Final

Long-Term Environmental Monitoring Program

2022–2023 Technical Supplement

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Prince William Sound Regional Citizens' Advisory Council
3709 Spenard Road, Suite 100
Anchorage, Alaska 99503

PRINCE WILLIAM SOUND RCAC REGIONAL CITIZENS' ADVISORY COUNCIL

Prepared by:
Morgan L. Bender, Ph.D.
Owl Ridge Natural Resource Consultants, Inc.
4060 B Street, Suite 200
Anchorage, Alaska 99503
T: 907.344.3448
www.owlridgenrc.com

OWL RIDGE NATURAL RESOURCE CONSULTANTS

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ACRONYMS AND ABBREVIATIONS

°C	Degrees Celsius
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
m	Meter
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
SHC	Saturated Hydrocarbons
SIM	Specific Ion Monitoring
SLB	Sleepy Bay
SOP	Standard Operating Procedure
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, and passive samples collected in the 2022 campaign in Port Valdez and the 2023 campaign in Port Valdez and greater Prince William Sound. This document should function as an aid to the assertions made in the 2023 Long-Term Environmental Monitoring Program Summary Report (Owl Ridge 2023).

1. METHODS

1.1. Field Methods

1.1.1. Sediments and Mussel Tissue

In 2022, sediment sampling at Valdez Marine Terminal (Alyeska Marine Terminal (AMT)) took place on June 3 and at Gold Creek (GOC) on June 1 (Table 1, Figure 1). In 2023, sample dates were June 3 and 4 for GOC and AMT, respectively. 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 a small research vessel. For each replicate, a ~ 250 milliliters (mL) sample of the surface 1–5 mL was collected at each site, placed in a hydrocarbon-free jar, and frozen for hydrocarbons and total organic carbon analysis. Samples were sent frozen to the lab for analysis.

The 2022 Pacific blue mussel sampling was performed at GOC, Jackson Point (JAC), and Saw Island (SAW) on June 1 and at the Valdez Small Boat Harbor – RED (RED) on June 3. In 2023, mussels were collected from Port Valdez station on June 3, RED on June 5, Disk Island and Knowles Head on June 6, and Sleepy Bay, Sheep Bay, and Zaikof Bay (2 sites) on June 7. 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. Dissections were performed by the analytical lab as a whole mussel including all internal organs.

1.1.2. Passive Sampling Devices

In 2022, the Passive Sampler Devices (PSDs) were retrieved June 1 at sites GOC, JAC, and SAW. In 2023, PSDs were deployed May 6 and retrieved June 3. The PSDs used are a low density polyethylene membrane submerged in shallow water to absorb passing hydrocarbons. The PSD is intended to only sample 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 prior to deployment. 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 and were transferred to hydrocarbon-free Teflon bags, sealed, and stored at room temperature following LTEMP field protocols (2019 LTEMP PSD SOP). A deployment field blank and a retrieval field blank was included in each annual analysis. Samples were sent to the Oregon State University 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 hydrocarbons analytes at Alpha Analytical (previously NewFields 2022) lab in Mansfield, Massachusetts. Extractions used the ALPHA OP-018 method for tissues and ALPHA OP-013 method for sediments. The usual hydrocarbon data reported polycyclic aromatic hydrocarbons (PAH), sterane/triterpene biomarkers, and saturated hydrocarbons (SHC). Semi-volatile compounds, the PAH, alkylated PAH, and petroleum biomarkers, 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 homologues, 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 biomarkers analytes are presented in Table 2, Table 3, and Table 4.

Using a modified EPA Method 8015B, SHC in sediments are quantified as total extractable materials (C_9-C_{44}), and as concentrations of n-alkanes (C_9-C_{40}) and selected (C_{15}-C_{20}) acyclic isoprenoids (e.g., pristane and phytane). A high-resolution gas chromatography-flame ionization detector (GC/FID) fingerprint of the sediment and tissue samples is also provided. Petroleum samples were diluted but not extracted. At the lab's discretion, extracts may be fractionated (F1) to improve the discrimination of biomarkers.

Surrogates are novel or deuterated compounds added in known amounts to each raw sample to assess, by their final percent recovery, the efficiency of extraction and analysis. 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 MDLs for hydrocarbons exceed the performance of most commercial labs, falling within the accepted stricter concentrations for forensic purposes. Duplicates sediment and tissue samples were run for method quality control and to assess precision.

1.2.2. 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. Briefly, 62 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 prior to analyses. Calculation of freely dissolved water concentration of organic compounds was done following the lab specific standard operating procedure (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 93% of the target analytes being 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 accuracy an over-spike analysis was performed where the sample was spiked with target compounds post extraction. The average percent recovery was 85%, meeting FSES DQO's. To demonstrate instrument precision, a duplicate analysis was performed. The average relative percent difference was 3.1%, meeting FSES DQO's. Field blanks are presented in pg/μL extract as time calculated C-free concentrations are not applicable.

1.3. Data Analysis

Data analysis and data management was done using the R statistical program (R Core Team 2021). Briefly, data were reformatted to allow for individual locations and analytes to be accessed. For summary purposes all data with concentrations reported as "non-detect" by Alpha Analytics were removed though 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 for matrix interference. For Sediment analysis, samples with negative detection and matrix interference were plotted for forensic determination. Only a select group of commonly used analytes were plotted to ease interpretation at the author's discretion and ordered using previously used LTEMP standards when possible. Method detection concentrations were plotted for sediment and tissue samples. 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 allow for historical data comparison (Auke Bay Lab, NewFields / Alpha Analytical, and GERG).

Passive sampling device data were extracted and merged into a single dataset. A group of PAHs aimed at forensic determinations was used to gather toxicological information and Oregon State University (OSU)-produced ratios were plotted for potential source determination. Common lab flags were "B" for background corrected and applied broadly to Naphthalene and Fluorene and "J" which is close to the detection level and therefore estimated.

1.4. Source Identification, Petroleum Fingerprinting, and Biomarker Analysis

Source identification through petroleum fingerprinting and biomarker analysis was performed using the following sources: Alaska North Slope (ANS) whole crude oil run as laboratory standard with 2022 and 2023 samples, filtered (0.7 μm glass fiber filter) Ballast Water Treatment Facility (BWTF) effluent collected in March 2017, oil/water sample collected from the April 2020 spill at the terminal (HOT), 2016 terminal spill (Barge), a weathered diesel spill in Port Chalmers from 2006 and a crude oil sample from Cook Inlet. The first three respective sources are displayed for each replicate sediment sample to avoid a single snapshot in time of a potential ANS source. Two additional non-ANS sources were investigated to provide an outside reference including a Cook Inlet whole crude oil sample and a heavily weathered diesel fuel spill collected opportunistically from Port Chalmers, Prince William Sound, in 2006, but not displayed in figures. Profiles were scaled to C2-naphthobenzothiophenes for PAHs, n-heptacosane (C27) for saturated hydrocarbons, and T19-hopane for biomarkers when possible, to aid in interpretation. Profiles were visually evaluated for the best match between individual replicates and potential sources using expertise outlined in previous LTEMP reports (Payne and Driskell 2021; Wang et al. 2014; Stout and Wang 2016).

1.5. 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 methods are through summing a select group of PAHs. This includes 42, 16, and other specific PAHs, referred to as summed (∑) PAHs due to the variety of methods used. This metric is similar to the Total PAH metric used prior to 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 weight and lipid weight for mussel tissues to aid in cross study comparisons. Sediment values were compared to acute and chronic EPA sediment-quality benchmarks and tissue concentrations were compared against the most recently available published literature and concentration-of-concern guidelines, as appropriate. 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 biomarkers were not a focus of toxicological interpretations as they are not known to have specific modes of toxic action.

2. RESULTS

2.1. Sediments

2.1.1. Analytical Results and Source Identification

In the sediments, we detect hydrocarbons in all stations and replicates. Summed PAH levels between AMT and GOC alternate in ranking between 2022 and 2023 (Table 5; Figure 2). PAH profile patterns are largely petrogenic at AMT and some pyrogenic at GOC with some weathered/water washed petrogenic patterns at GOC. When overlaid with ANS related sources (i.e., ANS whole crude, BWTF filter effluent from spring 2017, and recovered oil/water from the April 2020 spill at AMT (HOT) there is good agreement between the PAH profiles (Figure 3 7). Elevated concentrations of higher molecular weight PAHs at both sites are indicative of combustion sources and could be related to exhaust, stormwater, or runoff (Figure 5–Figure 7). Sediments were moderately weathered with a near-complete loss of saturated hydrocarbons, except those present in terrestrial plants (i.e., C27, C29, C31, C33) at both sites in both years (Figure 8–Figure 10).

In the biomarkers, the ratio of T15-Norhopane and T19-Hopane indicates a crude oil source for AMT in both years (Table 9) but not GOC, which further supports the forensic differences found in the PAH pattern analysis (Figure 14–Figure 16).

2.1.2. A Note on Toxicity

The potential toxicity of hydrocarbons in the sediments was calculated using total organic matter conversions for 35 individual PAHs with EPA Sediment Benchmarks for Aquatic Life (Table 5; https://archive.epa.gov/emergency/bpspill/web/html/sediment-benchmarks.html#anthracenes).

Results show that no single PAH measured in AMT or GOC sites exceeded the chronic Potency Divisor, which represents the amount of an individual chemical (i.e., phenanthrene), by itself, that can cause an adverse effect. Correcting samples for total organic carbon content accounts for the difference in bioavailability between samples. These benchmarks are meant to be used for screening purposes only; they are not regulatory standards, site-specific cleanup levels, or remediation goals. These screening benchmarks are presented with the EPA data to help the public understand the condition of the environment as it relates to the oil spill. Additional research on PAH sediment levels from polluted and pristine areas are comparable to those found at AMT and GOC in 2022 and 2023 (see LTEMP Summary Report, Owl Ridge 2023).

2.2. Pacific Blue Mussel Tissues

Relatively few compounds were detected in the mussel tissue sampled from different locations in Port Valdez in 2022, and Port Valdez and Prince William Sound in 2023. The majority of the concentrations of PAHs, saturated hydrocarbons, and biomarkers were at or below the method level of detection (Table 6; Figure 20–Figure 25). PAH profiles, while sparse, do suggest a petrogenic source at JAC, SAW/AMT and GOC while mostly pyrogenic source at all other sites. High variability in PAH profiles and concentrations between duplicates from Knowles Head and Disk Island may require further investigation.

Biomarker ratios indicate more fresh pyrogenic sources in the Valdez Small Boat Harbor while greater biogenic sources are found at other stations (Table 6, Table 9; Figure 36, Figure 37).

Saturated hydrocarbons were similar in concentration across mussels from all sites (Table 9; Figure 38, Figure 39). GOC and JAC mussels had greater representation of larger C23-32 compounds, showing greater weathering of sources while the Valdez Small Boat Harbor, Sheep Bay, and Sleepy Bay had greater concentrations of lower molecular weight saturated hydrocarbons compared to the other sites indicating a less weathered and more recent source. Figures for laboratory blanks PAH, biomarkers, and SHC compounds show good laboratory quality control methods although higher PAH contaminant is found for 2023 samples compared to 2022 (Figure 40, Figure 41).

2.3. Water via Passive Sampling Device

Many compounds in the 2022 and 2023 passive sampling devices were not detected (Table 7, Table 8). However, naphthalene and alkylated naphthalenes were detected at all four sites in all years. Non-naphthalene PAH levels in 2022 Port Valdez stations were low (<0.1 ng/L) and in line with 2021 concentrations, while 2023 non-naphthalene PAHs were an order of magnitude higher especially at

Disk Island and Jackson Point (6–8 ng/L) (Figure 42–Figure 50). PAH patterns were generally water washed petrogenic and did not contain many higher molecular weight compounds. Laboratory calculated ratios developed for passive sampler forensics show petrogenic signal for all 2022 sites (P0/A0 > 30) (Stogiannidis and Laane 2015). No ratio was calculated for 2023 results, but PAH profiles indicate petrogenic sources for 2023 samples.

3. REFERENCES

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TABLES

Table 1. Long-Term Monitoring Program sites sampled in 2022 and 2023 for subtidal marine sediments, Pacific blue mussels and deployment/retrival of the passive sampling devices.

2022	2023	Site	Latitude	Longitude	Datum	Matrix
X	X	AMT-S	61.09056	-146.3928	WGS84	Sediment
X	X	GOC-S	61.12417	-146.4906	WGS84	Sediment
X	X	RED	61.123719	-146.35315	WGS84	Pacific Blue Mussel Tissue
X	X	JAC-B	61.090051	-146.375706	WGS84	Pacific Blue Mussel Tissue
X	X	GOC-B	61.1243682	-146.4961415	WGS84	Pacific Blue Mussel Tissue
X	X	GOC-PSD	61.1242561	-146.4946931	WGS84	Passive Sampler Device
X	X	SAW-B	61.0903062	-146.4091853	WGS84	Pacific Blue Mussel Tissue
X	X	JAC-PSD	61.0906991	-146.3757111	WGS84	Passive Sampler Device
X	X	SAW-PSD	61.0913844	-146.4091726	WGS84	Passive Sampler Device
	X	DII-B	60.49861	-147.6586	WGS84	Pacific Blue Mussel Tissue
	X	DII-PSD	60.49886	-147.66	WGS84	Passive Sampler Device
	X	SHP-B	60.64722	-145.995	WGS84	Pacific Blue Mussel Tissue
	X	SLB-B	60.0675	-147.8319445	WGS84	Pacific Blue Mussel Tissue
	X	KNH-B	60.69055	-146.5833	WGS84	Pacific Blue Mussel Tissue
	X	ZAB-B	60.26583	-147.08445	WGS84	Pacific Blue Mussel Tissue
	X	ZAB2-B	60.298926	-147.00218	WGS84	Pacific Blue Mussel Tissue

Table 2. Analytes reported for 2022 and 2023 sediments and mussel tissue samples.

Saturated Hydrocarbons	
Nonane (C9)	
Decane (C10)	
Undecane	
Dodecane (C12)	
Tridecane	
2,6,10 Trimethyldodecane (1380)	
n-Tetradecane (C14)	
2,6,10-Trimethyltridecane (1470)	
n-Pentadecane (C15)	
n-Hexadecane (C16)	
Norpristane (1650)	
n-Heptadecane (C17)	
Pristane	
n-Octadecane (C18)	
Phytane	
n-Nonadecane (C19)	
n-Eicosane (C20)	
n-Heneicosane (C21)	
n-Docosane (C22)	
n-Tricosane (C23)	
n-Tetracosane (C24)	
n-Pentacosane (C25)	
n-Hexacosane (C26)	
n-Heptacosane (C27)	
n-Octacosane (C28)	
n-Nonacosane (C29)	
n-Triacontane (C30)	
n-Hentriacontane (C31)	
n-Dotriacontane (C32)	
n-Tritriacontane (C33)	
n-Tetratriacontane (C34)	
n-Pentatriacontane (C35)	
n-Hexatriacontane (C36)	
n-Heptatriacontane (C37)	
n-Octatriacontane (C38)	
n-Nonatriacontane (C39)	
n-Tetracontane (C40)	
Total Petroleum Hydrocarbons (C9-C44)	Laboratory Calculation
Total Saturated Hydrocarbons	Laboratory Calculation
o-terphenyl	Surrogate
d50-Tetracosane	Surrogate

Table 2. Analytes reported for 2022 and 2023 sediments and mussel tissue samples.

PAHs

cis/trans-Decalin
C1-Decalins
C2-Decalins
C3-Decalins
C4-Decalins
Naphthalene
C1-Naphthalenes
C2-Naphthalenes
C3-Naphthalenes
C4-Naphthalenes
Benzothiophene
C1-Benzo(b)thiophenes
C2-Benzo(b)thiophenes
C3-Benzo(b)thiophenes
C4-Benzo(b)thiophenes
Biphenyl
Dibenzofuran
Acenaphthylene
Acenaphthene
Fluorene
C1-Fluorenes
C2-Fluorenes
C3-Fluorenes
Dibenzothiophene
C1-Dibenzothiophenes
C2-Dibenzothiophenes
C3-Dibenzothiophenes
C4-Dibenzothiophenes
Phenanthrene
C1-Phenanthrenes/Anthracenes
C2-Phenanthrenes/Anthracenes
C3-Phenanthrenes/Anthracenes
C4-Phenanthrenes/Anthracenes
Retene
Anthracene
Carbazole
Fluoranthene
Benzo[b]fluorene
Pyrene
C1-Fluoranthenes/Pyrenes
C2-Fluoranthenes/Pyrenes
C3-Fluoranthenes/Pyrenes
C4-Fluoranthenes/Pyrenes
Naphthobenzothiophenes
C1-Naphthobenzothiophenes
C2-Naphthobenzothiophenes
C3-Naphthobenzothiophenes
C4-Naphthobenzothiophenes
Benz[a]anthracene
Chrysene/Triphenylene
C1-Chrysenes
C2-Chrysenes
C3-Chrysenes
C4-Chrysenes
Benzo[b]fluoranthene
Benzo[j]fluoranthene/Benzo[k]fluoranthene
Benzo[a]fluoranthene
Benzo[e]pyrene
Benzo[a]pyrene
Perylene
Indeno[1,2,3-cd]pyrene
Dibenz[a,h]anthracene/Dibenz[a,c]anthracene
Benzo[g,h,i]perylene
2-Methylnaphthalene
1-Methylnaphthalene
2,6-Dimethylnaphthalene
2,3,5-Trimethylnaphthalene
4-Methyldibenzothiophene(4MDT)
2/3-Methyldibenzothiophene(2MDT)
1-Methyldibenzothiophene(1MDT)
3-Methylphenanthrene
2-Methylphenanthrene (2MP)
2-Methylanthracene (2MA)
9/4-Methylphenanthrene (9MP)
1-Methylphenanthrene

Surrogates

Naphthalene-d8
Phenanthrene-d10
Benzo(a)pyrene-d12
5B(H)Cholane

Table 2. Analytes reported for 2022 and 2023 sediments and mussel tissue samples.

Geochemical Petroleum Biomarkers

Hopane (T19)
C23 Tricyclic Terpane (T4)
C24 Tricyclic Terpane (T5)
C25 Tricyclic Terpane (T6)
C24 Tetracyclic Terpane (T6a)
C26 Tricyclic Terpane-22S (T6b)
C26 Tricyclic Terpane-22R (T6c)
C28 Tricyclic Terpane-22S (T7)
C28 Tricyclic Terpane-22R (T8)
C29 Tricyclic Terpane-22S (T9)
C29 Tricyclic Terpane-22R (T10)
18a-22,29,30-Trisnorneohopane-TS (T11)
C30 Tricyclic Terpane-22S
C30 Tricyclic Terpane-22R
17a(H)-22,29,30-Trisnorhopane-TM
17a/b,21b/a 28,30-Bisnorhopane (T14a)
17a(H),21b(H)-25-Norhopane (T14b)
30-Norhopane (T15)
18a(H)-30-Norneohopane-C29Ts (T16)
17a(H)-Diahopane (X)
30-Normoretane (T17)
18a(H)&18b(H)-Oleananes (T18)
Moretane (T20)
30-Homohopane-22S (T21)
30-Homohopane-22R (T22)
Gammacerane/C32-Diahopane
30,31-Bishomohopane-22S (T26)
30,31-Bishomohopane-22R (T27)
30,31-Trishomohopane-22S (T30)
30,31-Trishomohopane-22R (T31)
Tetrakishomohopane-22S (T32)
Tetrakishomohopane-22R (T33)
Pentakishomohopane-22S (T34)
Pentakishomohopane-22R (T35)
13b(H),17a(H)-20S-Diacholestane (S4)
13b(H),17a(H)-20R-Diacholestane (S5)
13b,17a-20S-Methyldiacholestane (S8)
14b(H),17b(H)-20R-Cholestane (S14)
14b(H),17b(H)-20S-Cholestane (S15)
17a(H)20SC27/C29dia
17a(H)20rc27/C29dia
Unknown Sterane (S18)
13a,17b-20S-Ethyldiacholestane (S19)
14a,17a-20S-Methylcholestane (S20)
14a,17a-20R-Methylcholestane (S24)
14a(H),17a(H)-20S-Ethylcholestane (S25)
14a(H),17a(H)-20R-Ethylcholestane (S28)
14b,17b-20R-Methylcholestane (S22)
14b,17b-20S-Methylcholestane (S23)
14b(H),17b(H)-20R-Ethylcholestane (S26)
14b(H),17b(H)-20S-Ethylcholestane (S27)
C20 Pregnane
C21 20-Methylpregnane
C22 20-Ethylpregnane (a)
C22 20-Ethylpregnane (b)
C26,20S TAS
C26,20R+C27,20S TAS
C28,20S TAS
C27,20R TAS
C28,20R TAS
C29,20S TAS
C29,20R TAS
5b(H)-C27 (20S) MAS+
5b(H)-C27 (20R) MAS+
5a(H)-C27 (20S) MAS
5b(H)-C28 (20S) MAS+
5a(H)-C27 (20R) MAS
5a(H)-C28 (20S) MAS
5b(H)-C28 (20R) MAS+
5b(H)-C29 (20S) MAS+
5a(H)-C29 (20S) MAS
5a(H)-C28 (20R) MAS
5b(H)-C29 (20R) MAS+
5a(H)-C29 (20R) MAS

Surrogates

Naphthalene-d8
Phenanthrene-d10
Benzo[a]pyrene-d12
5B(H)Cholane

Other

Total Organic Carbon (Rep1)
Total Organic Carbon (Rep2)
Total Organic Carbon (Average)
Percent Lipids
Moisture

Table 3. 2022 Analytes quantified in water samples via passive sampling device.

