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Long-Term Environmental Monitoring Program

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"The opinions expressed in this PWSRCAC commissioned report are not necessarily those of PWSRCAC. PWSRCAC Contract #9510.25.06."

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ACRONYMS AND ABBREVIATIONS

°C	Degrees Celsius
AIB	Aialik Bay
AMT	Alyeska Marine Terminal [officially known as the Valdez Marine Terminal]
ANS	Alaska North Slope [Crude Oil]
BWTF	Ballast Water Treatment Facility
cm	Centimeter
CV	Calibration Verification
DII	Disk Island
DQO	Data Quality Objective
EPA	U.S. Environmental Protection Agency
FID	Flame Ionization Detector [FID chromatogram]
FSES	Food Safety and Environmental Stewardship [Oregon State University lab]
GC/MS	Gas Chromatography/Mass Spectrometry
GOC	Gold Creek
HOT	Site of the April 2020 oil spill at the Valdez Marine Terminal
HMW	High Molecular Weight [PAH]
JAC	Jackson Point
KNH	Knowles Head
LMW	Low Molecular Weight [PAH]
LTEMP	Long-Term Environmental Monitoring Program
mL	Milliliter
MDL	Method Detection Limit
ng/g	Nanogram per Gram
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	Valdez Small Boat Harbor Entrance [red light]
SAW	Saw Island
SHB	Sheep Bay
SHH	Shuyak Harbor
SHC	Saturated Hydrocarbons
SIM	Specific Ion Monitoring
SLB	Sleepy Bay
SOP	Standard Operating Procedure
WIB	Windy Bay
ZAB	Zaikof Bay

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 2024 campaign in Port Valdez and selected extended sampling sites in the north Gulf of Alaska coast. This document should aid in the assertions made in the 2024 Long-Term Environmental Monitoring Program Summary Report (fjord & fish sciences, 2024).

1. Methods

1.1. Field Methods

1.1.1. Sediments and Mussel Tissue

In 2024, sediment sampling at Valdez Marine Terminal (Alyeska Marine Terminal (AMT)) and Gold Creek (GOC) took place on June 5 (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 milliliters (mL) sample of the surface 1–5 centimeters (cm) was collected at each site, placed in a hydrocarbon-free jar, and frozen for hydrocarbons and total organic carbon 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 2024 Port Valdez Pacific blue mussel (*Mytilus trossulus*) sampling was performed at Jackson Point (JAC) and Saw Island (AMT/SAW) on June 5, and at the Valdez Small Boat Harbor – RED (RED) and GOC on June 6. On June 11 and 12, blue mussel samples were collected from Shuyak Harbor (SHH), Aialik Bay (AIB), and Windy Bay (WIB) via float plane out of Homer. 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 2024, the Passive sampling devices (PSDs) were collected on June 5 at sites JAC and AMT/SAW, and on June 6 from GOC after a May 9 deployment. The PSDs are a low-density polyethylene membrane 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, for biota, are the most bioavailable hydrocarbons. 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 petrogeochemical markers, and saturated hydrocarbons (SHC) are quantified as a concentration 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 50 tricyclic and pentacyclic triterpenes, regular and rearranged steranes, and triaromatic and monoaromatic steroids. Complete lists of PAH, SHC, and petrogeochemical markers are presented in Tables 2-4.

Using a modified EPA Method 8015B, 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). A diluted Alaska North Slope (ANS) crude standard sample, collected in 2020, was run in parallel to sediment samples and used for forensic purposes.

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 50-130%. Surrogate percent recovery concentrations are acceptable across all analytes analyzed. One 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.” Alpha 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.

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 98% 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. An over-spike analysis was performed to demonstrate instrument accuracy where the sample was spiked with target compounds post-extraction. The average percent recovery was 92.2%, meeting FSES DQOs.

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 Alpha Analytics 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 8-21). 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 22-24).

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 44, 42, 16, and other specific PAHs, referred to as summed (∑) PAHs due to the various methods used. This metric is similar to the Total PAH metric used before the BP Deepwater Horizon oil spill in 2010, but accounts for the complex mixture and multitude of calculations that can

be used. 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 acute and chronic EPA sediment-quality benchmarks (Table 5), and tissue concentrations were compared against the most recently available published literature and concentration-of-concern guidelines, as appropriate (Table 6). Seawater samples are treated similarly (Table 8). 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).

Saturated hydrocarbons and petrogeochemical 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 petrogeochemical markers analysis was performed using ANS whole crude oil collected in 2020, and was run as laboratory standard with 2024 samples. For accurate comparisons, the ANS chemical profile is displayed for each replicate sediment sample (Figure 2-7). Profiles were scaled to C2-naphthobenzothiophenes for PAHs, T19-hopane for petrogeochemical markers, and n-heptacosane (C27) for saturated hydrocarbons 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 2021; Wang et al. 2014; Stout and Wang 2016). ANS crude oil profile line is shown for illustrative purposes and does not suggest continuity between measured points where an analyte specific result is not available. Biomarkers in tissues were displayed in tabular form as few analytes were detected (Table 8). Common hydrocarbon diagnostic ratios of low and high molecular weight PAHs and petrogeochemical biomarkers were calculated for sediments and tissue samples for quantitative source identification (Table 9).

2. TABLES

Table 1. Long-Term Monitoring Program sites sampled in 2024 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
AIB-B	59.8792	-149.6569	Pacific Blue Mussel Tissue
WIB-B	59.2189	-151.5186	Pacific Blue Mussel Tissue
SHH-B	58.5017	-152.6250	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 2024 Long-Term Environmental Monitoring Program

Analysis	Analyte	Analysis	Analyte
8270E-SIM(M)	cis/trans-Decalin	8270E-SIM(M)	17a(H)-Diahopane (X)
8270E-SIM(M)	C1-Decalins	8270E-SIM(M)	30-Normoretane (T17)
8270E-SIM(M)	C2-Decalins	8270E-SIM(M)	18a(H)&18b(H)-Oleananes (T18)
8270E-SIM(M)	C3-Decalins	8270E-SIM(M)	Moretane (T20)
8270E-SIM(M)	C4-Decalins	8270E-SIM(M)	30-Homohopane-22S (T21)
8270E-SIM(M)	Naphthalene	8270E-SIM(M)	30-Homohopane-22R (T22)
8270E-SIM(M)	C1-Naphthalenes	8270E-SIM(M)	Gammacerane/C32-Diahopane
8270E-SIM(M)	C2-Naphthalenes	8270E-SIM(M)	30,31-Bishomohopane-22S (T26)
8270E-SIM(M)	C3-Naphthalenes	8270E-SIM(M)	30,31-Bishomohopane-22R (T27)
8270E-SIM(M)	C4-Naphthalenes	8270E-SIM(M)	30,31-Trishomohopane-22S (T30)
8270E-SIM(M)	2-Methylnaphthalene	8270E-SIM(M)	30,31-Trishomohopane-22R (T31)
8270E-SIM(M)	1-Methylnaphthalene	8270E-SIM(M)	Tetrakishomohopane-22S (T32)
8270E-SIM(M)	Benzothiophene	8270E-SIM(M)	Tetrakishomohopane-22R (T33)
8270E-SIM(M)	C1-Benzo(b)thiophenes	8270E-SIM(M)	Pentakishomohopane-22S (T34)
8270E-SIM(M)	C2-Benzo(b)thiophenes	8270E-SIM(M)	Pentakishomohopane-22R (T35)
8270E-SIM(M)	C3-Benzo(b)thiophenes	8270E-SIM(M)	13b(H),17a(H)-20S-Diacholestane (S4)
8270E-SIM(M)	C4-Benzo(b)thiophenes	8270E-SIM(M)	13b(H),17a(H)-20R-Diacholestane (S5)
8270E-SIM(M)	Biphenyl	8270E-SIM(M)	13b,17a-20S-Methyldiacholestane (S8)
8270E-SIM(M)	C26 Tricyclic Terpane-22S (T6b)	8270E-SIM(M)	17a(H)20SC27/C29dia
8270E-SIM(M)	C26 Tricyclic Terpane-22R (T6c)	8270E-SIM(M)	17a(H)20rc27/C29dia
8270E-SIM(M)	C28 Tricyclic Terpane-22S (T7)	8270E-SIM(M)	Unknown Sterane (S18)
8270E-SIM(M)	C28 Tricyclic Terpane-22R (T8)	8270E-SIM(M)	13a,17b-20S-Ethyldiacholestane (S19)
8270E-SIM(M)	C29 Tricyclic Terpane-22S (T9)	8270E-SIM(M)	14a,17a-20S-Methylcholestane (S20)
8270E-SIM(M)	C29 Tricyclic Terpane-22R (T10)	8270E-SIM(M)	14a,17a-20R-Methylcholestane (S24)
8270E-SIM(M)	18a-22,29,30-Trisnorneohopane-TS (T11)	8270E-SIM(M)	14a(H),17a(H)-20S-Ethylcholestane (S25)
8270E-SIM(M)	C30 Tricyclic Terpane-22S	8270E-SIM(M)	14a(H),17a(H)-20R-Ethylcholestane (S28)
8270E-SIM(M)	C30 Tricyclic Terpane-22R	8270E-SIM(M)	14b(H),17b(H)-20R-Cholestane (S14)
8270E-SIM(M)	17a(H)-22,29,30-Trisnorhopane-TM	8270E-SIM(M)	14b(H),17b(H)-20S-Cholestane (S15)
8270E-SIM(M)	17a/b,21b/a 28,30-Bisnorhopane (T14a)	8270E-SIM(M)	14b,17b-20R-Methylcholestane (S22)
8270E-SIM(M)	17a(H),21b(H)-25-Norhopane (T14b)	8270E-SIM(M)	14b,17b-20S-Methylcholestane (S23)
8270E-SIM(M)	30-Norhopane (T15)	8270E-SIM(M)	14b(H),17b(H)-20R-Ethylcholestane (S26)
8270E-SIM(M)	18a(H)-30-Norneohopane-C29Ts (T16)	8270E-SIM(M)	14b(H),17b(H)-20S-Ethylcholestane (S27)
8270E-SIM(M)	C26,20R+C27,20S TAS		
8270E-SIM(M)	C28,20S TAS		

Table 2. Analytes quantified in marine subtidal sediments of the 2024 Long-Term Environmental Monitoring Program

Analysis	Analyte	Analysis	Analyte
8270E-SIM(M)	C27,20R TAS	8270E-SIM(M)	2-Methylanthracene (2MA)
8270E-SIM(M)	C28,20R TAS	8270E-SIM(M)	9/4-Methylphenanthrene (9MP)
8270E-SIM(M)	3-Methylphenanthrene (3MP)	8270E-SIM(M)	1-Methylphenanthrene
8270E-SIM(M)	1-Methylphenanthrene (1MP)	8270E-SIM(M)	C1-Phenanthrenes/Anthracenes
8270E-SIM(M)	C24 Tetracyclic Terpane (T6A)	8270E-SIM(M)	C2-Phenanthrenes/Anthracenes
8270E-SIM(M)	C26 Tricyclic Terpane-22S (T6B)	8270E-SIM(M)	C3-Phenanthrenes/Anthracenes
8270E-SIM(M)	C26 Tricyclic Terpane-22R (T6C)	8270E-SIM(M)	C4-Phenanthrenes/Anthracenes
8270E-SIM(M)	18A-22,29,30-Trisnorneohopane-TS (T11)	8270E-SIM(M)	Retene
8270E-SIM(M)	17A(H)-22,29,30-Trisnorhopane-Tm (T12)	8270E-SIM(M)	Anthracene
8270E-SIM(M)	17A/B,21B/A 28,30-Bisnorhopane (T14A)	8270E-SIM(M)	Carbazole
8270E-SIM(M)	18A(H)-30-Norneohopane-C29TS (T16)	8270E-SIM(M)	Fluoranthene
8270E-SIM(M)	17A(H)-Diahopane (X)	8270E-SIM(M)	Benzo[b]fluorene
8270E-SIM(M)	Naphthalene-d8	8270E-SIM(M)	Pyrene
8270E-SIM(M)	Phenanthrene-d10	8270E-SIM(M)	C1-Fluoranthenes/Pyrenes
8270E-SIM(M)	2,6-Dimethylnaphthalene	8270E-SIM(M)	C2-Fluoranthenes/Pyrenes
8270E-SIM(M)	Dibenzofuran	8270E-SIM(M)	C3-Fluoranthenes/Pyrenes
8270E-SIM(M)	Acenaphthylene	8270E-SIM(M)	C4-Fluoranthenes/Pyrenes
8270E-SIM(M)	Acenaphthene	8270E-SIM(M)	Naphthobenzothiophenes
8270E-SIM(M)	2,3,5-Trimethylnaphthalene	8270E-SIM(M)	C1-Naphthobenzothiophenes
8270E-SIM(M)	Fluorene	8270E-SIM(M)	C2-Naphthobenzothiophenes
8270E-SIM(M)	C1-Fluorenes	8270E-SIM(M)	C3-Naphthobenzothiophenes
8270E-SIM(M)	C2-Fluorenes	8270E-SIM(M)	C4-Naphthobenzothiophenes
8270E-SIM(M)	C3-Fluorenes	8270E-SIM(M)	Benz[a]anthracene
8270E-SIM(M)	Dibenzothiophene	8270E-SIM(M)	Chrysene/Triphenylene
8270E-SIM(M)	4-Methyldibenzothiophene(4MDT)	8270E-SIM(M)	C1-Chrysenes
8270E-SIM(M)	2/3-Methyldibenzothiophene(2MDT)	8270E-SIM(M)	C2-Chrysenes
8270E-SIM(M)	1-Methyldibenzothiophene(1MDT)	8270E-SIM(M)	C3-Chrysenes
8270E-SIM(M)	C1-Dibenzothiophenes	8270E-SIM(M)	C4-Chrysenes
8270E-SIM(M)	C2-Dibenzothiophenes	8270E-SIM(M)	Benzo[b]fluoranthene
8270E-SIM(M)	C3-Dibenzothiophenes	8270E-SIM(M)	Benzo[j]fluoranthene/Benzo[k]fluoranthene
8270E-SIM(M)	C4-Dibenzothiophenes	8270E-SIM(M)	Benzo[a]fluoranthene
8270E-SIM(M)	Phenanthrene	8270E-SIM(M)	Benzo[e]pyrene
8270E-SIM(M)	3-Methylphenanthrene	8270E-SIM(M)	Benzo[a]pyrene
8270E-SIM(M)	2-Methylphenanthrene (2MP)	8270E-SIM(M)	Perylene

Table 2. Analytes quantified in marine subtidal sediments of the 2024 Long-Term Environmental Monitoring Program

Analysis	Analyte	Analysis	Analyte
8270E-SIM(M)	Indeno[1,2,3-cd]pyrene	EPA 8015D(M)	Norpristane (1650)
8270E-SIM(M)	Dibenz[a,h]anthracene/Dibenz[a,c]anthracene	EPA 8015D(M)	n-Heptadecane (C17)
8270E-SIM(M)	Benzo[g,h,i]perylene	EPA 8015D(M)	Pristane
8270E-SIM(M)	Hopane (T19)	EPA 8015D(M)	n-Octadecane (C18)
8270E-SIM(M)	C23 Tricyclic Terpane (T4)	EPA 8015D(M)	Phytane
8270E-SIM(M)	C24 Tricyclic Terpane (T5)	EPA 8015D(M)	n-Nonadecane (C19)
8270E-SIM(M)	C25 Tricyclic Terpane (T6)	EPA 8015D(M)	n-Eicosane (C20)
8270E-SIM(M)	C24 Tetracyclic Terpane (T6a)	EPA 8015D(M)	n-Heneicosane (C21)
8270E-SIM(M)	Benzo[a]pyrene-d12	EPA 8015D(M)	n-Docosane (C22)
8270E-SIM(M)	5B(H)Cholane	EPA 8015D(M)	n-Tricosane (C23)
9060A	Total Organic Carbon (Rep1)	EPA 8015D(M)	n-Tetracosane (C24)
9060A	Total Organic Carbon (Rep2)	EPA 8015D(M)	n-Pentacosane (C25)
9060A	Total Organic Carbon (Average)	EPA 8015D(M)	n-Hexacosane (C26)
D6913/D7928	Cobbles	EPA 8015D(M)	n-Heptacosane (C27)
D6913/D7928	% Coarse Gravel	EPA 8015D(M)	n-Octacosane (C28)
D6913/D7928	% Fine Gravel	EPA 8015D(M)	n-Nonacosane (C29)
D6913/D7928	Gravel	EPA 8015D(M)	n-Triacontane (C30)
D6913/D7928	% Coarse Sand	EPA 8015D(M)	n-Hentriacontane (C31)
D6913/D7928	% Medium Sand	EPA 8015D(M)	n-Dotriacontane (C32)
D6913/D7928	% Fine Sand	EPA 8015D(M)	n-Tritriacontane (C33)
D6913/D7928	Sand	EPA 8015D(M)	n-Tetratriacontane (C34)
D6913/D7928	% Silt Fine	EPA 8015D(M)	n-Pentatriacontane (C35)
D6913/D7928	% Clay Fine	EPA 8015D(M)	n-Hexatriacontane (C36)
D6913/D7928	Fines	EPA 8015D(M)	n-Heptatriacontane (C37)
EPA 8015D(M)	Nonane (C9)	EPA 8015D(M)	n-Octatriacontane (C38)
EPA 8015D(M)	Decane (C10)	EPA 8015D(M)	n-Nonatriacontane (C39)
EPA 8015D(M)	Undecane	EPA 8015D(M)	n-Tetracontane (C40)
EPA 8015D(M)	Dodecane (C12)	EPA 8015D(M)	n-Undecane
EPA 8015D(M)	Tridecane	EPA 8015D(M)	Tridecane (C13)
EPA 8015D(M)	2,6,10 Trimethyldodecane (1380)	EPA 8015D(M)	n-Hentatriacontane (C31)
EPA 8015D(M)	n-Tetradecane (C14)	EPA 8015D(M)	Total Petroleum Hydrocarbons (C9-C44)
EPA 8015D(M)	2,6,10-Trimethyltridecane (1470)	EPA 8015D(M)	Total Saturated Hydrocarbons
EPA 8015D(M)	n-Pentadecane (C15)	EPA 8015D(M)	o-terphenyl
EPA 8015D(M)	n-Hexadecane (C16)	EPA 8015D(M)	d50-Tetracosane

Table 3. Analytes quantified in intertidal mussels of the 2024 Long-Term Environmental Monitoring Program

