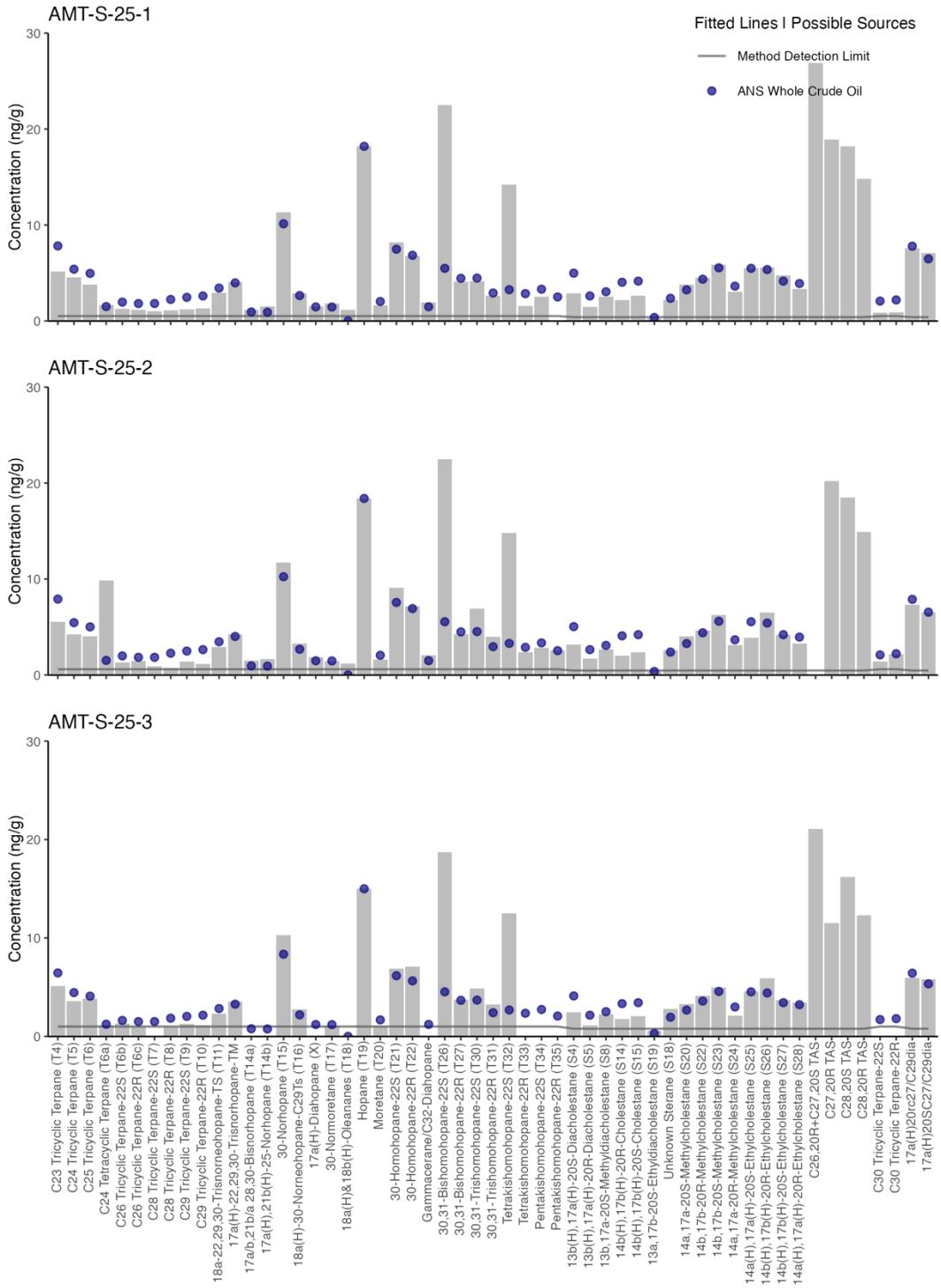

Figure 4. 2025 petro-geochemical profiles from individual sediment samples at the Valdez Marine Terminal (AMT) with the ANS potential source profile superimposed as blue points and the analyte-specific method detection limit superimposed as a line. ANS profile lines are scaled to Hopane (T19) and represent data only where points are present.

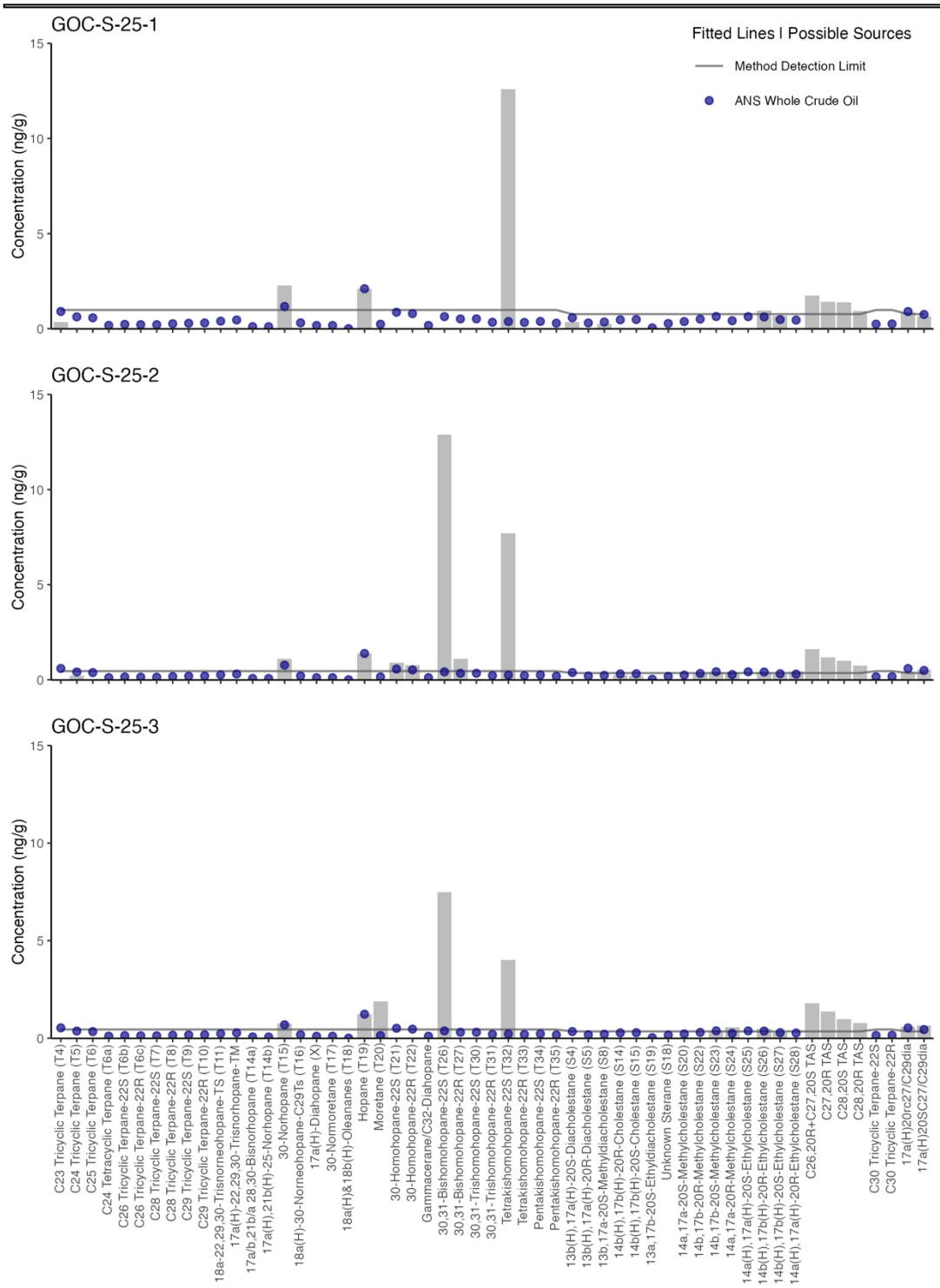

Figure 5. 2025 petro-geochemical biomarker profiles from individual sediment samples at the Gold Creek (GOC) reference site with the ANS potential source profile superimposed as blue points and the analyte-specific method detection limit superimposed as a line. ANS profile lines are scaled to Hopane (T19) and represent data only where points are present.