#	Analytes	#	Analytes
1	1,2-dimethylnaphthalene	48	Dibenzo[e,l]pyrene
2	1,4-dimethylnaphthalene	49	Dibenzothiophene
3	1,5-dimethylnaphthalene	50	Fluoranthene
4	1,6and1,3-Dimethylnaphthalene	51	Fluorene
5	1,8-dimethylnaphthalene	52	Indeno[1,2,3-cd]pyrene
6	1-methylnaphthalene	53	Naphthalene
7	1-methylphenanthrene	54	Naphtho[1,2-b]fluoranthene
8	1-methylpyrene	55	Naphtho[2,3-a]pyrene
9	2,3-dimethylanthracene	56	Naphtho[2,3-b]fluoranthene
10	2,6-diethylnaphthalene	57	Naphtho[2,3-e]pyrene
11	2,6-dimethylnaphthalene	58	Naphtho[2,3-j]andNaphtho[1,2-k]fluoranthene
12	2-ethylnaphthalene	59	Naphtho[2,3-k]fluoranthene
13	2-methylanthracene	60	Perylene
14	2-methylnaphthalene	61	Phenanthrene
15	2-methylphenanthrene	62	Pyrene
16	3,6-dimethylphenanthrene	63	Retene
17	5-methylchrysene	64	Triphenylene
18	6-methylchrysene	65	A0/PA0
19	7,12-dimethylbenz[a]anthracene	66	BaA/228
20	9,10-dimethylanthracene	67	BaA/Ch0
21	9-methylanthracene	68	C1-benz[a]anthracenes&chrysenes&triphenylenes
22	Acenaphthene	69	C1-dibenzothiophenes
23	Acenaphthylene	70	C1-fluoranthenes&pyrenes
24	Anthanthrene	71	C1-fluorenes
25	Anthracene	72	C1-naphthalenes
26	Benz[a]anthracene	73	C1-phenanthrenes&anthracenes
27	Benz[j]and[e]aceanthrylene	74	C2-benz[a]anthracenes&chrysenes&triphenylenes
28	Benzo[a]chrysene	75	C2-dibenzothiophenes
29	Benzo[a]fluorene	76	C2-fluoranthenes&pyrenes
30	Benzo[a]pyrene	77	C2-fluorenes
31	Benzo[b]fluoranthene	78	C2-naphthalenes
32	Benzo[b]fluorene	79	C2-phenanthrenes&C2-anthracenes
33	Benzo[b]perylene	80	C3-dibenzothiophenes
34	Benzo[c]fluorene	81	C3-fluorenes
35	Benzo[e]pyrene	82	C3-naphthalenes
36	Benzo[ghi]perylene	83	C3-phenanthrenes&anthracenes
37	Benzo[j]fluoranthene	84	C4-naphthalenes
38	Benzo[k]fluoranthene	85	C4-phenanthrenes&C4-anthracenes
39	Chrysene	86	FL0/FLPY
40	Coronene	87	FL0/PY0
41	Cyclopenta[cd]pyrene	88	FLP1/FLPY0
42	Dibenzo[a,e]fluoranthene	89	FLP1/PY0
43	Dibenzo[a,e]pyrene	90	FLPY/(P2+P3+P4)
44	Dibenzo[a,h]anthracene	91	FLPY0/FLPY01
45	Dibenzo[a,h]pyrene	92	P0/A0
46	Dibenzo[a,i]pyrene	93	PA0/PA01
47	Dibenzo[a,l]pyrene	94	PA1/PA0

Table 4. 2023 Analytes quantified in water samples via passive sampling device.

#	Analyte	#	Analyte
1	1,2-dimethylnaphthalene	48	Dibenzo[e,l]pyrene
2	1,4-dimethylnaphthalene	49	Dibenzothiophene
3	1,5-dimethylnaphthalene	50	Fluoranthene
4	1,6and1,3-Dimethylnaphthalene	51	Fluorene
5	1,8-dimethylnaphthalene	52	Indeno[1,2,3-cd]pyrene
6	1-methylnaphthalene	53	Naphthalene
7	1-methylphenanthrene	54	Naphtho[1,2-b]fluoranthene
8	1-methylpyrene	55	Naphtho[2,3-a]pyrene
9	2,3-dimethylanthracene	56	Naphtho[2,3-b]fluoranthene
10	2,6-diethylnaphthalene	57	Naphtho[2,3-e]pyrene
11	2,6-dimethylnaphthalene	58	Naphtho[2,3-j]andNaphtho[1,2-k]fluoranthene
12	2-ethylnaphthalene	59	Naphtho[2,3-k]fluoranthene
13	2-methylanthracene	60	Perylene
14	2-methylnaphthalene	61	Phenanthrene
15	2-methylphenanthrene	62	Pyrene
16	3,6-dimethylphenanthrene	63	Retene
17	5-methylchrysene	64	Triphenylene
18	6-methylchrysene	65	C1-benz[a]anthracenes&chrysenes&triphenylenes
19	7,12-dimethylbenz[a]anthracene	66	C1-dibenzothiophenes
20	9,10-dimethylanthracene	67	C1-fluoranthenes&pyrenes
21	9-methylanthracene	68	C1-fluorenes
22	Acenaphthene	69	C1-naphthalenes
23	Acenaphthylene	70	C1-phenanthrenes&anthracenes
24	Anthanthrene	71	C2-benz[a]anthracenes&chrysenes&triphenylenes
25	Anthracene	72	C2-dibenzothiophenes
26	Benz[a]anthracene	73	C2-fluoranthenes&pyrenes
27	Benz[j]and[e]aceanthrylene	74	C2-fluorenes
28	Benzo[a]chrysene	75	C2-naphthalenes
29	Benzo[a]fluorene	76	C2-phenanthrenes&C2-anthracenes
30	Benzo[a]pyrene	77	C3-benz[a]anthracenes&chrysenes&triphenylenes
31	Benzo[b]fluoranthene	78	C3-dibenzothiophenes
32	Benzo[b]fluorene	79	C3-fluorenes
33	Benzo[b]perylene	80	C3-naphthalenes
34	Benzo[c]fluorene	81	C3-phenanthrenes&anthracenes
35	Benzo[e]pyrene	82	C4-benz[a]anthracenes&chrysenes&triphenylenes
36	Benzo[ghi]perylene	83	C4-dibenzothiophenes
37	Benzo[j]fluoranthene	84	C4-fluorenes
38	Benzo[k]fluoranthene	85	C4-naphthalenes
39	Chrysene	86	C4-phenanthrenes&C4-anthracenes
40	Coronene		
41	Cyclopenta[cd]pyrene		
42	Dibenzo[a,e]fluoranthene		
43	Dibenzo[a,e]pyrene		
44	Dibenzo[a,h]anthracene		
45	Dibenzo[a,h]pyrene		
46	Dibenzo[a,i]pyrene		
47	Dibenzo[a,l]pyrene		

Table 5. 2022 and 2023 Sediment PAH loads and toxicity comparisons.

	2022 Sediment Samples									2023 Sediment Samples						Acute Toxicity Threshold (ng/g)*	Chronic Toxicity Threshold (ng/g)*
Analyte (ng/g dry weight)	GOC-S-22-1	GOC-S-22-2	GOC-S-22-3	GOC-SAND-22	AMT-S-22-1	AMT-S-22-2	AMT-S-22-3	AMT-SAND-22	GOC-S-22-1-DUP	GOC-S-23-1	GOC-S-23-2	GOC-S-23-3	AMT-S-23-1	AMT-S-23-2	AMT-S-23-3		
Naphthalene	1.77	2.5	2.87	0.319	2.69	1.96	2.57	0.249	2.05	1.46	1.31	1.24	2.34	1.92	2.12	1600000	385000
C1-Naphthalenes	1.46	1.79	2.02	0.242	2.38	1.89	2.55	0.304	1.65	1.26	0.893	0.878	2	2.14	2.02	1850000	444000
C2-Naphthalenes	2.3	2.94	3.12	0.841	4.44	3.25	4.14	0.836	2.58	2.42	2	1.69	4.11	3.38	3.75	2120000	510000
C3-Naphthalenes	1.97	2.72	2.83	0.841	3.71	2.95	3.9	0.836	1.92	2.3	1.75	1.38	3.92	3.76	3.74	2420000	581000
C4-Naphthalenes	1.56	2.25	1.85	0.841	3.12	2.37	2.91	0.836	1.54	1.42	0.996	1.34	1.35	2.42	2.17	2730000	657000
Acenaphthylene	0.257	0.278	0.332	0.841	0.196	0.214	0.381	0.836	0.587	1.71	0.719	0.739	1.1	1.31	1.09	1880000	452000
Acenaphthene	0.569	0.714	0.663	0.841	0.517	0.559	1.26	0.836	0.724	0.636	0.586	0.519	0.785	0.629	0.624	2040000	491000
Fluorene	1.22	1.56	1.61	0.084	1.48	1.27	1.97	0.093	1.13	0.728	0.738	0.669	1.05	1.16	1.27	2240000	538000
C1-Fluorenes	1.38	2.04	2.36	0.841	2.75	2.12	2.68	0.836	1.43	1.22	1.01	0.955	1.91	1.9	2.12	2540000	611000
C2-Fluorenes	1.95	2.47	2.27	0.841	3.42	2.59	2.91	0.836	1.98	1.42	0.996	1.34	1.35	2.15	2.89	2850000	686000
C3-Fluorenes	1.56	1.13	1.11	0.841	5.43	5.35	10.8	0.836	1.54	1.42	0.996	1.34	1.35	1.23	5.91	3200000	769000
Dibenzothiophene	0.447	0.548	0.568	0.035	0.608	0.568	1.1	0.04	0.405	0.311	0.241	0.208	0.535	0.694	0.612	-	-
C1-Dibenzothiophenes	0.626	0.696	0.541	0.841	1.09	0.82	1.2	0.242	0.576	0.316	0.246	0.302	0.895	0.802	0.743	-	-
C2-Dibenzothiophenes	1.27	1.13	1.34	0.841	2.54	2.15	2.86	0.836	1.19	0.822	0.646	0.704	2.48	2.04	2.2	-	-
C3-Dibenzothiophenes	1.56	1.13	1.11	0.841	3.14	2.68	3.5	0.836	1.54	1.42	0.996	1.34	3.3	2.9	2.86	-	-
C4-Dibenzothiophenes	1.56	1.13	1.11	0.841	3.02	2.21	3.38	0.836	1.54	1.42	0.996	1.34	11.3	2.73	2.81	-	-
Phenanthrene	3.71	5.17	5.22	0.151	5.12	4.51	11.8	0.184	3.67	2.45	1.93	1.63	3.55	4.19	4.06	2480000	596000
C1-Phenanthrenes/Anthracenes	6.67	6.6	4.87	0.294	5.84	3.6	6.47	0.306	5.96	2.16	1.74	1.4	4.2	4.54	4.24	2790000	670000
C2-Phenanthrenes/Anthracenes	1.59	1.97	2.05	0.841	4.33	3.16	4.68	0.836	1.83	2.22	0.942	1.26	3.62	3.18	3.55	3100000	746000
C3-Phenanthrenes/Anthracenes	1.08	1.46	1.37	0.841	3.82	2.72	3.7	0.836	1.21	1.15	0.724	0.804	3.87	3.27	2.69	3450000	829000
C4-Phenanthrenes/Anthracenes	1.56	0.786	0.993	0.841	2.35	2.3	2.79	0.836	1.54	0.93	0.996	1.34	3.61	2.32	2.48	3790000	912000
Anthracene	0.618	0.666	0.678	0.841	0.594	0.681	1.78	0.836	0.525	0.781	0.405	0.359	0.934	1.48	1.28	2470000	594000
Fluoranthene	2.96	5.27	6.81	0.065	3.8	3.77	22.1	0.1	5.1	1.96	1.34	1.04	1.83	2.5	2.58	2940000	707000
Pyrene	1.81	3.34	4.25	0.053	2.81	2.68	9.67	0.071	4.71	1.81	1.14	0.885	1.78	2.84	2.82	2900000	697000
C1-Fluoranthenes/Pyrenes	1.91	2.43	2.79	0.841	3.2	2.85	4.78	0.836	3.08	2.68	1.18	1.22	3.52	3.57	3.11	3200000	770000
C2-Fluoranthenes/Pyrenes	1.32	1.92	1.83	0.841	3.32	3.12	5.77	0.836	1.99	1.35	0.932	0.731	2.14	2.54	2.58	-	-
C3-Fluoranthenes/Pyrenes	1.56	1.51	1.54	0.841	3.31	3.09	4.74	0.836	1.54	1.42	0.996	1.34	2.75	2.8	3.05	-	-
C4-Fluoranthenes/Pyrenes	1.56	1.13	1.11	0.841	4.26	3.84	5.31	0.836	1.54	1.42	0.996	1.34	2.89	3.48	3.71	-	-
Benz[a]anthracene	0.714	1.15	1.09	0.026	0.86	1.16	1.02	0.029	1.4	1.97	0.606	0.324	1.29	2.58	1.88	3500000	841000
Chrysene/Triphenylene	1.44	1.96	1.78	0.072	2.08	2.42	5.37	0.076	1.86	2.78	0.819	0.524	2.02	5.31	2.62	3510000	844000
C1-Chrysenes	0.657	1.17	0.944	0.841	2.1	1.83	2.42	0.836	1.19	1.54	0.719	0.663	2.35	2.92	2.9	3870000	929000
C2-Chrysenes	2.94	2.21	1.77	0.841	3.46	3.26	4.37	0.836	2.13	1.42	1.41	1.34	3.79	4.13	4.95	4200000	1010000
C3-Chrysenes	1.56	1.13	1.11	0.841	8.1	1.23	8.83	0.836	1.54	1.42	0.996	1.34	1.35	1.23	1.34	4620000	1110000
C4-Chrysenes	1.56	1.13	1.11	0.841	1.18	1.23	1.23	0.836	1.54	1.42	0.996	1.34	1.35	1.23	1.34	5030000	1210000
Benzo[b]fluoranthene	0.769	1.34	1.17	0.085	1.36	1.38	2.52	0.836	1.77	2.09	0.71	0.348	1.22	2.24	1.87	4070000	979000
Benzo[j]fluoranthene/Benzo[k]fluoranthene	0.609	1.1	0.859	0.841	0.775	1.06	1.15	0.836	1.44	2.12	0.521	0.313	1.11	2.11	1.64	4080000	981000
Benzo[e]pyrene	0.616	1.09	0.919	0.841	1.24	1.22	1.56	0.836	1.3	1.84	0.603	0.426	1.24	2.2	2.08	4020000	967000
Benzo[a]pyrene	0.432	0.934	0.719	0.841	0.822	1.19	0.689	0.836	1.48	1.94	0.67	0.348	1.17	2.3	1.8	4020000	965000
Indeno[1,2,3-cd]pyrene	0.448	0.545	0.426	0.841	0.59	0.63	0.548	0.836	0.872	1.96	0.455	0.312	1.16	2.35	1.85	4620000	1110000
Dibenz[a,h]anthracene/Dibenz[a,c]anthracene	0.261	0.18	0.15	0.841	0.126	0.222	0.172	0.836	0.256	1.14	0.2	0.11	0.468	1.23	0.878	4660000	1120000
Benzo[g,h,i]perylene	0.5	0.78	0.593	0.841	1.18	1.04	1.04	0.836	1.08	2	0.503	0.391	1.32	2.49	1.96	4540000	1090000

Table 5. 2022 and 2023 Sediment PAH loads and toxicity comparisons.

	2022 Sediment Samples									2023 Sediment Samples						Acute Toxicity Threshold (ng/g)*	Chronic Toxicity Threshold (ng/g)*
Analyte (ng/g dry weight)	GOC-S-22-1	GOC-S-22-2	GOC-S-22-3	GOC-SAND-22	AMT-S-22-1	AMT-S-22-2	AMT-S-22-3	AMT-SAND-22	GOC-S-22-1-DUP	GOC-S-23-1	GOC-S-23-2	GOC-S-23-3	AMT-S-23-1	AMT-S-23-2	AMT-S-23-3		
Total Organic Carbon (%)	0.459	0.629	0.601	NA	0.487	0.463	0.547	NA	0.491	0.509	0.56	0.452	0.626	0.52	0.596		
Ratio of Acute Benchmark to TOC	3.8E-05	3.6E-05	3.8E-05	-	6E-05	5.1E-05	8.4E-05	-	4.4E-05	3.6E-05	2E-05	2.3E-05	3.7E-05	5.2E-05	4.6E-05		
Risk for Acute Toxic Effects	Low	Low	Low	-	Low	Low	Low	-	Low	Low	Low	Low	Low	Low	Low		
Ratio of Chronic Benchmark to	0.00016	0.00015	0.00016	-	0.00025	0.00021	0.00035	-	0.00018	0.00015	8.3E-05	9.6E-05	0.00016	0.00022	0.00019		
Risk for Chronic Toxic Effects	Low	Low	Low	-	Low	Low	Low	-	Low	Low	Low	Low	Low	Low	Low		
Sum 42 PAHs	60.3	72.0	71.9	26.7	107.2	87.1	162.6	26.8	72.9	64.3	37.6	37.1	94.3	100.2	100.2		
Sum 16 PAHs	18.1	27.5	29.2	7.6	25.0	24.7	64.0	8.3	28.7	27.5	12.7	9.8	23.1	36.6	30.3		
Low Molecular weight PAH[1]	36.7	41.7	40.9	14.6	62.6	49.9	79.3	14.0	37.1	30.0	21.9	22.8	59.6	50.1	55.2		
High Molecular weight PAH[2]	23.6	30.3	31.0	12.1	44.6	37.2	83.3	12.8	35.8	34.3	15.8	14.3	34.7	50.1	45.0		
%LMW PAH	60.8	57.9	56.9	54.7	58.4	57.3	48.8	52.1	50.9	46.6	58.1	61.4	63.2	50.0	55.1		
%HMW PAH	39.2	42.1	43.1	45.3	41.6	42.7	51.2	47.9	49.1	53.4	41.9	38.6	36.8	50.0	44.9		
Sum of Carcinogenic PAHs [3]	4.7	7.2	6.2	3.5	6.6	8.1	11.5	4.3	9.1	14.0	4.0	2.3	8.4	18.1	12.5		

* EPA Sediment Toxicity Benchmarks : https://archive.epa.gov/emergency/Bpspill/web/html/sediment-Benchmarks.html
[1] Low Molecular Weight PAHs : naphthalenes - phenanthrenes (2-3-ring PAH)
[2] High Molecular weight PAHs: fluoranthene - Benzo (g,h,i)perylene (3-6 ring PAH)
[3] Carcinogenic PAHs: Benz[a]anthracene, Chrysene/Triphenylene, Benzo[b]fluoranthene, Benzo[j]fluoranthene/Benzo[k]fluoranthene, Benzo[a]pyrene, Indeno[1,2,3-cd]pyrene, Dibenz[a,h]anthracene/Dibenz[a,c]anthracene

Table 6. 2022 and 2023 tissue samples PAH summaries.

Sample	Sum 42 PAH (wet weight)	Sum 42 PAH (dry weight)	Sum 42 PAH (lipid weight)	Sum 16 PAH[1] (wet weight)	Sum 16 PAH (dry weight)	Sum low molecular weight PAH[2]	Sum high molecular weight PAH[3]	% low molecular weight PAH	% high molecular weight PAH	Sum of carcin-ogenic PAH4
JAC-B-22-1	9.60	55.15	278.95	7.45	42.83	5.71	3.89	59.51	40.49	1.60
JAC-B-22-2	5.72	46.90	301.16	4.59	37.61	3.73	1.99	65.24	34.76	0.46
JAC-B-22-3	5.05	34.60	237.14	4.43	30.34	3.75	1.30	74.26	25.74	0.40
SAW-B-22-1	7.01	57.01	381.09	3.88	31.54	5.93	1.09	84.53	15.47	0.29
SAW-B-22-2	4.75	32.95	227.03	4.16	28.89	3.46	1.28	72.96	27.04	0.39
SAW-B-22-3	5.99	44.70	290.78	3.81	28.44	4.95	1.04	82.67	17.33	0.25
GOC-B-22-1	7.05	45.20	284.31	5.74	36.78	4.80	2.26	68.00	32.00	0.53
GOC-B-22-2	6.38	45.92	320.75	5.23	37.61	4.22	2.16	66.11	33.89	0.55
GOC-B-22-3	8.78	65.54	513.57	5.08	37.87	6.77	2.02	77.06	22.94	0.58
RED-B-22-1	23.24	173.43	1408.48	7.77	57.97	18.28	4.97	78.64	21.36	0.50
RED-B-22-2	15.93	136.11	925.87	7.30	62.43	10.73	5.20	67.35	32.65	2.70
RED-B-22-3	18.38	159.83	1038.47	5.88	51.16	14.38	4.01	78.21	21.79	1.18
RED-B-22-2-DUP	16.33	120.05	850.36	7.33	53.90	11.02	5.31	67.48	32.52	2.72
JAC-B-23-1	6.30	-	-	4.91	-	4.25	2.04	67.56	32.44	0.69
JAC-B-23-2	6.30	42.58	263.68	5.01	33.85	4.75	1.56	75.33	24.67	0.40
JAC-B-23-3	6.04	35.30	183.50	4.56	26.69	4.03	2.01	66.74	33.26	0.59
AMT-B-23-1	6.15	39.69	232.15	4.60	29.70	4.80	1.35	78.01	21.99	0.27
AMT-B-23-2	6.03	35.45	171.71	4.32	25.44	5.03	1.00	83.47	16.53	0.23
AMT-B-23-3	5.90	34.10	174.56	4.57	26.40	4.41	1.49	74.71	25.29	0.33
GOC-B-23-1	7.42	43.65	234.84	5.61	33.02	5.66	1.76	76.32	23.68	0.54
GOC-B-23-2	7.59	43.59	226.42	5.92	34.05	5.58	2.00	73.61	26.39	0.55
GOC-B-23-3	10.44	56.42	278.35	6.11	33.04	8.48	1.96	81.26	18.74	0.55
DII-B-23-1	32.14	158.33	728.80	27.98	137.83	12.98	19.16	40.39	59.61	10.48
DII-B-23-2	3.43	17.31	-	2.40	12.12	2.80	0.63	81.56	18.44	0.15
DII-B-23-3	2.85	-	115.85	2.53	-	2.19	0.66	76.98	23.02	0.18
KNH-B-23-1	7.24	43.62	274.28	5.83	35.13	4.98	2.26	68.80	31.20	0.50
KNH-B-23-2	2.85	18.50	175.86	2.08	13.47	2.28	0.57	79.85	20.15	0.18
KNH-B-23-3	73.76	501.77	-	62.20	423.13	26.70	47.06	36.20	63.80	26.77
SLB-B-23-1	6.47	38.28	306.59	5.45	32.23	3.45	3.02	53.39	46.61	1.49
SLB-B-23-2	3.50	21.89	152.30	2.63	16.46	2.83	0.68	80.65	19.35	0.21
SLB-B-23-3	2.92	17.19	135.32	2.15	12.65	2.33	0.59	79.71	20.29	0.17
RED-B-23-1	17.54	110.30	759.18	7.01	44.08	12.05	5.49	68.71	31.29	0.43
RED-B-23-2	29.73	203.65	1327.37	13.98	95.73	20.36	9.37	68.48	31.52	4.27
RED-B-23-3	19.58	123.11	755.79	7.71	48.48	13.50	6.08	68.96	31.04	0.52
ZAB-B-23-1	4.04	23.22	171.23	2.85	16.35	3.34	0.70	82.68	17.32	0.17
ZAB-B-23-2	4.71	32.06	157.63	3.01	20.48	4.07	0.65	86.31	13.69	0.13
ZAB-B-23-3	12.63	66.85	473.18	9.58	50.70	7.35	5.28	58.21	41.79	4.34
ZAB2-B-23-1	5.79	40.47	208.17	4.37	30.57	4.07	1.72	70.30	29.70	0.59
ZAB2-B-23-2	5.47	36.25	316.36	5.09	33.69	3.20	2.28	58.41	41.59	1.14
ZAB2-B-23-3	7.92	48.61	257.24	6.06	37.17	5.31	2.61	67.07	32.93	1.06
SHB-B-23-1	3.84	22.60	199.07	2.56	15.06	3.12	0.72	81.18	18.82	0.15
SHB-B-23-2	3.78	22.76	119.56	2.57	15.48	3.38	0.40	89.33	10.67	0.00
SHB-B-23-3	5.24	29.76	256.76	3.40	19.33	4.27	0.97	81.56	18.44	0.21

[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 : naphthalenes - 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 7. 2022 Water PAH concentrations quantified via passive sampling device.