ANALMETH	ANALYTE	ANALMETH	ANALYTE	ANALMETH	ANALYTE
EPA 8015D(M)	Nonane (C9)	EPA 8015D(M)	n-Octatriacontane (C38)	8270E-SIM(M)	4-Methyldibenzothiophene(4MDT)
EPA 8015D(M)	Decane (C10)	EPA 8015D(M)	n-Nonatriacontane (C39)	8270E-SIM(M)	2/3-Methyldibenzothiophene(2MDT)
EPA 8015D(M)	Undecane	EPA 8015D(M)	n-Tetracontane (C40)	8270E-SIM(M)	1-Methyldibenzothiophene(1MDT)
EPA 8015D(M)	Dodecane (C12)	EPA 8015D(M)	Total Petroleum Hydrocarbons (C9-C44)	8270E-SIM(M)	C1-Dibenzothiophenes
EPA 8015D(M)	Tridecane	EPA 8015D(M)	Total Saturated Hydrocarbons	8270E-SIM(M)	C2-Dibenzothiophenes
EPA 8015D(M)	2,6,10 Trimethyldodecane (1380)	EPA 8015D(M)	d50-Tetracosane	8270E-SIM(M)	C3-Dibenzothiophenes
EPA 8015D(M)	n-Tetradecane (C14)	8270E-SIM(M)	cis/trans-Decalin	8270E-SIM(M)	C4-Dibenzothiophenes
EPA 8015D(M)	2,6,10-Trimethyltridecane (1470)	8270E-SIM(M)	C1-Decalins	8270E-SIM(M)	Phenanthrene
EPA 8015D(M)	n-Pentadecane (C15)	8270E-SIM(M)	C2-Decalins	8270E-SIM(M)	3-Methylphenanthrene
EPA 8015D(M)	n-Hexadecane (C16)	8270E-SIM(M)	C3-Decalins	8270E-SIM(M)	2-Methylphenanthrene (2MP)
EPA 8015D(M)	Norpristane (1650)	8270E-SIM(M)	C4-Decalins	8270E-SIM(M)	2-Methylanthracene (2MA)
EPA 8015D(M)	n-Heptadecane (C17)	8270E-SIM(M)	Naphthalene	8270E-SIM(M)	9/4-Methylphenanthrene (9MP)
EPA 8015D(M)	Pristane	8270E-SIM(M)	C1-Naphthalenes	8270E-SIM(M)	1-Methylphenanthrene
EPA 8015D(M)	n-Octadecane (C18)	8270E-SIM(M)	C2-Naphthalenes	8270E-SIM(M)	C1-Phenanthrenes/Anthracenes
EPA 8015D(M)	Phytane	8270E-SIM(M)	C3-Naphthalenes	8270E-SIM(M)	C2-Phenanthrenes/Anthracenes
EPA 8015D(M)	n-Nonadecane (C19)	8270E-SIM(M)	C4-Naphthalenes	8270E-SIM(M)	C3-Phenanthrenes/Anthracenes
EPA 8015D(M)	n-Eicosane (C20)	8270E-SIM(M)	2-Methylnaphthalene	8270E-SIM(M)	C4-Phenanthrenes/Anthracenes
EPA 8015D(M)	n-Heneicosane (C21)	8270E-SIM(M)	1-Methylnaphthalene	8270E-SIM(M)	Retene
EPA 8015D(M)	n-Docosane (C22)	8270E-SIM(M)	Benzothiophene	8270E-SIM(M)	Anthracene
EPA 8015D(M)	n-Tricosane (C23)	8270E-SIM(M)	C1-Benzo(b)thiophenes	8270E-SIM(M)	Carbazole
EPA 8015D(M)	n-Tetracosane (C24)	8270E-SIM(M)	C2-Benzo(b)thiophenes	8270E-SIM(M)	Fluoranthene
EPA 8015D(M)	n-Pentacosane (C25)	8270E-SIM(M)	C3-Benzo(b)thiophenes	8270E-SIM(M)	Benzo[b]fluorene
EPA 8015D(M)	n-Hexacosane (C26)	8270E-SIM(M)	C4-Benzo(b)thiophenes	8270E-SIM(M)	Pyrene
EPA 8015D(M)	n-Heptacosane (C27)	8270E-SIM(M)	Biphenyl	8270E-SIM(M)	C1-Fluoranthenes/Pyrenes
EPA 8015D(M)	n-Octacosane (C28)	8270E-SIM(M)	2,6-Dimethylnaphthalene	8270E-SIM(M)	C2-Fluoranthenes/Pyrenes
EPA 8015D(M)	n-Nonacosane (C29)	8270E-SIM(M)	Dibenzofuran	8270E-SIM(M)	C3-Fluoranthenes/Pyrenes
EPA 8015D(M)	n-Triacontane (C30)	8270E-SIM(M)	Acenaphthylene	8270E-SIM(M)	C4-Fluoranthenes/Pyrenes
EPA 8015D(M)	n-Hentriacontane (C31)	8270E-SIM(M)	Acenaphthene	8270E-SIM(M)	Naphthobenzothiophenes
EPA 8015D(M)	n-Dotriacontane (C32)	8270E-SIM(M)	2,3,5-Trimethylnaphthalene	8270E-SIM(M)	C1-Naphthobenzothiophenes
EPA 8015D(M)	n-Tritriacontane (C33)	8270E-SIM(M)	Fluorene	8270E-SIM(M)	C2-Naphthobenzothiophenes
EPA 8015D(M)	n-Tetratriacontane (C34)	8270E-SIM(M)	C1-Fluorenes	8270E-SIM(M)	C3-Naphthobenzothiophenes
EPA 8015D(M)	n-Pentatriacontane (C35)	8270E-SIM(M)	C2-Fluorenes	8270E-SIM(M)	C4-Naphthobenzothiophenes
EPA 8015D(M)	n-Hexatriacontane (C36)	8270E-SIM(M)	C3-Fluorenes	8270E-SIM(M)	Benz[a]anthracene
EPA 8015D(M)	n-Heptatriacontane (C37)	8270E-SIM(M)	Dibenzothiophene	8270E-SIM(M)	Chrysene/Triphenylene

Table 3. Analytes quantified in intertidal mussels of the 2024 Long-Term Environmental Monitoring Program

ANALMETH	ANALYTE
8270E-SIM(M)	C1-Chrysenes
8270E-SIM(M)	C2-Chrysenes
8270E-SIM(M)	C3-Chrysenes
8270E-SIM(M)	C4-Chrysenes
8270E-SIM(M)	Benzo[b]fluoranthene
8270E-SIM(M)	Benzo[j]fluoranthene/Benzo[k]fluoranth
8270E-SIM(M)	Benzo[a]fluoranthene
8270E-SIM(M)	Benzo[e]pyrene
8270E-SIM(M)	Benzo[a]pyrene
8270E-SIM(M)	Perylene
8270E-SIM(M)	Indeno[1,2,3-cd]pyrene
8270E-SIM(M)	Dibenz[a,h]anthracene/Dibenz[a,c]anthı
8270E-SIM(M)	Benzo[g,h,i]perylene
8270E-SIM(M)	Naphthalene-d8
8270E-SIM(M)	Phenanthrene-d10
8270E-SIM(M)	Benzo[a]pyrene-d12
8270E-SIM(M)	Hopane (T19)
8270E-SIM(M)	C23 Tricyclic Terpane (T4)
8270E-SIM(M)	C24 Tricyclic Terpane (T5)
8270E-SIM(M)	C25 Tricyclic Terpane (T6)
8270E-SIM(M)	C24 Tetracyclic Terpane (T6a)
8270E-SIM(M)	C26 Tricyclic Terpane-22S (T6b)
8270E-SIM(M)	C26 Tricyclic Terpane-22R (T6c)
8270E-SIM(M)	C28 Tricyclic Terpane-22S (T7)
8270E-SIM(M)	C28 Tricyclic Terpane-22R (T8)
8270E-SIM(M)	C29 Tricyclic Terpane-22S (T9)
8270E-SIM(M)	C29 Tricyclic Terpane-22R (T10)
8270E-SIM(M)	18a-22,29,30-Trisnorneohopane-TS (T1:
8270E-SIM(M)	C30 Tricyclic Terpane-22S
8270E-SIM(M)	C30 Tricyclic Terpane-22R
8270E-SIM(M)	17a(H)-22,29,30-Trisnorhopane-TM
8270E-SIM(M)	17a/b,21b/a 28,30-Bisnorhopane (T14a)
8270E-SIM(M)	17a(H),21b(H)-25-Norhopane (T14b)
8270E-SIM(M)	30-Norhopane (T15)

ANALMETH	ANALYTE
8270E-SIM(	18a(H)-30-Norneohopane-C29Ts (T16)
8270E-SIM(	17a(H)-Diahopane (X)
8270E-SIM(	30-Normoretane (T17)
8270E-SIM(	18a(H)&18b(H)-Oleananes (T18)
8270E-SIM(	Moretane (T20)
8270E-SIM(	30-Homohopane-22S (T21)
8270E-SIM(	30-Homohopane-22R (T22)
8270E-SIM(	Gammacerane/C32-Diahopane
8270E-SIM(	30,31-Bishomohopane-22S (T26)
8270E-SIM(	30,31-Bishomohopane-22R (T27)
8270E-SIM(	30,31-Trishomohopane-22S (T30)
8270E-SIM(	30,31-Trishomohopane-22R (T31)
8270E-SIM(	Tetrakishomohopane-22S (T32)
8270E-SIM(	Tetrakishomohopane-22R (T33)
8270E-SIM(	Pentakishomohopane-22S (T34)
8270E-SIM(	Pentakishomohopane-22R (T35)
8270E-SIM(	13b(H),17a(H)-20S-Diacholestane (S4)
8270E-SIM(	13b(H),17a(H)-20R-Diacholestane (S5)
8270E-SIM(	13b,17a-20S-Methyldiacholestane (S8)
8270E-SIM(	17a(H)20SC27/C29dia
8270E-SIM(	17a(H)20rc27/C29dia
8270E-SIM(	Unknown Sterane (S18)
8270E-SIM(	13a,17b-20S-Ethyldiacholestane (S19)
8270E-SIM(	14a,17a-20S-Methylcholestane (S20)
8270E-SIM(	14a,17a-20R-Methylcholestane (S24)
8270E-SIM(	14a(H),17a(H)-20S-Ethylcholestane (S25)
8270E-SIM(	14a(H),17a(H)-20R-Ethylcholestane (S28)
8270E-SIM(	14b(H),17b(H)-20R-Cholestane (S14)
8270E-SIM(	14b(H),17b(H)-20S-Cholestane (S15)
8270E-SIM(	14b,17b-20R-Methylcholestane (S22)
8270E-SIM(	14b,17b-20S-Methylcholestane (S23)
8270E-SIM(	14b(H),17b(H)-20R-Ethylcholestane (S26)
8270E-SIM(	14b(H),17b(H)-20S-Ethylcholestane (S27)
8270E-SIM(	5B(H)Cholane

ANALMETH	ANALYTE
NOAA NOS (	Percent Lipids
2540G	Moisture

Table 4. Analytes quantified in seawater by passive sampling device of the 2024 Long-Term Environmental Monitoring Program

Analysis Method	Analytes
GC-MS/MS	1,2-dimethylnaphthalene
GC-MS/MS	1,4-dimethylnaphthalene
GC-MS/MS	1,5-dimethylnaphthalene
GC-MS/MS	1,6and1,3-Dimethylnaphthalene
GC-MS/MS	1,8-dimethylnaphthalene
GC-MS/MS	1-methylnaphthalene
GC-MS/MS	1-methylphenanthrene
GC-MS/MS	1-methylpyrene
GC-MS/MS	2,3-dimethylanthracene
GC-MS/MS	2,6-diethylnaphthalene
GC-MS/MS	2,6-dimethylnaphthalene
GC-MS/MS	2-ethylnaphthalene
GC-MS/MS	2-methylanthracene
GC-MS/MS	2-methylnaphthalene
GC-MS/MS	2-methylphenanthrene
GC-MS/MS	3,6-dimethylphenanthrene
GC-MS/MS	5-methylchrysene
GC-MS/MS	6-methylchrysene
GC-MS/MS	7,12-dimethylbenz[a]anthracene
GC-MS/MS	9,10-dimethylanthracene
GC-MS/MS	9-methylanthracene
GC-MS/MS	Acenaphthene
GC-MS/MS	Acenaphthylene
GC-MS/MS	Anthanthrene
GC-MS/MS	Anthracene
GC-MS/MS	Benz[a]anthracene
GC-MS/MS	Benz[j]and[e]aceanthrylene
GC-MS/MS	Benzo[a]chrysene
GC-MS/MS	Benzo[a]fluorene
GC-MS/MS	Benzo[a]pyrene
GC-MS/MS	Benzo[b]fluoranthene
GC-MS/MS	Benzo[b]fluorene
GC-MS/MS	Benzo[b]perylene
GC-MS/MS	Benzo[c]fluorene

Analysis Met	Analytes
GC-MS/MS	Benzo[e]pyrene
GC-MS/MS	Benzo[ghi]perylene
GC-MS/MS	Benzo[j]fluoranthene
GC-MS/MS	Benzo[k]fluoranthene
GC-MS/MS	Chrysene
GC-MS/MS	Coronene
GC-MS/MS	Cyclopenta[cd]pyrene
GC-MS/MS	Dibenzo[a,e]fluoranthene
GC-MS/MS	Dibenzo[a,e]pyrene
GC-MS/MS	Dibenzo[a,h]anthracene
GC-MS/MS	Dibenzo[a,h]pyrene
GC-MS/MS	Dibenzo[a,i]pyrene
GC-MS/MS	Dibenzo[a,l]pyrene
GC-MS/MS	Dibenzo[e,l]pyrene
GC-MS/MS	Dibenzothiophene
GC-MS/MS	Fluoranthene
GC-MS/MS	Fluorene
GC-MS/MS	Indeno[1,2,3-cd]pyrene
GC-MS/MS	Naphthalene
GC-MS/MS	Naphtho[1,2-b]fluoranthene
GC-MS/MS	Naphtho[2,3-a]pyrene
GC-MS/MS	Naphtho[2,3-b]fluoranthene
GC-MS/MS	Naphtho[2,3-e]pyrene
GC-MS/MS	Naphtho[2,3-j]andNaphtho[1,2-k]fluoranthene
GC-MS/MS	Naphtho[2,3-k]fluoranthene
GC-MS/MS	Perylene
GC-MS/MS	Phenanthrene
GC-MS/MS	Pyrene
GC-MS/MS	Retene
GC-MS/MS	Triphenylene
GC-QQQ	C1-benz[a]anthracenes&chrysenes&triphenylenes
GC-QQQ	C1-dibenzothiophenes
GC-QQQ	C1-fluoranthenes&pyrenes
GC-QQQ	C1-fluorenes

Analysis Met	Analytes
GC-QQQ	C1-naphthalenes
GC-QQQ	C1-naphthalenes
GC-QQQ	C1-phenanthrenes&anthracenes
GC-QQQ	C2-benz[a]anthracenes&chrysenes&triphenylenes
GC-QQQ	C2-dibenzothiophenes
GC-QQQ	C2-fluoranthenes&pyrenes
GC-QQQ	C2-fluorenes
GC-QQQ	C2-naphthalenes
GC-QQQ	C2-phenanthrenes&C2-anthracenes
GC-QQQ	C3-dibenzothiophenes
GC-QQQ	C3-fluorenes
GC-QQQ	C3-naphthalenes
GC-QQQ	C3-phenanthrenes&anthracenes
GC-QQQ	C4-naphthalenes
GC-QQQ	C4-phenanthrenes&C4-anthracenes

Table 5. Sediment PAH loads and toxicity comparisons from 2024 samples.

Analyte (ng/g dry weight)	AMT-S-24-1	AMT-S-24-2	AMT-S-24-3	GOC-S-24-1	GOC-S-24-2	GOC-S-24-3	GOC-S-24-2-DUP	Threshold Effect Level (CCME/NOAA)	Acute Potency Divisor (µg/kg Organic Carbon)[5]	Chronic Potency Divisor (µg/kg Organic Carbon)[5]
Naphthalene	2.560	2.060	1.710	1.380	0.937	1.680	0.737	34.6	1600000	385000
C1-Naphthalenes	1.970	1.450	1.810	0.929	0.641	1.030	0.471		1850000	444000
C2-Naphthalenes	3.000	3.340	3.530	1.410	1.100	2.150	0.942		2120000	510000
C3-Naphthalenes	2.740	3.030	3.200	1.370	0.768	1.650	0.815		2420000	581000
C4-Naphthalenes	2.320	2.370	2.570	-	-	-	-		2730000	657000
Acenaphthylene	1.640	1.080	0.226	0.147	0.120	0.187	0.048	5.87	1880000	452000
Acenaphthene	1.390	0.632	1.240	0.516	0.379	0.492	0.292	6.71	2040000	491000
Fluorene	2.120	1.240	2.270	0.720	0.558	0.876	0.407		2240000	538000
C1-Fluorenes	1.790	2.020	2.240	0.953	0.640	1.090	0.486		2540000	611000
C2-Fluorenes	2.540	2.550	2.500	-	-	1.440	-		2850000	686000
C3-Fluorenes	-	-	-	-	-	-	-		3200000	769000
Dibenzothiophene	0.580	0.688	1.050	0.267	0.146	0.252	0.119		-	-
C1-Dibenzothiophenes	0.802	0.891	1.060	0.347	0.178	0.298	0.163		-	-
C2-Dibenzothiophenes	2.880	2.760	3.430	0.636	-	0.726	-		-	-
C3-Dibenzothiophenes	4.090	3.960	5.150	-	-	-	-		-	-
C4-Dibenzothiophenes	3.010	3.400	4.070	-	-	-	-		-	-
Phenanthrene	5.400	6.150	11.400	2.060	1.480	2.400	1.110	86.7	2480000	596000
C1-Phenanthrenes/Anthracenes	3.420	5.460	5.170	1.180	0.698	1.440	0.638		2790000	670000
C2-Phenanthrenes/Anthracenes	4.630	5.340	5.420	1.410	-	1.110	-		3100000	746000
C3-Phenanthrenes/Anthracenes	4.430	4.220	5.470	-	-	-	-		3450000	829000
C4-Phenanthrenes/Anthracenes	2.740	-	3.140	-	-	-	-		3790000	912000
Anthracene	2.220	2.170	2.540	0.180	0.129	0.288	0.129	46.9	2470000	594000
Fluoranthene	4.700	11.100	9.440	1.210	1.070	1.710	0.782	113	2940000	707000
Pyrene	4.150	9.020	7.280	0.801	0.740	1.250	0.546	153	2900000	697000
C1-Fluoranthenes/Pyrenes	5.340	6.180	4.970	0.924	0.606	1.110	0.514		3200000	770000
C2-Fluoranthenes/Pyrenes	3.940	5.100	3.850	0.804	1.230	1.060	0.874		-	-
C3-Fluoranthenes/Pyrenes	3.960	3.680	4.960	-	-	-	-		-	-
C4-Fluoranthenes/Pyrenes	4.460	4.140	4.820	-	-	-	-		-	-
Benz[a]anthracene	4.680	3.310	3.370	0.219	0.160	0.369	0.101	74.8	3500000	841000
Chrysene/Triphenylene	5.630	6.260	5.950	0.515	0.458	0.878	0.302	108	3510000	844000
C1-Chrysenes	3.330	3.080	3.170	0.479	0.336	0.698	0.332		3870000	929000
C2-Chrysenes	3.280	3.230	3.970	-	-	-	-		4200000	1010000
C3-Chrysenes	-	9.460	10.200	-	-	-	-		4620000	1110000
C4-Chrysenes	-	-	-	-	-	-	-		5030000	1210000
Benzo[b]fluoranthene	5.460	3.410	2.830	0.483	0.374	0.870	0.216		4070000	979000
Benzo[j]fluoranthene/ Benzo[k]fluoranthene	4.420	3.030	2.390	0.297	0.200	0.607	0.173		4080000	981000
Benzo[e]pyrene	2.920	2.750	2.510	0.395	0.286	0.736	0.262		4020000	967000
Benzo[a]pyrene	4.210	2.320	2.620	0.182	0.150	0.501	-	88.8	4020000	965000
Indeno[1,2,3-cd]pyrene	3.010	1.680	1.880	0.218	0.147	0.924	0.130		4620000	1110000

Table 5. Sediment PAH loads and toxicity comparisons from 2024 samples.

Analyte (ng/g dry weight)	AMT-S-24-1	AMT-S-24-2	AMT-S-24-3	GOC-S-24-1	GOC-S-24-2	GOC-S-24-3	GOC-S-24-2-DUP	Threshold Effect Level (CCME/NOAA)	Acute Potency Divisor (µg/kg Organic Carbon)[5]	Chronic Potency Divisor (µg/kg Organic Carbon)[5]
Dibenz[a,h]anthracene/ Dibenz[a,c]anthracene	2.190	0.669	0.659	0.122	0.133	0.856	0.099	6.22	4660000	1120000
Benzo[g,h,i]perylene	3.220	1.990	2.340	0.205	0.185	0.811	0.102		4540000	1090000
Total Organic Carbon (Average)	0.485	0.557	0.518	0.472	0.494	0.533	-	-		
Sum 42 PAH (ng/g dry weight)	125.17	135.22	146.41	20.36	13.85	29.49	10.79			
Sum 42 PAH (ng/g DOC corrected)	258.09	242.76	282.64	43.13	28.03	55.33	-			
Sum 16 PAH[1] (ng/g dry weight)	57.00	56.12	58.15	9.26	7.22	14.70	5.17			
Sum low molecular weight PAH[2] (ng/g)	44.91	43.11	54.44	12.26	7.45	15.83	6.08			
Sum high molecular weight PAH[3] (ng/g)	65.98	77.66	74.70	6.46	5.79	11.64	4.17			
% low molecular weight PAH	40%	36%	42%	65%	56%	58%	59%			
% high molecular weight PAH	60%	64%	58%	35%	44%	42%	41%			
Sum of Carcinogenic PAH[4] (ng/g dry weight)	32.820	22.669	22.039	2.241	1.807	5.816	1.123			
Sum of 9 PAHs	37.220	44.000	46.820	5.590	4.519	9.131	3.202	1684		

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, and dibenz[a,h]anthracene

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. Mussel Tissue PAH loads from 2024 LTEMP samples.