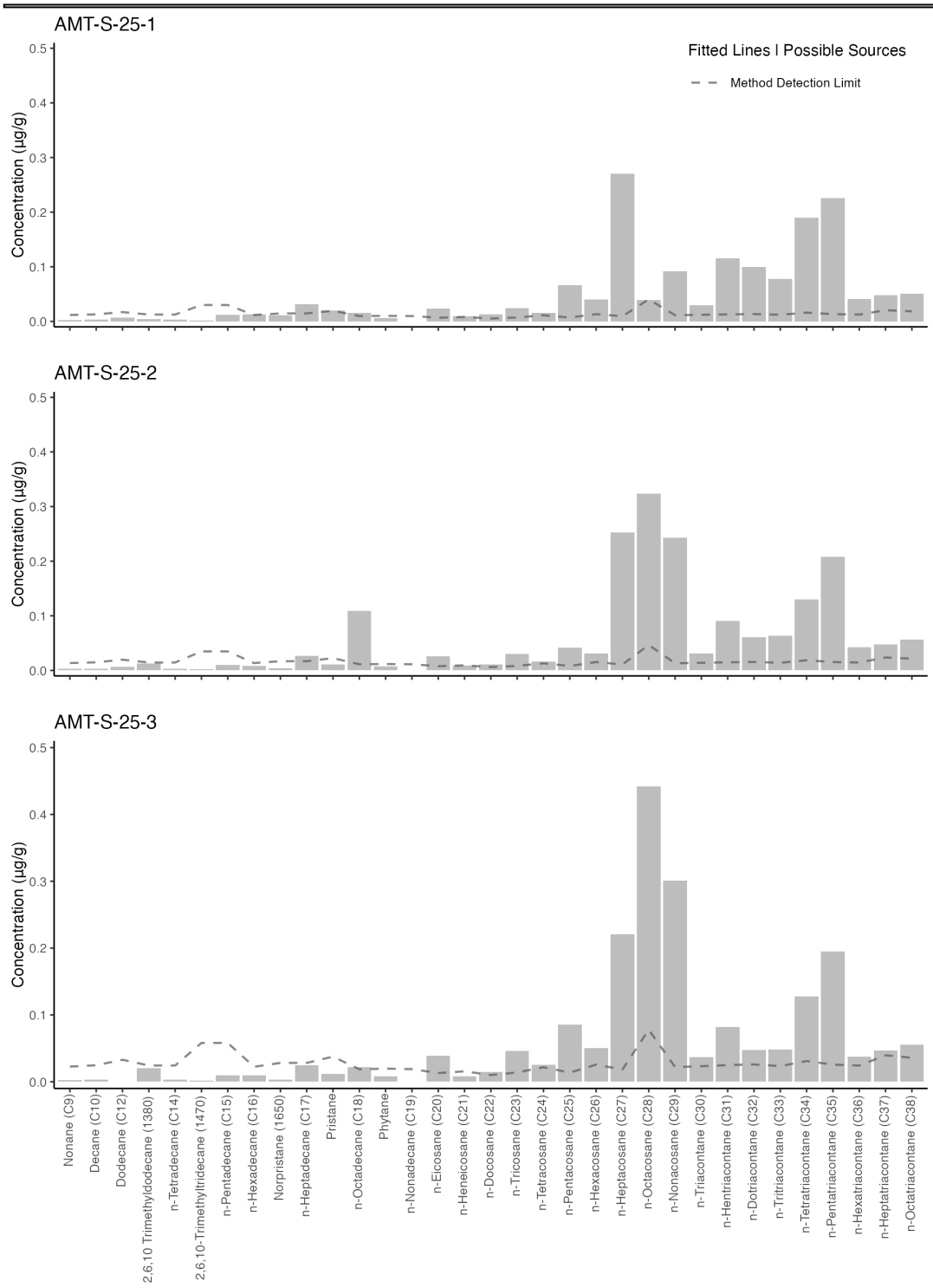

Figure 6. 2025 saturated hydrocarbon profiles from individual sediment samples at the Valdez Marine Terminal (AMT) with the analyte-specific method detection limit superimposed as a dashed line.