Analyte (ng/L C-Free)	GOC 01	GOC 02	GOC 03	SAW 01	SAW 02	SAW 03	JAC 01	JAC 02	JAC 03	Field Blk SAW	Field Blk JAC	Trip Blk Deploy	Trip Blk Retrieve
Naphthalene	1.12	1.41	1.15	-	-	-	-	-	-	7.1	7.3	-	7.2
C1-naphthalenes	-	-	-	-	-	-	-	-	-	22.9	29	-	17.5
C2-naphthalenes	2.57	3.42	3.67	4.57	3.61	4.13	3.38	3.84	4.22	16.6	21.4	-	9.41
C3-naphthalenes	11.9	15	17.4	18.4	20.2	16.9	14.9	21.2	19.7	-	-	-	-
C4-naphthalenes	23.6	24.1	34.9	21.9	18.7	25.7	20.9	32.6	34.1	-	-	-	-
Acenaphthylene	-	-	-	-	-	-	-	-	-	-	-	-	-
Acenaphthene	0.176	0.265	0.223	0.00489	0.0699	0.0409	0.0834	0.0851	0.0847	1.07	1.07	1.07	1.07
Fluorene	0.14	0.174	0.19	0.0891	0.0851	0.0939	0.082	0.119	0.134	1.55	0.81	-	-
C1-fluorenes	0.112	0.147	0.179	0.115	0.0925	0.148	0.0828	0.181	0.152	8.86	5.77	-	-
C2-fluorenes	0.452	0.0216	0.605	0.347	0.34	0.3	0.359	0.68	0.555	-	-	-	-
C3-fluorenes	0.638	0.664	0.706	0.522	0.426	0.491	0.443	0.764	0.776	-	-	-	-
Anthracene	0.00106	0.00125	0.00123	0.0134	0.0157	0.00209	0.00155	0.00208	0.00216	1.05	1.05	1.05	1.05
Phenanthrene	0.271	0.392	0.384	0.162	0.163	0.185	0.155	0.25	0.279	-	-	-	-
C1-phenanthrenes&anthracenes	0.1	0.156	0.148	0.14	0.137	0.155	0.108	0.195	0.191	-	-	-	-
C3-phenanthrenes&anthracenes	-	-	-	0.77	0.444	0.625	0.364	0.614	-	-	-	-	-
Dibenzothiophene	0.0128	0.018	0.017	0.011	0.0121	0.0128	0.00866	0.0135	0.0157	0.75	0.24	0.24	0.33
C1-dibenzothiophenes	0.018	0.0234	0.0223	0.0419	0.0328	0.0444	0.028	0.0469	0.0377	-	-	-	-
C2-dibenzothiophenes	0.0179	0.02	0.025	0.0503	0.0381	0.041	0.0324	0.0527	0.0549	-	-	-	-
C3-dibenzothiophenes	-	-	-	-	-	-	-	-	0.153	-	-	-	-
Fluoranthene	0.106	0.216	0.201	0.0678	0.062	0.0704	0.0672	0.12	0.131	0.54	0.54	0.54	0.54
Pyrene	0.0223	0.0404	0.0402	0.014	0.012	0.0158	0.0123	0.0252	0.0216	0.42	0.42	0.42	0.42
C1-fluoranthenes&pyrenes	0.0219	0.0443	0.0265	0.0366	-	-	-	-	-	-	-	-	-
C2-fluoranthenes&pyrenes	-	-	-	-	-	-	-	-	-	-	-	-	-
Benz[a]anthracene	0.00206	0.00488	0.00425	0.000998	0.000978	0.00105	0.000669	0.00104	0.00109	0.75	0.75	0.75	0.75
Perylene	0.000332	0.000635	0.00061	0.00158	0.00155	0.00166	0.00106	0.00164	0.00173	1	1	1	1
Benzo[b]fluoranthene	0.00102	0.00226	0.00194	0.000495	0.000485	0.00052	0.000331	0.000514	0.000541	0.37	0.37	0.37	0.37
Benzo[e]pyrene	0.000871	0.000494	0.000474	0.00123	0.00121	0.0013	0.000822	0.00128	0.00135	0.71	0.71	0.71	0.71
Benzo[a]pyrene	0.000373	0.000713	0.000685	0.00177	0.00174	0.00186	0.00118	0.00184	0.00194	1.18	1.18	1.18	1.18
Indeno[1,2,3-cd]pyrene	0.000109	0.000209	0.00020	0.000521	0.00051	0.000548	0.000348	0.000542	0.00057	0.26	0.26	0.26	0.26
Sum 42 PAHs[1]	41.284	46.122	59.896	47.262	44.447	48.962	41.012	60.795	60.615	65.110	71.870	7.590	41.790
Sum 42 PAH w/o Naphthalene	2.094	2.192	2.776	2.392	1.937	2.232	1.832	3.155	2.595	18.510	14.170	7.590	7.680
Sum 16 PAHs[2]	1.841	2.508	2.198	0.358	0.414	0.415	0.406	0.608	0.660	16.000	15.460	7.350	14.550
Sum low molecular weight PAH[3]	41.129	45.812	59.621	47.137	44.366	48.869	40.928	60.643	60.455	59.880	66.640	2.360	36.560
Sum high molecular weight PAH[4]	0.155	0.310	0.276	0.125	0.080	0.093	0.084	0.152	0.160	5.230	5.230	5.230	5.230
Percent low molecular weight PAH	0.996	0.993	0.995	0.997	0.998	0.998	0.998	0.997	0.997	0.920	0.927	0.311	0.875
Percent high molecular weight PAH	0.004	0.007	0.005	0.003	0.002	0.002	0.002	0.003	0.003	0.080	0.073	0.689	0.125
Sum of Carcinogenic PAHs [5]	0.004	0.008	0.007	0.004	0.004	0.004	0.003	0.004	0.004	2.560	2.560	2.560	2.560
Analyte Count	24	24	24	24	23	23	23	23	23	16	16	11	14
Percent Naphthalene	0.949	0.952	0.954	0.949	0.956	0.954	0.955	0.948	0.957	0.716	0.803	0.000	0.816

[1] All PAHs listed

[2] 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

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

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

[5] 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. 2023 Water PAH concentrations quantified via passive sampling device

Analyte (ng/L C-Free)	GOC_PSD_23_1 F23-06	GOC_PSD_23_2 F23-06	GOC_PSD_23_3 F23-06	DII_PSD_23_1 F23-06	DII_PSD_23_2 F23-06	DII_PSD_23_3 F23-06	JAC_PSD_23_1 F23-06	JAC_PSD_23_2 F23-06	JAC_PSD_23_3 F23-06	SAW_PSD_23_1 F23-06	SAW_PSD_23_2 F23-06	SAW_PSD_23_3 F23-06	F23-06 trip blank 1	F23-06 trip blank - 02	F23-06 field blank 5/6/23	F23-06 field blank 6/3/23
Naphthalene	2.47	2.31	1.83	1.6	0.936	1.25	1.18	1.67	1.84	12.2	5.4	3.2	23.5	23.5	48.9	17.2
C1-naphthalenes	1.67	1.46	1.68	0.403	0.276	0.368	1.49	1.45	1.08	1.31	1.01	1.03	15.7	15	30.7	11.3
C2-naphthalenes	5.69	4.6	5.72	1.44	1.75	1.92	4.94	4.43	5.54	5.65	4.6	4.11	26.2	25	38.5	26.6
C3-naphthalenes	23.9	21.3	30.4	12.6	9.12	9.26	20.8	17.9	21	31.8	21.8	20	41.8	37.8	67.6	43
C4-naphthalenes	39.2	36.9	56.7	25.4	16	16.4	35	35.5	49.5	57.3	40.9	36.8	-	-	-	-
Acenaphthylene	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Acenaphthene	0.245	0.204	0.261	-	-	-	0.181	-	-	-	-	-	-	-	-	-
Fluorene	0.0905	0.0907	-	-	-	-	0.0668	0.0651	0.101	0.15	0.0926	0.0956	-	-	-	-
C1-fluorenes	0.605	0.704	0.43	1.13	0.283	0.156	0.502	1.5	0.457	0.617	0.478	0.479	-	-	-	-
C2-fluorenes	1.99	2.57	3.22	7.16	1.15	1.24	2.76	8	5.37	3.04	3.13	2.76	-	-	-	-
C3-fluorenes	-	-	1.4	6.77	-	-	1.42	7.15	1.81	2.15	1.6	2.8	-	-	-	-
Anthracene	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Phenanthrene	0.242	0.254	0.264	0.0711	0.0684	0.0937	0.267	0.248	0.313	0.284	0.22	0.255	-	-	-	-
C1-phenanthrenes&anthracenes	0.159	0.166	0.172	0.122	0.0677	0.101	0.166	0.206	0.197	0.23	0.161	0.198	-	-	-	-
C3-phenanthrenes&anthracenes	0.598	0.577	0.581	0.583	-	-	-	1.05	1.09	1.16	0.984	0.886	-	-	-	-
Dibenzothiophene	0.012	0.0109	0.012	0.0218	-	-	0.00963	0.0253	0.0222	0.024	0.0202	0.024	-	-	-	-
C1-dibenzothiophenes	0.0353	0.0417	0.0441	0.215	0.0191	0.0261	0.0417	0.225	0.176	0.191	0.158	0.189	0	0	0	3.39
C2-dibenzothiophenes	0.0381	0.0267	0.0427	0.46	-	-	0.0486	0.364	0.306	0.36	0.285	0.312	-	-	-	-
C3-dibenzothiophenes	-	-	-	0.348	-	-	-	0.283	0.206	0.287	0.176	0.213	-	-	-	-
C4-dibenzothiophenes	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Fluoranthene	0.136	0.129	0.14	0.016	0.0127	0.0175	0.115	0.124	0.142	0.0975	0.0742	0.0893	-	-	-	-
Pyrene	0.0295	0.0305	0.0313	-	-	-	0.0198	0.019	0.0294	0.0151	0.0123	0.0159	-	-	-	-
C1-fluoranthenes&pyrenes	0.0474	0.0371	0.0298	-	-	-	-	0.0617	0.057	0.0575	0.0278	0.0483	-	-	-	-
C2-fluoranthenes&pyrenes	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Benz[a]anthracene	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Perylene	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Benzo[b]fluoranthene	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Benzo[e]pyrene	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Benzo[a]pyrene	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Indeno[1,2,3-cd]pyrene	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Sum 42 PAHs[1]	77.1578	71.4116	102.9579	58.3399	29.6829	30.8323	69.00753	80.2711	89.2366	116.9231	81.1291	73.5051	107.2	101.3	185.7	101.49
Sum 42 PAH w/o Naphthalene	4.228	4.842	6.628	16.897	1.601	1.634	5.598	19.321	10.277	8.663	7.419	8.365	0.000	0.000	0.000	3.390
Sum 16 PAHs[2]	3.213	3.018	2.526	1.687	1.017	1.361	1.830	2.126	2.425	12.747	5.799	3.656	23.500	23.500	48.900	17.200
Sum low molecular weight PAH[3]	76.945	71.215	102.757	58.324	29.670	30.815	68.873	80.066	89.008	116.753	81.015	73.352	107.200	101.300	185.700	101.490
Sum high molecular weight PAH[4]	0.213	0.197	0.201	0.016	0.013	0.018	0.135	0.205	0.228	0.170	0.114	0.154	0.000	0.000	0.000	0.000
Percent low molecular weight PAH	0.997	0.997	0.998	1.000	1.000	0.999	0.998	0.997	0.997	0.999	0.999	0.998	1.000	1.000	1.000	1.000
Percent high molecular weight PAH	0.003	0.003	0.002	0.000	0.000	0.001	0.002	0.003	0.003	0.001	0.001	0.002	0.000	0.000	0.000	0.000
Sum of Carcinogenic PAHs[5]	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
Analyte Count	18	18	18	16	11	11	17	19	19	19	19	19	5	5	5	5
Percent Naphthalene	0.945	0.932	0.936	0.710	0.946	0.947	0.919	0.759	0.885	0.926	0.909	0.886	1.000	1.000	1.000	0.967

[1] All PAHs listed
[2] 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
[3] Low molecular weight PAHs: naphthalenes - phenanthrenes (2-3-ring PAH)
[4] High molecular weight PAHs: fluoranthene - benzo (g,h,i)perylene (3-6 ring PAH)
[5] 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 9. Saturated hydrocarbon (SHC) totals and diagnostic ratios of sediment and mussel tissues sampled in 2022 and 2023.

		Saturated Hydrocarbons (µg/g)		Diagonistic Ratios			
	Sample ID	Total Petroleum Hydrocarbons (C9-C44)	Total Saturated Hydrocarbons	Ratio of T15/T19[1]	Ratio of Pristane/ Phytane[2]	Ratio of Pristane/ C17[3]	Ratio of Phytane/ C18[4]
Sediments	GOC-S-22-1	5.25	1.75	1.005	0.857	0.500	0.636
	GOC-S-22-2	21.6	2.7	0.615	1.833	0.846	0.667
	GOC-S-22-3	22.6	2.38	0.713	1.833	0.786	0.667
	GOC-SAND-22	0.213	0.052	-	-	-	-
	AMT-S-22-1	38.6	2.41	0.648	2.700	1.350	0.714
	AMT-S-22-2	28.5	1.43	0.569	0.917	0.423	0.857
	AMT-S-22-3	33.3	2.38	0.528	3.636	2.222	1.100
	AMT-SAND-22	-	0.052	-	-	-	-
	GOC-S-22-1-DUP	5.57	1.68	0.608	1.400	0.778	0.625
	GOC-S-23-1	19.1	2.18	-	-	0.818	-
	GOC-S-23-2	32.2	3.27	0.681	4.667	1.167	0.500
	GOC-S-23-3	21.5	1.63	-	-	0.500	-
	AMT-S-23-1	69.6	2.1	0.540	1.154	0.214	1.444
	AMT-S-23-2	44.4	1.66	0.542	1.500	0.191	0.667
	AMT-S-23-3	63	2.08	0.527	1.100	0.183	1.000
Pacific Blue Mussel Tissue*	JAC-B-22-1	1.45	0.92	-	14.286	1.887	0.304
	JAC-B-22-2	-	0.689	-	15.250	1.794	0.222
	JAC-B-22-3	-	0.586	-	20.667	2.000	0.231
	SAW-B-22-1	-	0.677	-	9.800	1.690	0.294
	SAW-B-22-2	-	0.607	-	12.250	1.400	0.235
	SAW-B-22-3	-	0.685	-	22.000	1.467	0.231
	GOC-B-22-1	0.488	0.768	-	10.500	1.400	0.400
	GOC-B-22-2	-	0.716	-	10.800	1.256	0.294
	GOC-B-22-3	6.09	0.646	-	8.800	1.100	0.357
	RED-B-22-1	13.5	0.786	-	3.556	0.696	0.529
	RED-B-22-2	8.75	0.467	-	4.167	0.926	0.667
	RED-B-22-3	12.2	0.692	-	3.750	0.732	0.500
	RED-B-22-2-DUP	11.4	0.582	-	3.250	0.765	0.667
	JAC-B-23-1	8.88	2.9	-	41.400	4.929	0.385
	JAC-B-23-2	3.73	1.65	-	29.500	3.218	0.545
	JAC-B-23-3	3.16	1.57	0.774	32.500	3.250	0.308
	AMT-B-23-1	7.41	4.11	0.361	29.600	2.596	0.385
	AMT-B-23-2	0.961	1.59	-	35.600	3.179	0.357
	AMT-B-23-3	2.44	1.41	0.866	-	2.940	-
	GOC-B-23-1	3.6	3.64	-	14.500	2.109	0.667
	GOC-B-23-2	0.64	1.73	0.740	21.429	2.586	0.778
	GOC-B-23-3	1.92	1.88	-	29.857	2.155	0.778
	DII-B-23-1	3.19	3.64	-	-	3.533	-
	DII-B-23-2	10.1	2.73	-	114.500	5.089	0.154
	DII-B-23-3	7.02	2.38	0.570	-	4.556	-
	KNH-B-23-1	17.8	3.32	-	-	0.658	-
	KNH-B-23-2	7.62	1.77	-	-	0.904	-

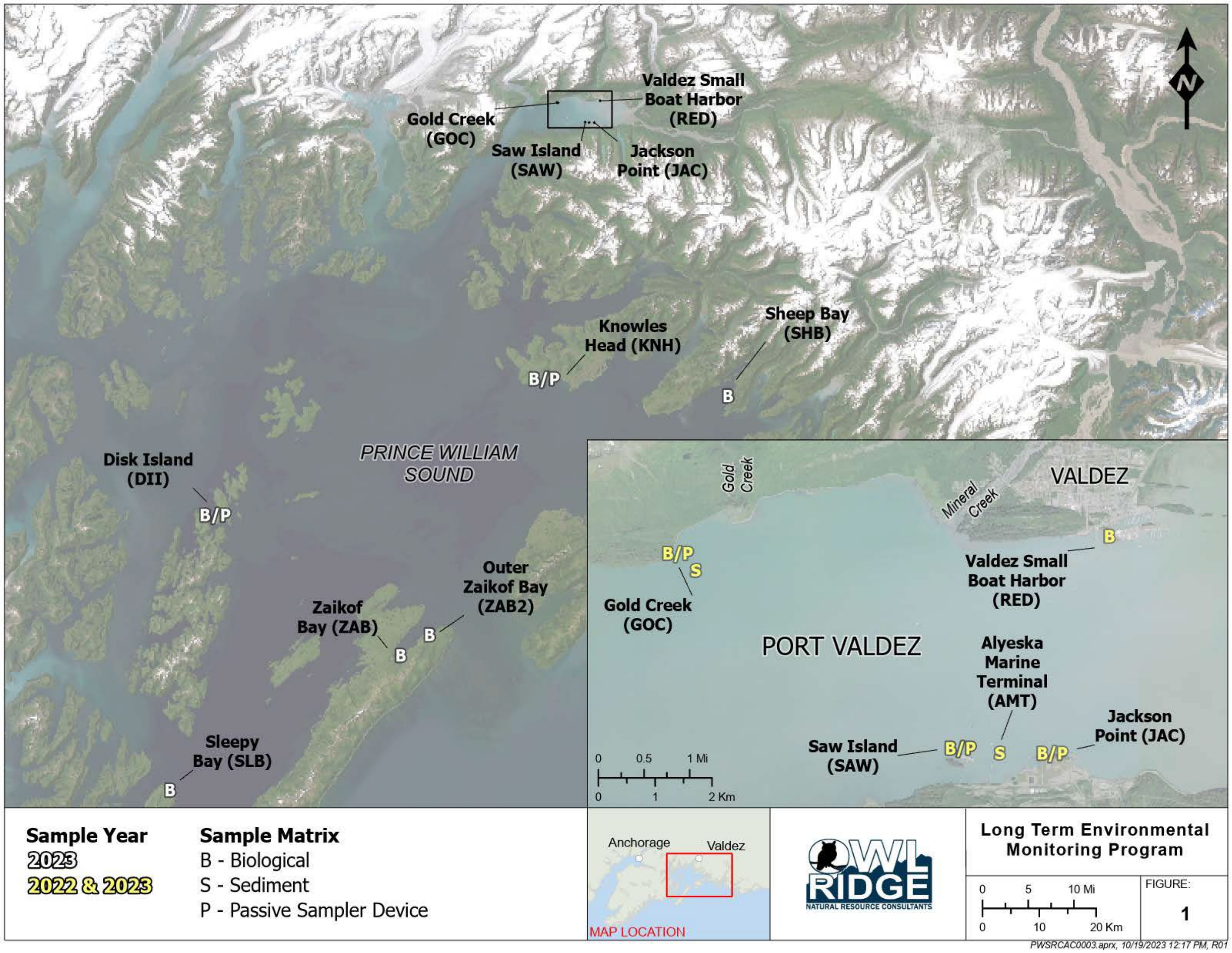
Table 9. Saturated hydrocarbon (SHC) totals and diagnostic ratios of sediment and mussel tissues sampled in 2022 and 2023.

	Saturated Hydrocarbons (µg/g)		Diagonistic Ratios			
Sample ID	Total Petroleum Hydrocarbons (C9-C44)	Total Saturated Hydrocarbons	Ratio of T15/T19[1]	Ratio of Pristane/ Phytane[2]	Ratio of Pristane/ C17[3]	Ratio of Phytane/ C18[4]
KNH-B-23-3	18.9	5.61	-	-	0.836	-
SLB-B-23-1	-	2.91	-	-	43.429	-
SLB-B-23-2	-	1.69	-	-	19.921	-
SLB-B-23-3	-	1.68	-	-	17.400	-
RED-B-23-1	3.35	1.48	1.107	2.085	2.722	3.615
RED-B-23-2	4.1	1.73	0.860	2.214	3.263	4.000
RED-B-23-3	4.91	1.49	0.741	2.313	2.581	4.364
ZAB-B-23-1	9.91	3.32	-	-	1.353	-
ZAB-B-23-2	7.35	3.27	-	-	1.294	-
ZAB-B-23-3	9.1	3.51	-	-	1.432	-
ZAB2-B-23-1	1.07	3.41	-	-	9.667	-
ZAB2-B-23-2	12.3	3.07	-	-	10.383	-
ZAB2-B-23-3	9.81	3.34	-	-	10.542	-
SHB-B-23-1	5.57	1.41	-	8.333	0.284	0.300
SHB-B-23-2	5.75	1.42	-	5.750	0.295	0.308
SHB-B-23-3	9.16	1.63	-	8.000	0.296	0.235
Whole ANS Crude Oil	563000	77351.80	0.557	1.729	0.863	0.578

* Wet weight
[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

FIGURES

Figure 1. Long-Term Environmental Monitoring Program sites from 2022 and 2023 campaign.



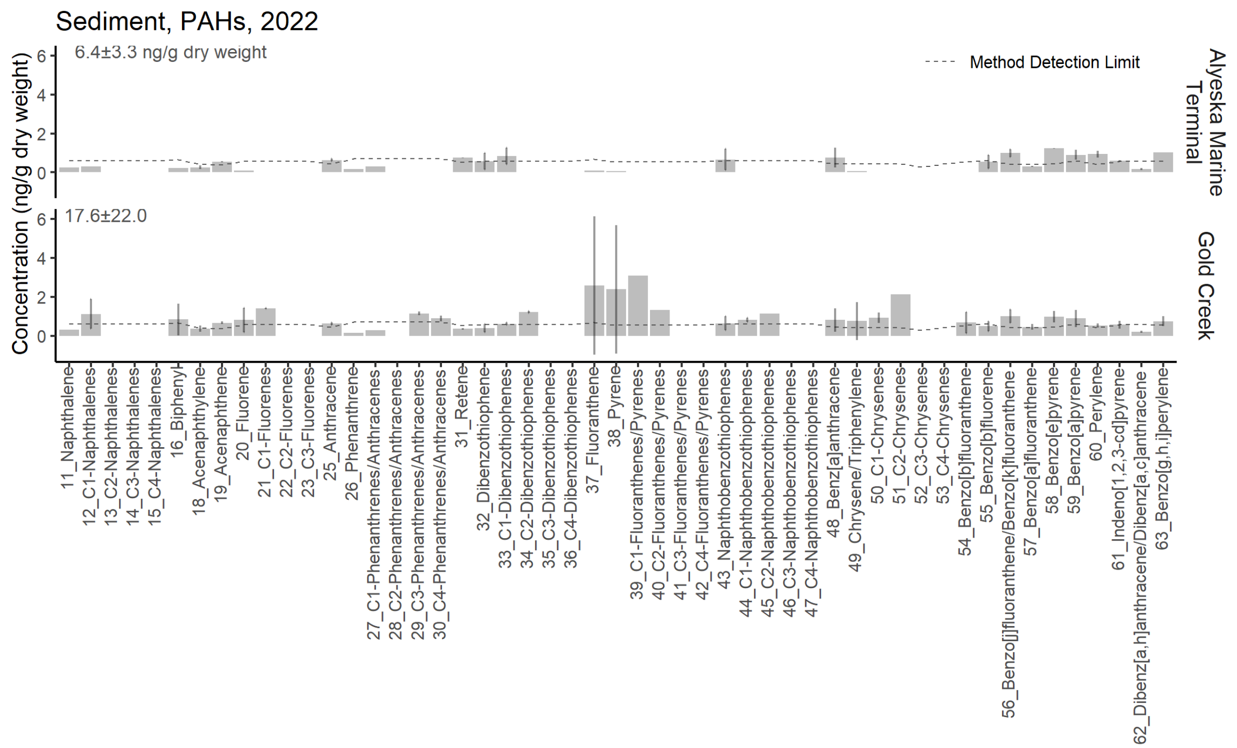


Figure 2. PAH profiles from 2022 sediment samples plotted by mean ± 1 standard deviation. The analyte-specific method detection limit is superimposed as a dashed line. Sum 43 PAH values (mean ± 1 standard deviation) are found in the upper left corner of each site profile.