	ANALYTE (ng/g)	RED-B-24-1	RED-B-24-2	RED-B-24-3	JAC-B-24-1	JAC-B-24-2	JAC-B-24-3	AMT-B-24-1	AMT-B-24-2	AMT-B-24-3	GOC-B-24-1	GOC-B-24-2	GOC-B-24-3	SHH-B-24-1
1	Naphthalene	0.526	0.435	0.666	0.909	0.843	0.734	0.603	0.481	0.541	0.655	0.408	0.617	0.606
2	C1-Naphthalenes	0.451	0.478	0.571	0.528	0.613	0.487	0.397	-	0.375	0.821	0.31	0.614	0.394
3	C2-Naphthalenes	-	-	-	1.26	-	-	-	-	-	-	-	-	0.88
4	C4-Naphthalenes	-	-	-	1.17	-	-	-	-	-	-	-	-	0.704
5	C3-Naphthalenes	-	-	-	-	-	-	-	-	-	-	-	-	-
6	Biphenyl	0.324	0.34	0.42	0.528	0.336	0.437	0.24	-	0.286	0.548	0.224	-	0.342
7	Dibenzofuran	0.613	0.651	0.759	0.504	0.158	-	0.14	-	-	-	0.198	-	0.519
8	Acenaphthylene	0.175	0.314	0.202	0.071	-	-	0.189	-	-	-	-	-	0.051
9	Acenaphthene	0.731	0.611	0.66	0.306	-	-	-	-	-	-	-	-	0.33
10	Fluorene	0.763	0.627	0.631	0.841	-	0.334	0.199	-	0.279	-	0.311	-	0.933
11	C1-Fluorenes	-	-	-	0.433	-	-	-	-	-	-	-	-	0.404
12	C2-Fluorenes	-	-	-	-	-	-	-	-	-	-	-	-	-
13	Dibenzothiophene	0.37	0.346	0.357	0.708	-	0.093	-	0.337	0.08	0.177	0.06	0.234	0.51
14	C1-Dibenzothiophenes	-	-	-	0.356	-	-	-	-	-	-	-	-	0.343
15	C2-Dibenzothiophenes	-	-	-	0.871	-	-	-	-	-	-	-	-	0.901
16	C3-Dibenzothiophenes	-	-	-	-	-	-	-	-	-	-	-	-	-
17	C4-Dibenzothiophenes	-	-	-	-	-	-	-	-	-	-	-	-	-
18	Phenanthrene	5.66	4.8	5.16	4.35	0.977	0.979	0.994	0.955	0.933	1.46	1.05	1.24	3.58
19	C1-Phenanthrenes/Anthracenes	1.76	1.57	1.72	0.812	-	-	-	-	-	-	-	-	2.45
20	C3-Phenanthrenes/Anthracenes	-	-	-	1.1	-	-	-	-	-	-	-	-	0.786
21	C2-Phenanthrenes/Anthracenes	-	-	-	-	-	-	-	-	-	-	-	-	-
22	C4-Phenanthrenes/Anthracenes	-	-	-	-	-	-	-	-	-	-	-	-	-
23	Anthracene	0.458	0.498	0.491	0.294	-	-	-	-	-	-	-	-	0.228
24	Fluoranthene	8.01	6.34	7.11	2.17	0.441	0.496	0.534	0.33	0.386	0.667	0.622	0.578	1.71
25	Benzo[b]fluorene	0.802	0.389	0.618	0.067	-	-	-	-	-	-	-	-	-
26	Pyrene	3.96	2.71	2.89	0.626	0.133	0.229	0.37	0.311	0.155	0.311	0.267	0.4	0.458
27	C1-Fluoranthenes/Pyrenes	3.01	2.44	2.57	0.587	-	-	-	-	-	-	-	-	-
28	C2-Fluoranthenes/Pyrenes	-	-	-	-	-	-	-	-	-	-	-	-	-
29	C3-Fluoranthenes/Pyrenes	-	-	-	-	-	-	-	-	-	-	-	-	-
30	Naphthobenzothiophenes	1.25	1.06	1	0.137	-	-	-	-	-	-	-	-	0.078
31	C1-Naphthobenzothiophenes	-	0.905	-	-	-	-	-	-	-	-	-	-	-
32	C2-Naphthobenzothiophenes	-	1.64	-	-	-	-	-	-	-	-	-	-	-
33	Benz[a]anthracene	2.05	1.93	2.16	0.126	-	-	0.171	-	-	-	0.06	-	0.046
34	Chrysene/Triphenylene	3.45	3.46	3.38	0.256	0.165	0.236	0.482	0.278	0.168	0.246	0.233	0.243	0.194
35	C1-Chrysenes	0.873	0.789	0.745	0.235	-	-	-	-	-	-	-	-	-
36	Benzo[b]fluoranthene	1.37	1.41	1.46	0.115	-	-	0.593	-	-	-	-	-	0.061
37	Benzo[j]fluoranthene/Benzo[k]fluoranthene	1.29	1.11	1.31	0.077	-	-	0.319	-	-	-	-	-	-
38	Benzo[e]pyrene	0.983	0.779	0.957	0.112	-	-	0.414	-	-	-	-	-	-
39	Benzo[g,h,i]perylene	0.232	0.248	0.415	0.148	-	-	0.505	-	-	-	-	-	0.114
40	Benzo[a]pyrene	-	0.338	0.528	0.076	-	-	-	-	-	-	-	-	-
41	Indeno[1,2,3-cd]pyrene	-	0.192	0.31	0.118	-	-	0.361	-	-	-	-	-	0.055
42	Carbazole	-	-	-	0.386	-	-	-	-	-	-	0.194	-	0.413
43	Perylene	-	-	-	0.147	-	-	-	-	-	-	-	-	0.168
44	Dibenz[a,h]anthracene/Dibenz[a,c]anthracene	-	-	-	0.087	-	-	-	-	-	-	-	-	-
45	Retene	-	-	-	-	-	-	-	-	-	-	-	-	-

Table 6. Mussel Tissue PAH loads from 2024 LTEMP samples.

ANALYTE (ng/g)	RED-B-24-1	RED-B-24-2	RED-B-24-3	JAC-B-24-1	JAC-B-24-2	JAC-B-24-3	AMT-B-24-1	AMT-B-24-2	AMT-B-24-3	GOC-B-24-1	GOC-B-24-2	GOC-B-24-3	SHH-B-24-1
Percent Lipids (%)	1.64	2.11	2.25	1.54	1.69	1.74	2.04	1.84	1.78	1.92	1.5	2.01	1.81
Moisture (%)	85	85.9	85.5	83	86	85.4	85.3	84.9	85.1	85.8	83.4	84.8	84.5
Sum 42 PAH (ng/g wet weight)	36.55	31.47	34.55	17.02	3.17	3.50	6.13	2.36	2.84	4.16	3.26	3.69	14.15
Sum 42 PAH (ng/g dry weight)	243.69	223.18	238.30	100.12	22.66	23.94	41.71	15.60	19.04	29.30	19.64	24.29	91.30
Sum 42 PAH (ng/g lipid corrected)	2228.90	1491.37	1535.73	1105.26	187.69	200.86	300.54	127.99	159.38	216.67	217.40	183.68	781.88
Sum 16 PAH[1] (ng/g wet weight)	28.68	25.02	27.37	10.57	2.56	3.01	5.32	2.36	2.46	3.34	2.95	3.08	8.37
Sum 16 PAH[1] (ng/g dry weight)	191.17	177.47	188.78	62.18	18.28	20.60	36.19	15.60	16.52	23.51	17.78	20.25	53.97
Sum low molecular weight PAH[2] (ng/g wet weight)	10.52	9.33	10.10	12.07	2.43	2.53	2.38	1.44	2.13	2.94	2.08	2.47	11.35
Sum high molecular weight PAH[3] (ng/g wet weight)	26.03	22.14	24.45	4.95	0.74	0.96	3.75	0.92	0.71	1.22	1.18	1.22	2.81
% low molecular weight PAH	29%	30%	29%	71%	77%	73%	39%	61%	75%	71%	64%	67%	80%
% high molecular weight PAH	71%	70%	71%	29%	23%	27%	61%	39%	25%	29%	36%	33%	20%
Sum of Carcinogenic PAH[4] (ng/g wet weight)	8.16	8.44	9.148	0.855	0.165	0.236	1.926	0.278	0.168	0.246	0.293	0.243	0.356

1 16 EPA Priority PAHs - naphthalene, acenaphthylene, acenaphthene, fluorene, phenanthrene, anthracene, fluoranthene, pyrene, benzo[a]anthracene, chrysene, benzo[b]fluoranthene, benzo[k]fluoranthene , be

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,

Table 6. Mussel Tissue PAH loads from 2024 LTEMP samples.

	ANALYTE (ng/g)	SHH-B-24-2	SHH-B-24-3	AIB-B-24-1	AIB-B-24-2	AIB-B-24-3	WIB-B-24-1	WIB-B-24-2	WIB-B-24-3
1	Naphthalene	0.635	0.716	0.915	0.622	0.739	0.827	1.13	2.25
2	C1-Naphthalenes	0.565	0.563	0.566	0.454	0.516	0.589	0.709	1.2
3	C2-Naphthalenes	-	-	1.04	-	-	-	1.3	-
4	C4-Naphthalenes	-	-	1.16	-	-	-	-	-
5	C3-Naphthalenes	-	-	-	-	-	-	-	-
6	Biphenyl	0.398	0.453	0.456	0.479	0.438	0.514	0.578	1.12
7	Dibenzofuran	0.822	0.396	0.927	0.32	0.377	0.343	1.23	1.09
8	Acenaphthylene	-	-	0.051	-	-	-	-	-
9	Acenaphthene	0.104	0.146	0.556	0.153	0.14	0.174	0.73	0.701
10	Fluorene	0.354	0.395	1.73	0.342	0.4	0.348	1.92	1.75
11	C1-Fluorenes	-	-	0.568	-	-	-	0.718	0.792
12	C2-Fluorenes	-	-	1.31	-	-	-	-	-
13	Dibenzothiophene	0.234	0.265	0.751	0.164	0.227	0.235	1.22	1.35
14	C1-Dibenzothiophenes	0.369	0.349	0.412	0.245	0.323	0.378	0.607	0.654
15	C2-Dibenzothiophenes	0.816	0.95	1.15	0.698	0.846	0.81	-	-
16	C3-Dibenzothiophenes	-	-	-	-	-	-	-	-
17	C4-Dibenzothiophenes	-	-	-	-	-	-	-	-
18	Phenanthrene	1.9	2.42	5.15	1.76	2.03	1.97	6.76	6.75
19	C1-Phenanthrenes/Anthracenes	1.14	0.938	5.83	0.954	0.97	0.981	13	4.59
20	C3-Phenanthrenes/Anthracenes	-	-	1.24	-	-	-	1.21	-
21	C2-Phenanthrenes/Anthracenes	-	-	-	-	-	-	-	-
22	C4-Phenanthrenes/Anthracenes	1.26	-	-	-	-	-	-	-
23	Anthracene	0.135	0.162	0.232	0.111	0.134	0.118	0.37	0.975
24	Fluoranthene	0.699	0.968	2.02	0.575	0.776	0.843	3.28	2.5
25	Benzo[b]fluorene	-	-	0.075	-	-	-	0.189	-
26	Pyrene	0.358	0.488	0.493	0.352	0.346	0.445	0.939	0.798
27	C1-Fluoranthenes/Pyrenes	-	-	-	-	-	-	0.89	-
28	C2-Fluoranthenes/Pyrenes	-	-	-	-	-	-	-	-
29	C3-Fluoranthenes/Pyrenes	-	-	-	-	-	-	-	-
30	Naphthobenzothiophenes	0.062	0.071	0.134	-	0.052	-	0.161	0.15
31	C1-Naphthobenzothiophenes	-	-	-	-	-	-	-	-
32	C2-Naphthobenzothiophenes	-	-	-	-	-	-	-	-
33	Benz[a]anthracene	0.079	0.047	-	0.046	-	0.041	-	-
34	Chrysene/Triphenylene	0.178	0.139	0.202	0.116	0.081	0.135	0.34	0.256
35	C1-Chrysenes	-	-	-	-	-	-	-	-
36	Benzo[b]fluoranthene	-	0.12	-	-	-	-	0.069	-
37	Benzo[j]fluoranthene/Benzo[k]fluoranthene	-	0.091	-	-	-	-	0.065	-
38	Benzo[e]pyrene	-	0.142	0.125	-	-	-	0.156	0.147
39	Benzo[g,h,i]perylene	0.108	0.122	0.127	0.076	0.077	0.306	0.124	0.164
40	Benzo[a]pyrene	-	-	-	-	-	-	-	-
41	Indeno[1,2,3-cd]pyrene	-	-	0.05	-	-	-	0.081	-
42	Carbazole	0.11	0.098	0.481	0.087	0.114	0.11	0.751	0.609
43	Perylene	-	-	-	-	-	0.252	0.194	-
44	Dibenz[a,h]anthracene/Dibenz[a,c]anthracene	-	-	-	-	-	-	-	-
45	Retene	0.418	-	-	-	-	-	-	-

Table 6. Mussel Tissue PAH loads from 2024 LTEMP samples.

ANALYTE (ng/g)	SHH-B-24-2	SHH-B-24-3	AIB-B-24-1	AIB-B-24-2	AIB-B-24-3	WIB-B-24-1	WIB-B-24-2	WIB-B-24-3
Percent Lipids (%)	1.5	1.53	2.19	2.46	1.56	2.29	2.69	1.68
Moisture (%)	84.3	84.3	83.2	83.1	82.4	83.4	80.7	78.9
Sum 42 PAH (ng/g wet weight)	7.52	7.46	23.44	5.56	6.21	7.03	34.17	22.87
Sum 42 PAH (ng/g dry weight)	47.87	47.50	139.52	32.91	35.28	42.34	177.07	108.40
Sum 42 PAH (ng/g lipid corrected)	501.00	487.39	1070.32	226.06	398.01	306.94	1270.41	1361.49
Sum 16 PAH[1] (ng/g wet weight)	4.55	5.81	11.53	4.15	4.72	5.21	15.81	16.14
Sum 16 PAH[1] (ng/g dry weight)	28.98	37.03	68.61	24.57	26.84	31.37	81.91	76.51
Sum low molecular weight PAH[2] (ng/g wet weight)	6.09	5.34	20.35	4.40	4.93	5.01	27.85	19.01
Sum high molecular weight PAH[3] (ng/g wet weight)	1.42	2.12	3.09	1.17	1.28	2.02	6.33	3.87
% low molecular weight PAH	81%	72%	87%	79%	79%	71%	81%	83%
% high molecular weight PAH	19%	28%	13%	21%	21%	29%	19%	17%
Sum of Carcinogenic PAH[4] (ng/g wet weight)	0.257	0.397	0.252	0.162	0.081	0.176	0.555	0.256

1 16 EPA Priority PAHs - naphthalene, acenaphthylene, benzo[a]pyrene, benzo[g,h,i]perylene, indeno[1,2,3-c,d]pyrene, and dibenz[a,h]anthracene

2 Low molecular weight PAHs : napthalenes - phenanth

3 High molecular weight PAHs: fluoranthene - benzo (g

4 Carcinogenic PAHs: benzo[a]pyrene, benz[a]anthrac

Table 7. 2024 Water PAH concentrations quantified via passive sampling device

Analyte (ng/L C free)	GOC-PSD-24-1	GOC-PSD-24-2	GOC-PSD-24-3	JAC-PSD-24-1	JAC-PSD-24-2	JAC-PSD-24-3	AMT-PSD-24-1	AMT-PSD-24-2	AMT-PSD-24-3
Naphthalene	23.5	< 0.0387 U	36	0.998	3.44	1.07	0.317	0.457	0.415
C1-naphthalenes	0.333	28.3	0.652	0.103	0.322	9.19E-02	0.168	0.203	0.242
C2-naphthalenes	0.399	25.5	0.86	0.3	0.424	0.243	0.371	0.564	0.483
C3-naphthalenes	1.29	74.6	3.63	0.904	1.06	0.536	1	1.66	1.34
C4-naphthalenes	1.68	99.2	5.36	1.52	1.43	0.808	1.41	2.32	2.24
Acenaphthylene	< 0.0150 U	< 0.0148 U	< 0.0183 U	< 0.0177 U	< 0.0160 U	< 0.0158 U	< 0.0181 U	< 0.0217 U	< 0.0195 U
Acenaphthene	0.201	< 0.00718 U	0.305	8.79E-02	9.17E-02	8.03E-02	6.79E-02	< 0.0103 U	0.133
Fluorene	0.22	0.243	0.393	9.26E-02	9.20E-02	6.89E-02	7.97E-02	9.63E-02	8.12E-02
C1-fluorenes	0.239	0.542	0.524	8.56E-02	0.181	7.21E-02	0.146	0.154	4.38E-02
C2-fluorenes	0.567	0.651	1.67	0.358	0.266	0.205	0.224	0.32	0.298
C4-fluorenes	0.502	0.535	1.52	0.215	0.208	0.16	0.172	0.286	0.249
C3-fluorenes	-	-	-	-	-	-	-	-	-
Anthracene	< 0.00236 U	< 0.00227 U	< 0.00391 U	< 0.00371 U	< 0.00298 U	< 0.00290 U	< 0.00394 U	< 0.00528 U	< 0.00447 U
Phenanthrene	0.328	0.378	0.723	0.312	0.239	0.225	0.241	0.29	0.26
C1-phenanthrenes&anthracenes	0.242	0.239	0.623	0.139	0.104	9.18E-02	0.115	0.143	0.141
C2-phenanthrenes&anthracenes	0.763	0.889	2.34	0.387	0.265	0.246	0.3	0.356	0.333
C3-phenanthrenes&anthracenes	1.14	1.25	3.12	0.44	0.399	0.315	0.417	0.727	0.538
C4-phenanthrenes&anthracenes	< 0.127 U	< 0.118 U	< 0.269 U	< 0.251 U	< 0.186 U	< 0.178 U	< 0.274 U	< 0.394 U	< 0.320 U
Dibenzothiophene	2.25E-02	2.61E-02	5.37E-02	1.98E-02	1.71E-02	1.42E-02	1.59E-02	0.02	1.79E-02
C1-dibenzothiophenes	9.58E-02	0.101	0.178	4.37E-02	3.88E-02	3.17E-02	3.26E-02	4.75E-02	3.93E-02
C2-dibenzothiophenes	0.132	4.40E-02	0.246	4.23E-02	3.42E-02	2.68E-02	2.18E-02	4.62E-02	4.68E-02
C3-dibenzothiophenes	< 0.0251 U	< 0.0243 U	< 0.0403 U	< 0.0382 U	< 0.0311 U	< 0.0303 U	< 0.0404 U	< 0.0537 U	< 0.0455 U
C4-dibenzothiophenes	-	-	-	-	-	-	-	-	-

[1-4]: See Tables 5 6

Table 7. 2024 Water PAH concentrations quantified via passive sampling device

Analyte (ng/L C free)	GOC-PSD-24-1	GOC-PSD-24-2	GOC-PSD-24-3	JAC-PSD-24-1	JAC-PSD-24-2	JAC-PSD-24-3	AMT-PSD-24-1	AMT-PSD-24-2	AMT-PSD-24-3
Fluoranthene	0.177	0.171	0.445	9.27E-02	7.13E-02	6.48E-02	4.58E-02	6.04E-02	4.98E-02
Pyrene	6.06E-02	6.03E-02	0.152	3.26E-02	2.55E-02	2.63E-02	2.52E-02	3.27E-02	2.52E-02
fluoranthenes&pyren	6.10E-02	5.61E-02	0.145	1.89E-02	1.10E-02	1.26E-02	1.62E-02	3.81E-02	2.33E-02
fluoranthenes&pyren	< 0.00171 U	< 0.00161 U	< 0.00348 U	< 0.00326 U	< 0.00245 U	< 0.00235 U	< 0.00354 U	< 0.00503 U	< 0.00412 U
fluoranthenes&pyren	-	-	-	-	-	-	-	-	-
fluoranthenes&pyren	-	-	-	-	-	-	-	-	-
Benz[a]anthracene	< 0.000974 U	< 0.000910 U	< 0.00204 U	< 0.00191 U	< 0.00141 U	< 0.00136 U	< 0.00209 U	< 0.00298 U	< 0.00244 U
Perylene	< 0.00154 U	< 0.00143 U	< 0.00324 U	< 0.00304 U	< 0.00224 U	< 0.00215 U	< 0.00332 U	< 0.00474 U	< 0.00388 U
Benzo[b]fluoranthene	5.28E-03	4.14E-03	1.20E-02	< 0.000949 U	< 0.000700 U	< 0.000673 U	< 0.00104 U	< 0.00148 U	< 0.00121 U
Benzo[e]pyrene	< 0.00120 U	< 0.00112 U	< 0.00252 U	< 0.00236 U	< 0.00174 U	< 0.00167 U	< 0.00258 U	< 0.00369 U	< 0.00302 U
Benzo[a]pyrene	< 0.00172 U	< 0.00161 U	< 0.00363 U	< 0.00340 U	< 0.00251 U	< 0.00241 U	< 0.00372 U	< 0.00531 U	< 0.00435 U
Benzo[j]fluoranthene	< 0.000812 U	< 0.000758 U	< 0.00171 U	< 0.00160 U	< 0.00118 U	< 0.00113 U	< 0.00175 U	< 0.00250 U	< 0.00205 U
Benzo[k]fluoranthene	< 0.000768 U	< 0.000717 U	< 0.00162 U	< 0.00152 U	< 0.00112 U	< 0.00107 U	< 0.00166 U	< 0.00236 U	< 0.00194 U
Indeno[1,2,3-cd]pyrene	< 0.000506 U	< 0.000472 U	< 0.00107 U	< 0.00100 U	< 0.000737 U	< 0.000708 U	< 0.00109 U	< 0.00156 U	< 0.00128 U
Sum 42 PAHs	31.95818	232.78964	58.9517	6.1921	8.7196	4.3894	5.1861	7.8212	6.9993
Sum 42 PAH w/o Naphthalene	4.756	5.190	12.450	2.367	2.044	1.641	1.920	2.617	2.279
Sum 16 PAHs[1]	24.492	0.856	38.030	1.616	3.960	1.535	0.777	0.936	0.964
Sum low molecular weight PAH[2]	31.654	232.498	58.198	6.048	8.612	4.286	5.099	7.690	6.901
Sum high molecular weight PAH[3]	0.304	0.292	0.754	0.144	0.108	0.104	0.087	0.131	0.098
Percent low molecular weight PAH	0.990	0.999	0.987	0.977	0.988	0.976	0.983	0.983	0.986
Percent high molecular weight PAH	0.010	0.001	0.013	0.023	0.012	0.024	0.017	0.017	0.014
Sum of Carcinogenic PAHs[4]	0.005	0.004	0.012	0.000	0.000	0.000	0.000	0.000	0.000
Analyte Count	21	19	21	20	20	20	20	19	20
Percent Naphthalene	0.851	0.978	0.789	0.618	0.766	0.626	0.630	0.665	0.674

[1-4]: See Tables 5 6

Table 8. Mussel tissue biomarkers from 2024 LTEMP samples. All positive analyte detections are reported for every sample with positive detections (i.e., not all samples had positive detections).