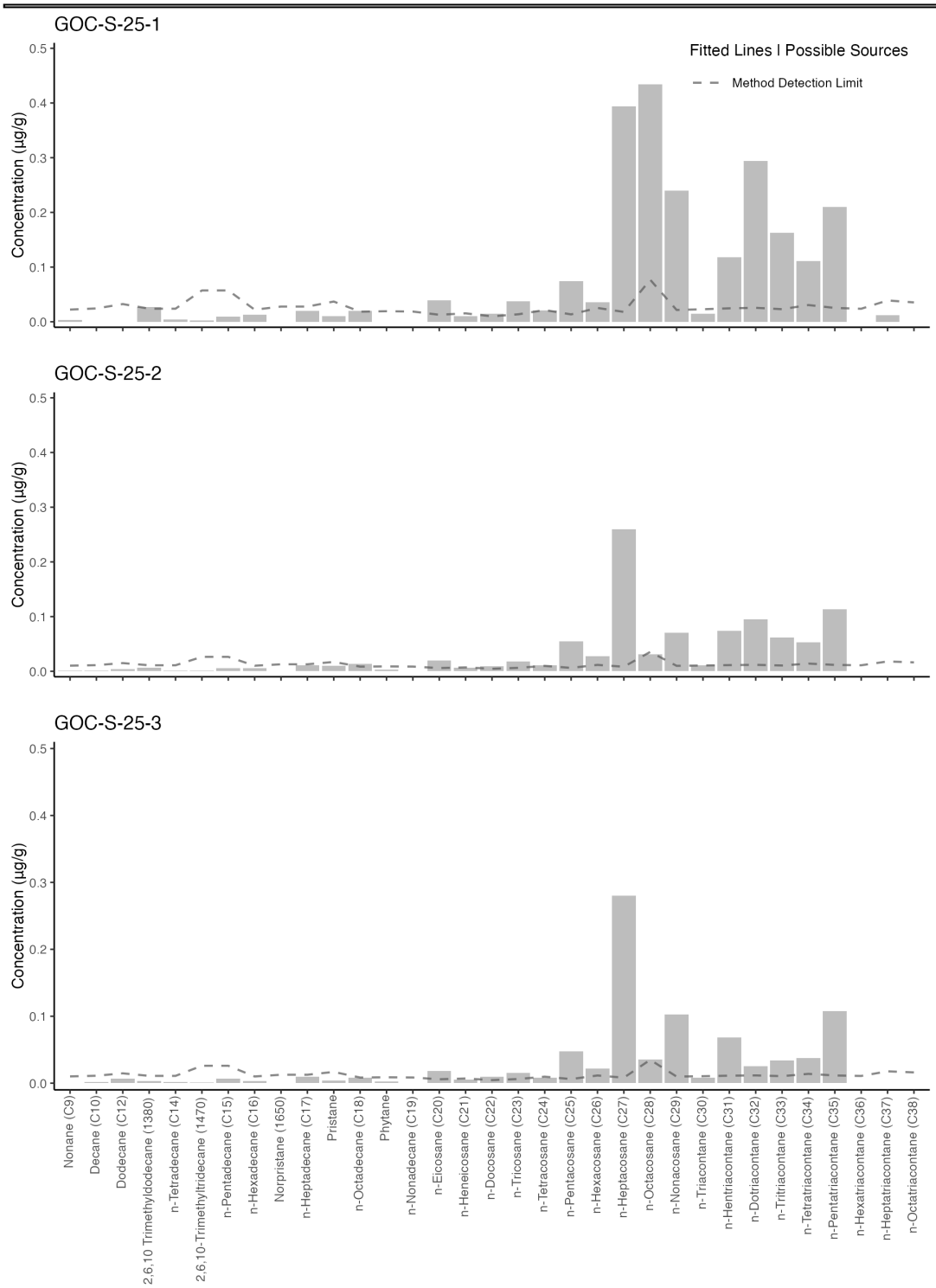

Figure 7. 2025 saturated hydrocarbon profiles from individual sediment samples at the Gold Creek (GOC) reference site with the analyte-specific method detection limit superimposed as a dashed line.

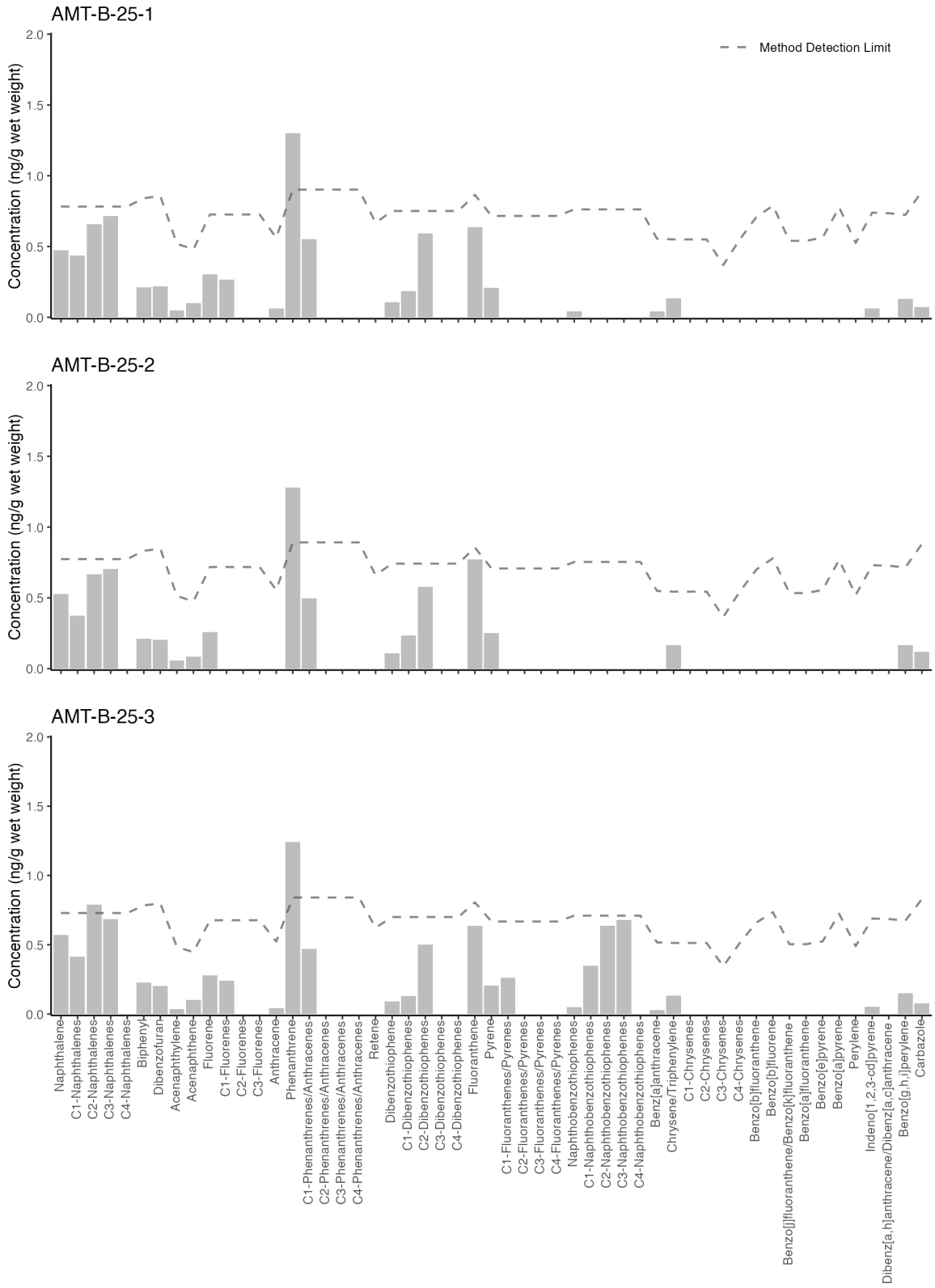

Figure 8. 2025 PAH profiles from individual tissue samples at the Valdez Marine Terminal (AMT) site with the analyte-specific method detection limit superimposed as a dashed line.