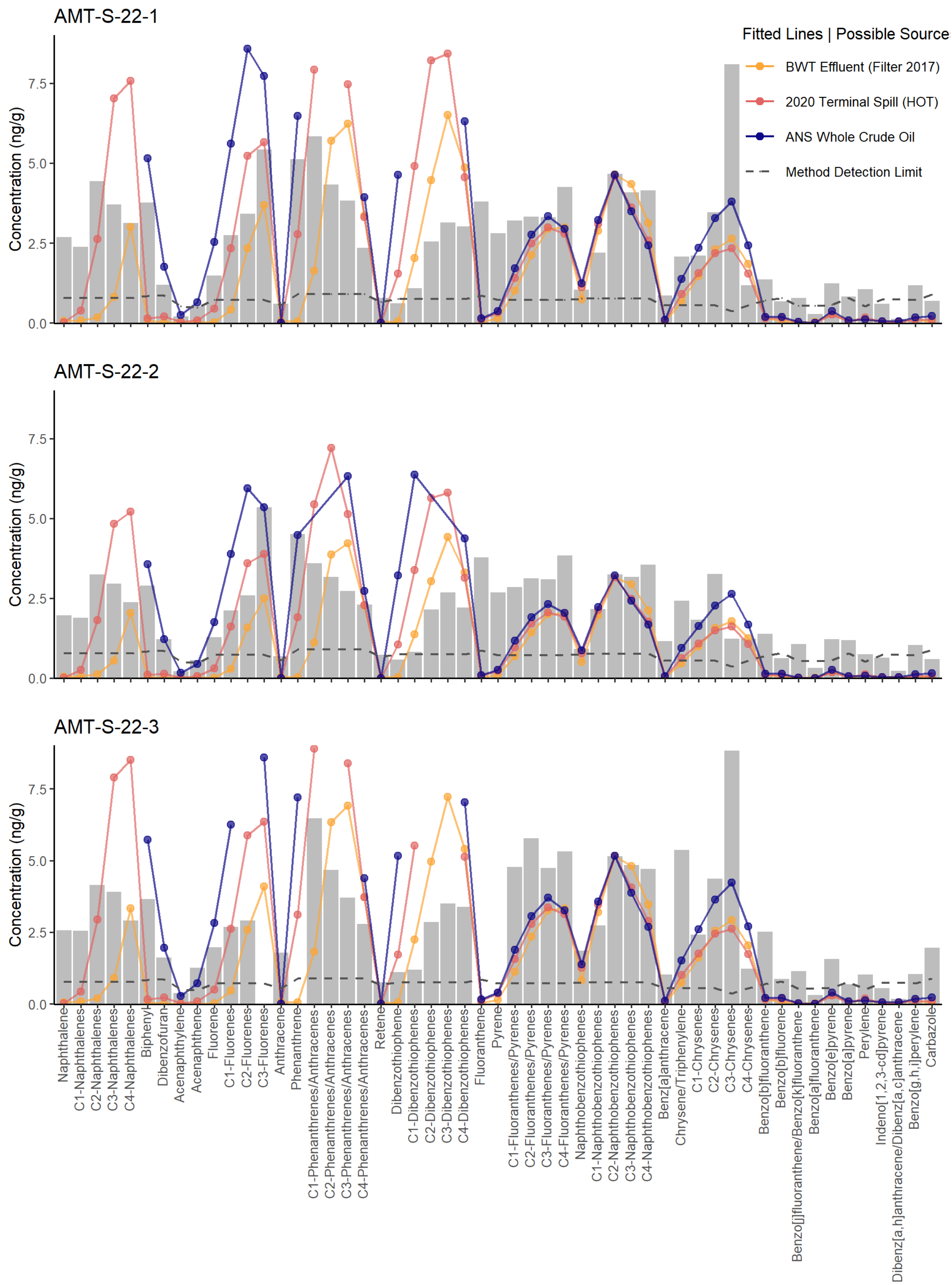


Figure 3. 2022 PAH profiles from individual sediment samples at the Valdez Marine Terminal (AMT) with three possible ANS-related source profiles and the analyte specific method detection limit superimposed as different lines.

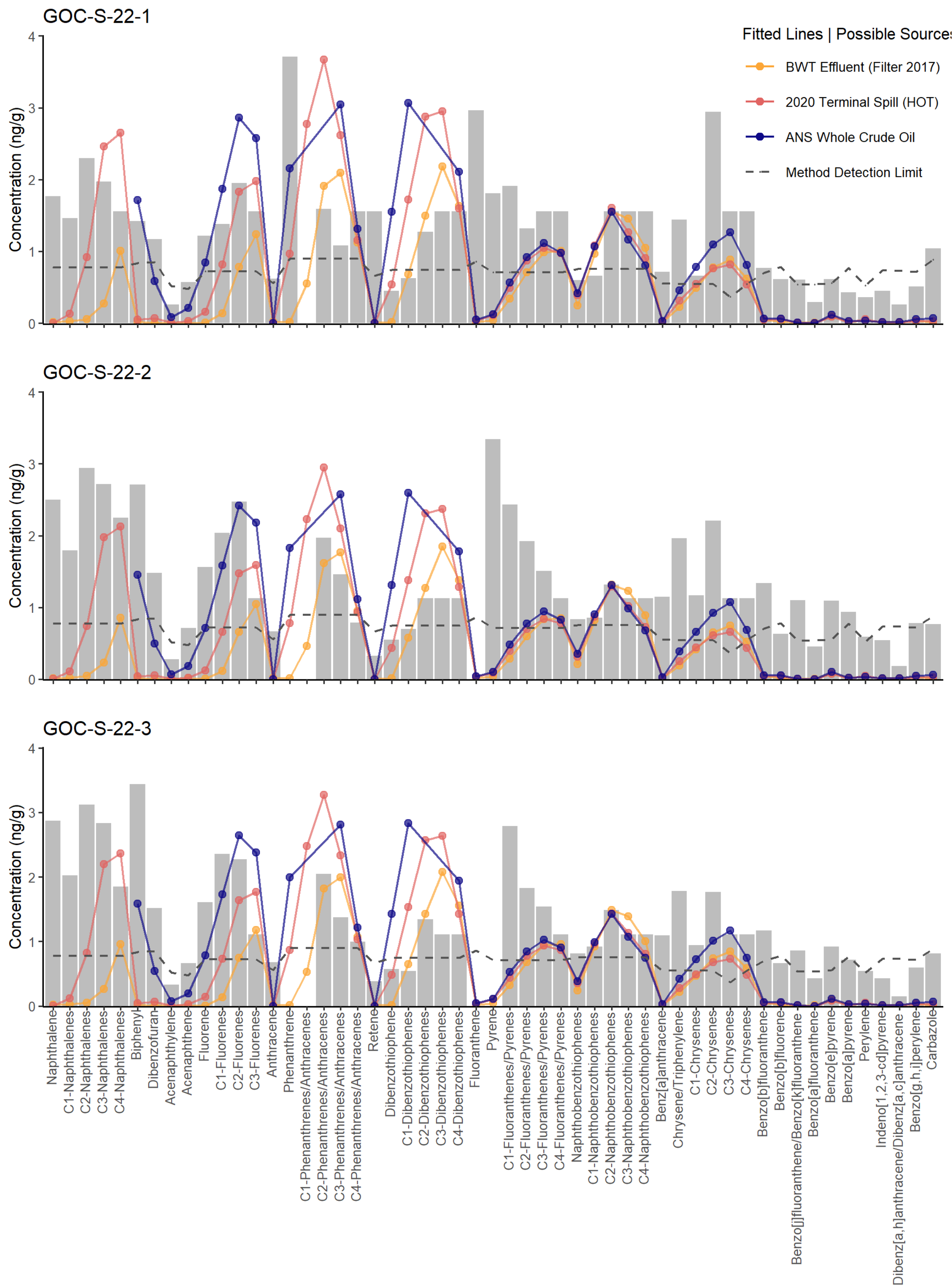


Figure 4. 2022 PAH profiles from individual sediment samples at Gold Creek (GOC) with the three possible ANS-related source profiles and the analyte specific method detection limit superimposed as different lines.

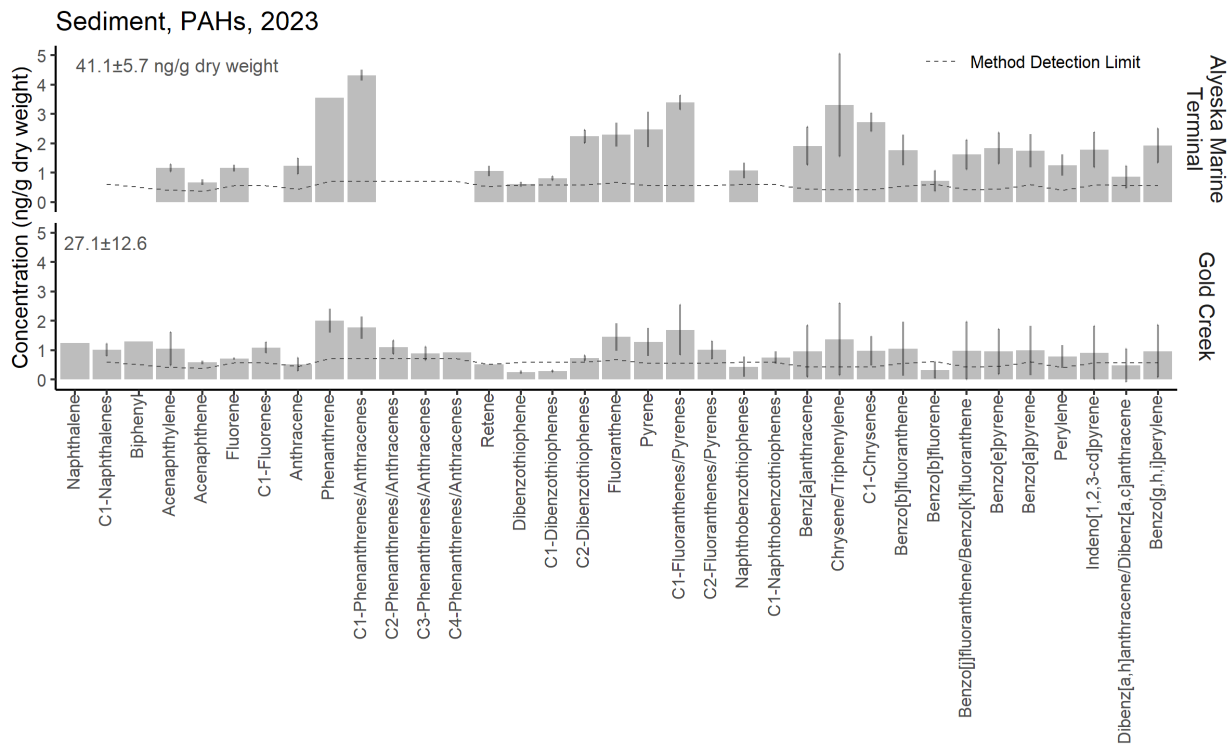


Figure 5. PAH profiles from 2023 sediment samples plotted by mean ± 1 standard deviation. The analyte-specific method detection limit is superimposed as a dashed line. Sum 43 PAH values (mean ± 1 standard deviation) are found in the upper left corner of each site profile.

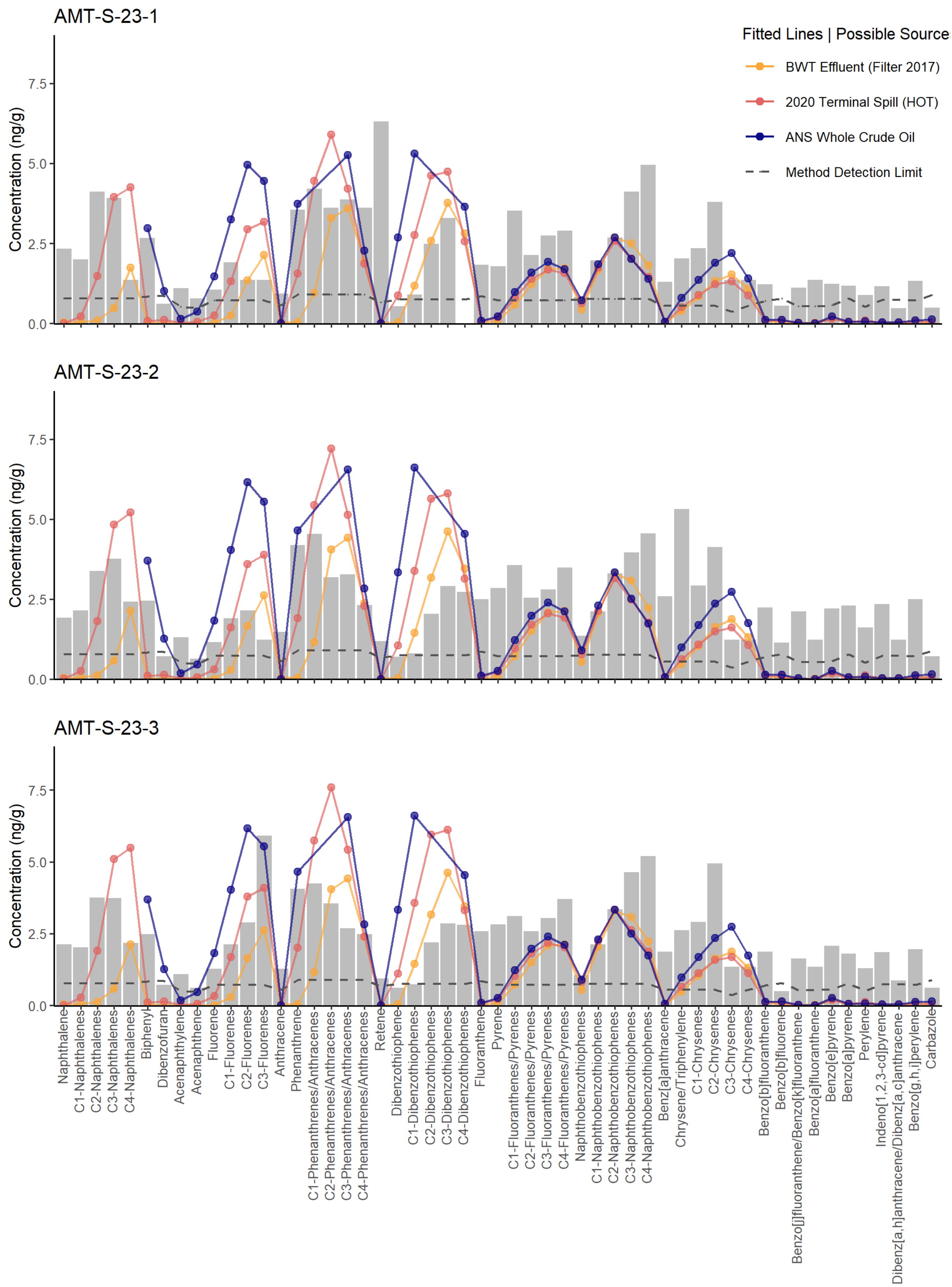


Figure 6. 2023 PAH profiles from individual sediment samples at Valdez Marine Terminal (AMT) with the three possible ANS-related source profiles and the analyte specific method detection limit superimposed as different lines.

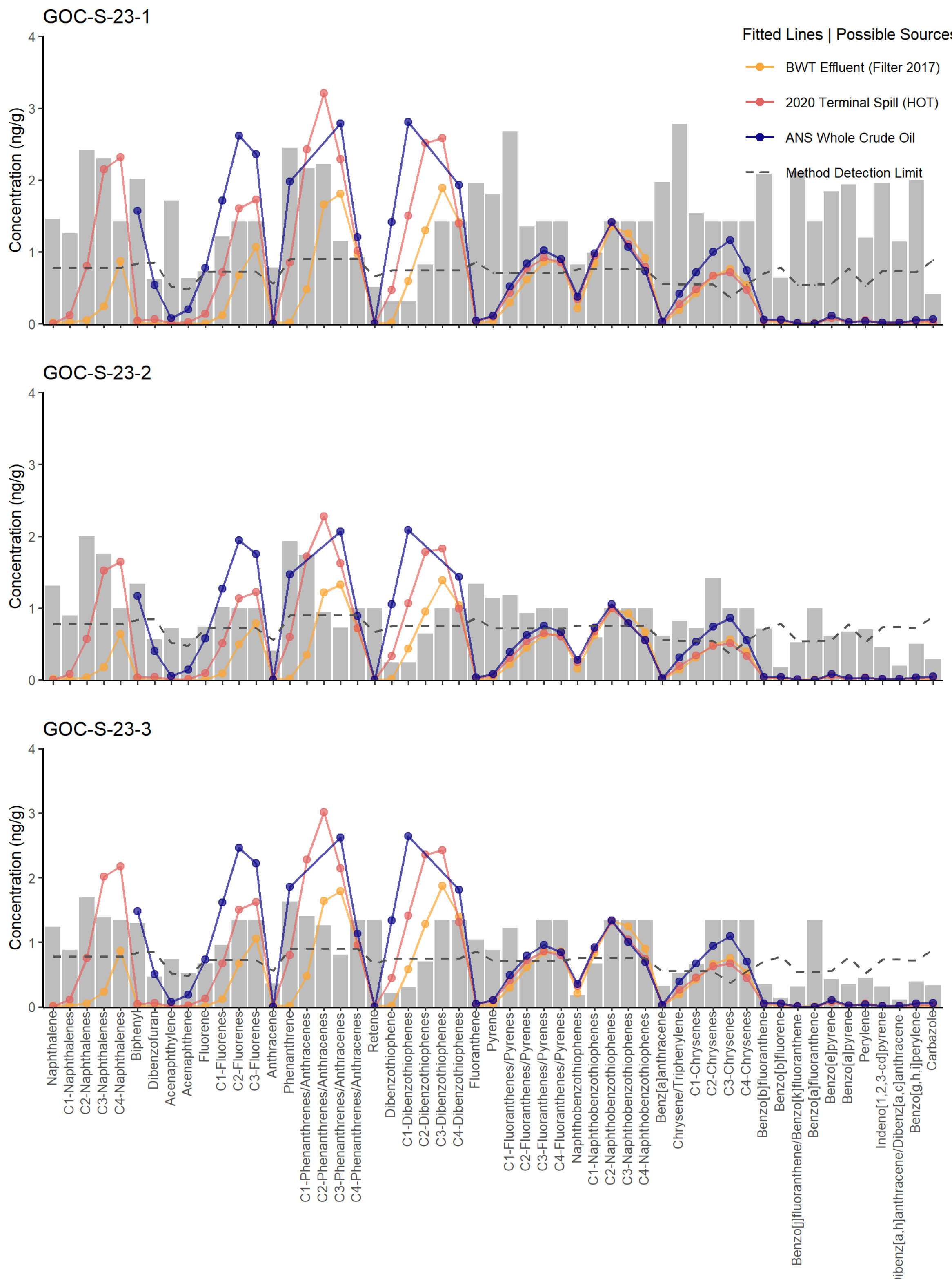


Figure 7. 2023 PAH profiles from individual sediment samples at Gold Creek (GOC) with the three possible ANS-related source profiles and the analyte specific method detection limit superimposed as different lines.

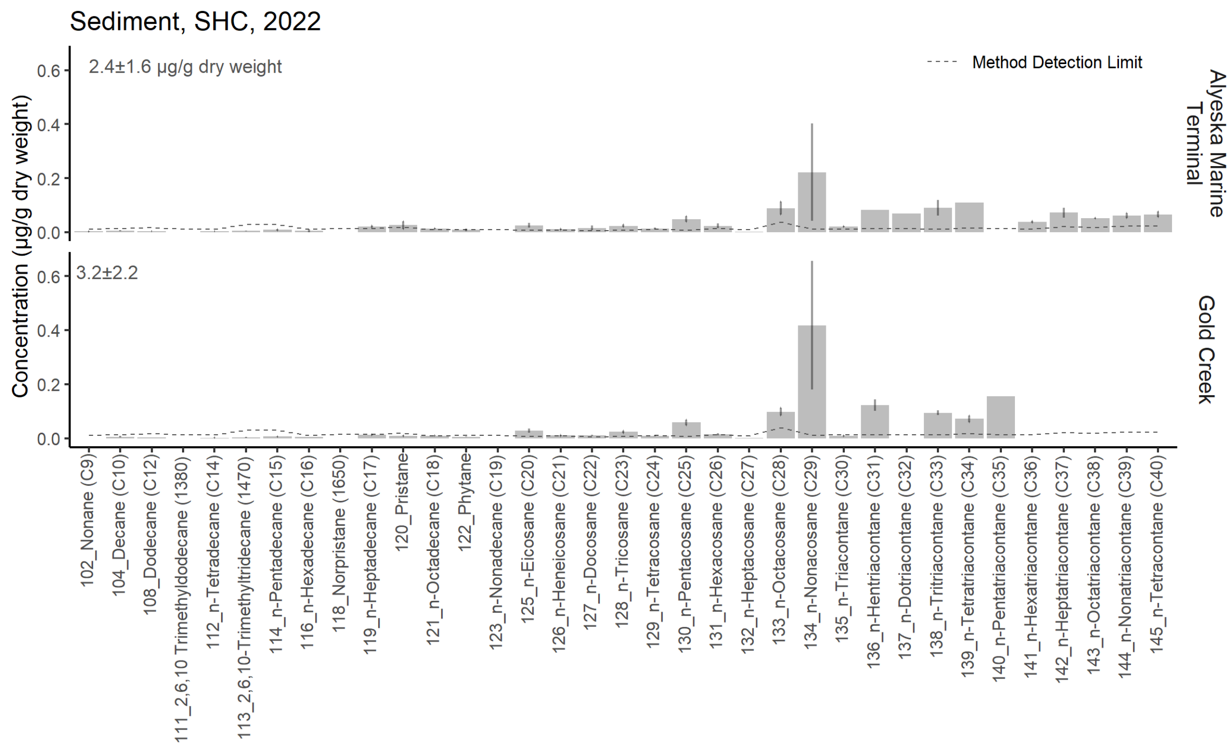


Figure 8. 2022 Saturated hydrocarbons (SHC) profiles from sediment samples plotted by mean ± 1 standard deviation. The analyte specific method detection limit is superimposed as a dashed line. Sum SHC values (mean ± 1 standard deviation) are found in the upper left corner of each site profile.