	ANALYTE	RED-B-24-1	RED-B-24-2	RED-B-24-3	JAC-B-24-1	JAC-B-24-2	JAC-B-24-3	GOC-B-24-3	SHH-B-24-1	SHH-B-24-2	SHH-B-24-3	AIB-B-24-1	AIB-B-24-2	AIB-B-24-3	WIB-B-24-1	WIB-B-24-2	WIB-B-24-3
1	Hopane (T19)	1.82	1.6	1.55	0.649	0.483	0.624	-	0.73	0.5	-	-	-	-	-	-	-
2	C23 Tricyclic Terpane (T4)	0.397	0.456	0.462	-	-	-	-	-	-	-	-	-	-	-	-	-
3	C24 Tricyclic Terpane (T5)	0.208	0.193	0.203	-	-	-	-	-	-	-	-	-	-	-	-	-
4	C24 Tetracyclic Terpane (T6a)	0.348	0.263	0.281	-	-	-	-	-	-	-	-	-	-	-	-	-
5	18a-22,29,30-Trisnorneohopane-TS (T11)	0.513	0.389	-	-	-	-	-	-	-	-	-	-	-	-	-	-
6	30-Norhopane (T15)	1.09	1.49	0.958	0.523	-	0.373	-	-	-	-	-	-	-	-	-	-
7	30-Homohopane-22S (T21)	0.766	0.833	0.519	-	-	-	-	-	-	-	-	-	-	-	-	-
8	30,31-Bishomohopane-22S (T26)	3.14	3.71	3.9	2.93	3.52	2.1	-	4.96	3.86	5.13	4.72	5.49	4	5.11	5.42	4.7
9	13b(H),17a(H)-20S-Diacholestane (S4)	0.263	0.219	0.299	-	-	-	-	0.07	-	-	-	-	-	-	-	-
10	13b(H),17a(H)-20R-Diacholestane (S5)	0.202	0.168	0.119	-	-	-	-	-	-	-	-	-	-	-	-	-
11	17a(H)20SC27/C29dia	0.58	0.503	0.603	-	0.232	0.217	-	0.16	0.15	-	-	0.26	0.21	0.34	-	-
12	17a(H)20rc27/C29dia	0.688	0.652	0.747	0.159	0.186	0.224	0.218	0.18	0.16	0.15	-	0.26	0.18	-	-	-
13	14a,17a-20R-Methylcholestane (S24)	0.506	0.484	0.508	-	-	-	-	-	-	-	-	-	-	-	-	-
14	14a(H),17a(H)-20S-Ethylcholestane (S25)	0.202	0.29	0.209	-	-	-	-	-	-	-	-	-	-	-	-	-
15	14a(H),17a(H)-20R-Ethylcholestane (S28)	0.479	0.762	0.52	-	-	-	-	-	-	-	-	-	-	-	-	-
16	14b(H),17b(H)-20R-Cholestane (S14)	0.263	0.245	0.299	-	-	-	-	-	-	-	-	-	-	-	-	-
17	14b(H),17b(H)-20S-Cholestane (S15)	0.297	0.29	0.287	-	-	-	-	-	-	-	-	-	-	-	-	-
18	14b,17b-20R-Methylcholestane (S22)	0.337	0.297	0.251	-	-	-	-	-	-	-	-	-	-	-	-	-
19	14b,17b-20S-Methylcholestane (S23)	0.344	0.4	0.37	-	-	-	-	-	-	-	-	-	-	-	-	-
20	14b(H),17b(H)-20R-Ethylcholestane (S26)	0.425	0.406	0.478	-	-	-	-	-	-	-	-	-	-	-	-	-
21	14b(H),17b(H)-20S-Ethylcholestane (S27)	0.29	0.413	0.263	-	-	-	-	-	-	-	-	-	-	-	-	-
22	18a(H)-30-Norneohopane-C29Ts (T16)	-	0.436	-	-	-	-	-	-	-	-	-	-	-	-	-	-
23	13b,17a-20S-Methyldiacholestane (S8)	-	0.239	-	-	-	-	-	-	-	-	-	-	-	-	-	-
24	14a,17a-20S-Methylcholestane (S20)	-	0.258	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Count		21	24	20	4	4	5	1	5	4	2	1	3	3	2	1	1

Table 9. Diagonistic Ratios for petroleum fingerprinting in marine sediment, intertidal mussel tissue, and seawater sampled by PSD for all replicates of the 2024 LTEMP campaign.

	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 + PY R)[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	1.000	0.500	0.400
1	AMT-S-24-1	Sediment	25.10	1.270	0.569	1.400	0.412	0.455	0.291	0.681	0.338	0.531
2	AMT-S-24-2	Sediment	33.90	1.490	0.572	3.750	0.714	0.235	0.261	0.555	0.121	0.552
3	AMT-S-24-3	Sediment	37.10	1.390	0.543	2.400	0.545	0.250	0.182	0.729	0.238	0.565
4	GOC-S-24-1	Sediment	21.90	1.020	0.575	6.333	1.462	0.429	0.080	1.897	0.473	0.602
5	GOC-S-24-2	Sediment	8.45	0.942	0.755	1.667	0.714	0.375	0.080	1.287	0.430	0.591
6	GOC-S-24-3	Sediment	27.10	1.310	0.709	15.000	4.615	0.364	0.107	1.360	0.412	0.578
7	GOC-S-24-2-DUP	Sediment	8.20	0.769	0.771	1.333	0.667	0.500	0.104	1.456	0.427	0.589
8	RED-B-24-1	Tissue	7.30	0.615	0.599	4.167	0.962	0.667	0.586	0.404	0.162	0.669
9	RED-B-24-2	Tissue	8.65	1.220	0.931	5.167	0.795	0.600	0.569	0.422	0.188	0.701
10	RED-B-24-3	Tissue	5.84	1.120	0.618	5.500	1.031	0.600	0.579	0.413	0.179	0.711
11	JAC-B-24-1	Tissue	1.43	0.652	0.806	0.465	2.323	31.000	0.333	2.441	0.573	0.776
12	JAC-B-24-2	Tissue	7.39	1.320	3.188	1.208	5.636	15.400	0.311	3.292	-	0.768
13	JAC-B-24-3	Tissue	5.26	0.722	0.598	0.477	1.850	8.158	0.336	2.637	0.593	0.684
14	AMT-B-24-1	Tissue	6.14	0.811	-	1.007	4.667	17.000	0.349	0.635	0.350	0.591
15	AMT-B-24-2	Tissue	4.44	0.592	-	0.427	2.792	19.625	0.257	1.563	-	0.515
16	AMT-B-24-3	Tissue	6.60	0.808	-	0.955	5.172	19.625	0.293	3.001	0.643	0.713
17	GOC-B-24-1	Tissue	4.51	0.570	-	0.245	0.897	14.300	0.314	2.399	-	0.682
18	GOC-B-24-2	Tissue	4.18	0.533	-	0.160	0.793	20.571	0.372	1.759	0.538	0.700
19	GOC-B-24-3	Tissue	4.49	0.664	-	0.369	1.625	20.143	0.318	2.024	-	0.591
20	SHH-B-24-1	Tissue	11.30	1.030	2.138	0.503	1.857	22.143	0.323	4.043	0.671	0.789
21	SHH-B-24-2	Tissue	5.51	1.200	3.072	0.431	1.886	30.600	0.269	4.285	0.497	0.661
22	SHH-B-24-3	Tissue	3.86	0.613	-	0.525	2.594	26.333	0.286	2.522	0.447	0.665
23	AIB-B-24-1	Tissue	4.97	1.110	-	1.286	10.909	35.000	0.282	6.581	0.778	0.804
24	AIB-B-24-2	Tissue	4.64	1.220	-	2.577	7.529	7.450	0.246	3.773	0.493	0.620
25	AIB-B-24-3	Tissue	3.44	1.020	-	1.148	5.182	21.286	0.277	3.851	0.536	0.692
26	WIB-B-24-1	Tissue	5.21	1.800	-	25.200	3.150	0.714	0.300	2.476	0.439	0.655
27	WIB-B-24-2	Tissue	3.72	0.996	-	0.653	4.683	26.727	0.327	4.401	0.672	0.777
28	WIB-B-24-3	Tissue	5.14	1.860	-	0.371	3.676	33.364	0.270	4.918	0.687	0.758

Table 9. Diagonistic Ratios for petroleum fingerprinting in marine sediment, intertidal mussel tissue, and seawater sampled by PSD for all replicates of the 2024 LTEMP campaign.

	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]
29	GOC-PSD-24-1	Water PSD	31.958	-	-	-	-	-	0.000	104.167	0.784	0.745
30	GOC-PSD-24-2	Water PSD	232.790	-	-	-	-	-	0.000	797.483	0.801	0.739
31	GOC-PSD-24-3	Water PSD	58.952	-	-	-	-	-	0.000	77.185	0.721	0.745
32	JAC-PSD-24-1	Water PSD	6.192	-	-	-	-	-	0.000	41.941	0.740	0.740
33	JAC-PSD-24-2	Water PSD	8.720	-	-	-	-	-	0.000	79.887	0.783	0.737
34	JAC-PSD-24-3	Water PSD	4.389	-	-	-	-	-	0.000	41.328	0.724	0.711
35	AMT-PSD-24-1	Water PSD	5.186	-	-	-	-	-	0.000	58.474	0.760	0.645
36	AMT-PSD-24-2	Water PSD	7.821	-	-	-	-	-	0.000	58.613	0.747	0.649
37	AMT-PSD-24-3	Water PSD	6.999	-	-	-	-	-	0.000	70.203	0.763	0.664

[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

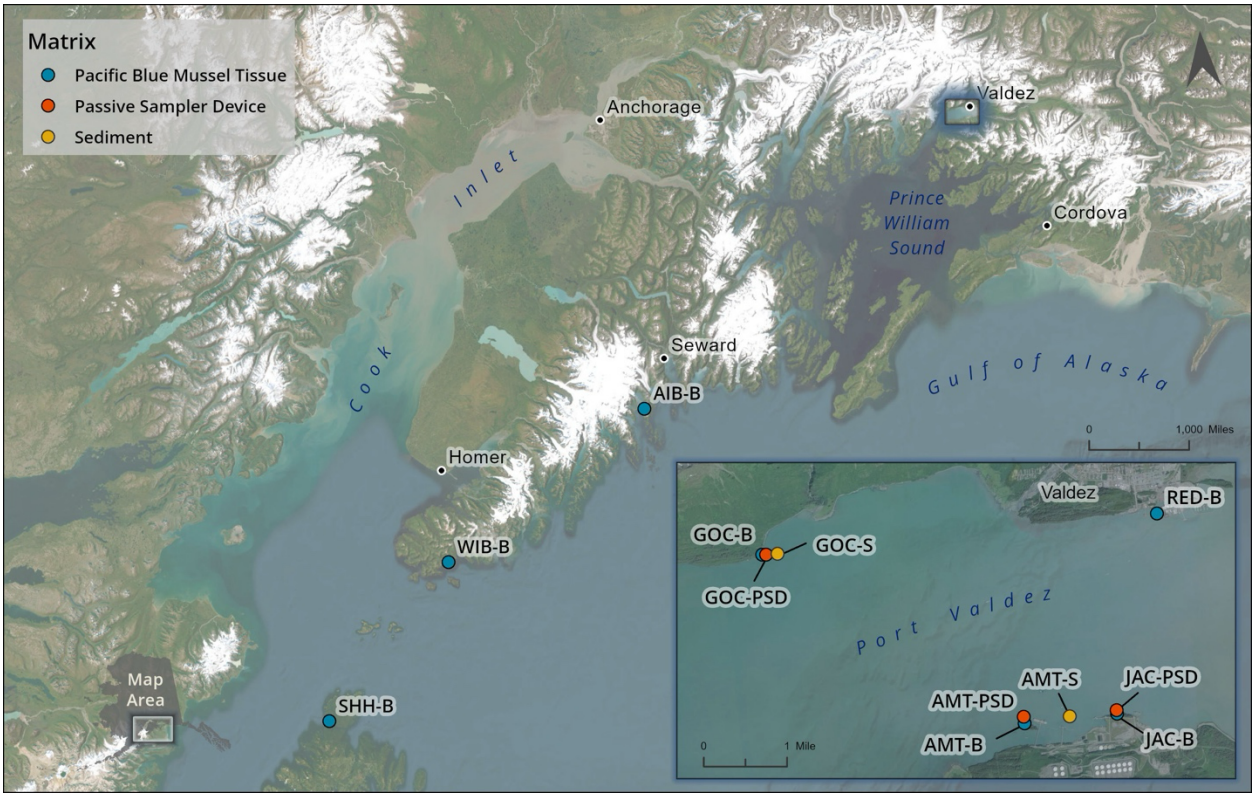

Figure 1. Long-Term Environmental Monitoring Program sites from the 2024 campaign.

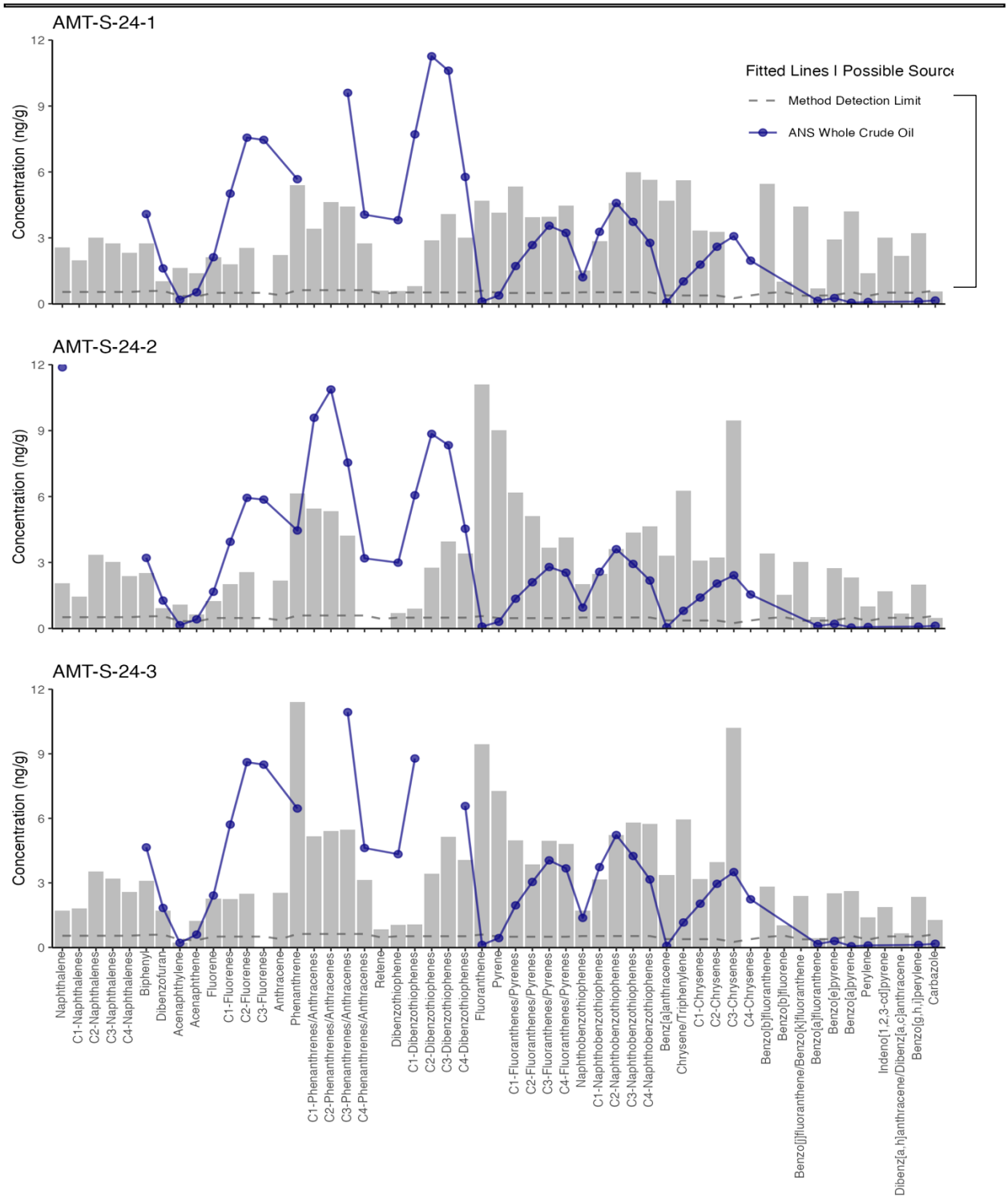

Figure 2. 2024 PAH profiles from individual sediment samples at the Valdez Marine Terminal (AMT) with the ANS potential source profile and the analyte-specific method detection limit superimposed as different lines. ANS profile lines are scaled to C2-Napthobenzothiophenes and represent data only where points are present.

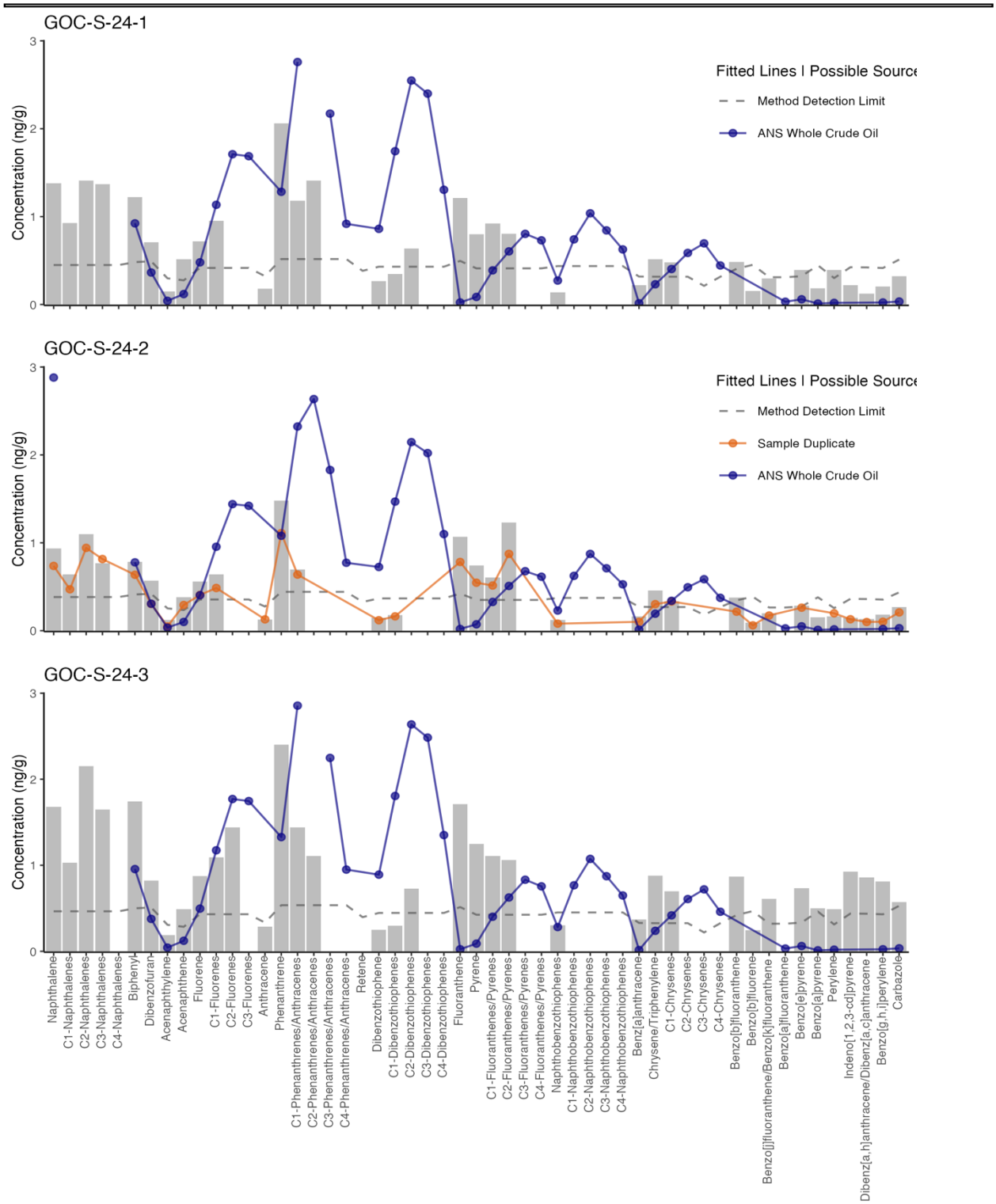

Figure 3. 2024 PAH profiles from individual sediment samples at the Gold Creek (GOC) reference site with the ANS potential source profile, sample duplicate, the analyte-specific method detection limit superimposed as different lines. ANS profile lines are scaled to Napthobenzothiophenes in the third replicate and represent data only where points are present.