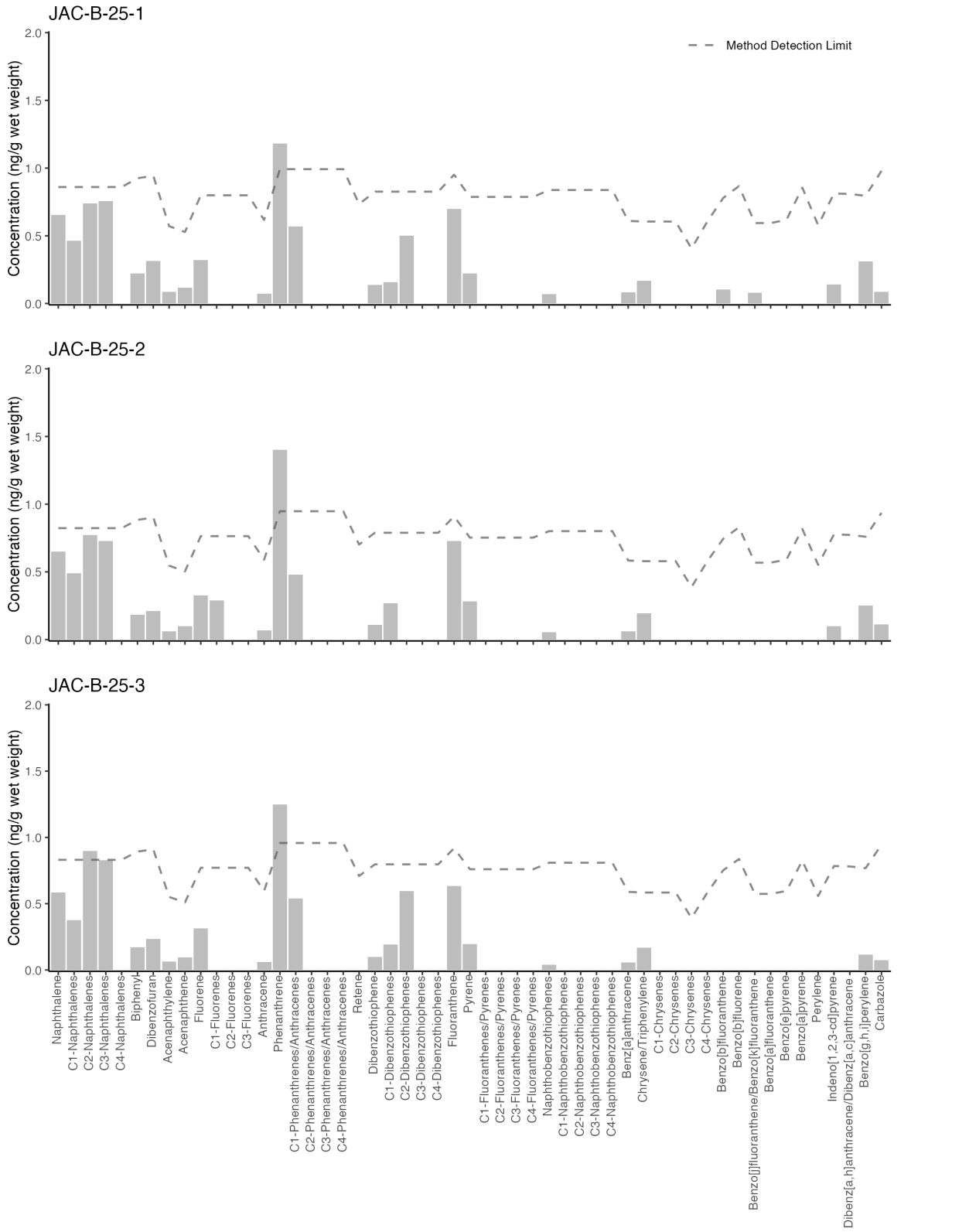

Figure 9. 2025 PAH profiles from individual tissue samples at the Jackson Point (JAC) site, near the Valdez Marine Terminal, with the analyte-specific method detection limit superimposed as a dashed line.

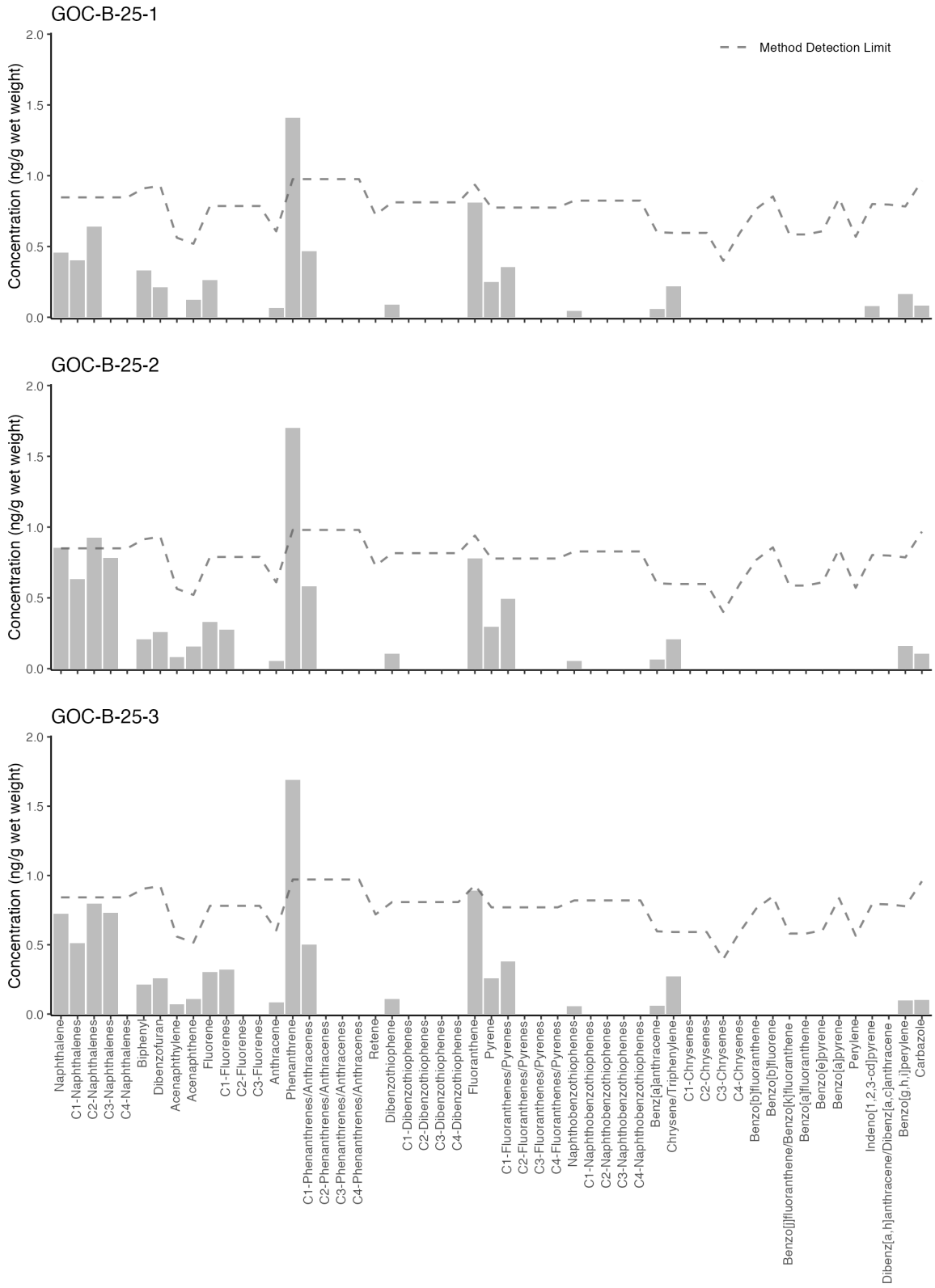

Figure 10. 2025 PAH profiles from individual tissue samples at the Gold Creek (GOC) reference site in Port Valdez with the analyte-specific method detection limit superimposed as a dashed line.