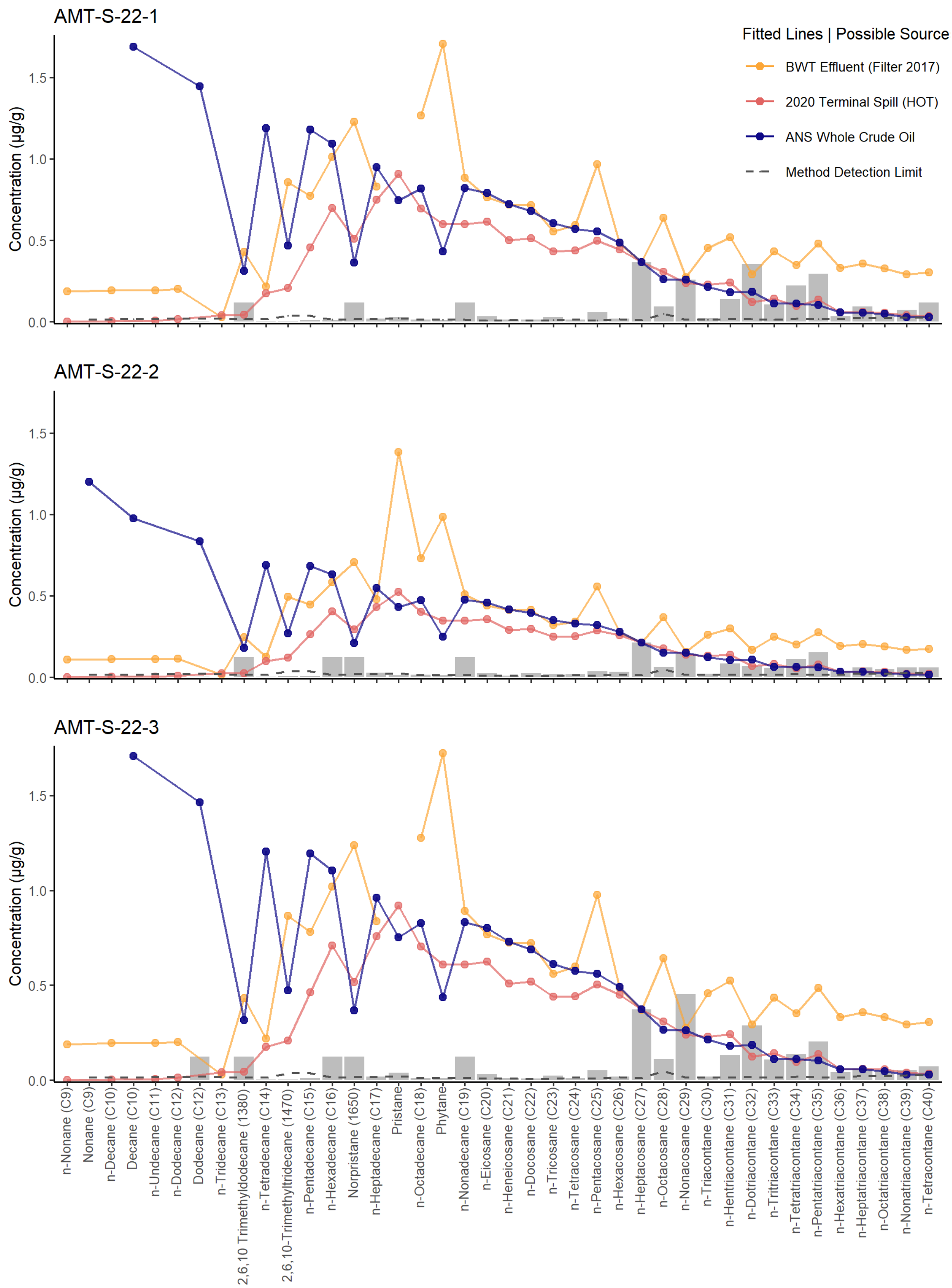


Figure 9. 2022 Saturated hydrocarbons (SHC) profiles from individual sediment samples at the Valdez Marine Terminal (AMT) with the duplicate replicate, three possible ANS-related source profiles, and the analyte specific method detection limit superimposed as different lines.

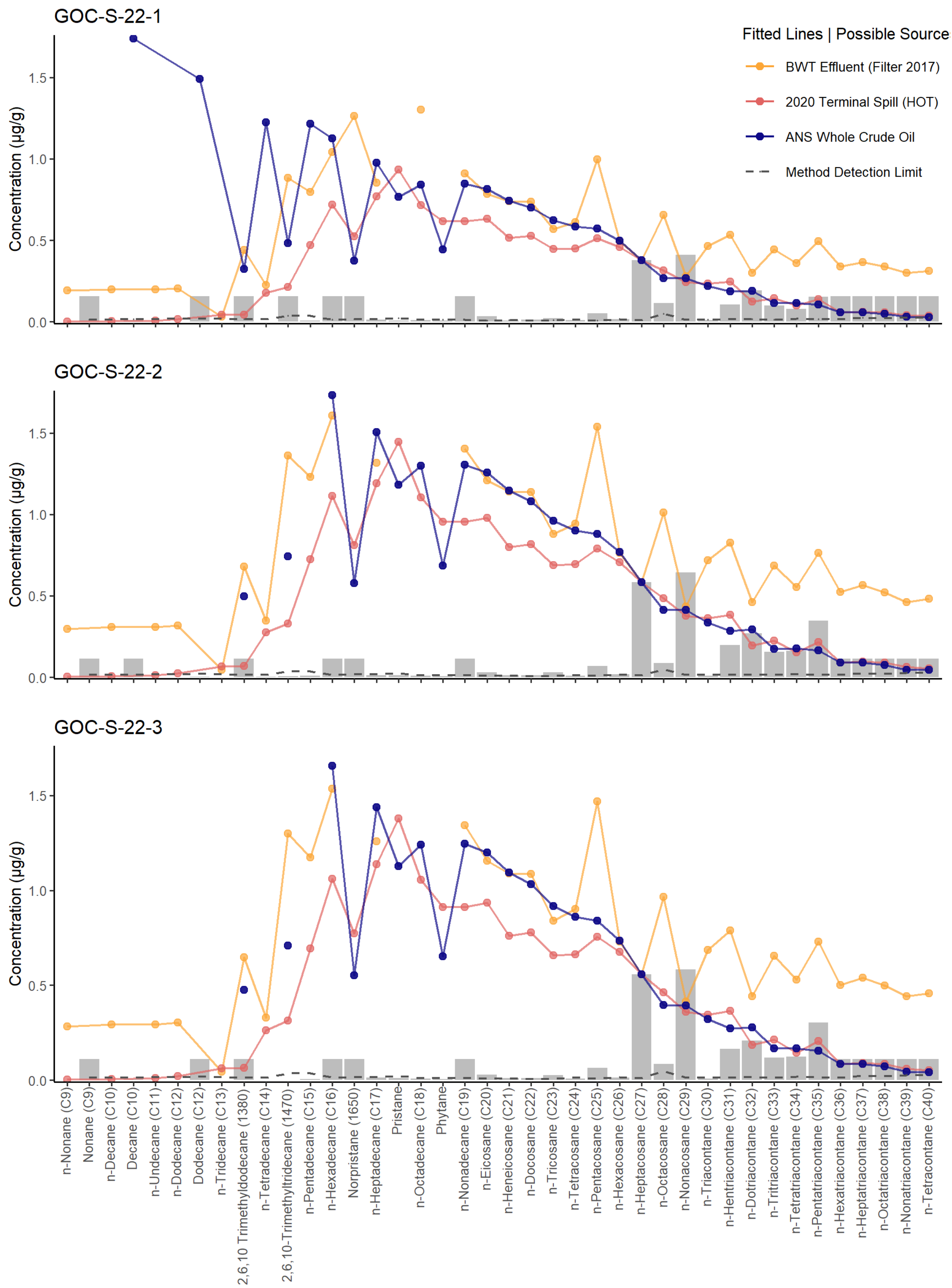


Figure 10. 2023 Saturated hydrocarbons (SHC) profiles from individual sediment samples at Gold Creek (GOC) with three possible ANS-related source profiles and the analyte specific method detection limit superimposed as different lines.

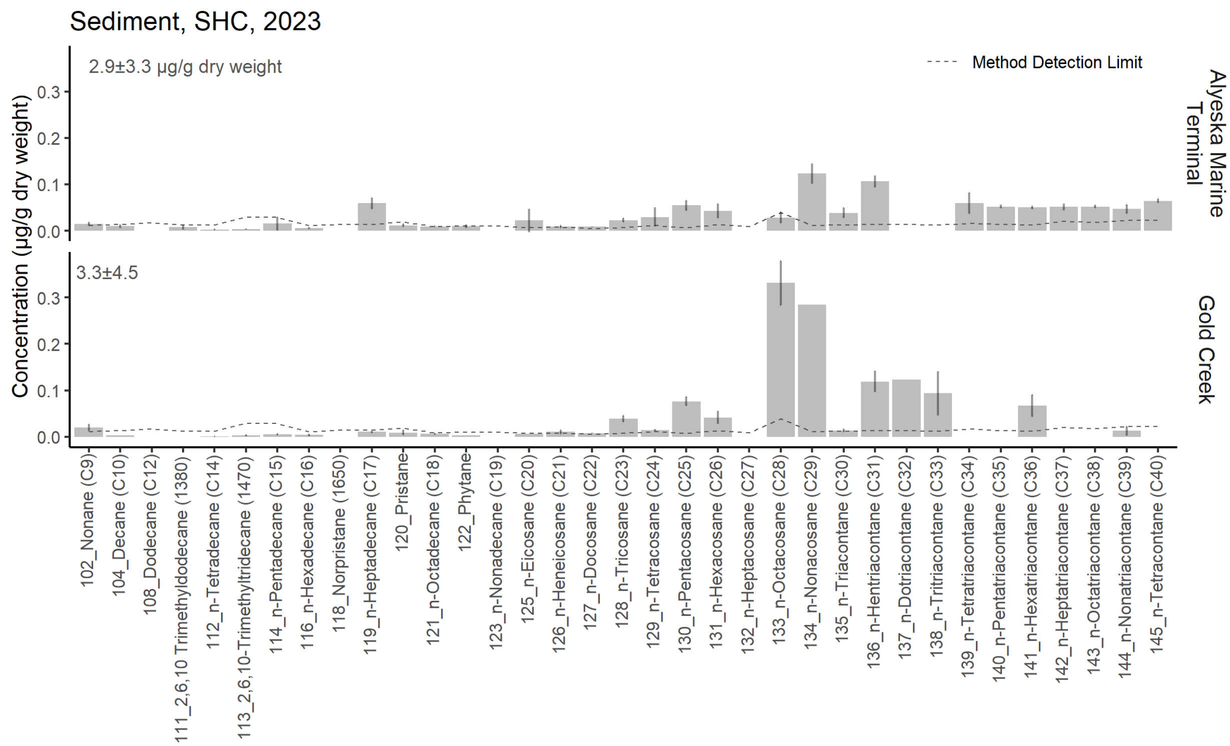


Figure 11. 2023 Saturated hydrocarbons (SHC) profiles from sediment samples plotted by mean ± 1 standard deviation. The analyte specific method detection limit is superimposed as a dashed line. Sum SHC values (mean ± 1 standard deviation) are found in the upper left corner of each site profile.

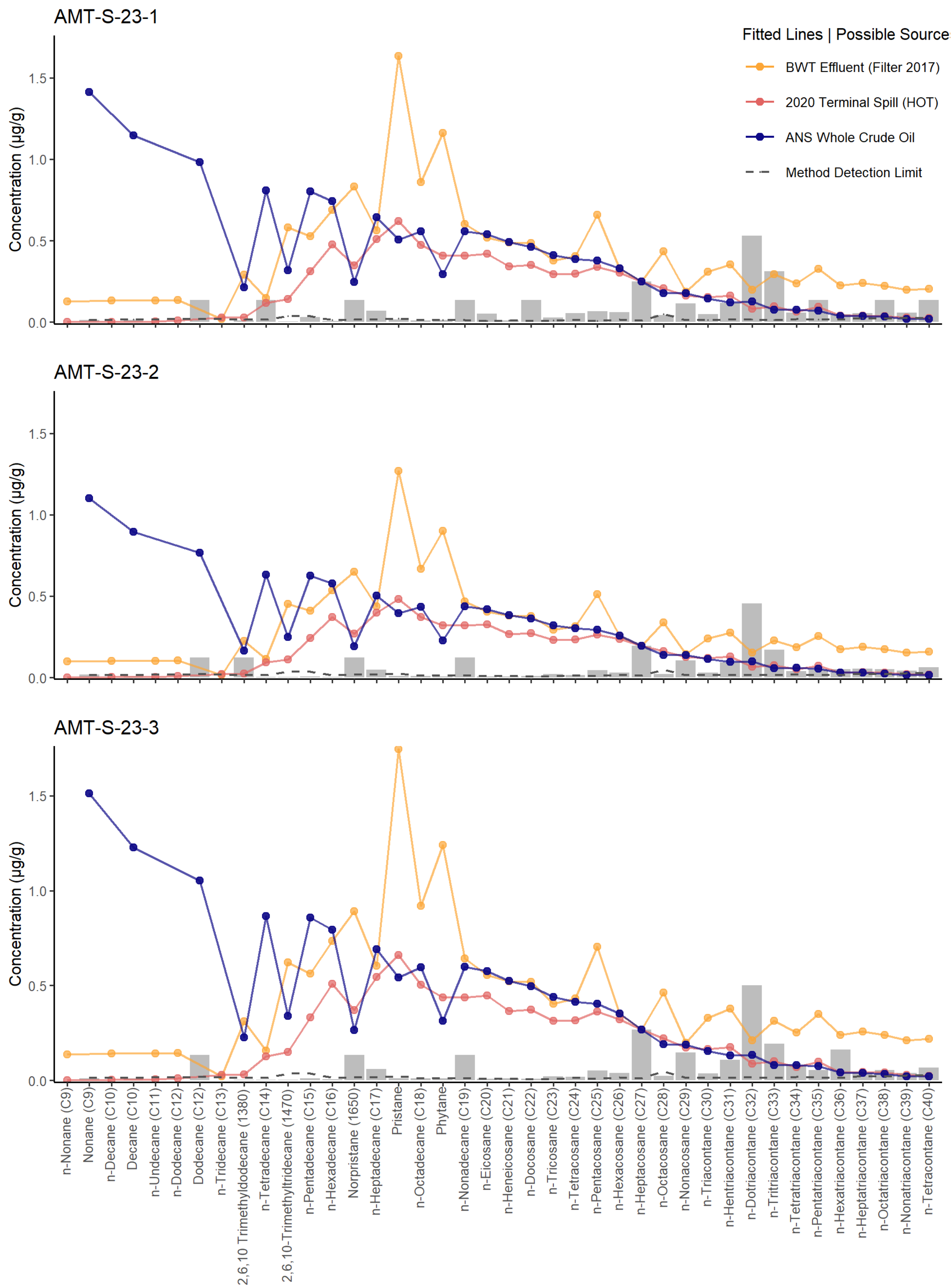


Figure 12. 2023 Saturated hydrocarbons (SHC) profiles from individual sediment samples at the Valdez Marine Terminal (AMT) with three possible ANS-related source profiles and the analyte specific method detection limit superimposed as different lines.

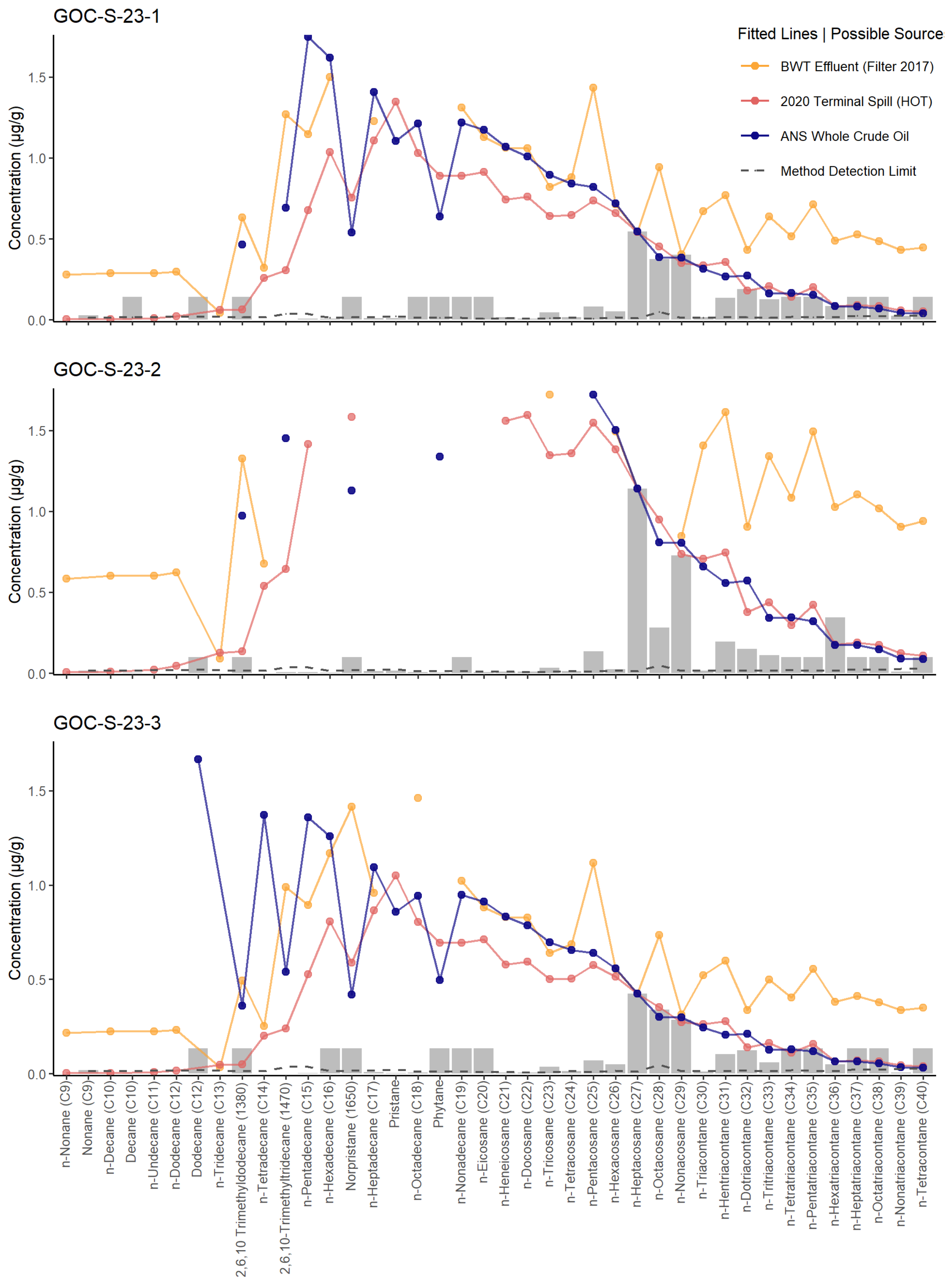


Figure 13. 2023 Saturated hydrocarbons (SHC) profiles from individual sediment samples at Gold Creek (GOC) with three possible ANS-related source profiles and the analyte specific method detection limit superimposed as different lines.

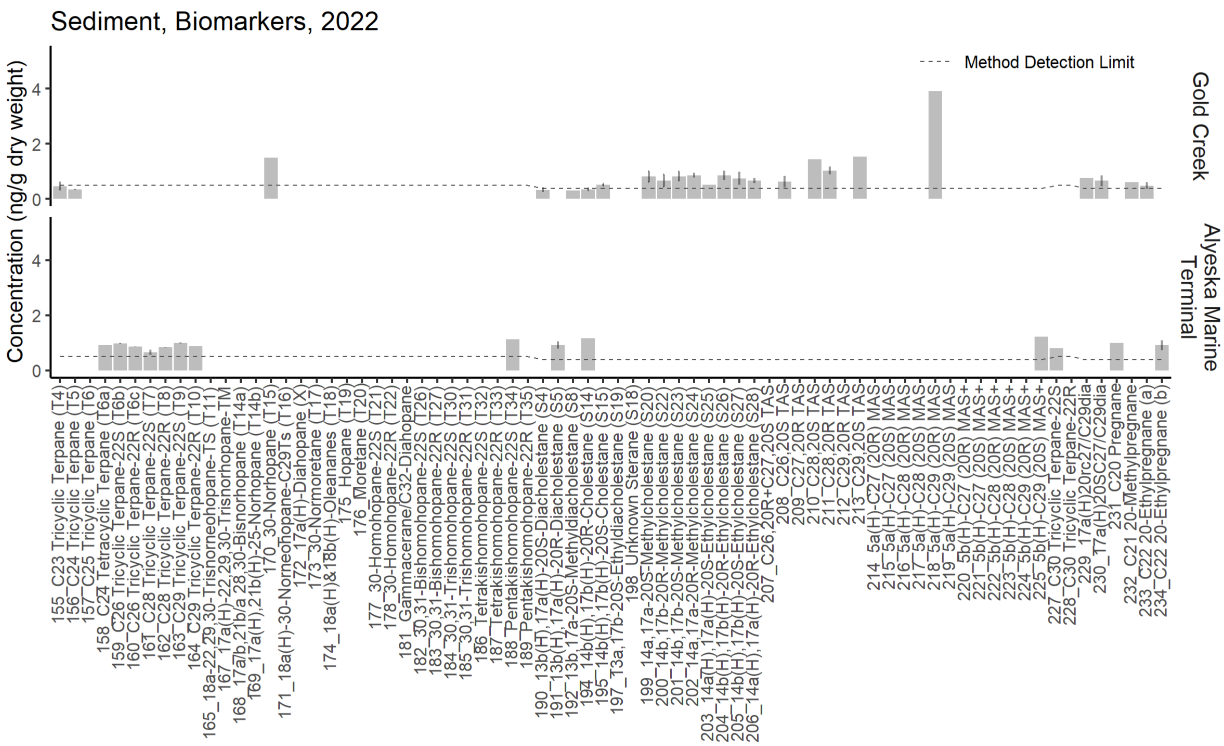


Figure 14. 2022 Petroleum chemical biomarker profiles from sediment samples plotted by mean ± 1 standard deviation. The analyte specific method detection limit is superimposed as a dashed line.