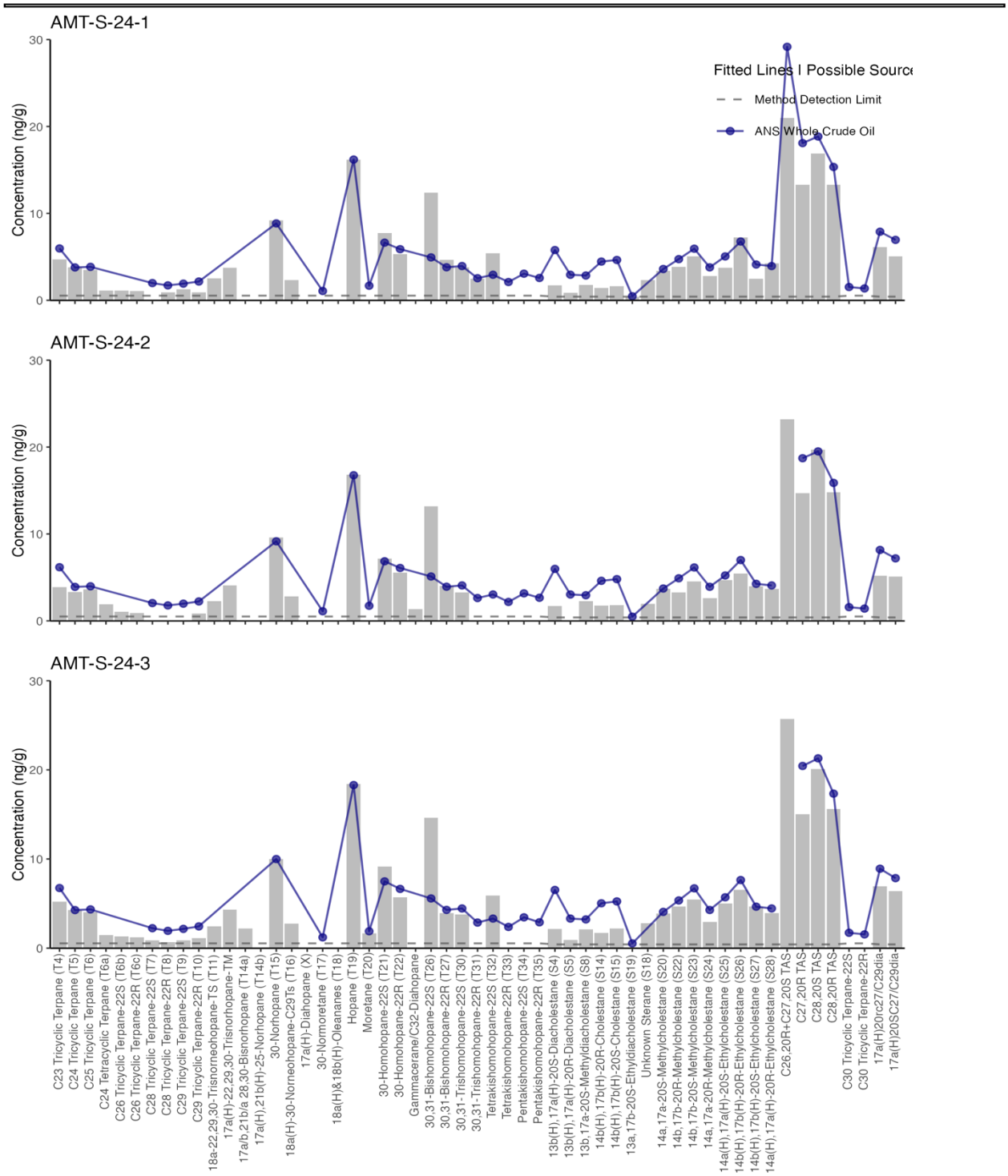

Figure 4. 2024 petro-geochemical profiles from individual sediment samples at the Valdez Marine Terminal (AMT) with the ANS potential source profile and the analyte-specific method detection limit superimposed as different lines. ANS profile lines are scaled to Hopane (T19) and represent data only where points are present.

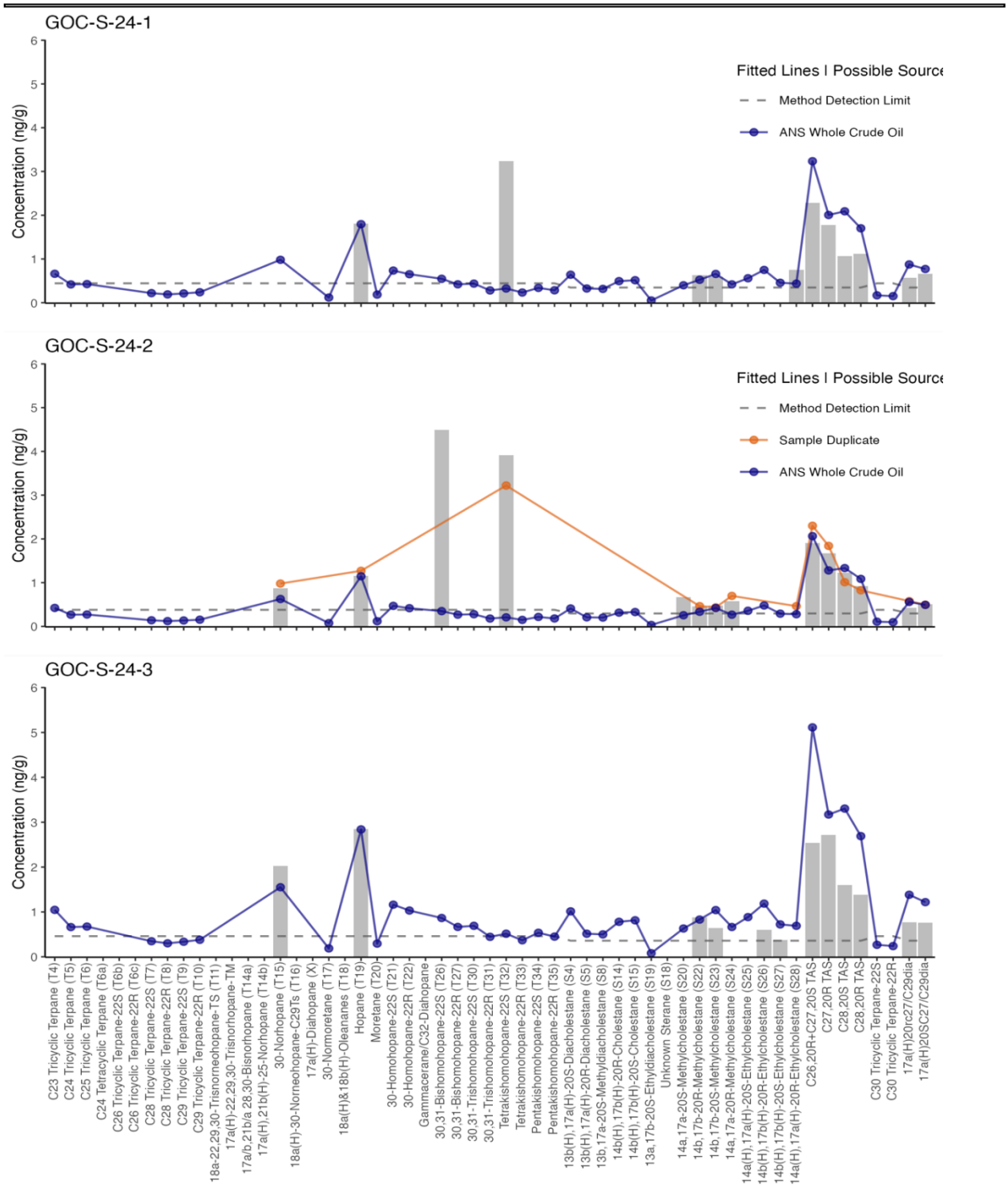

Figure 5. 2024 petro-geochemical biomarker profiles from individual sediment samples at the Gold Creek (GOC) reference site with the ANS potential source profile, sample duplicate, and the analyte-specific method detection limit superimposed as different lines. ANS profile lines are scaled to Hopane (T19) and represent data only where points are present.

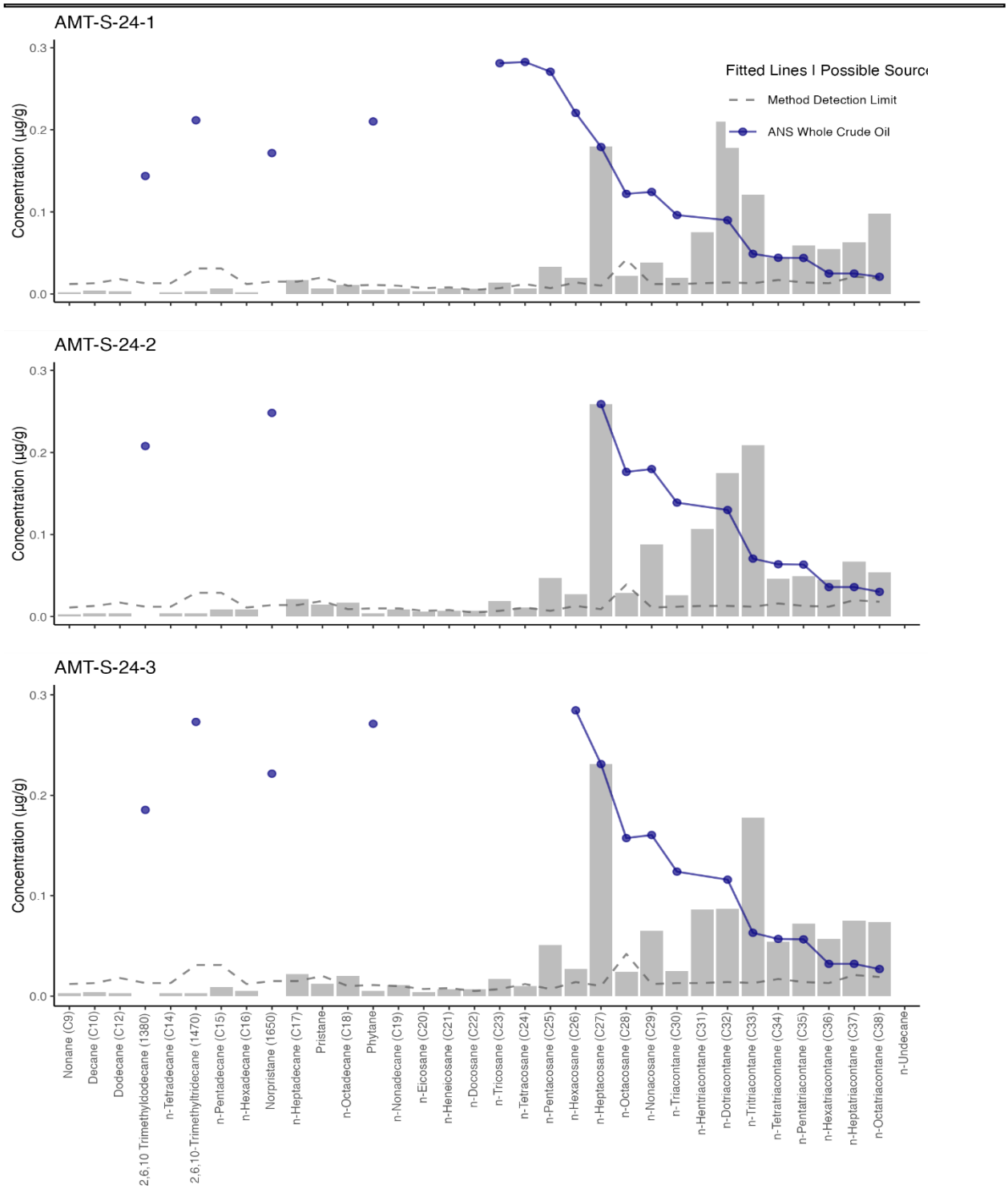

Figure 6. 2024 saturated hydrocarbon profiles from individual sediment samples at the Valdez Marine Terminal (AMT) with the ANS potential source profile and the analyte-specific method detection limit superimposed as different lines. ANS profile lines are scaled to n-Heptacosane (C27) and represent data only where points are present.

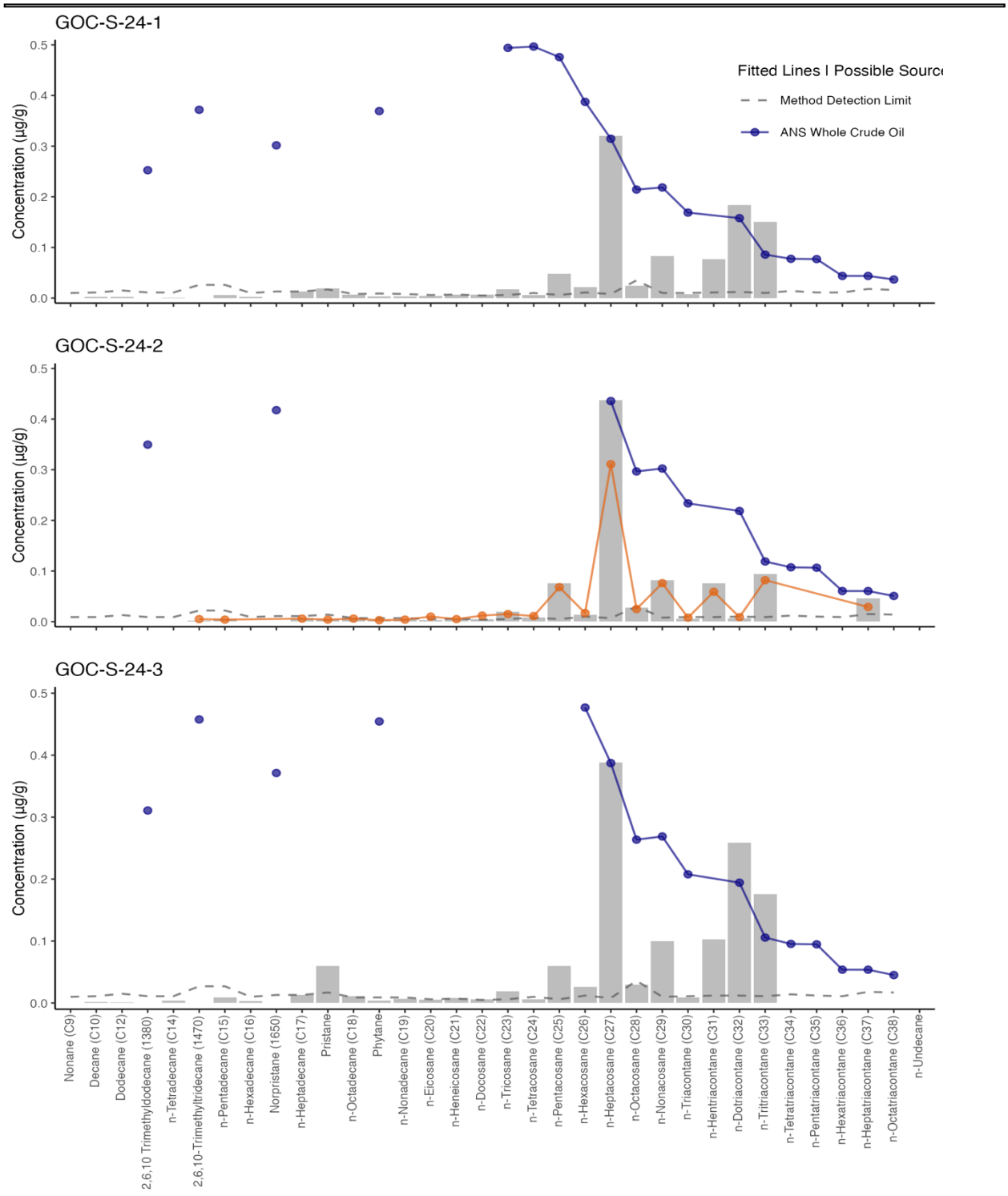

Figure 7. 2024 saturated hydrocarbon profiles from individual sediment samples at the Gold Creek (GOC) reference site with the ANS potential source profile, sample duplicate, and the analyte-specific method detection limit superimposed as different lines. ANS profile lines are scaled to n-Heptacosane (C27) and represent data only where points are present.

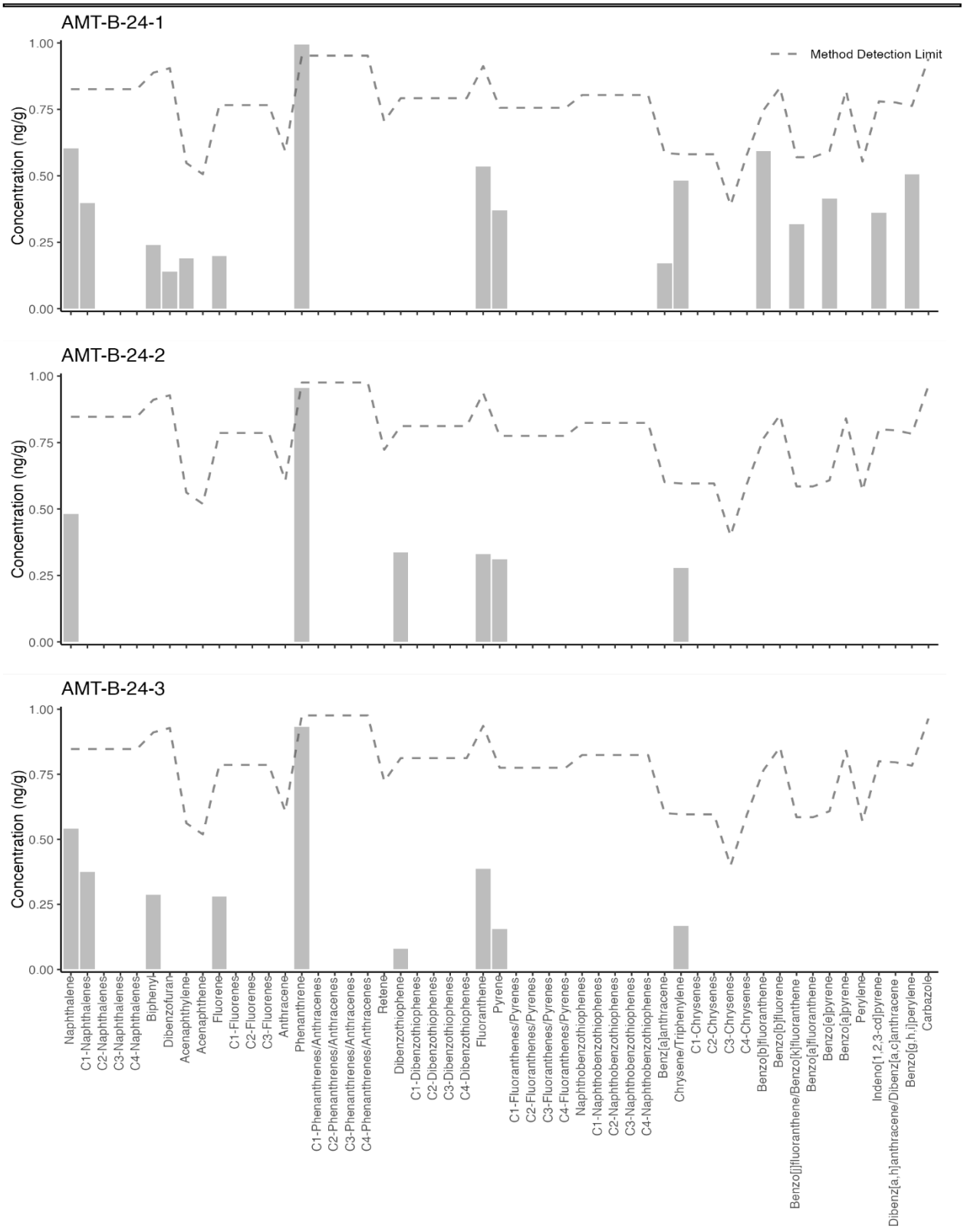

Figure 8. 2024 PAH profiles from individual tissue samples at the Valdez Marine Terminal (AMT) site with the analyte-specific method detection limit superimposed as a dotted line.