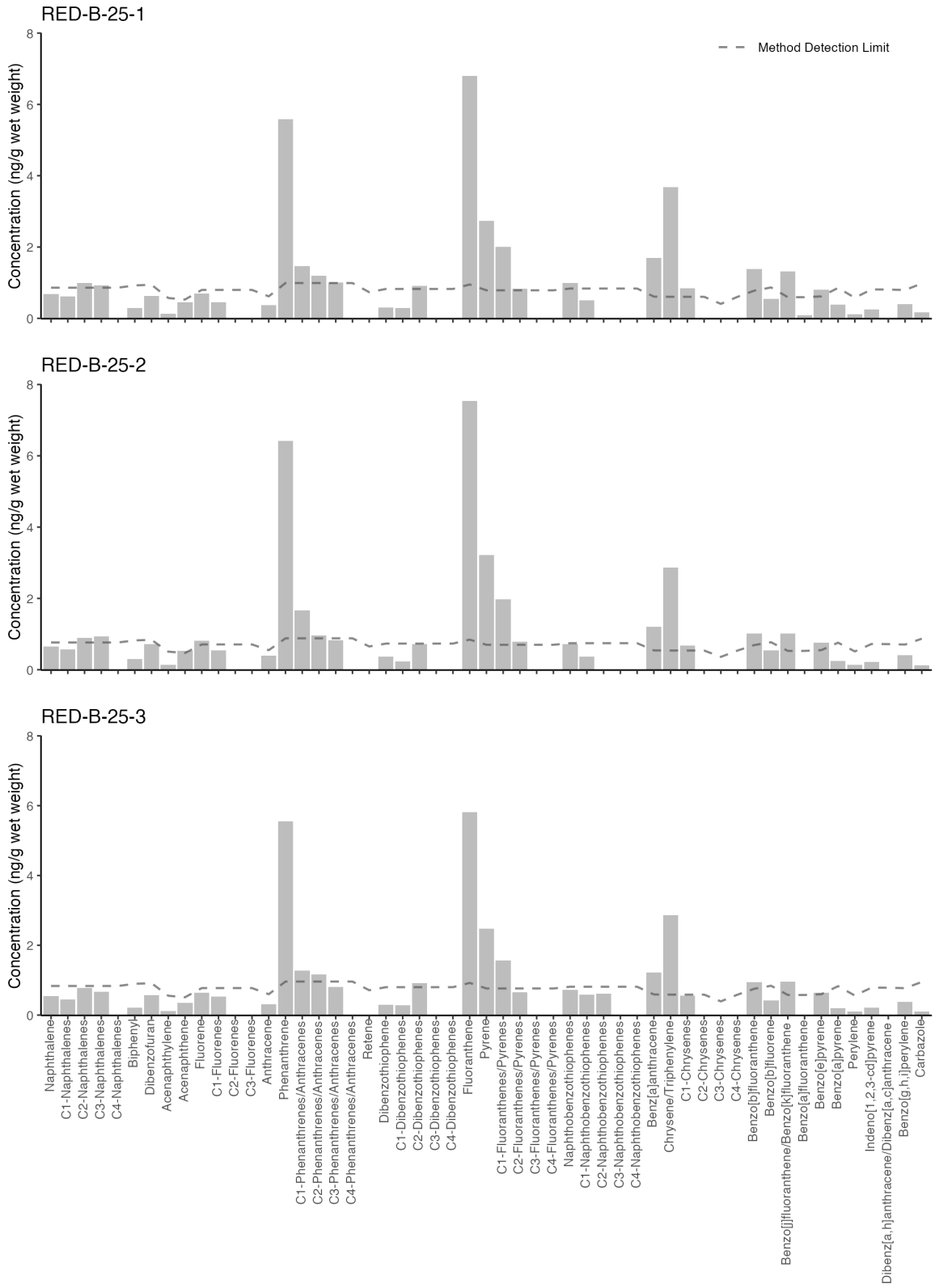

Figure 11. 2025 PAH profiles from individual tissue samples at positive control site at the entrance of the Valdez Small boat harbor (RED) site with the analyte specific method detection limit superimposed as a dashed line.

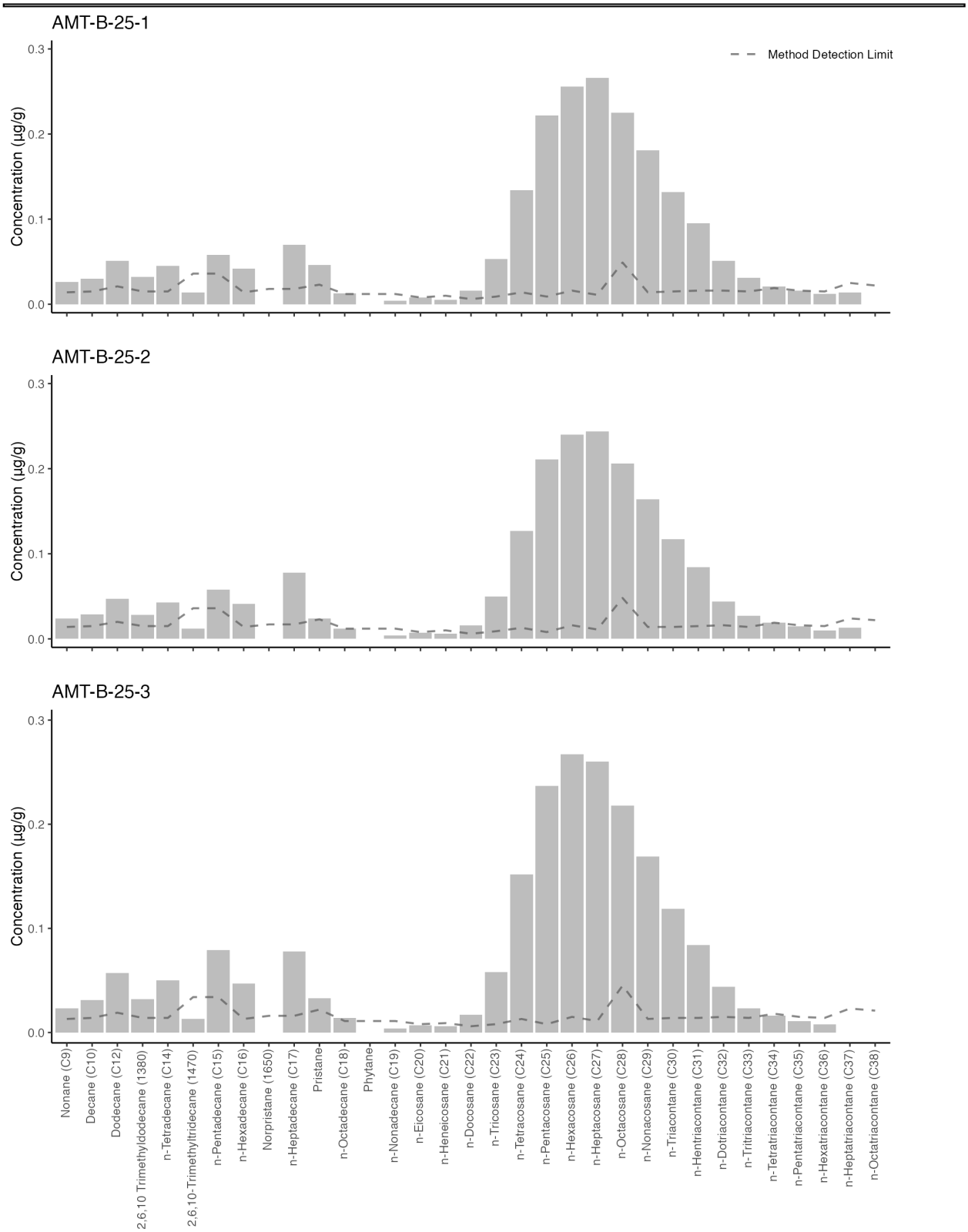

Figure 12. 2025 saturated hydrocarbon profiles from individual tissue samples at the Valdez Marine Terminal (AMT) site with the analyte-specific method detection limit superimposed as a dashed line.