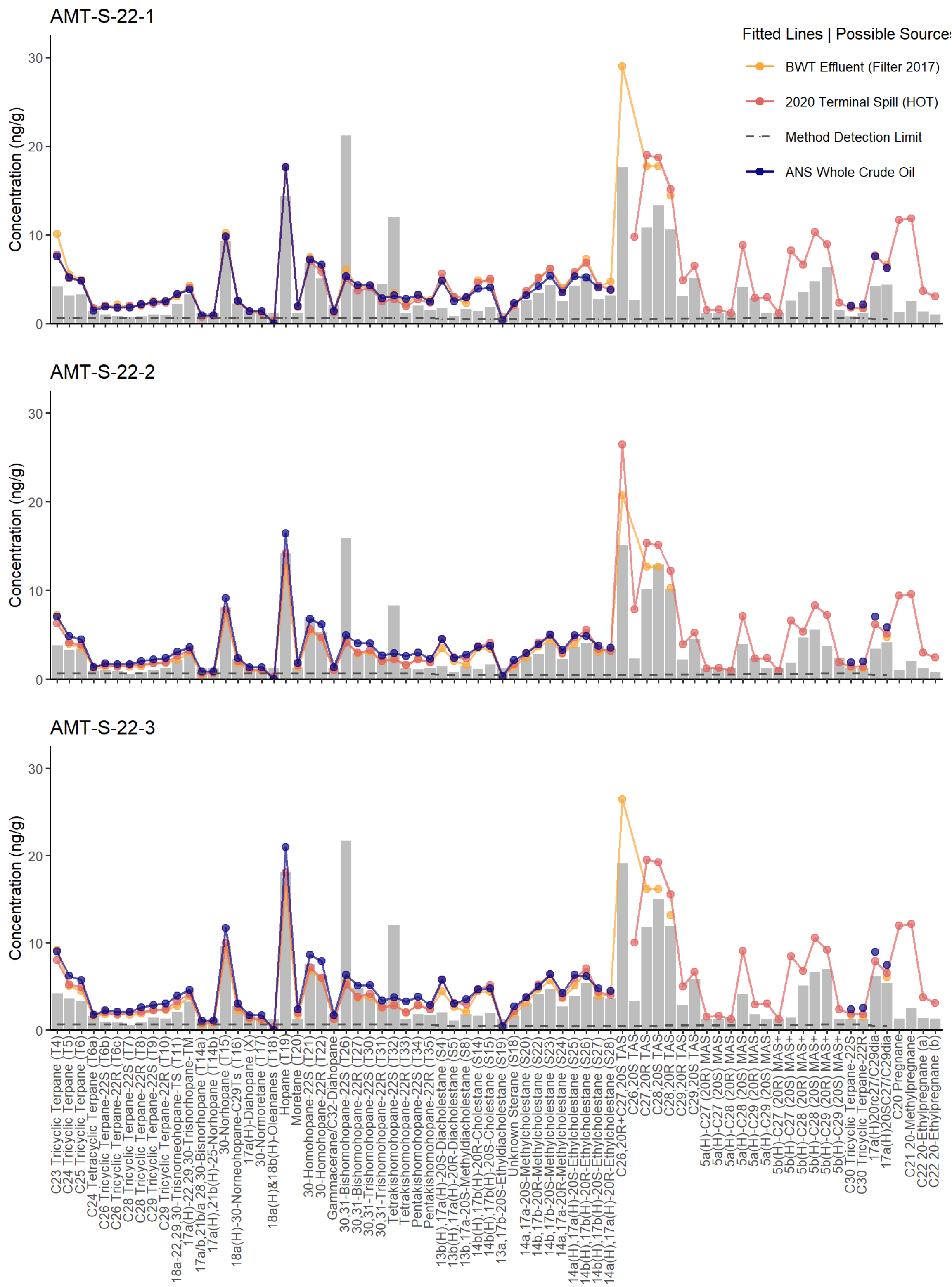


Figure 15. 2022 Petroleum chemical biomarker profiles from individual sediment samples at the Valdez Marine Terminal (AMT) with three possible ANS-related source profiles and the analyte specific method detection limit superimposed as different lines.

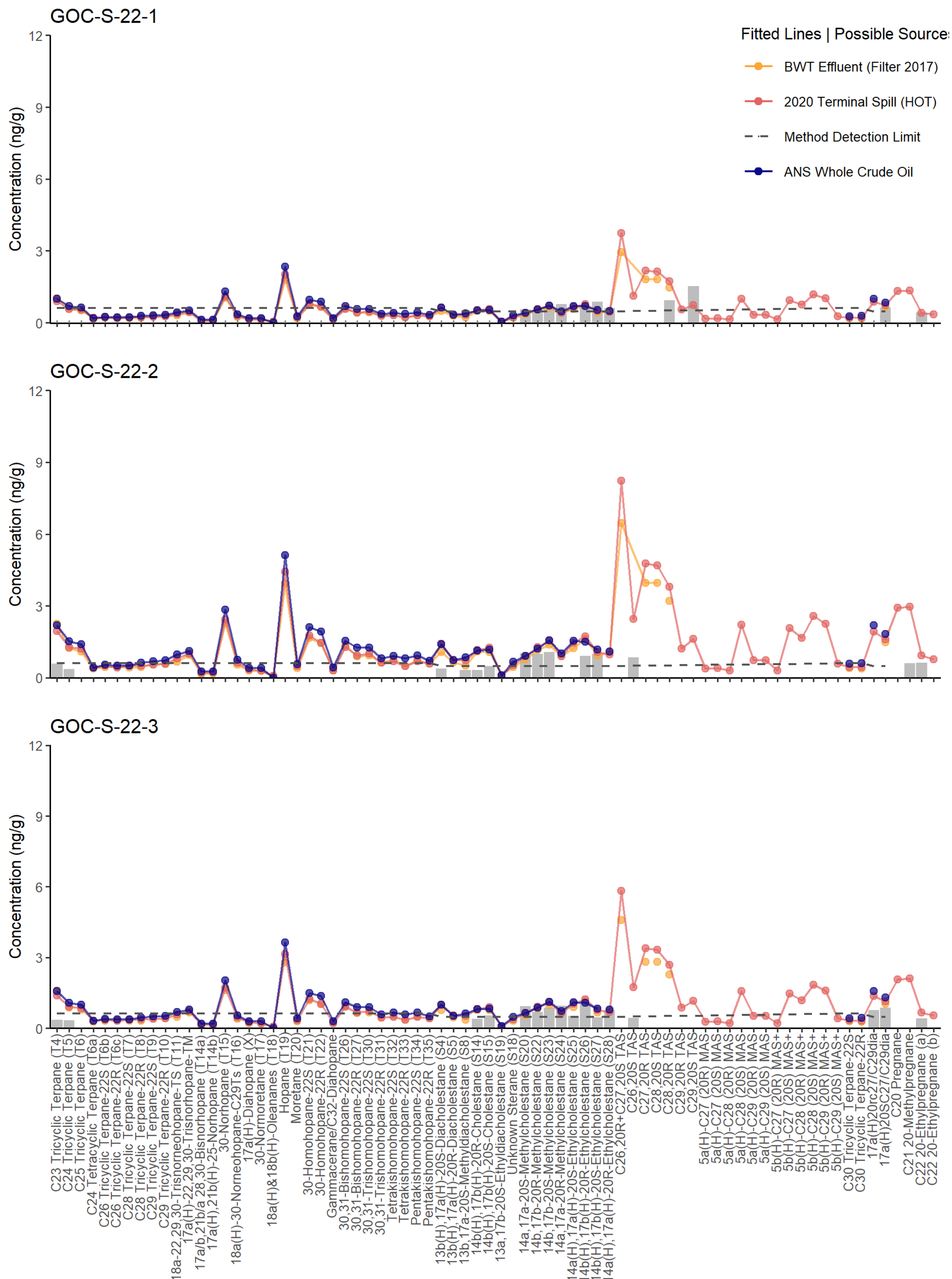


Figure 16. 2022 Petroleum chemical biomarker profiles from individual sediment samples at Gold Creek with (GOC) three possible ANS-related source profiles and the analyte specific method detection limit superimposed as different lines.

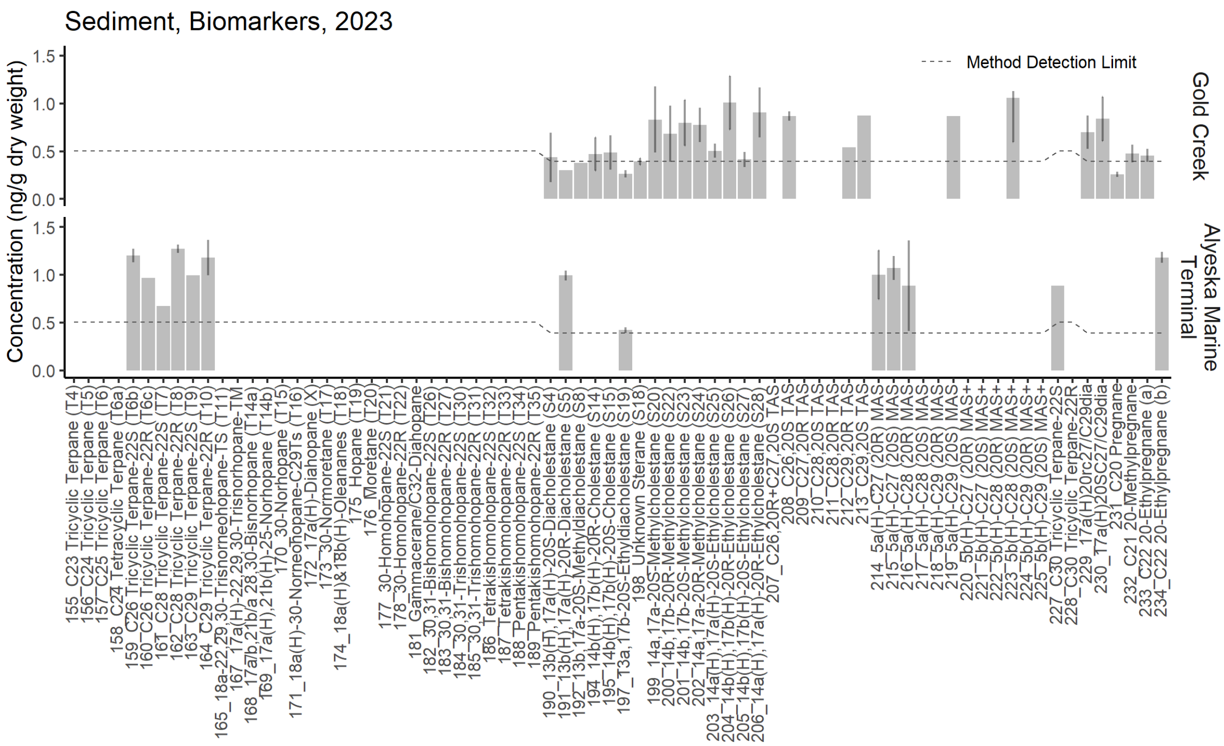


Figure 17. 2023 Petroleum chemical biomarker profiles from sediment samples plotted by mean ± 1 standard deviation. The analyte specific method detection limit is superimposed as a dashed line.

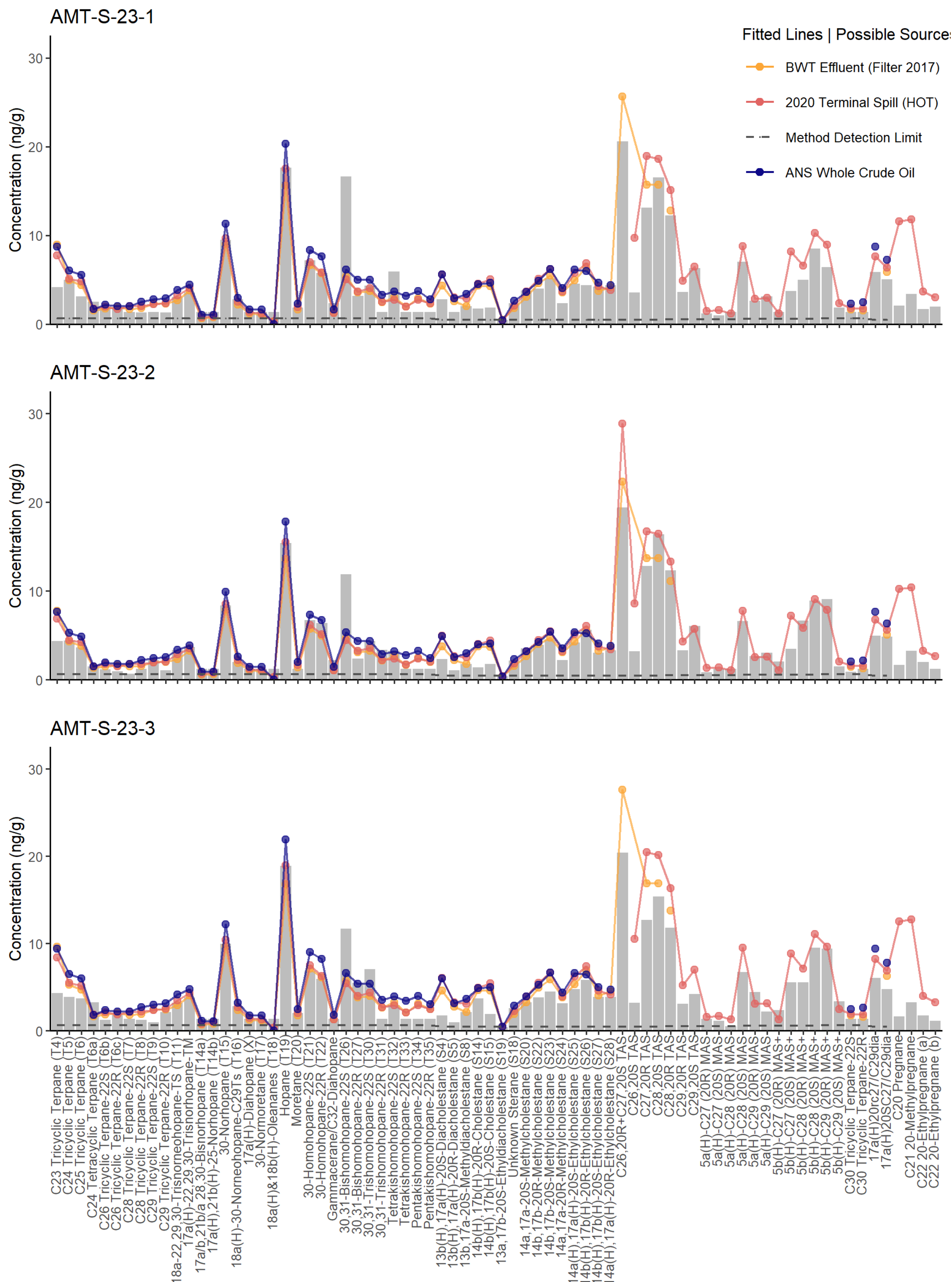


Figure 18. 2023 Petroleum chemical biomarker profiles from individual sediment samples at the Valdez Marine Terminal (AMT) with three possible ANS-related source profiles and the analyte specific method detection limit superimposed as different lines.

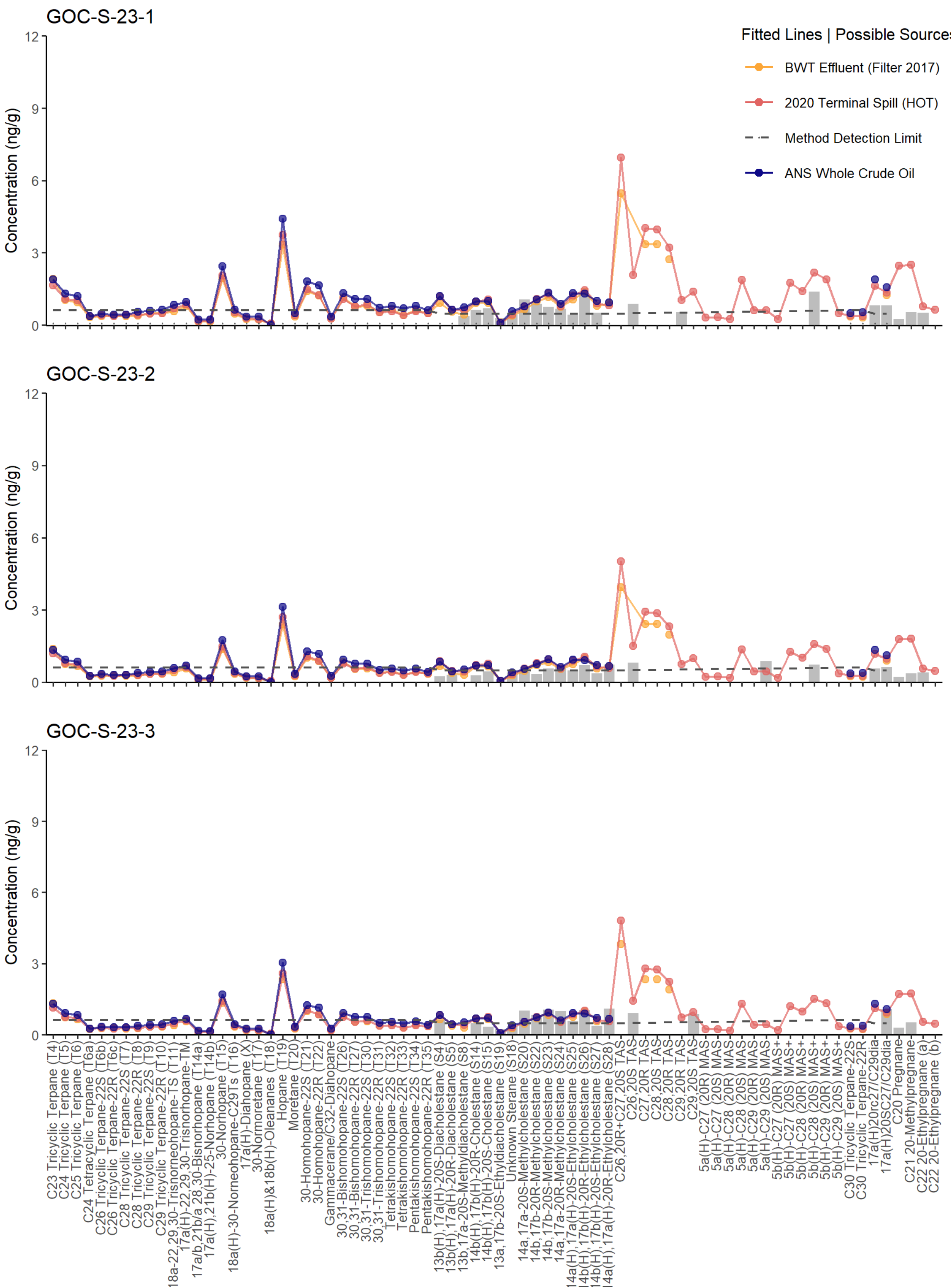


Figure 19. 2023 Petroleum chemical biomarker profiles from individual sediment samples at Gold Creek (GOC) with three possible ANS-related source profiles and the analyte specific method detection limit superimposed as different lines.

Mussel Tissue Data

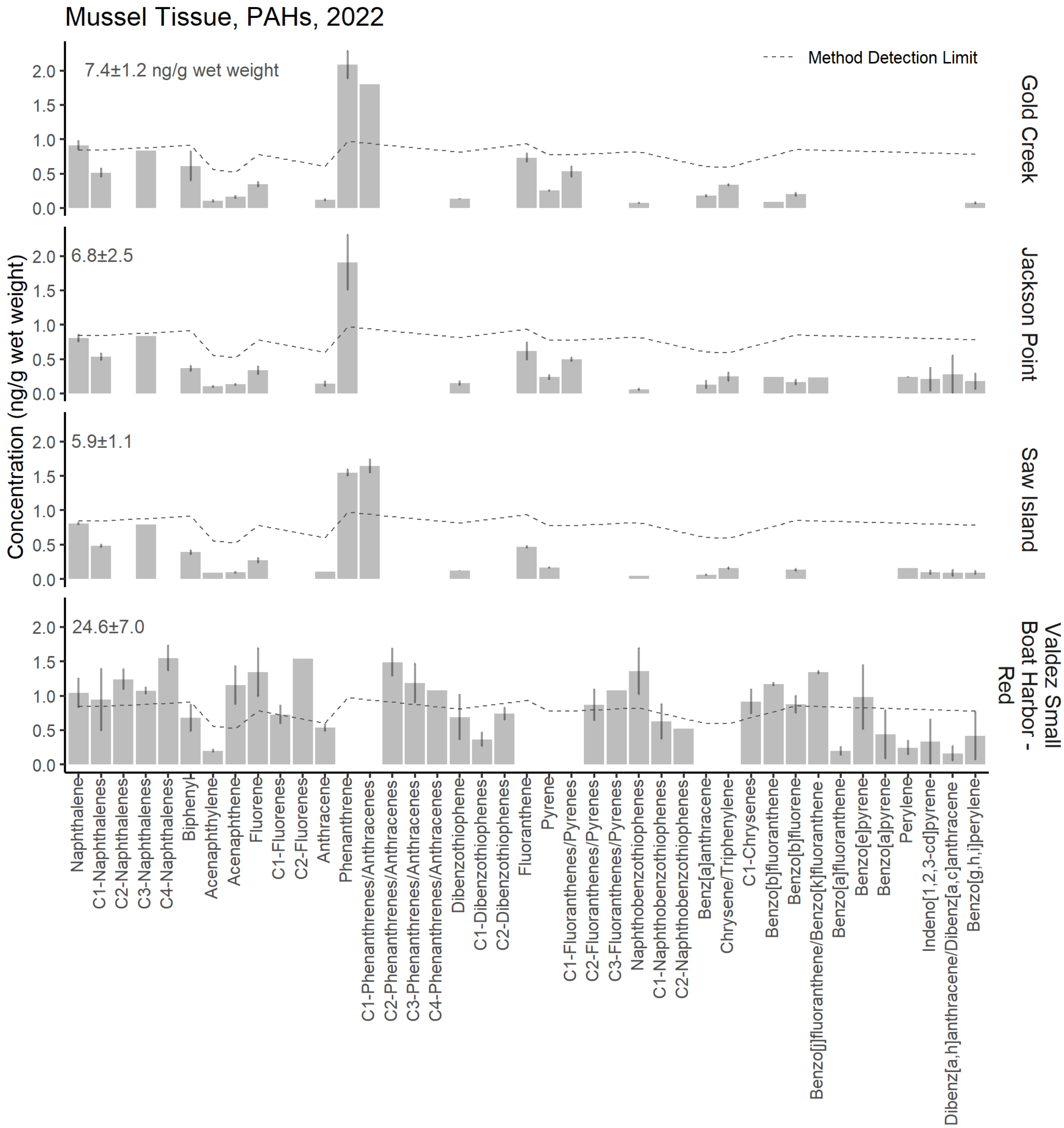


Figure 20. PAH profiles from 2022 mussel tissue samples plotted by mean ± 1 standard deviation. The analyte specific method detection limit is superimposed as a dashed line. Sum 42 PAH values (mean ± 1 standard deviation) are found in the upper left corner of each site profile.