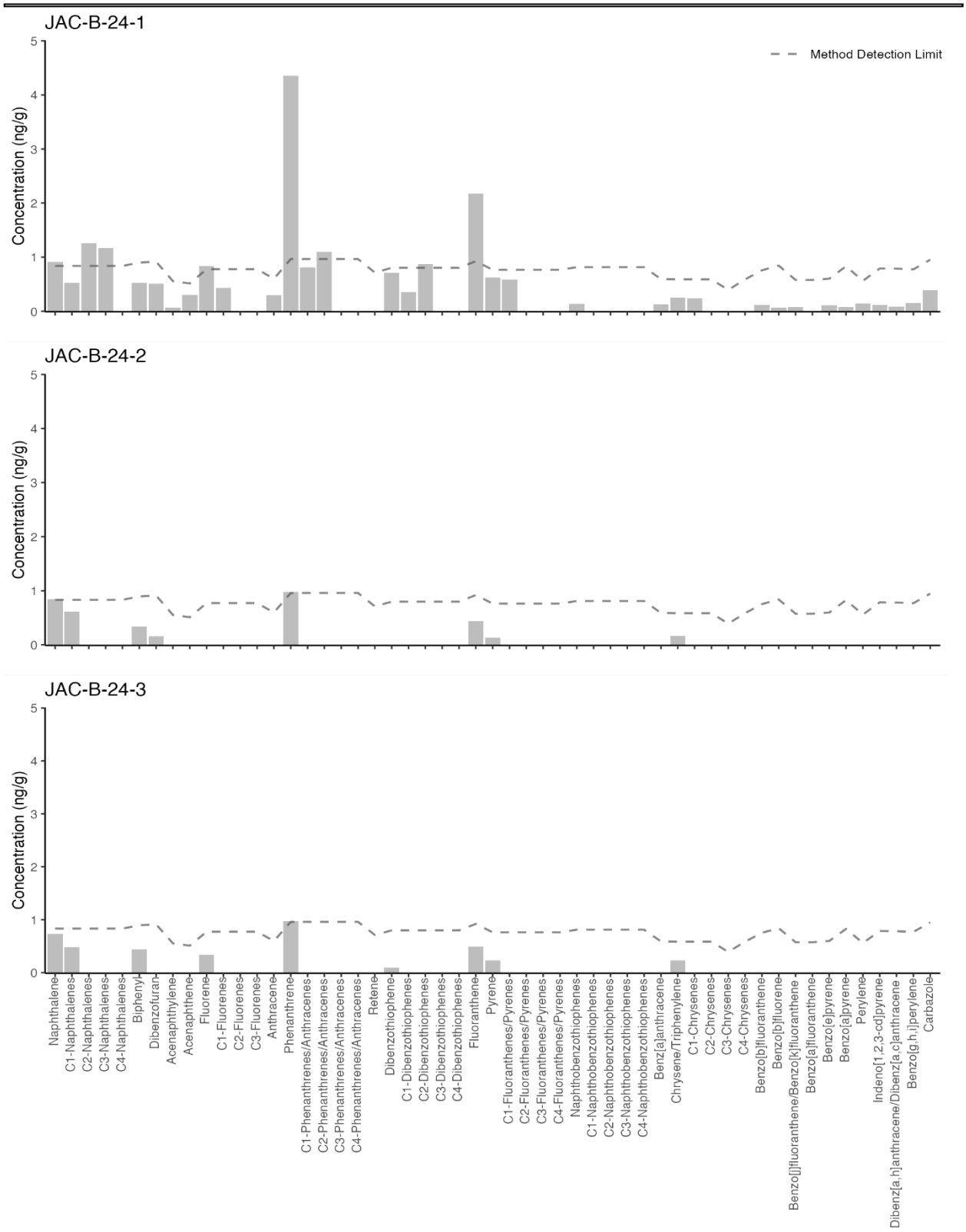

Figure 9. 2024 PAH profiles from individual tissue samples at the Jackson Point (JAC) site, near the Valdez Marine Terminal, with the analyte-specific method detection limit superimposed as a dotted line.

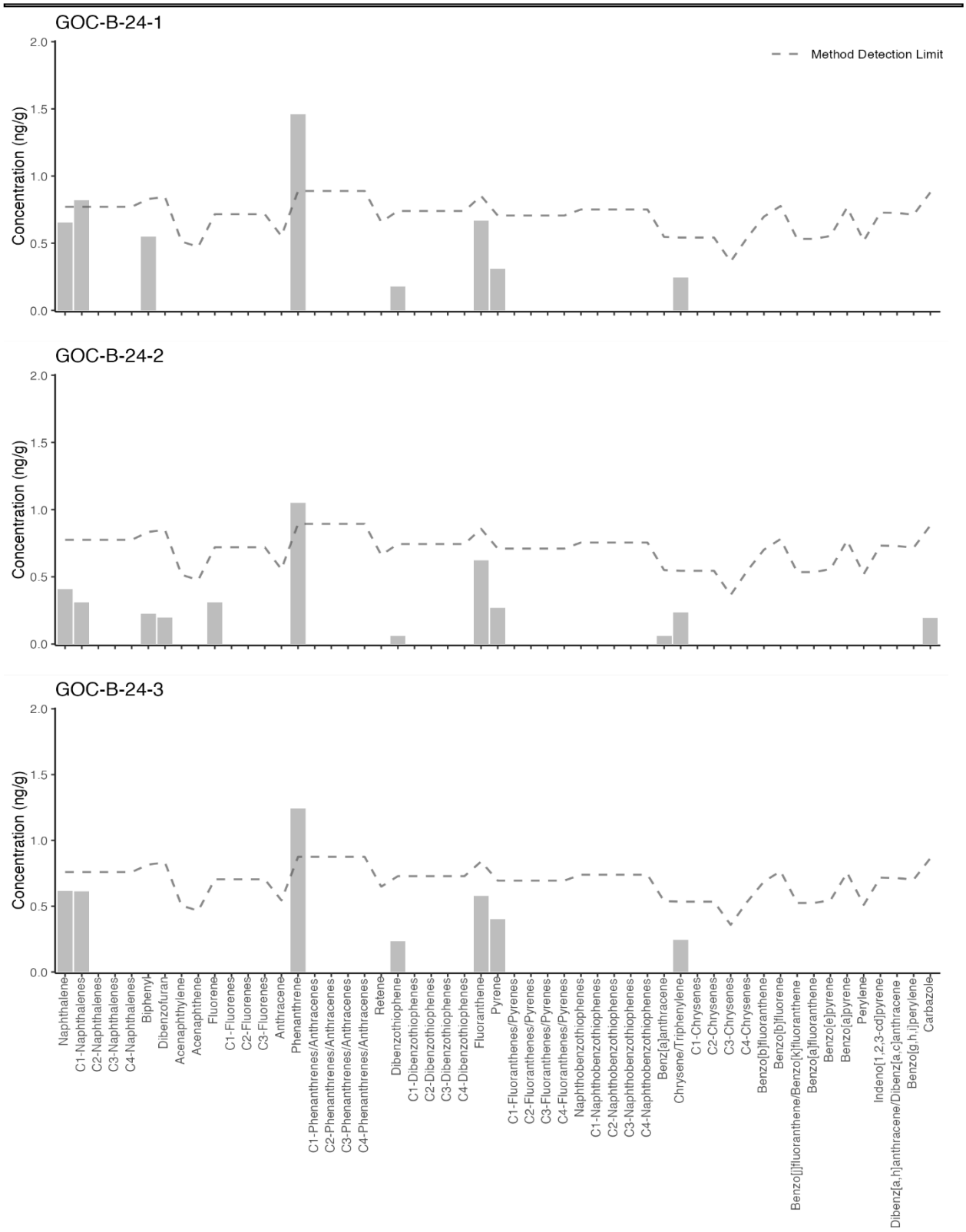

Figure 10. 2024 PAH profiles from individual tissue samples at the Gold Creek (GOC) reference site in Port Valdez with the analyte-specific method detection limit superimposed as a dotted line.

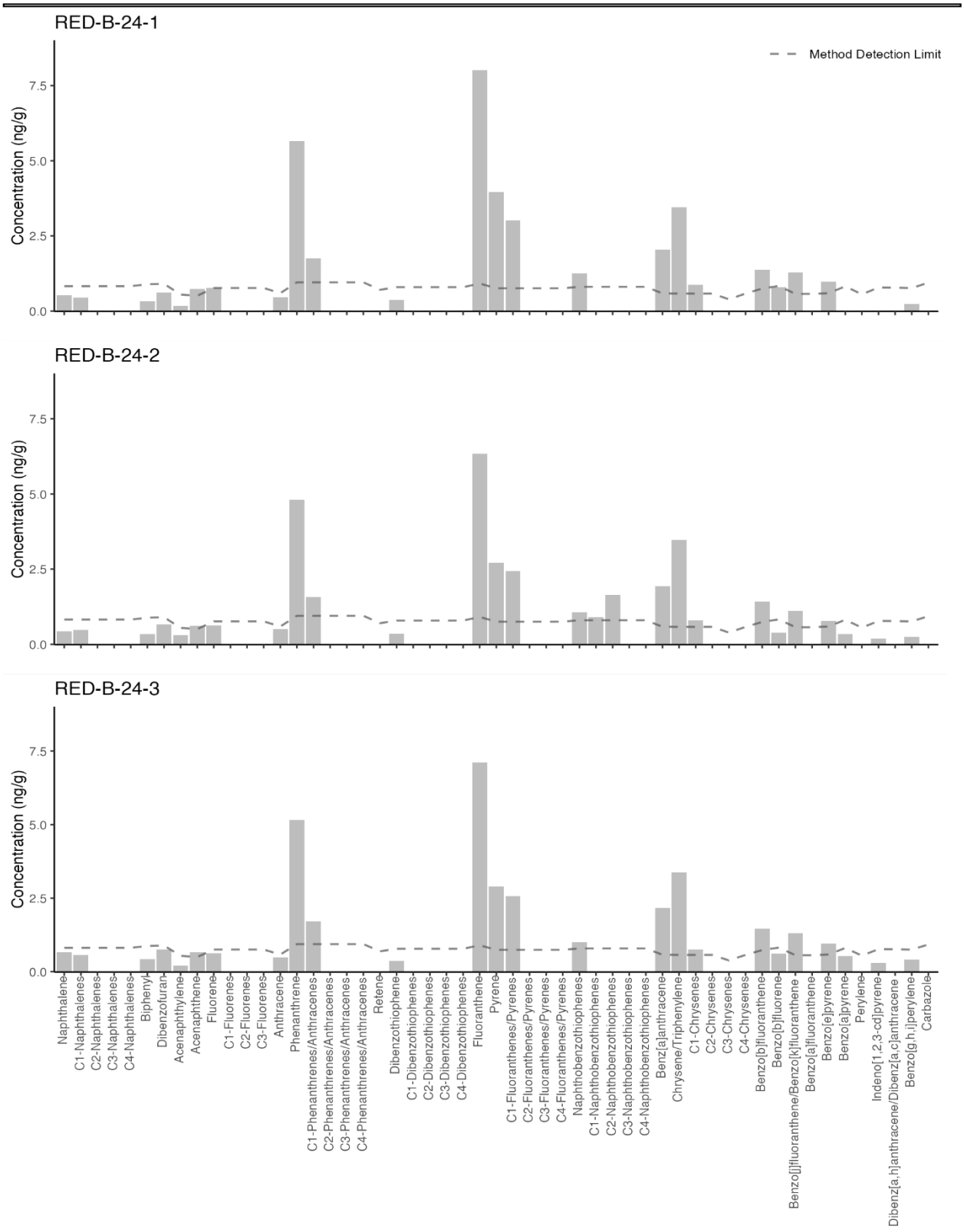

Figure 11.2024 PAH profiles from individual tissue samples at the entrance of the Valdez Small boat harbor (RED) site with the analyte specific method detection limit superimposed as a dotted line.

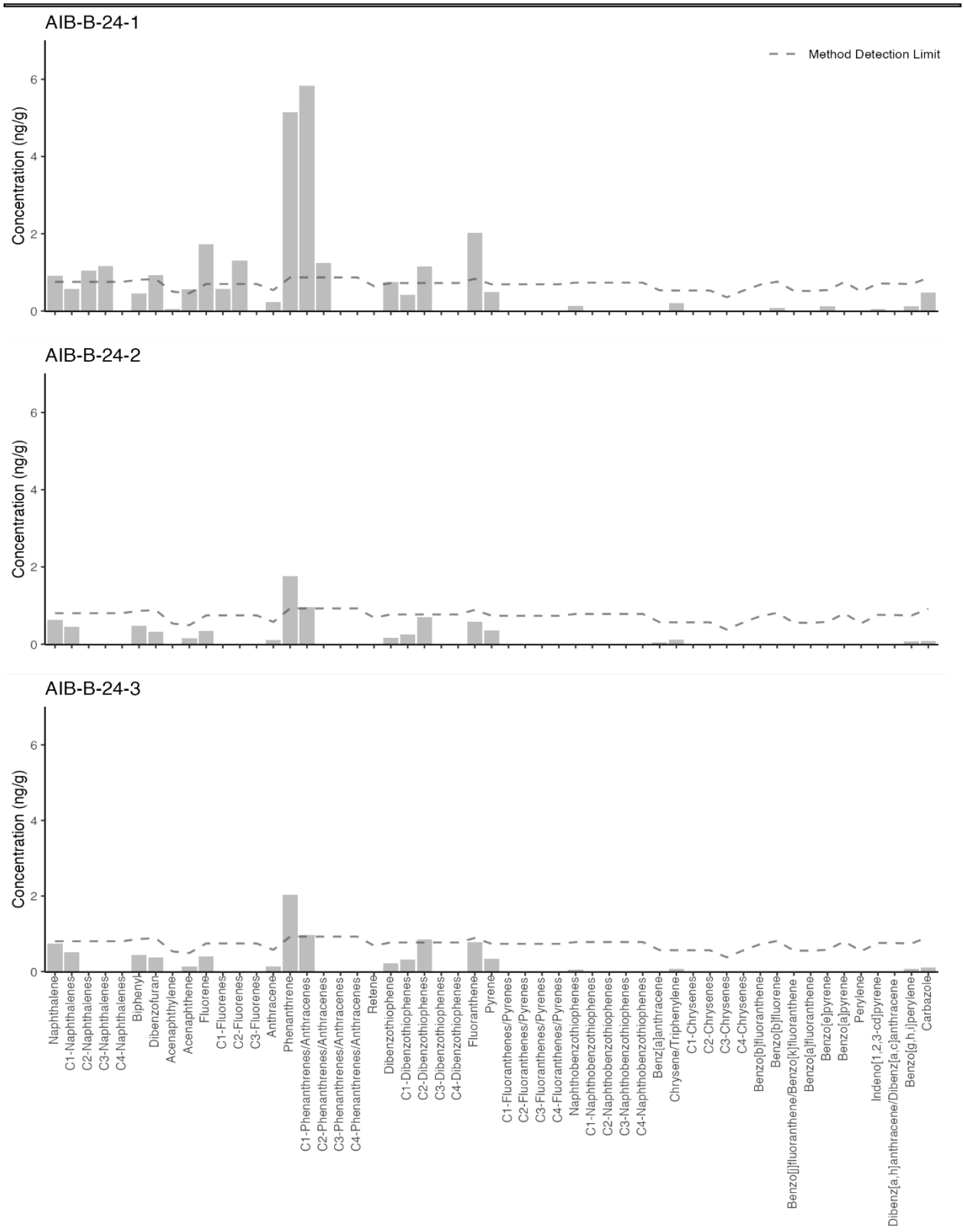

Figure 12. 2024 PAH profiles from individual tissue samples at the Aialik Bay (AIB) site, near the Valdez Marine Terminal, with the analyte specific method detection limit superimposed as a dotted line.

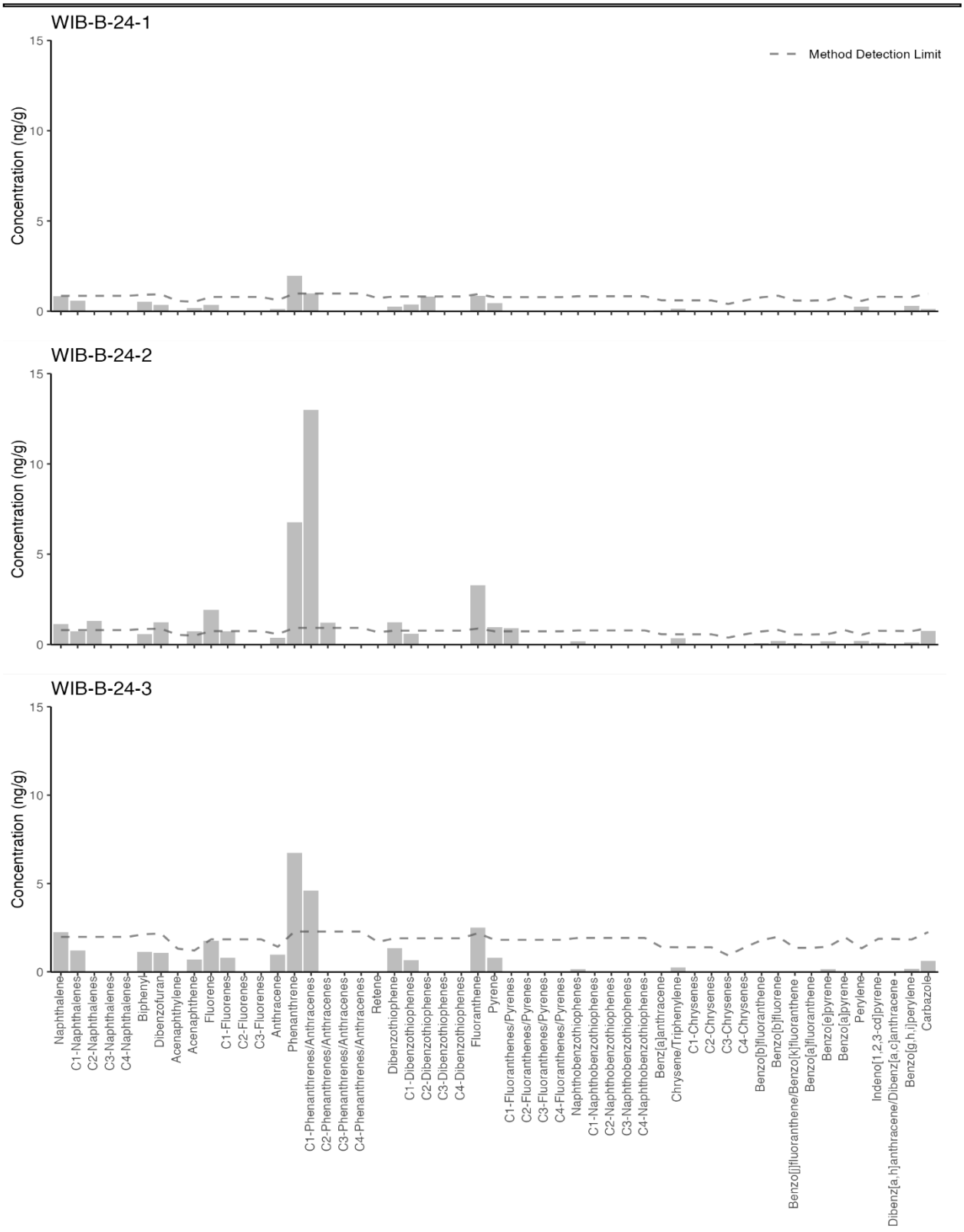

Figure 13. 2024 PAH profiles from individual tissue samples at the Windy Bay (WIB) site, near the Valdez Marine Terminal, with the analyte specific method detection limit superimposed as a dotted line.