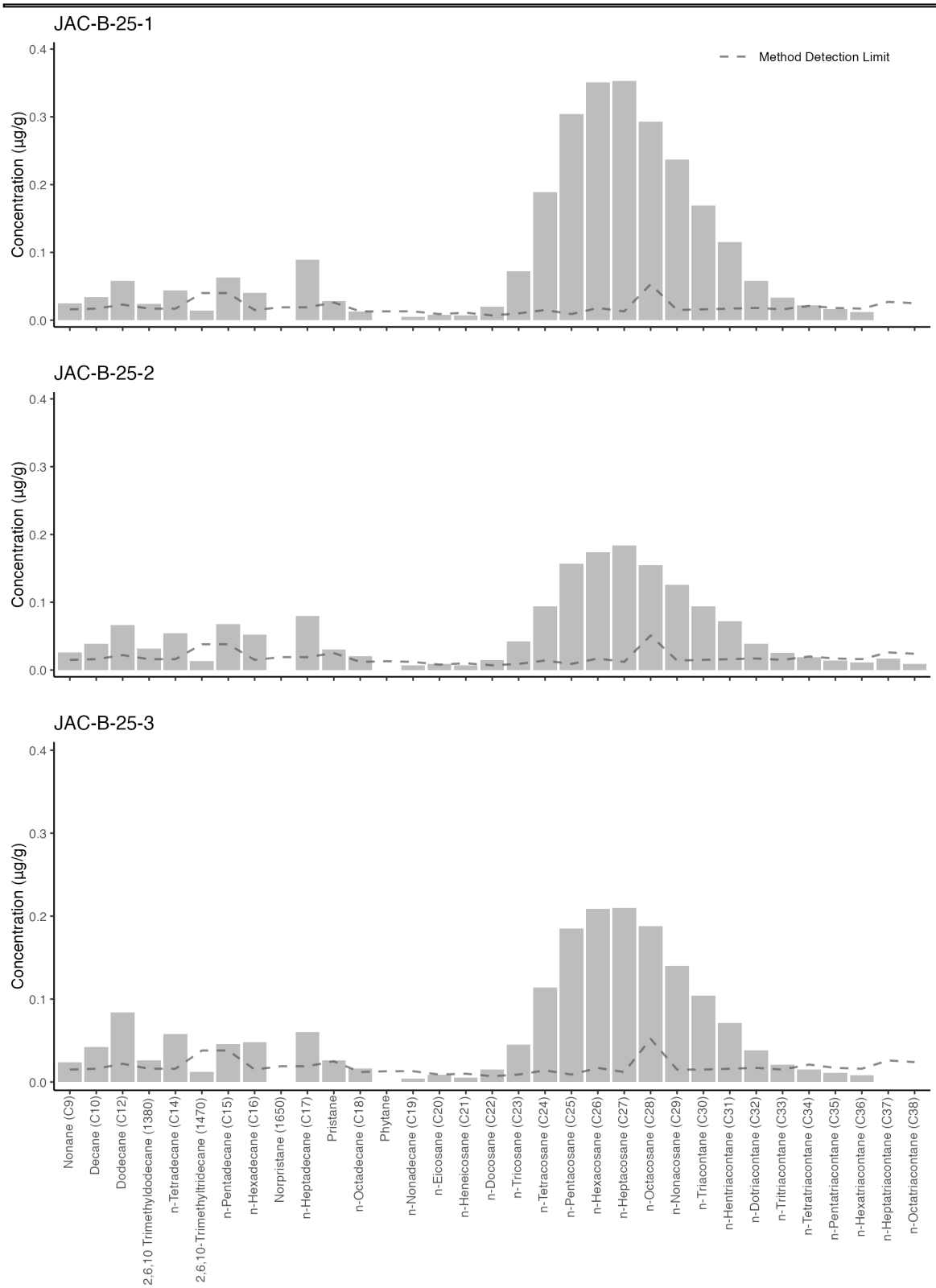

Figure 13. 2025 saturated hydrocarbon profiles from individual tissue samples at the Jackson Point (JAC) site with the analyte-specific method detection limit superimposed as a dashed line.

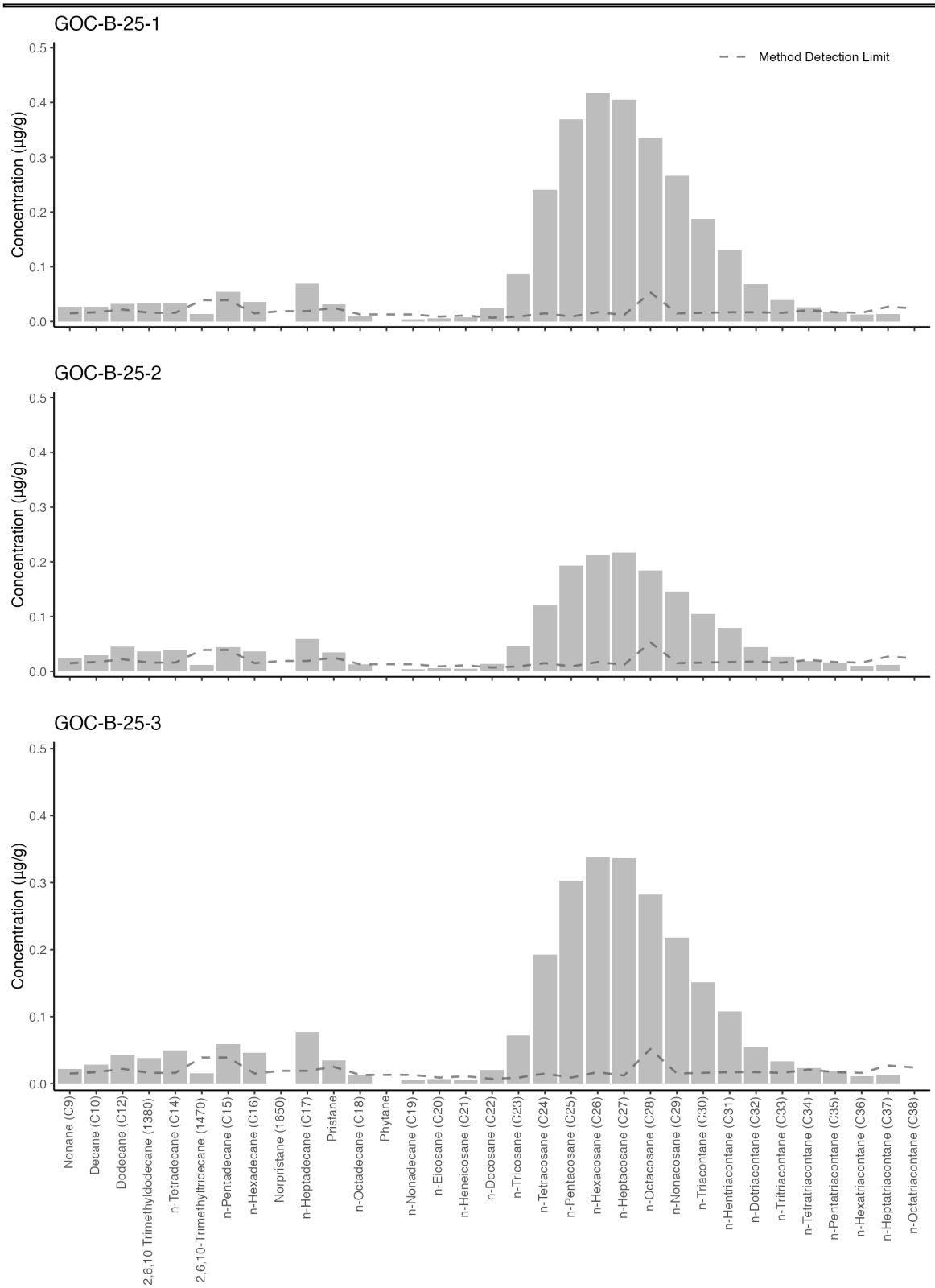

Figure 14. 2025 saturated hydrocarbon profiles from individual tissue samples at the Gold Creek (GOC) site with the analyte-specific method detection limit superimposed as a dashed line.