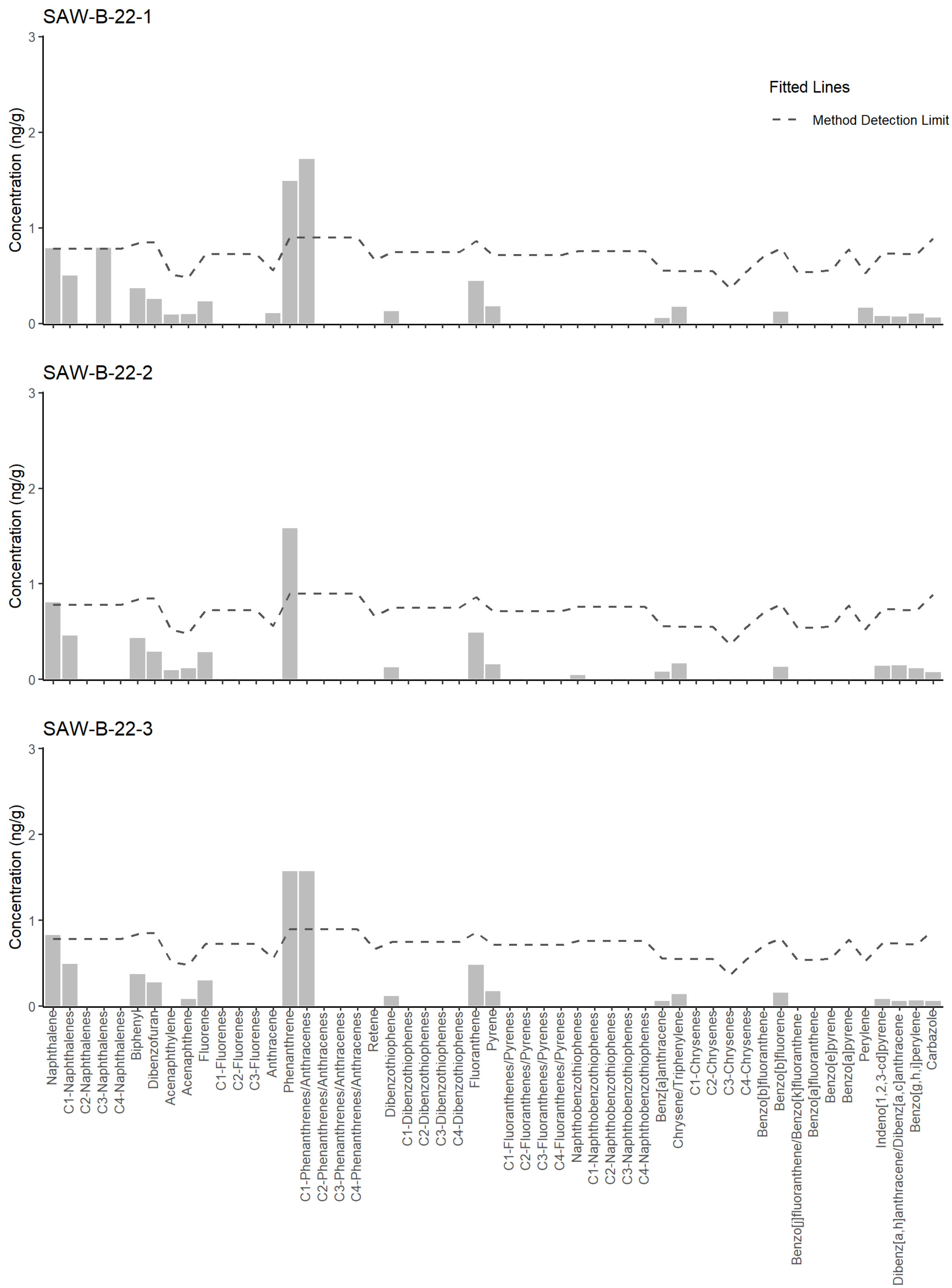


Figure 21. 2022 PAH profiles from individual mussel tissue samples at Saw Island (SAW) with the analyte specific method detection limit superimposed as a dashed line.

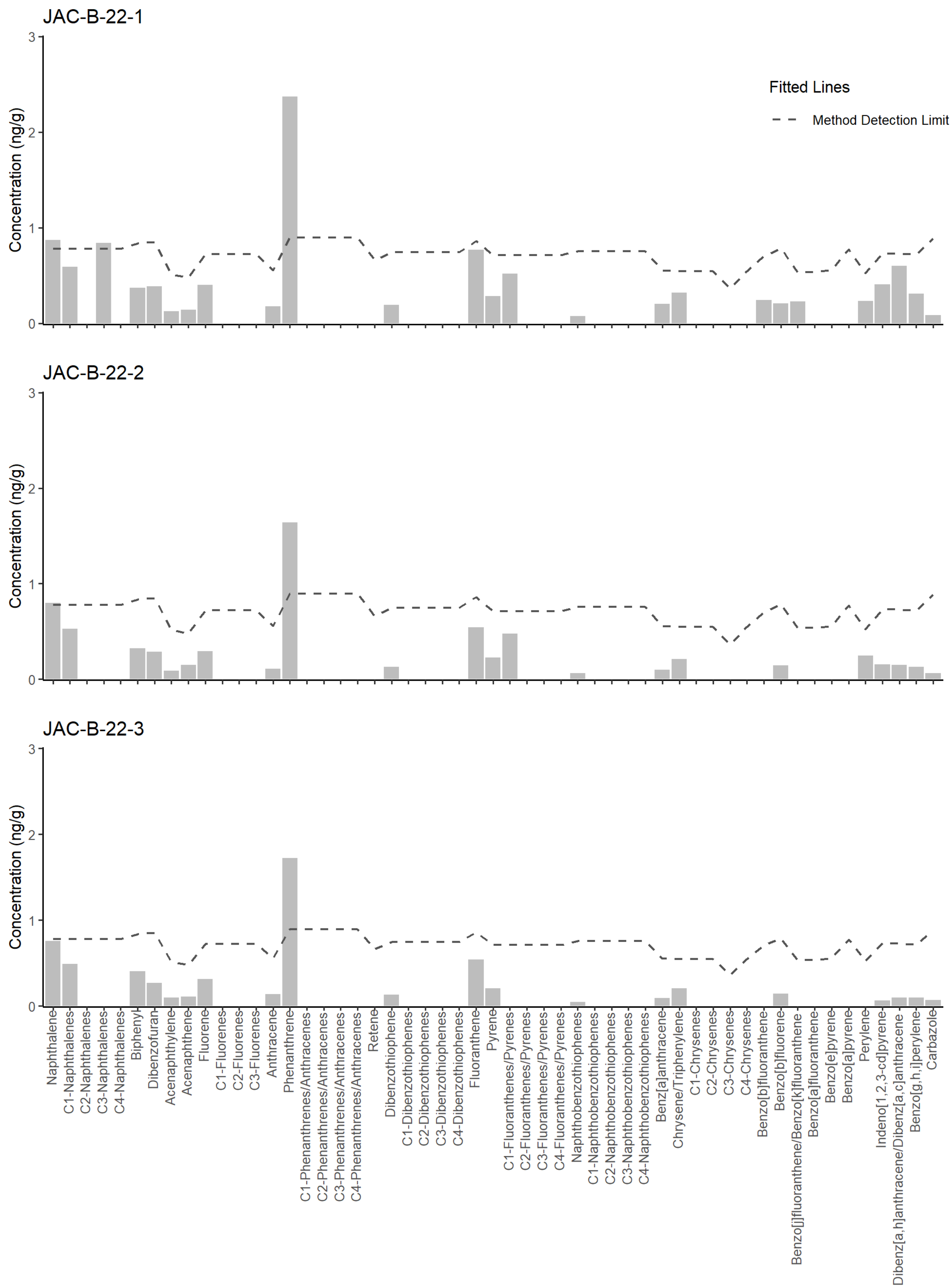


Figure 22. 2022 PAH profiles from individual mussel tissue samples at Jackson Point (JAC) with the analyte specific method detection limit superimposed as a dashed line.

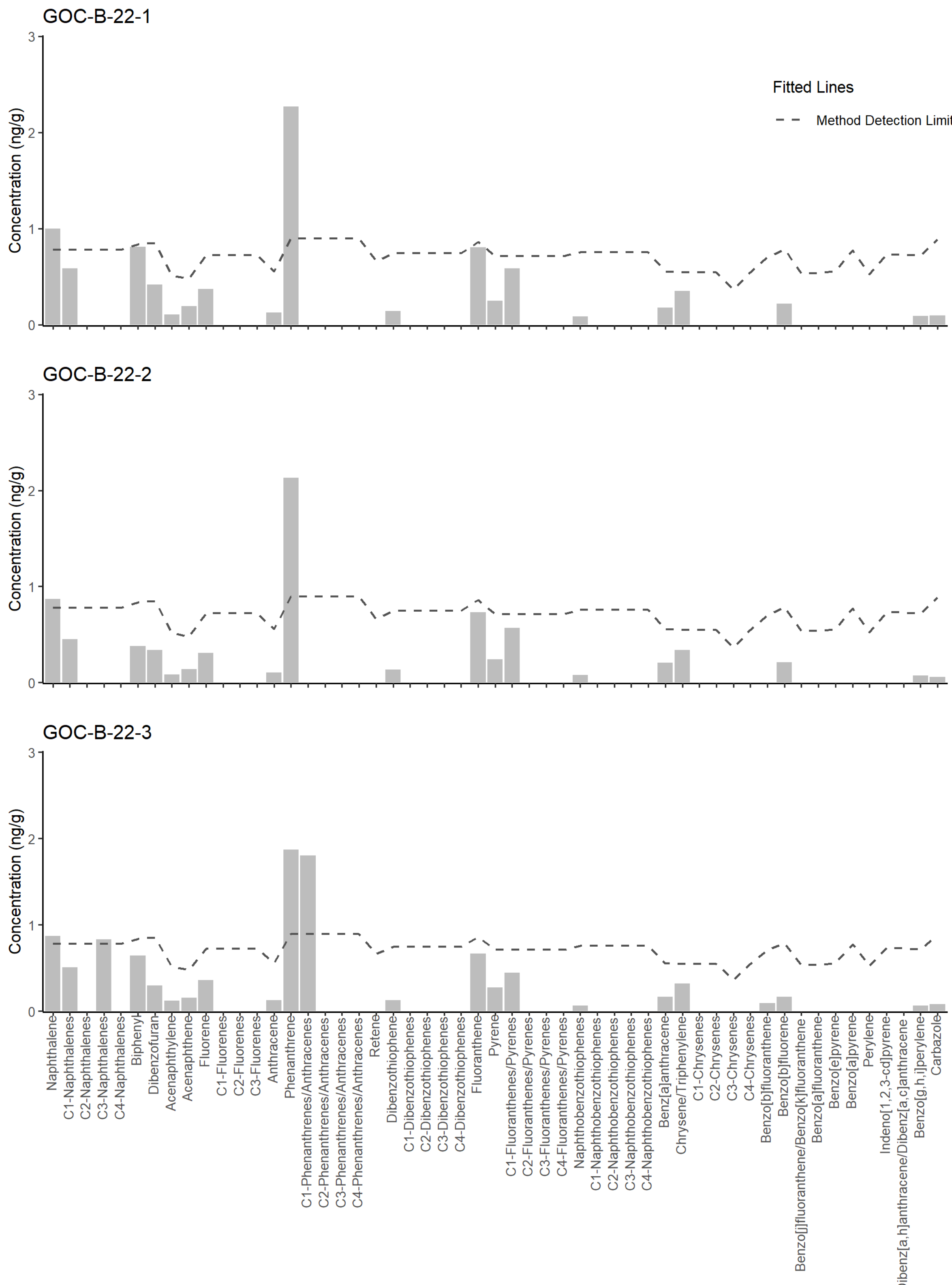


Figure 23. 2022 PAH profiles from individual mussel tissue samples at Gold Creek (GOC) with the analyte specific method detection limit superimposed as different lines.

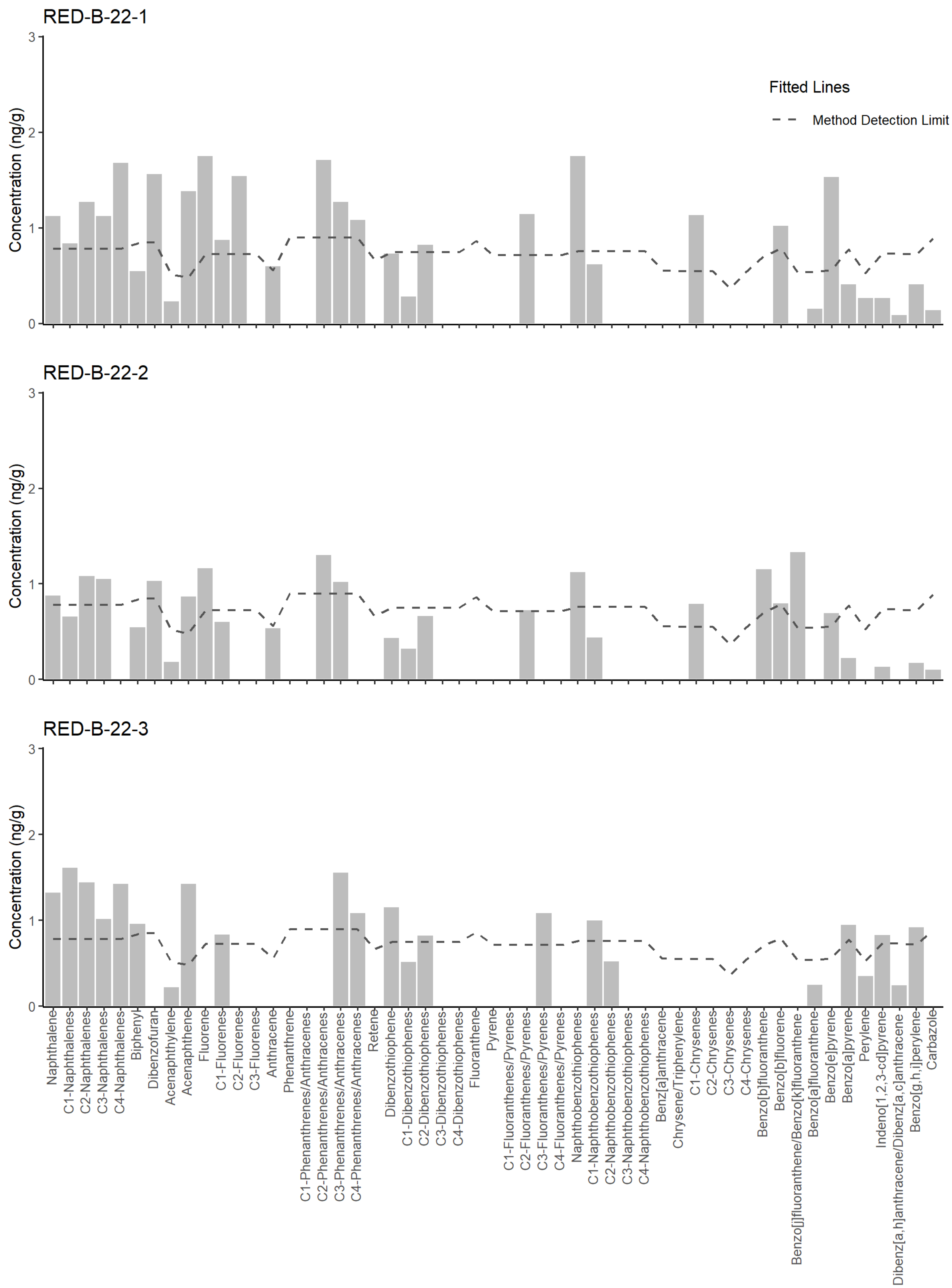


Figure 24. 2022 PAH profiles from individual mussel tissue samples at the Valdez Small Boat Harbor entrance (RED) with the analyte specific method detection limit superimposed as a dashed line.

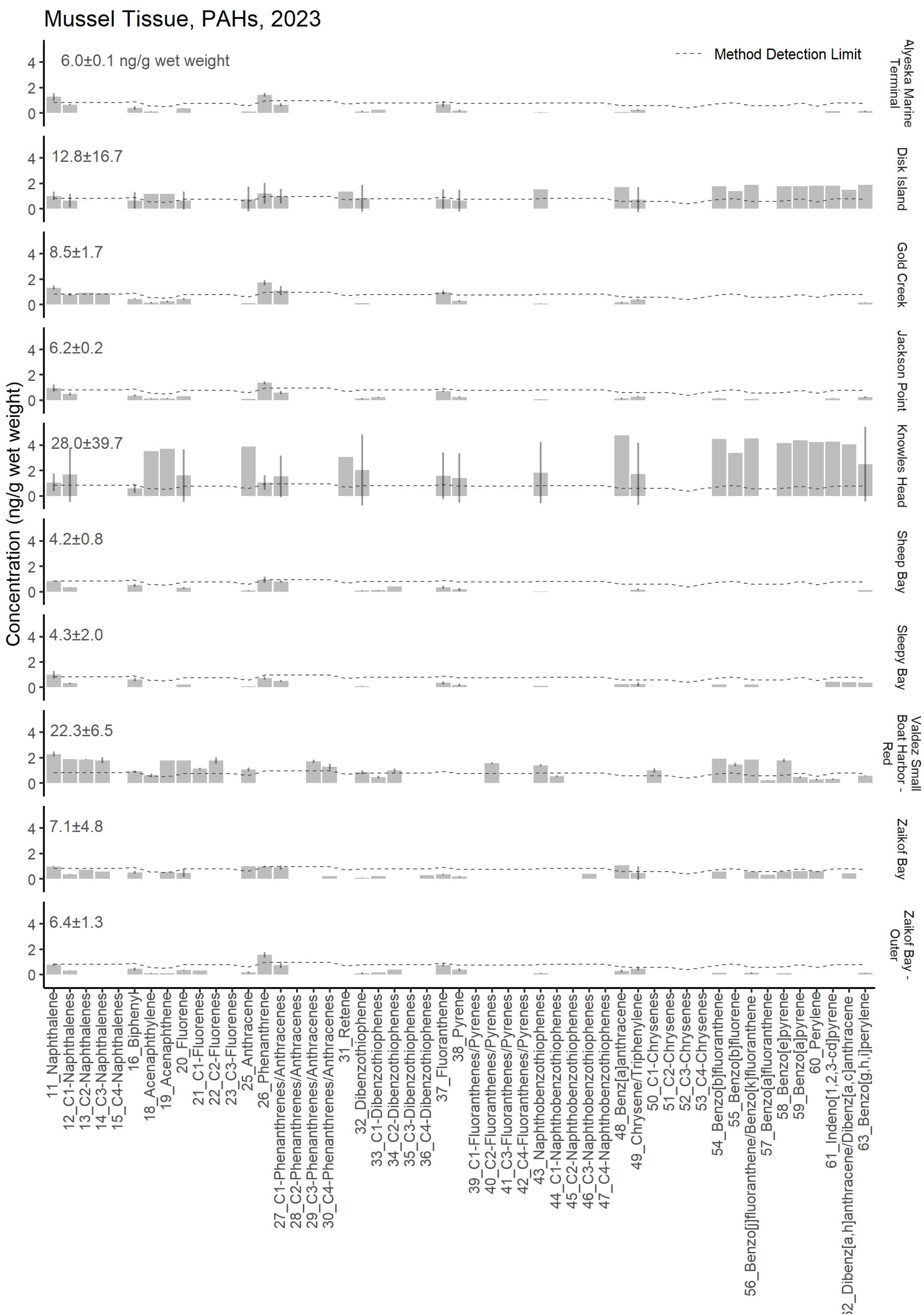


Figure 25. PAH profiles from 2023 mussel tissue samples plotted by mean ± 1 standard deviation. The analyte specific method detection limit is superimposed as a dashed line. Sum 42 PAH values (mean ± 1 standard deviation) are found in the upper left corner of each site profile.

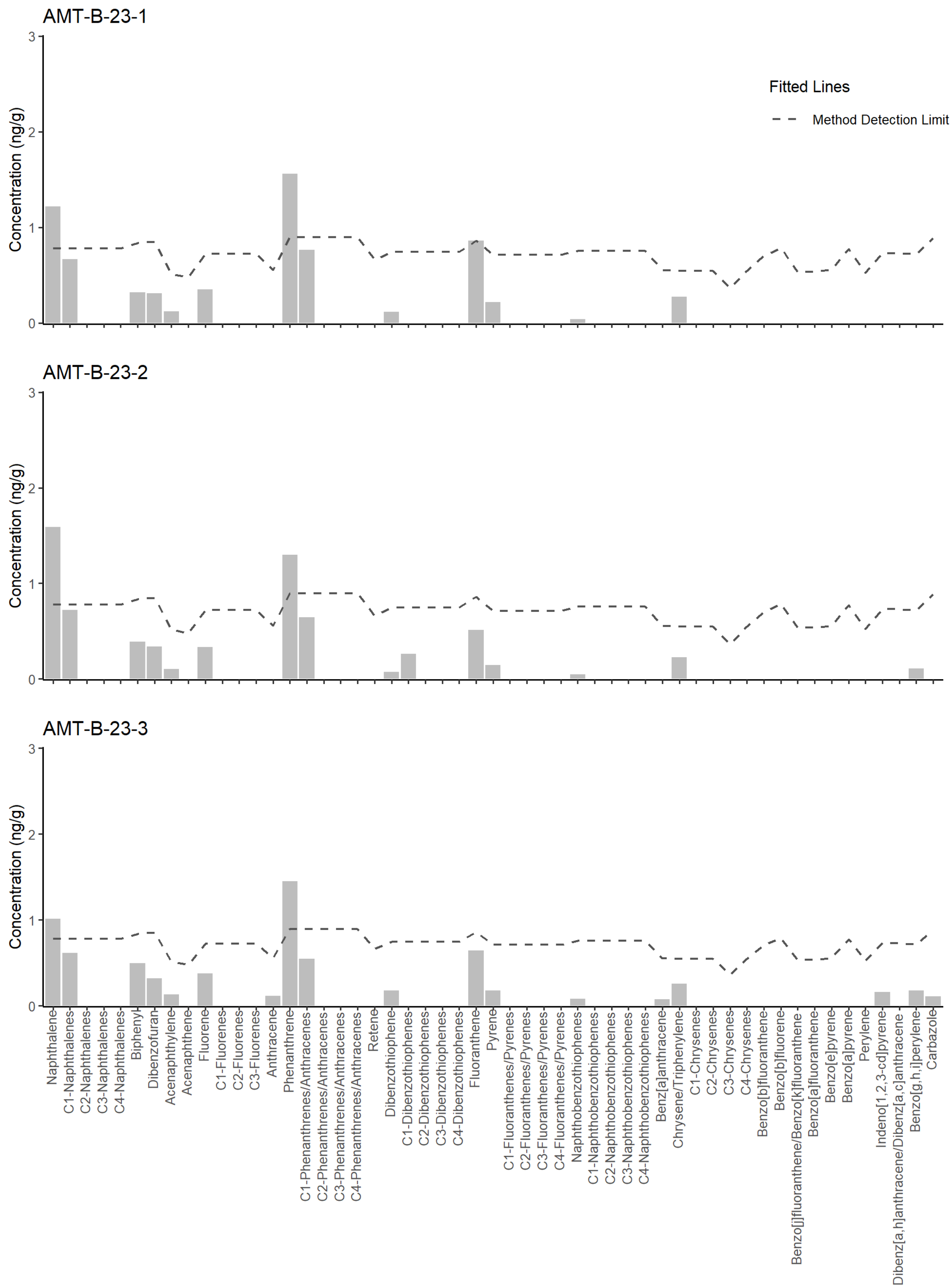


Figure 26. 2023 PAH profiles from individual mussel tissue samples at the Valdez Marine Terminal / Saw Island (AMT/SAW) with the analyte specific method detection limit superimposed as a dashed line.