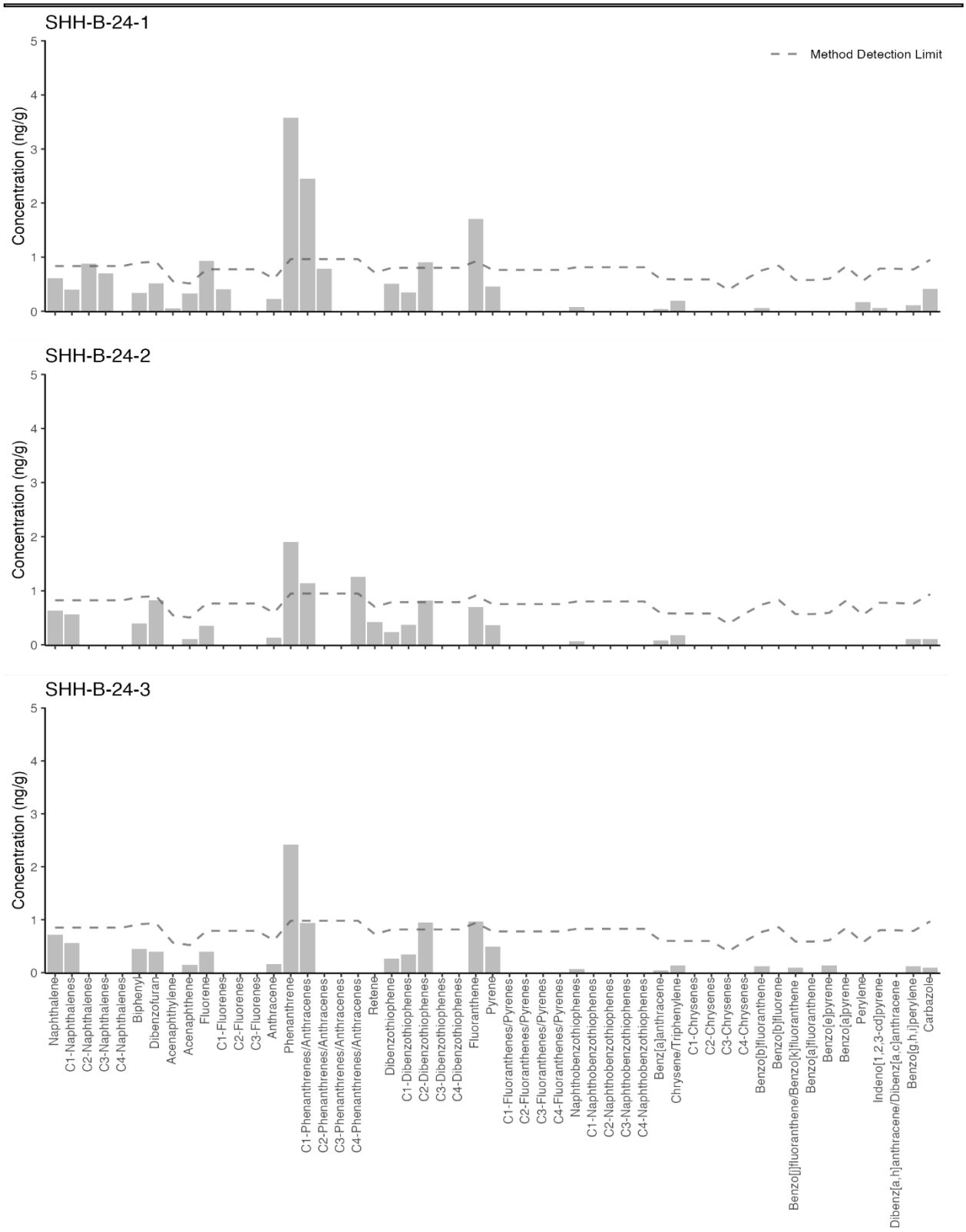

Figure 14. 2024 PAH profiles from individual tissue samples at the Shuyak Harbor (SHH) site, near the Valdez Marine Terminal, with the analyte specific method detection limit superimposed as a dotted line.

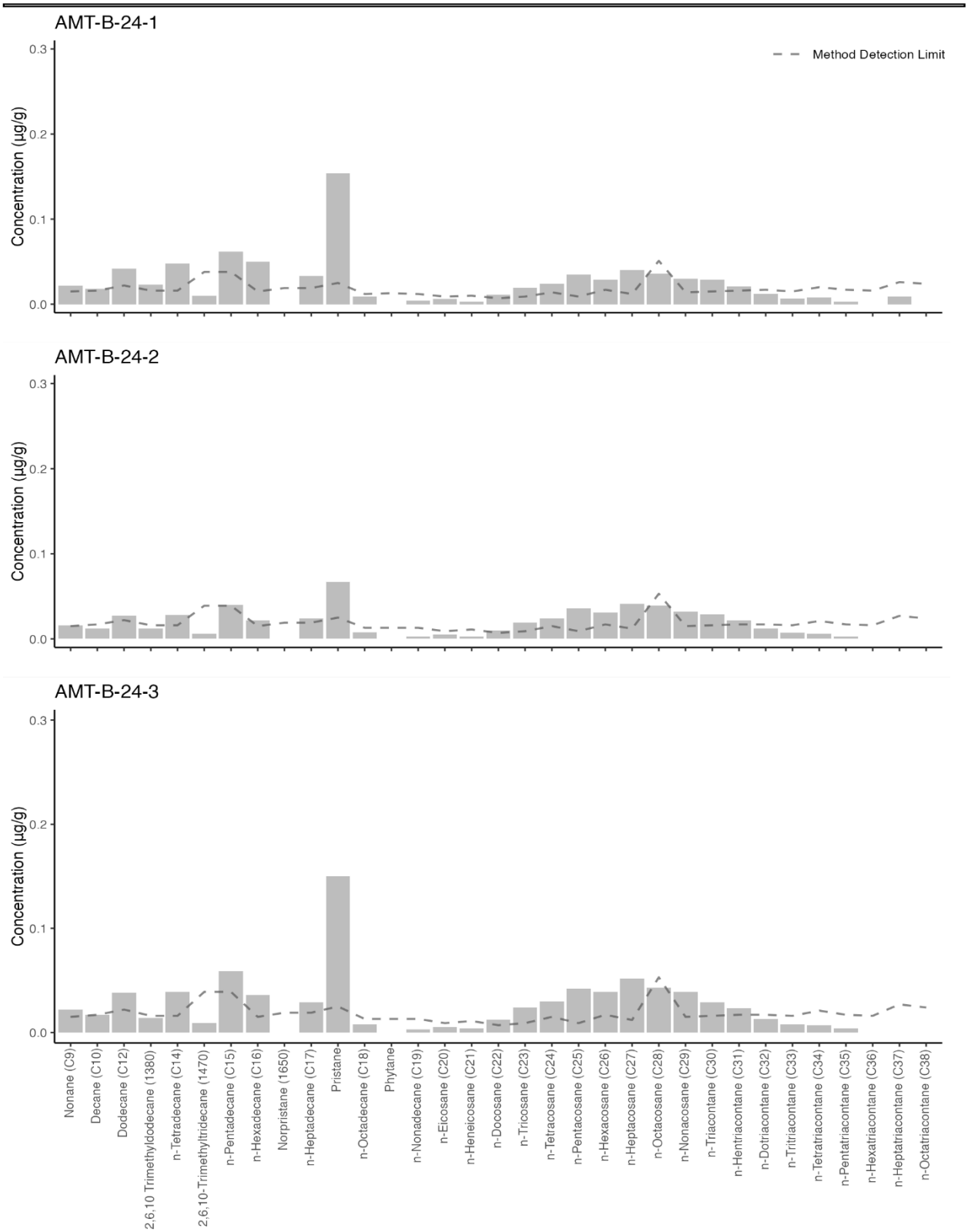

Figure 15. 2024 saturated hydrocarbon profiles from individual tissue samples at the Valdez Marine Terminal (AMT) site with the analyte-specific method detection limit superimposed as a dotted line.

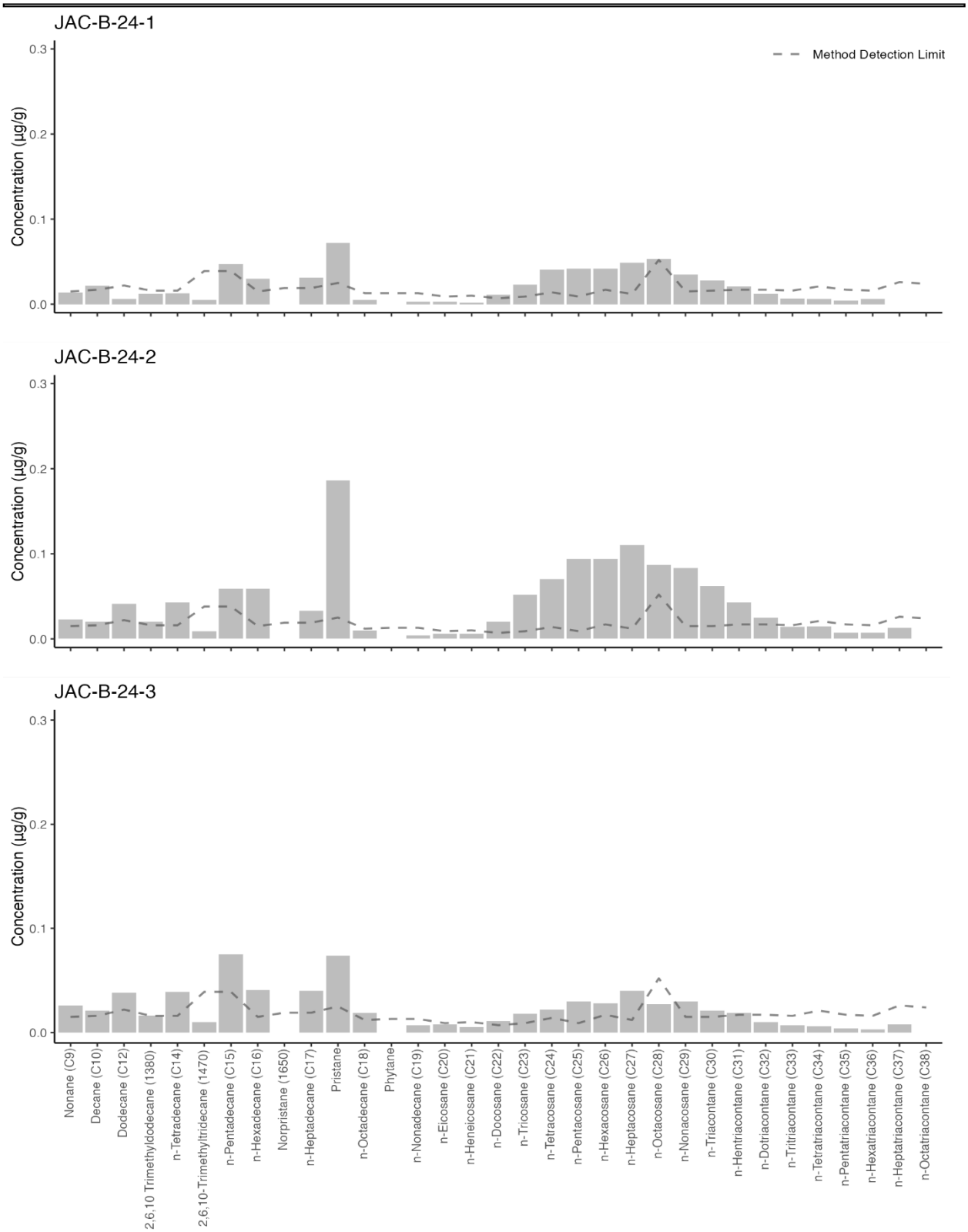

Figure 16. 2024 saturated hydrocarbon profiles from individual tissue samples at the Jackson Point (JAC) site with the analyte-specific method detection limit superimposed as a dotted line.

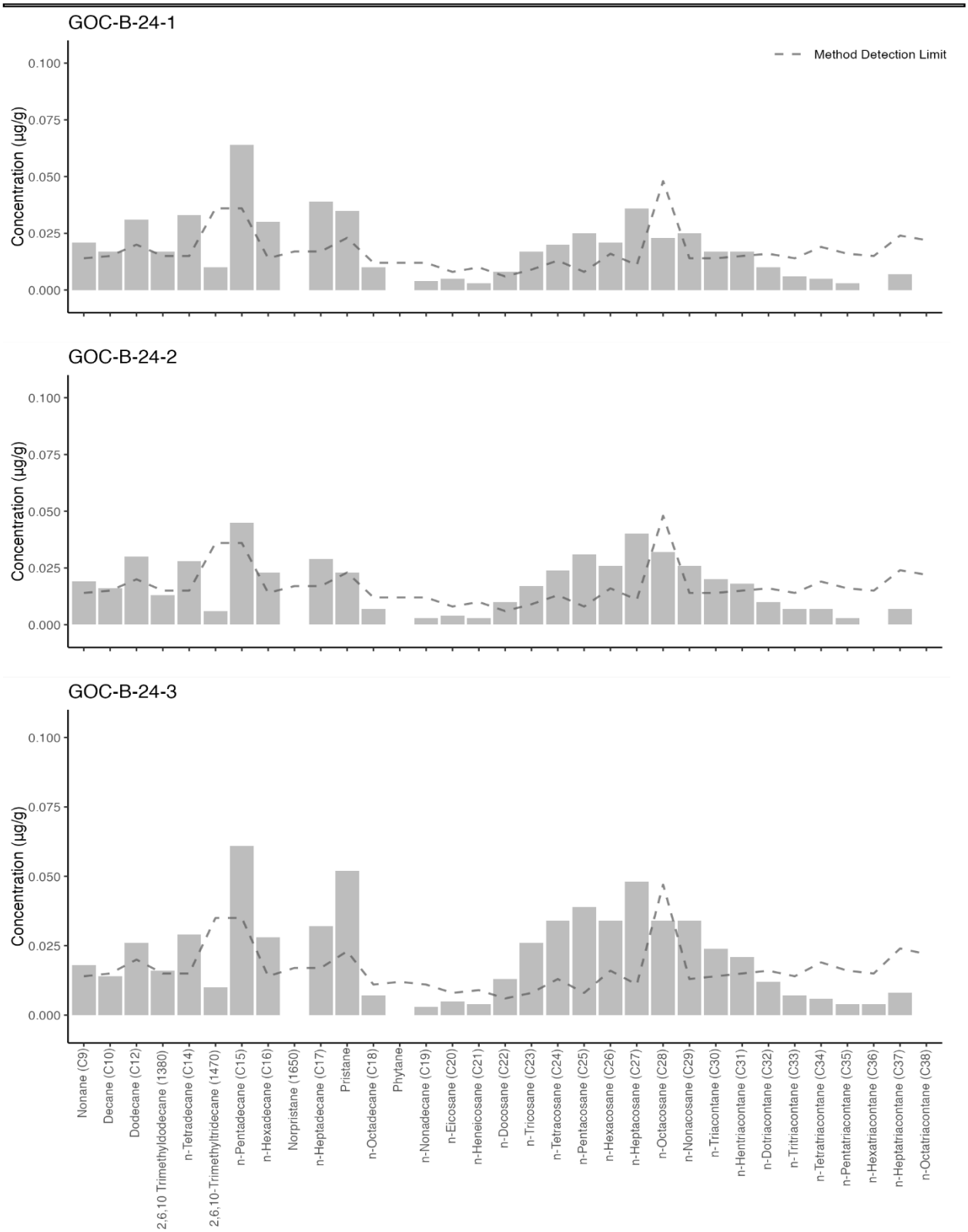

Figure 17. 2024 saturated hydrocarbon profiles from individual tissue samples at the Gold Creek (GOC) site with the analyte-specific method detection limit superimposed as a dotted line.

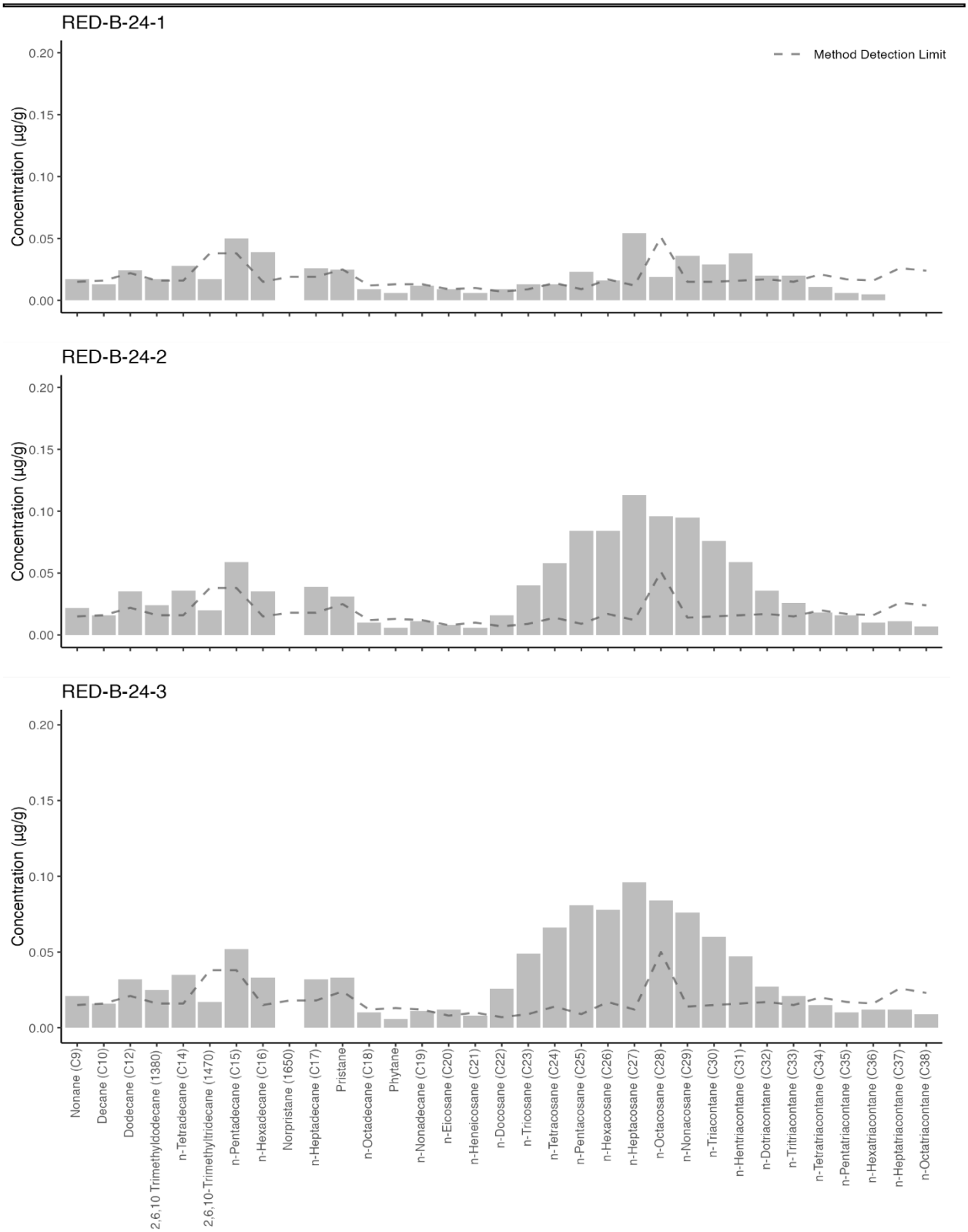

Figure 18. 2024 saturated hydrocarbon profiles from individual tissue samples at the entrance of the Valdez Small Boat Harbor (RED) site with the analyte-specific method detection limit superimposed as a dotted line.

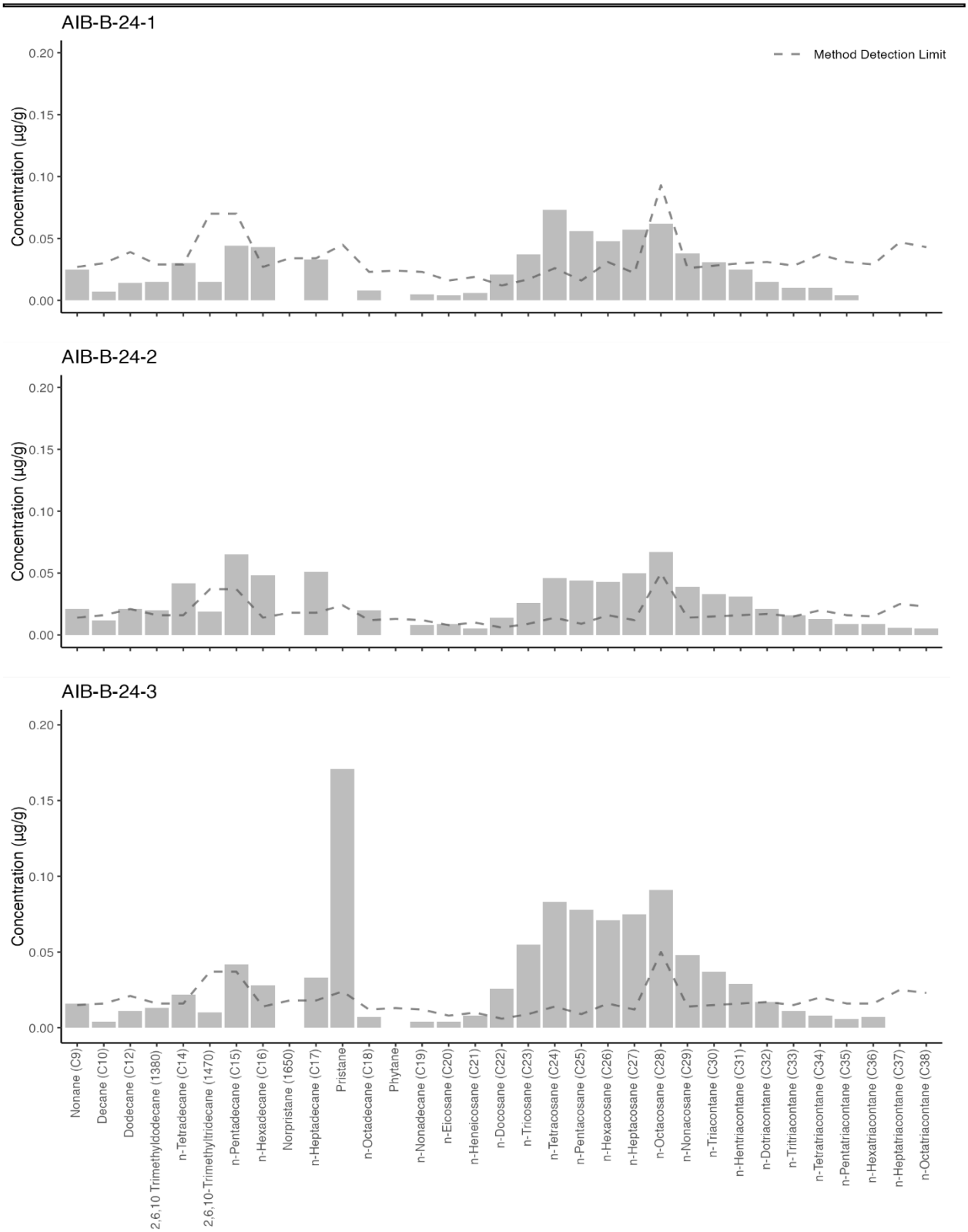

Figure 19. 2024 saturated hydrocarbon profiles from individual tissue samples at Aialik Bay (AIB) site with the analyte-specific method detection limit superimposed as a dotted line.