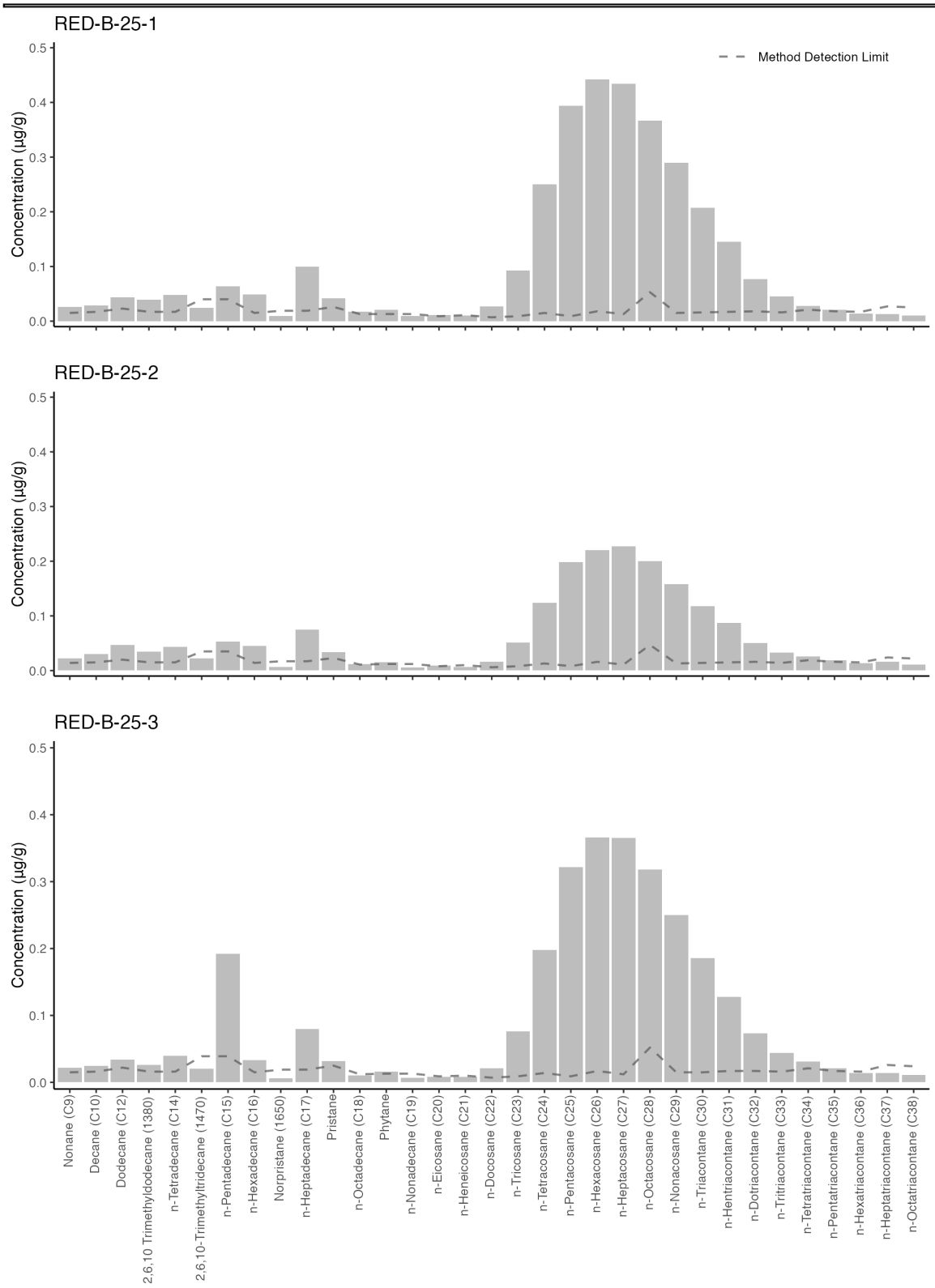

Figure 15. 2025 saturated hydrocarbon profiles from individual tissue samples at the positive control site at the entrance of the Valdez Small Boat Harbor (RED) site with the analyte-specific method detection limit superimposed as a dashed line.

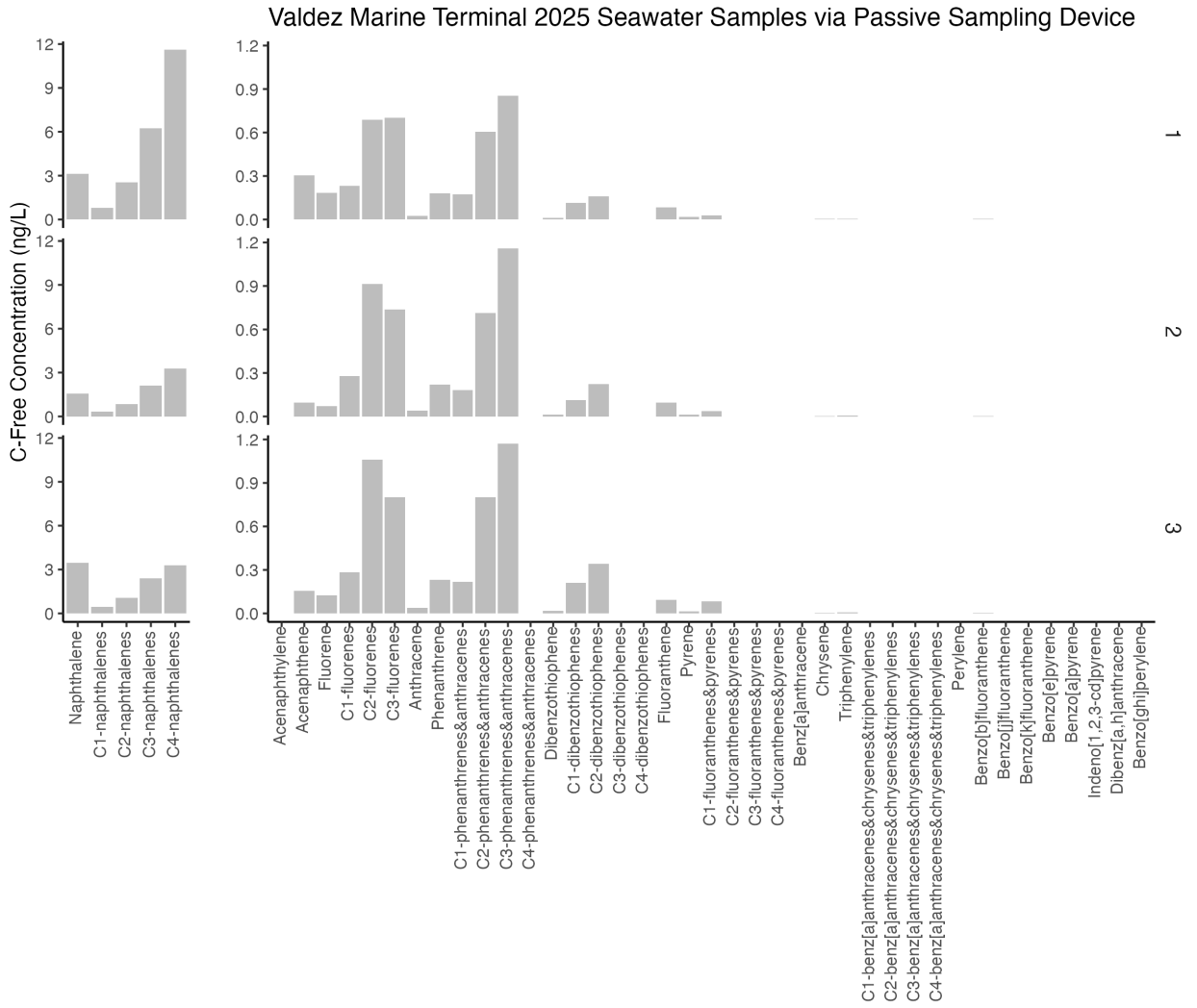

Figure 16. PAH profiles in seawater sampled via passive sampling devices placed at Valdez Marine Terminal in 2025. Values represent the reported values for the three replicates stacked vertically. Note the changes in scale between the Naphthalenes on the left and the other PAHs.

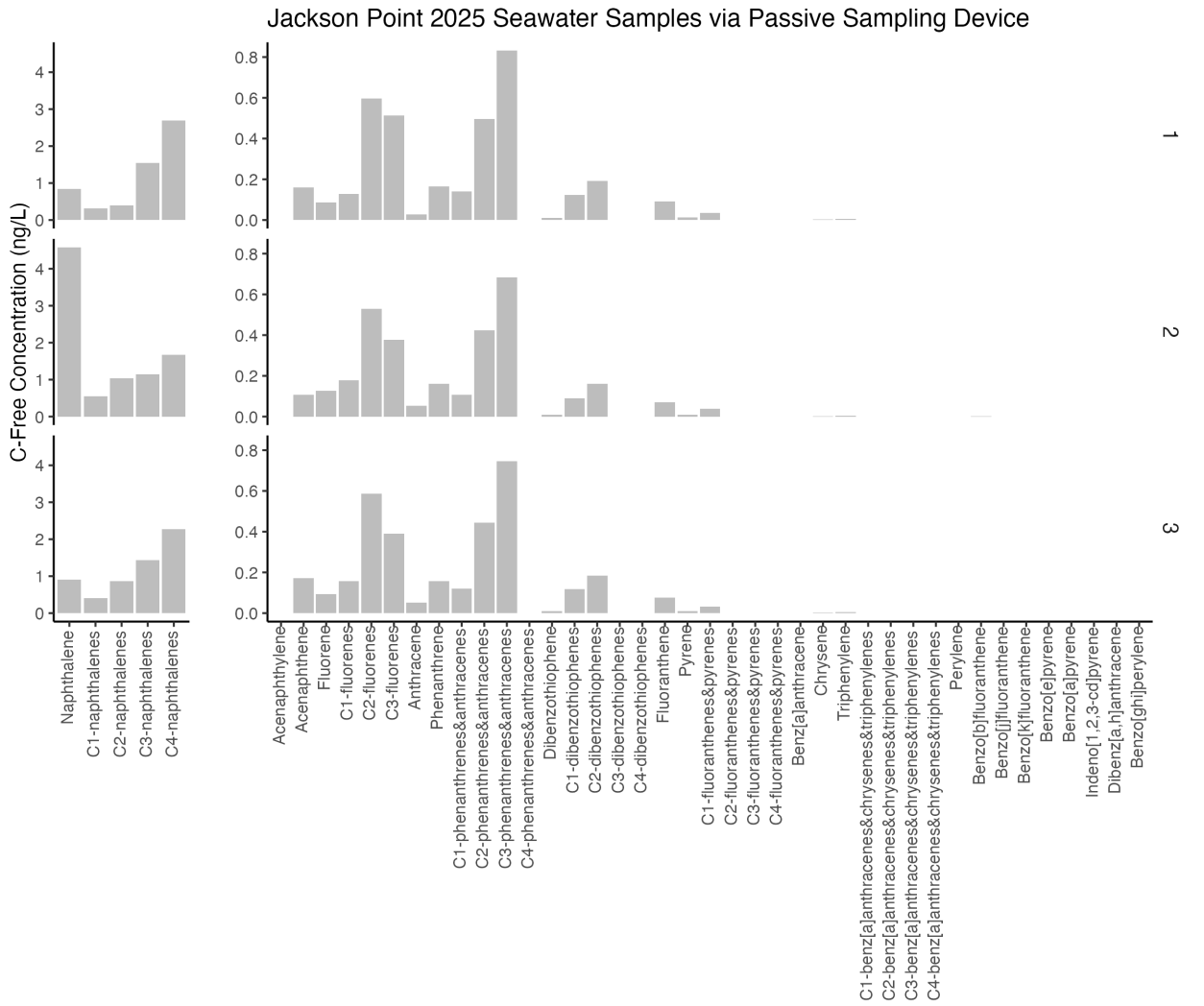

Figure 17. PAH profiles in seawater sampled via passive sampling devices placed at Jackson Point in 2025. Values represent the reported values for the three replicates stacked vertically. Note the changes in scale between the Naphthalenes on the left and the other PAHs.

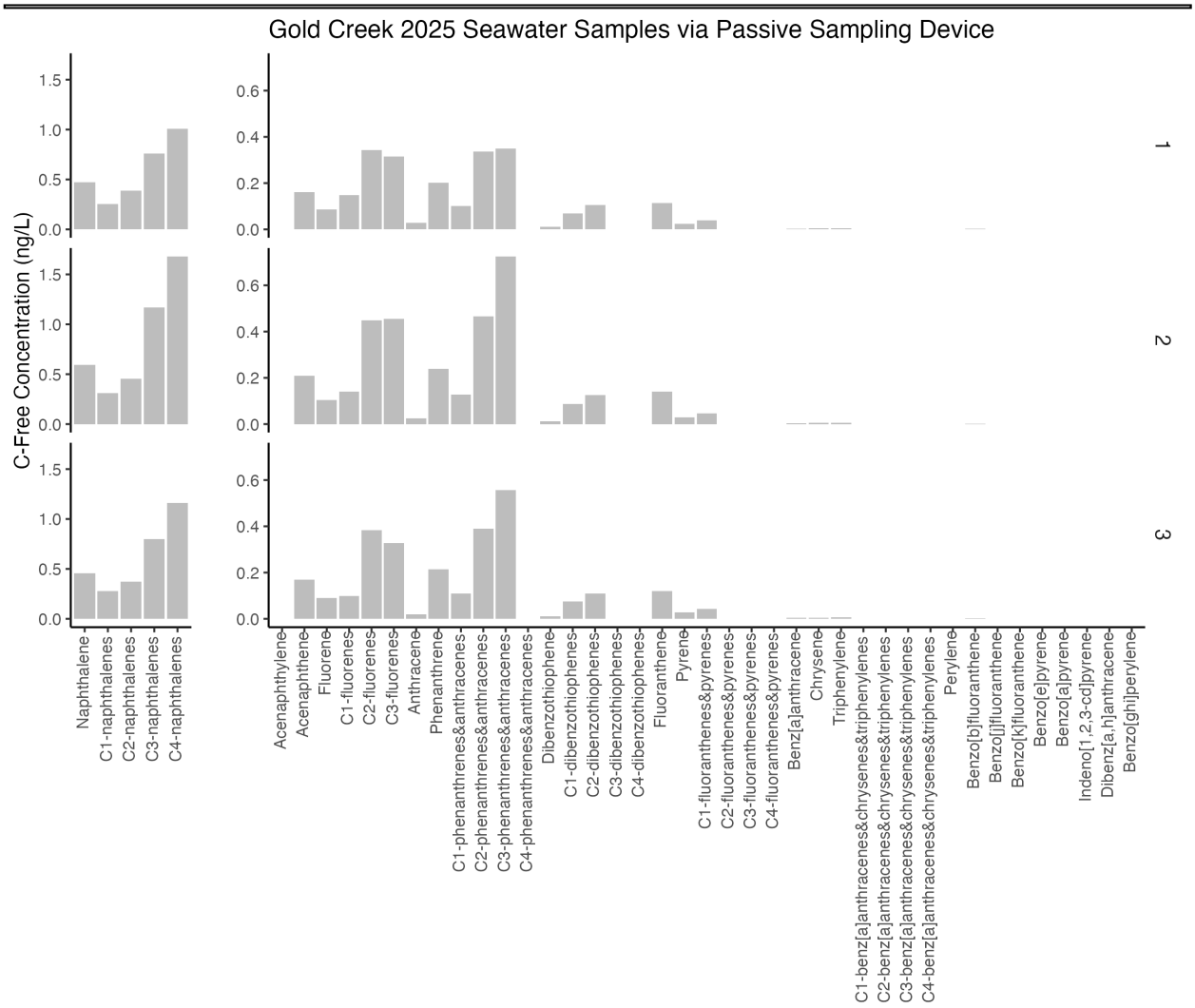

Figure 18. PAH profiles in seawater sampled via passive sampling devices placed at Gold Creek in 2025. Values represent the reported values for the three replicates stacked vertically. Note the changes in scale between the Naphthalenes on the left and the other PAHs.

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