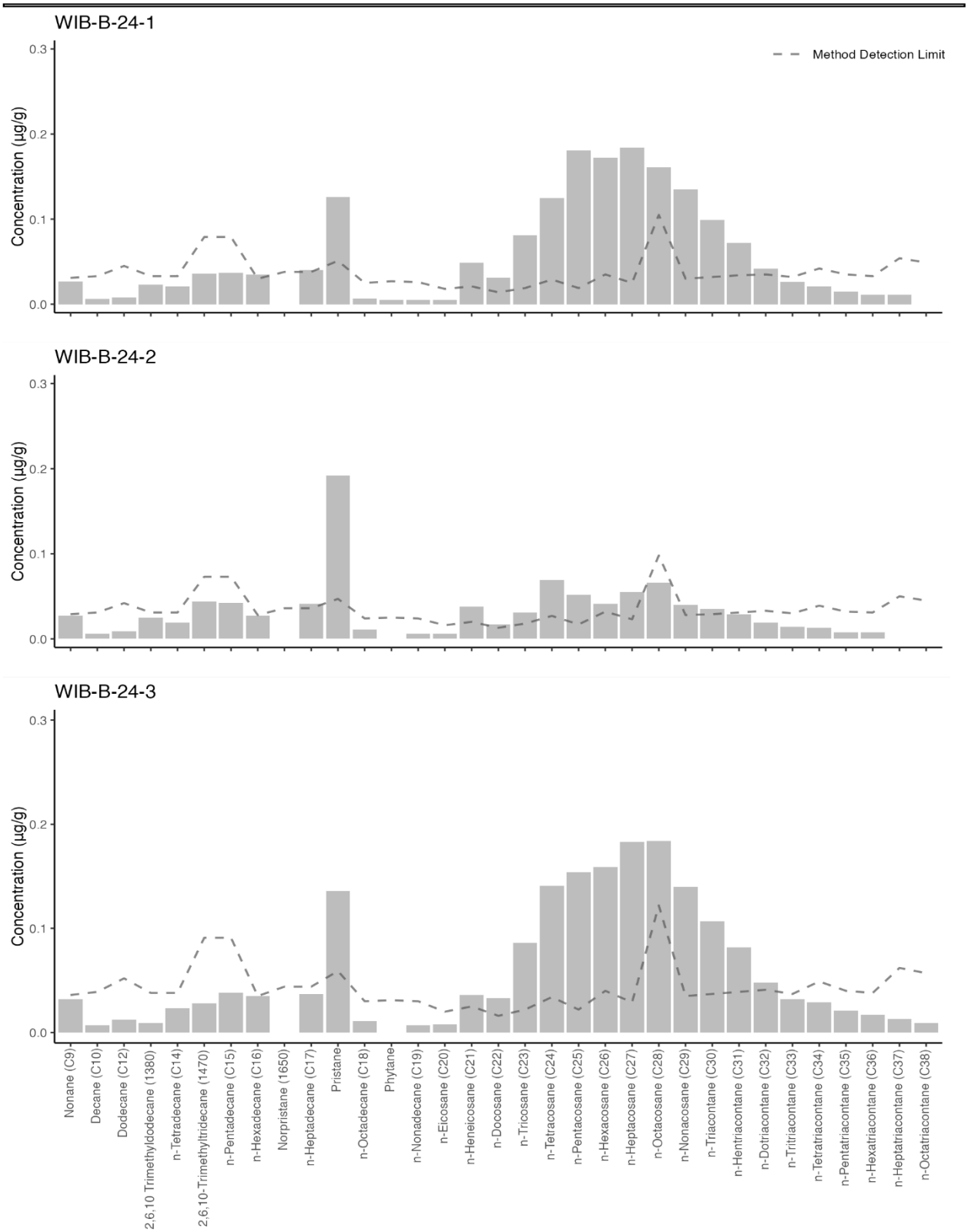

Figure 20. 2024 saturated hydrocarbon profiles from individual tissue samples at the Windy Bay (WIB) site with the analyte-specific method detection limit superimposed as a dotted line.

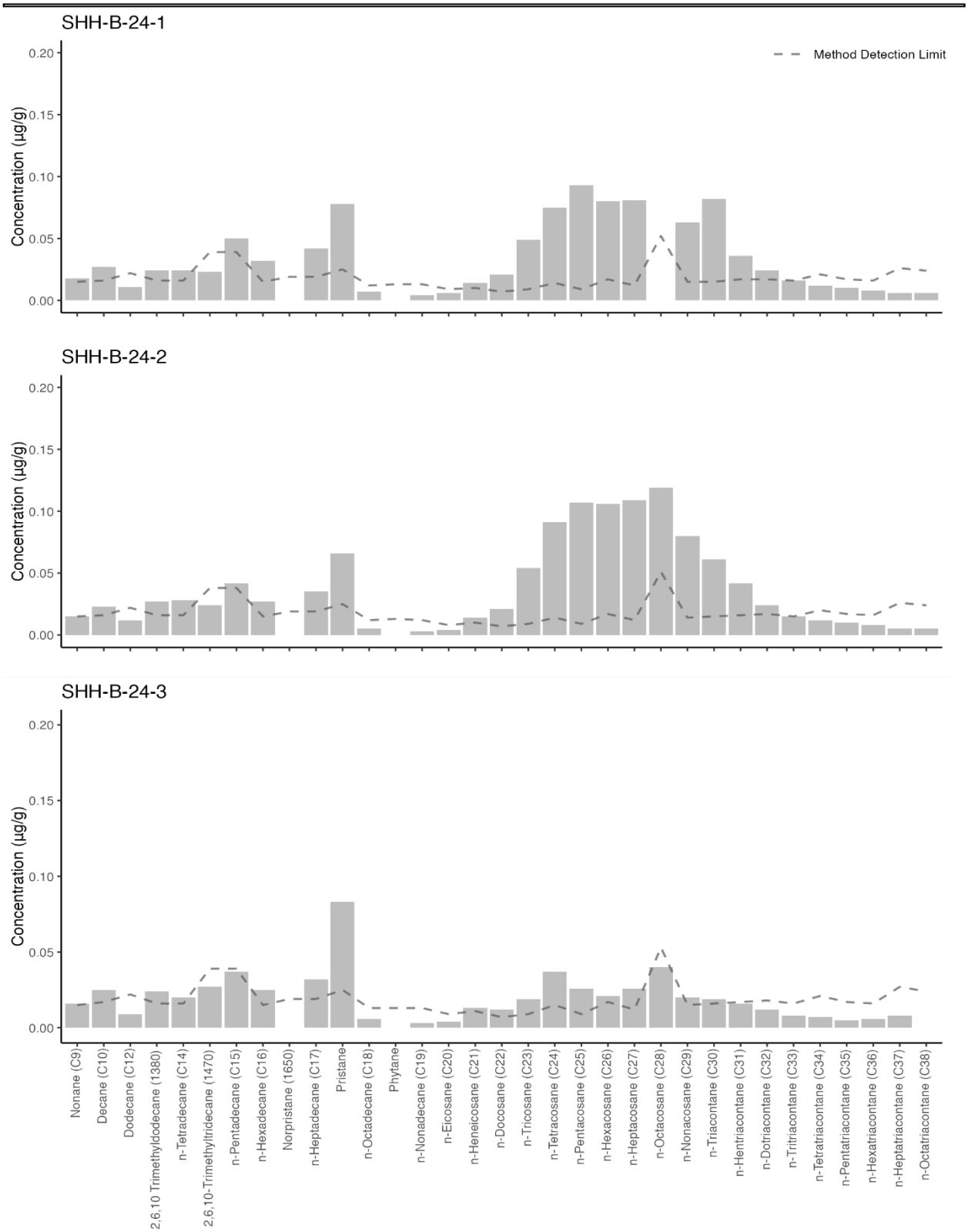

Figure 21. 2024 saturated hydrocarbon profiles from individual tissue samples at the Shuyak harbor (SHH) site with the analyte-specific method detection limit superimposed as a dotted line.

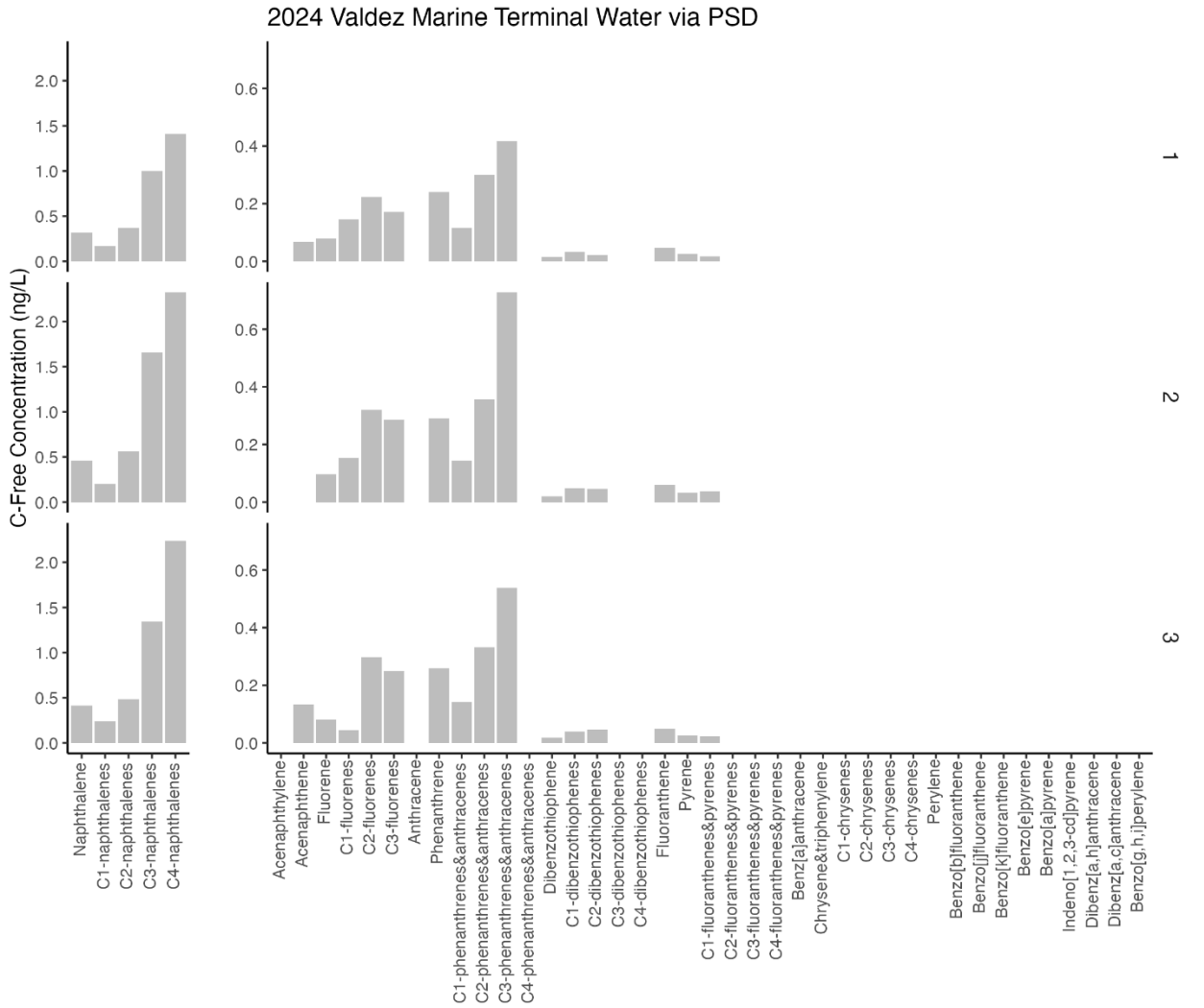

Figure 22. PAH profiles in seawater sampled via passive sampling devices placed at Valdez Marine Terminal in 2024. Values represent the reported values for the three replicates stacked vertically. Note the changes in scale between the Naphthalenes on the left and the other PAHs.

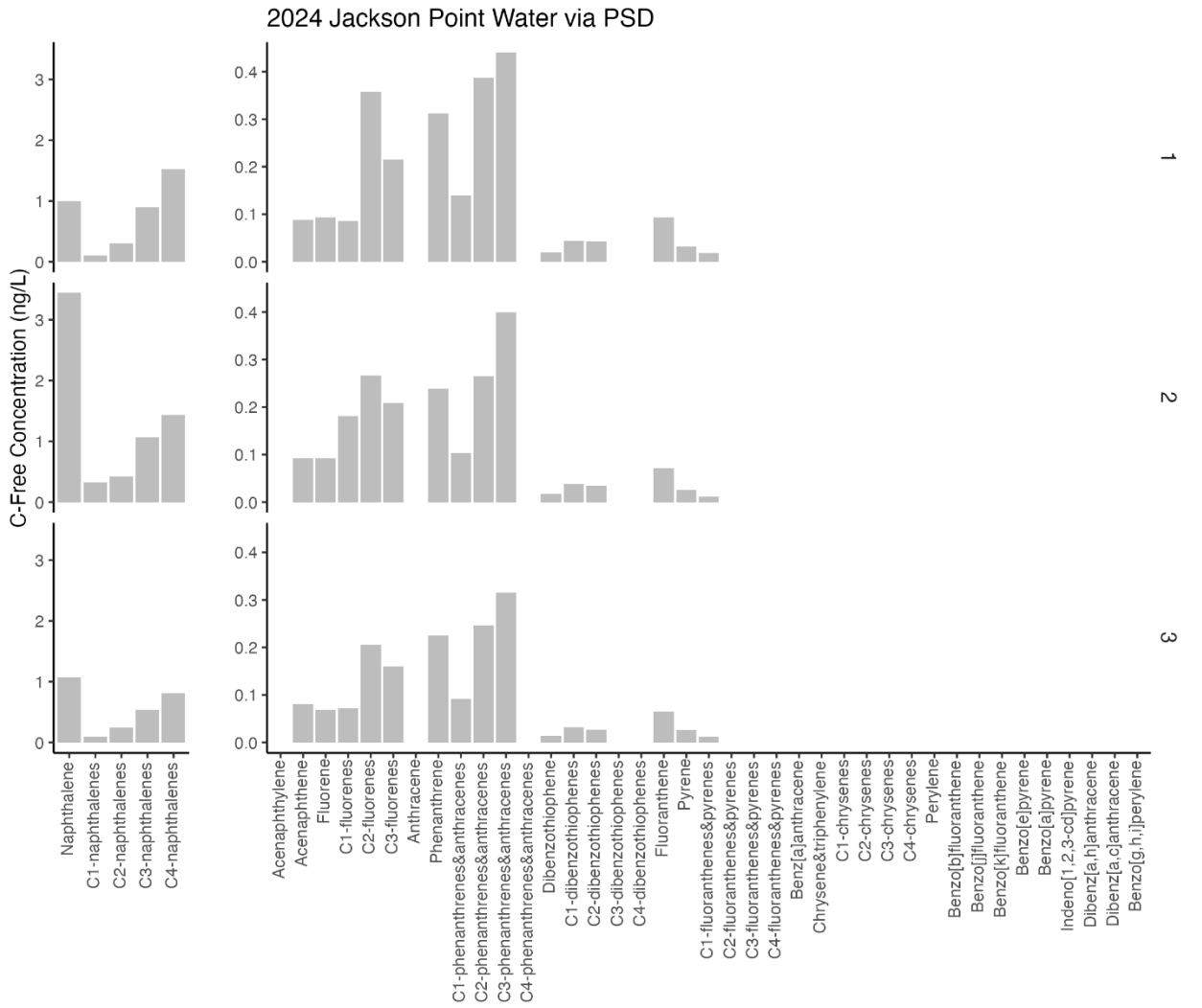

Figure 23. PAH profiles in seawater sampled via passive sampling devices placed at Jackson Point in 2024. Values represent the reported values for the three replicates stacked vertically. Note the changes in scale between the Naphthalenes on the left and the other PAHs.

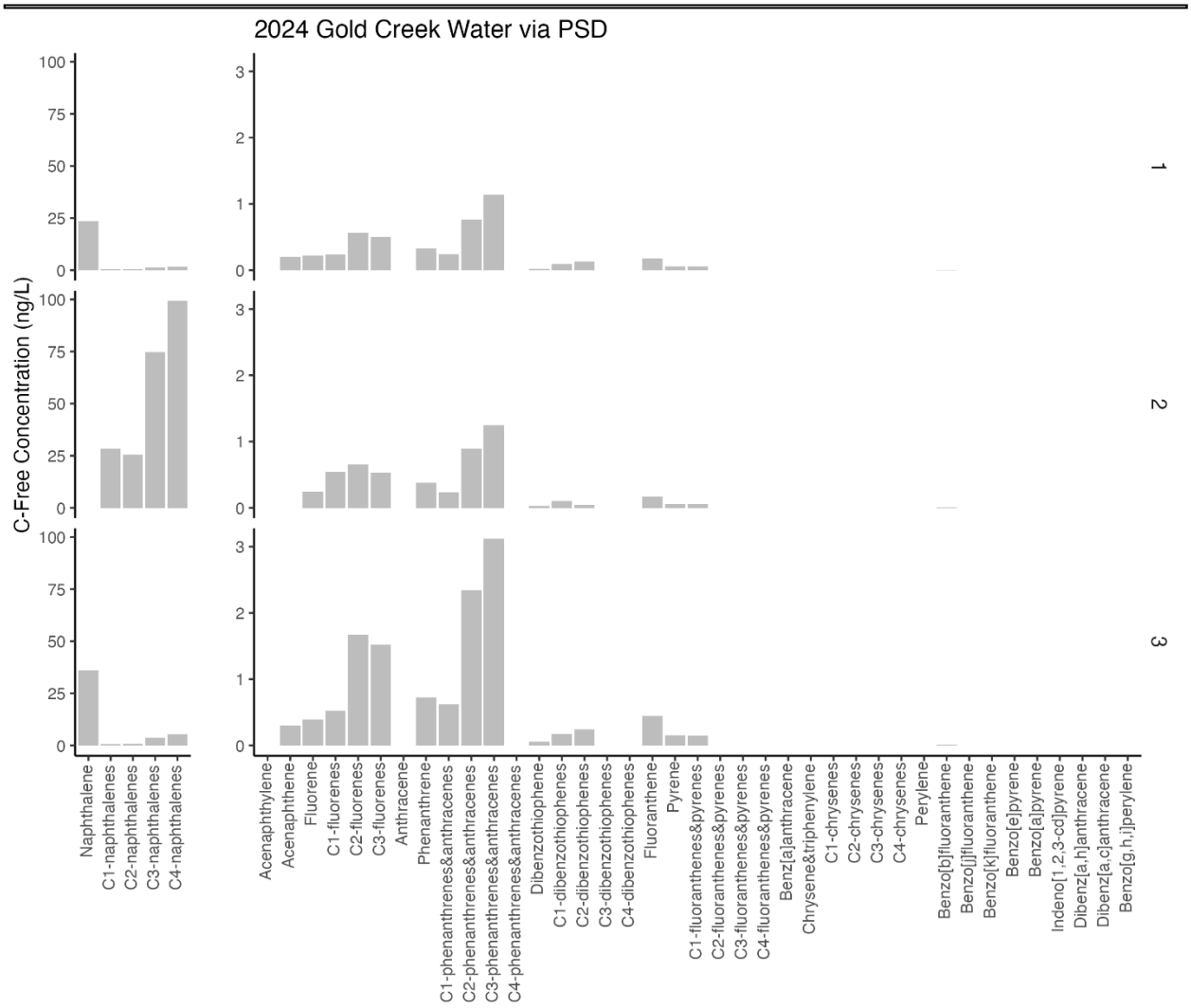

Figure 24. PAH profiles in seawater sampled via passive sampling devices placed at Gold Creek in 2024. Values represent the reported values for the three replicates stacked vertically. Note the changes in scale between the Naphthalenes on the left and the other PAHs.