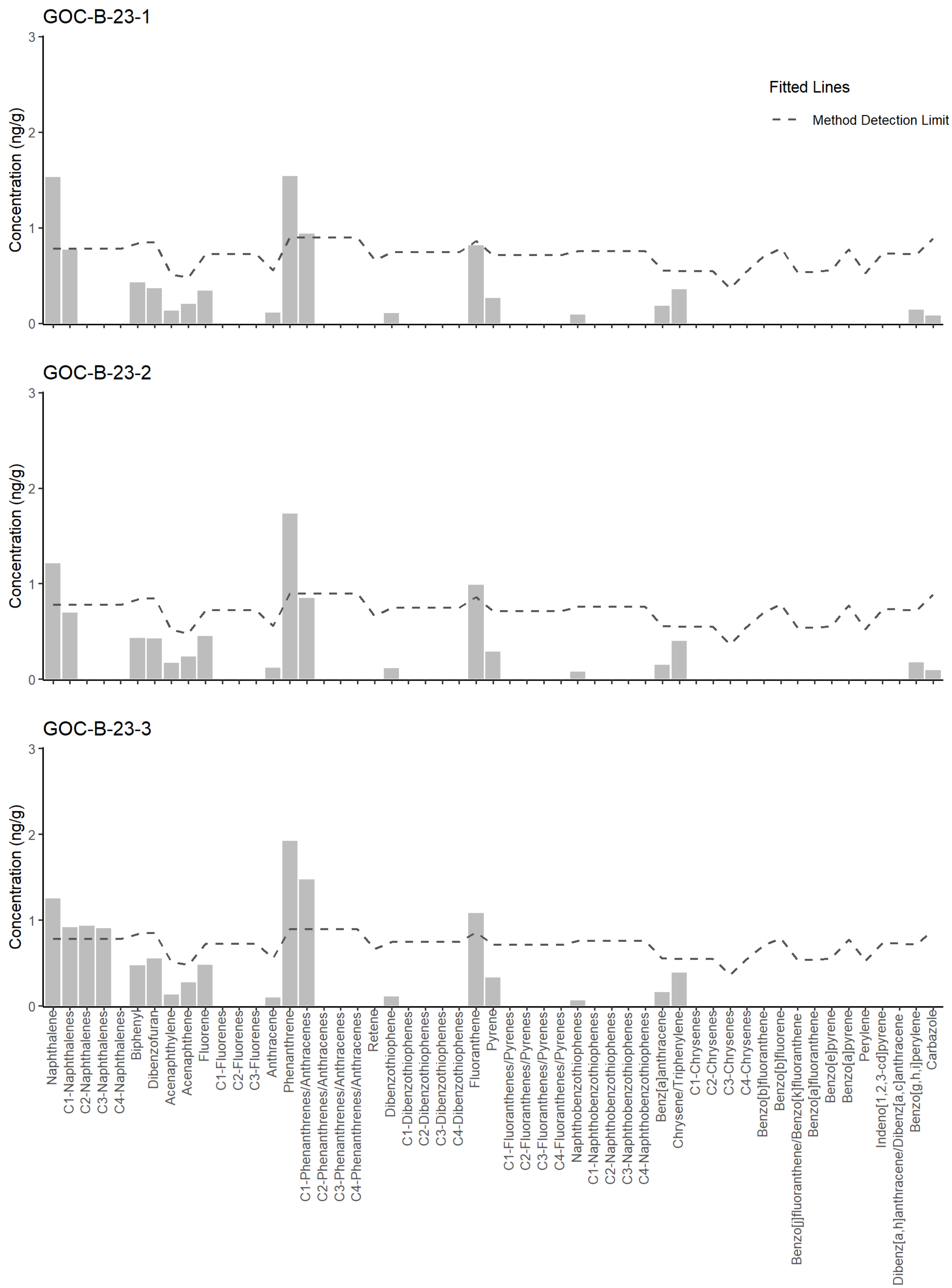


Figure 27. 2023 PAH profiles from individual mussel tissue samples at Gold Creek (GOC) with the analyte specific method detection limit superimposed as a dashed line.

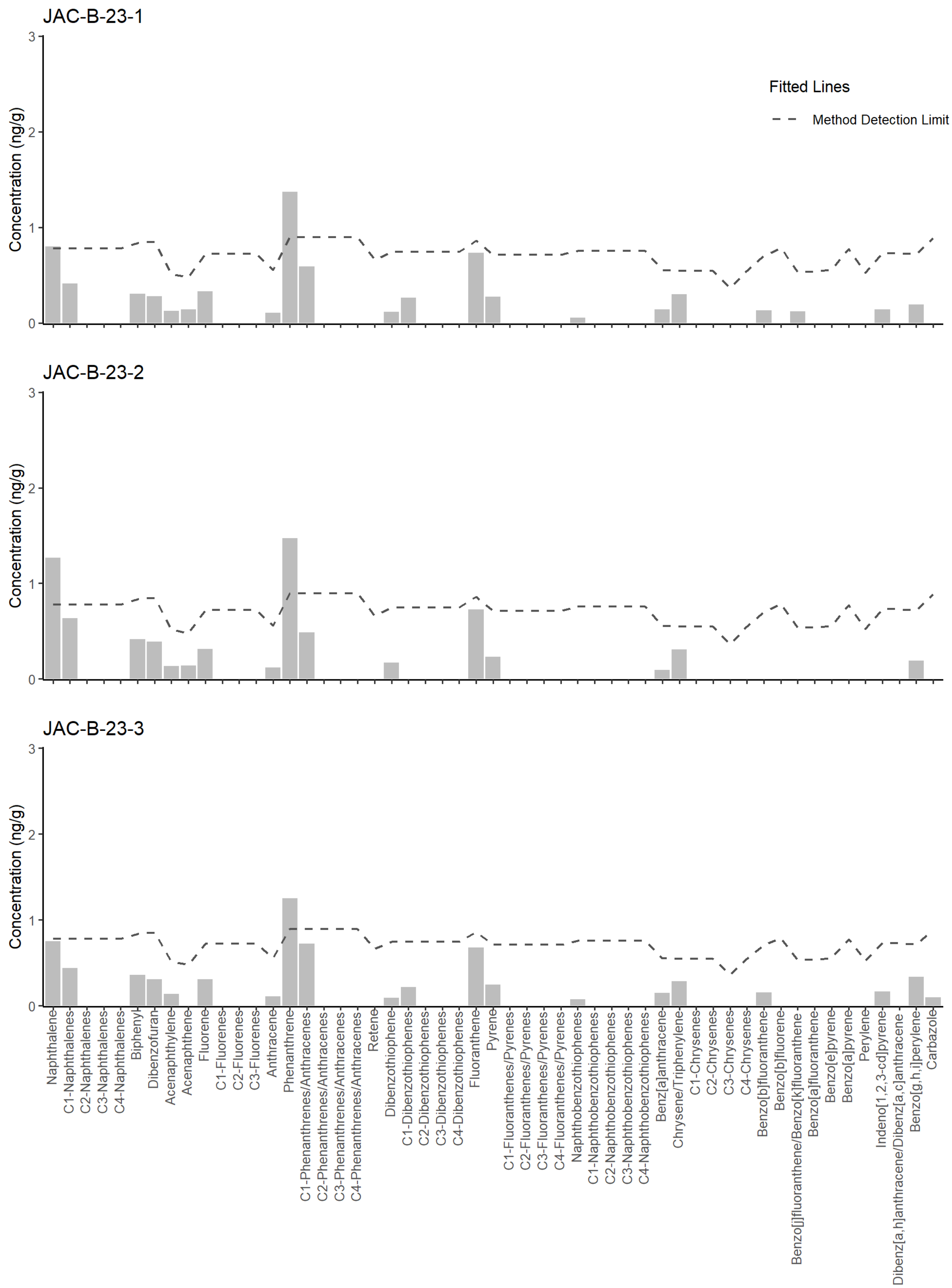


Figure 28. 2023 PAH profiles from individual mussel tissue samples at Jackson Point (JAC) with the analyte specific method detection limit superimposed as a dashed line.

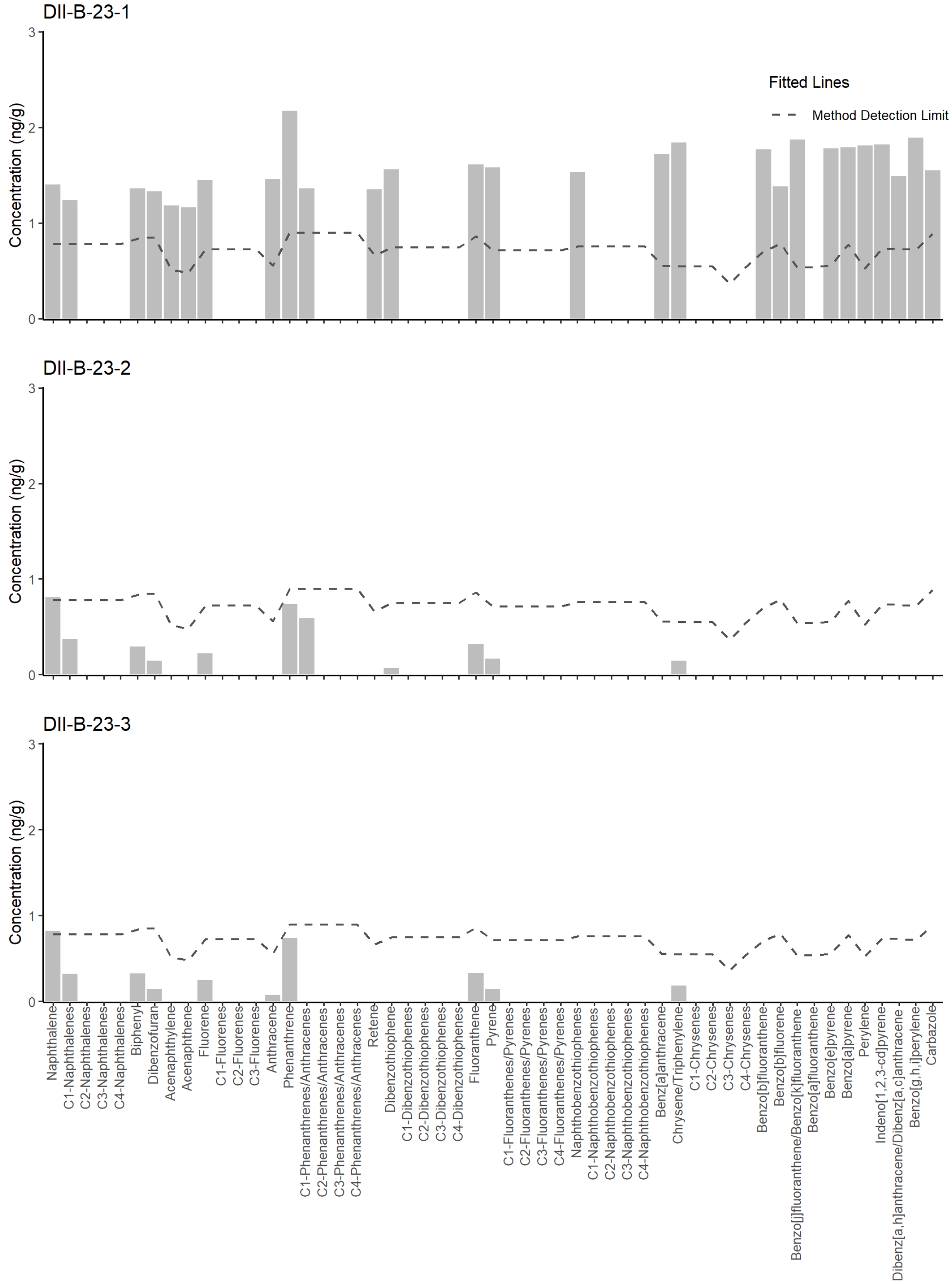


Figure 29. 2023 PAH profiles from individual mussel tissue samples at Disk Island (DII) with the analyte specific method detection limit superimposed as a dashed line.

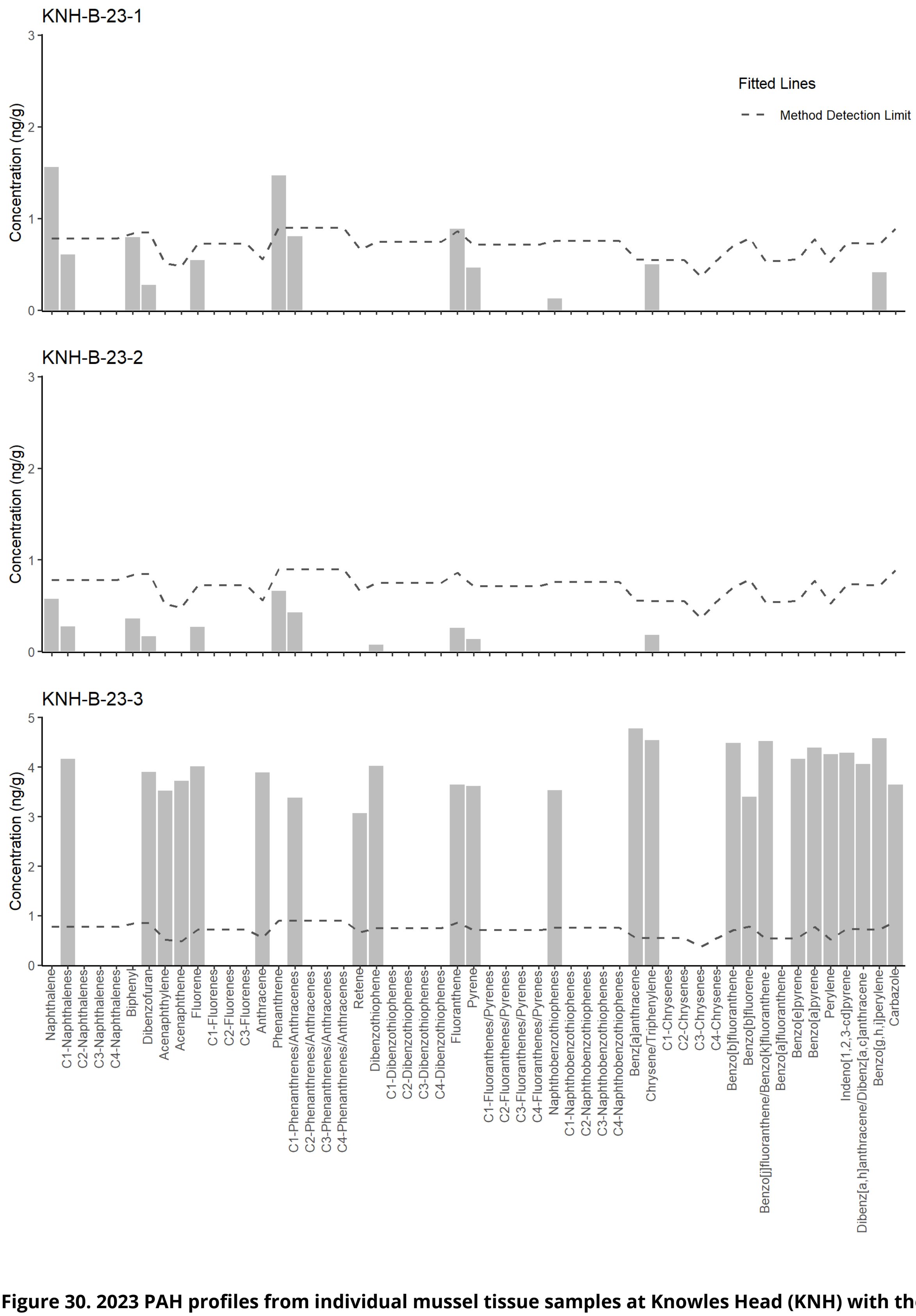


Figure 30. 2023 PAH profiles from individual mussel tissue samples at Knowles Head (KNH) with the analyte specific method detection limit superimposed as a dashed line.

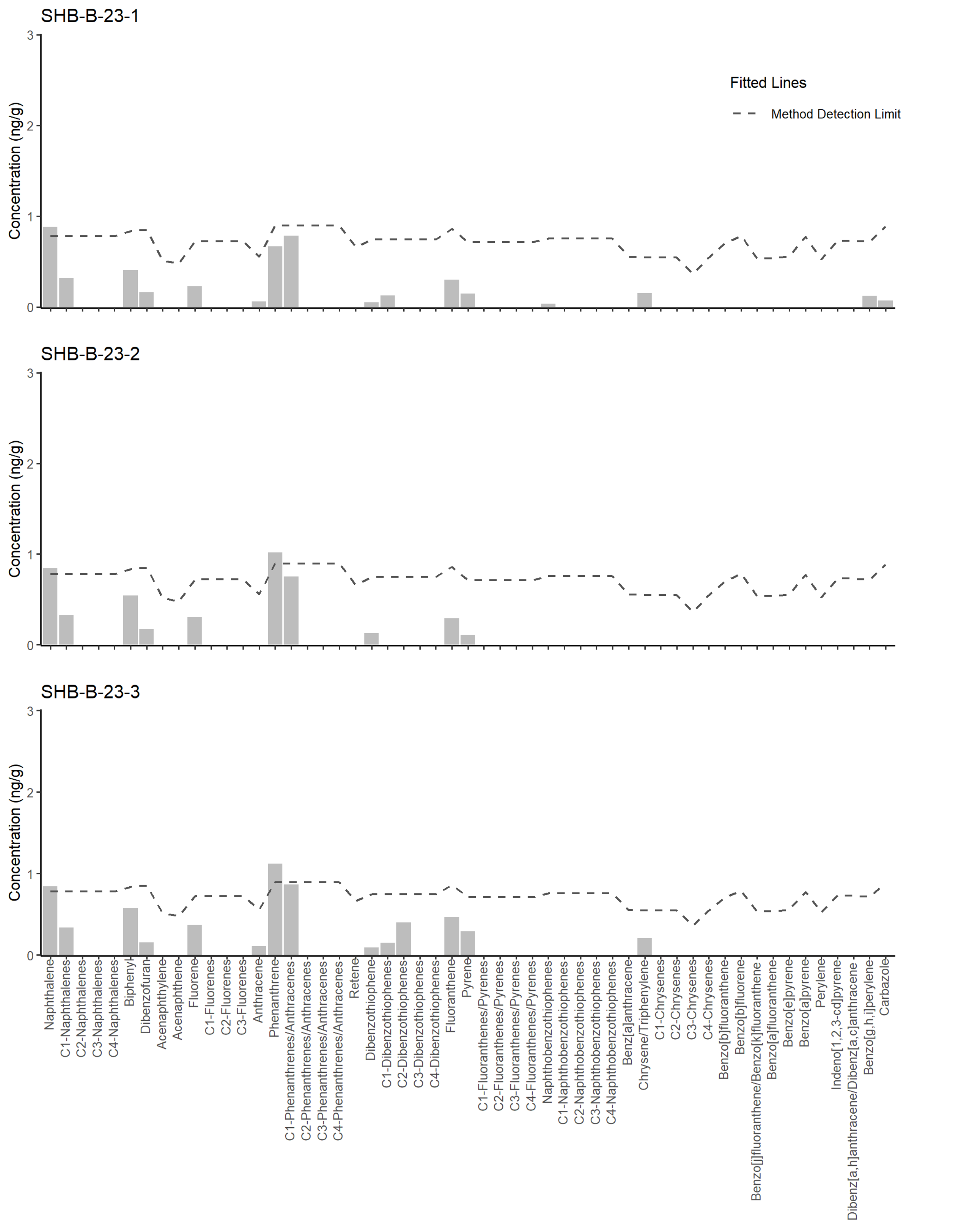


Figure 31. 2023 PAH profiles from individual mussel tissue samples at Sheep Bay (SHB) with the analyte specific method detection limit superimposed as a dashed line.

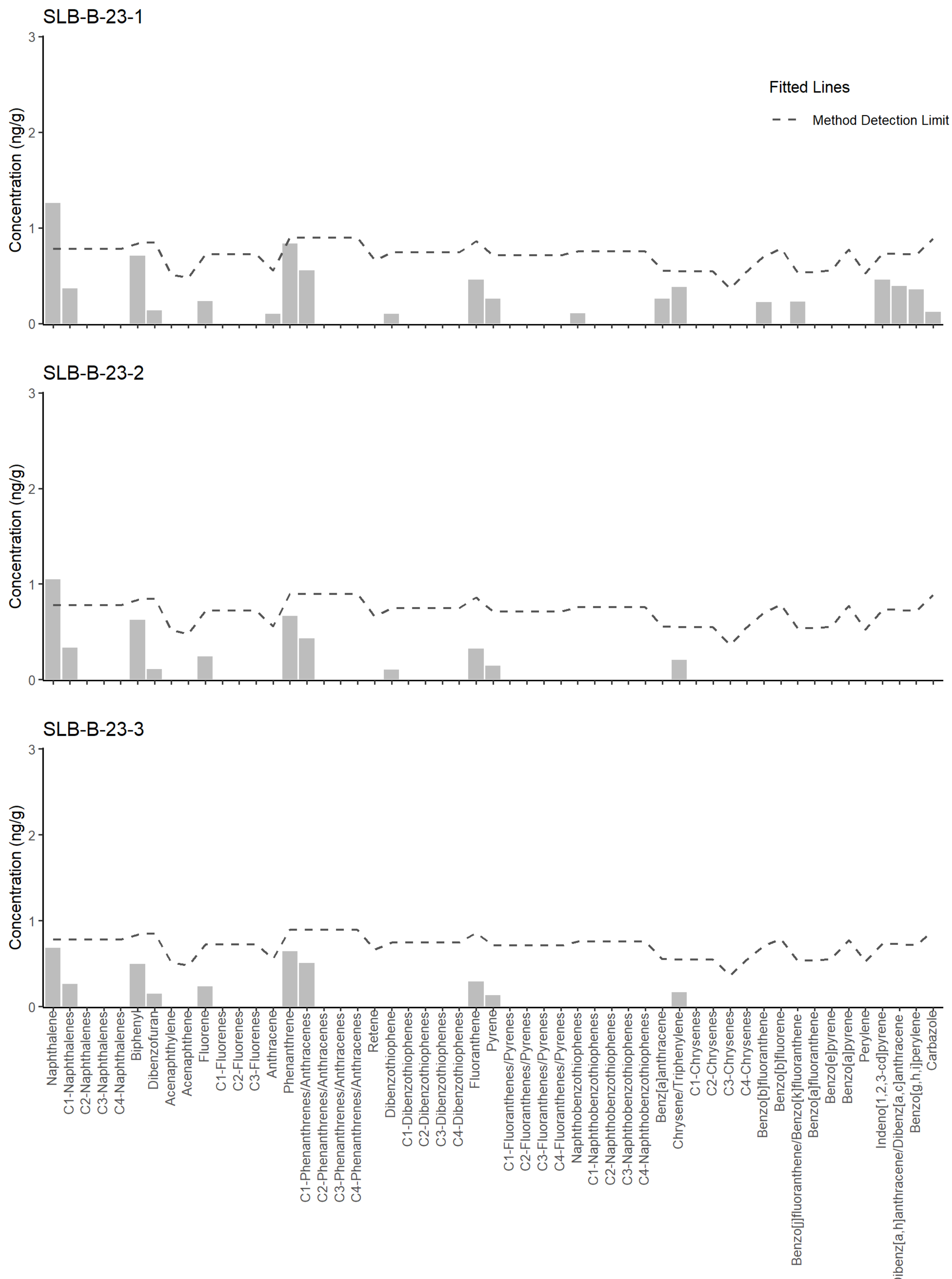


Figure 32. 2023 PAH profiles from individual mussel tissue samples at Sleepy Bay (SLB) with the analyte specific method detection limit superimposed as a dashed line.

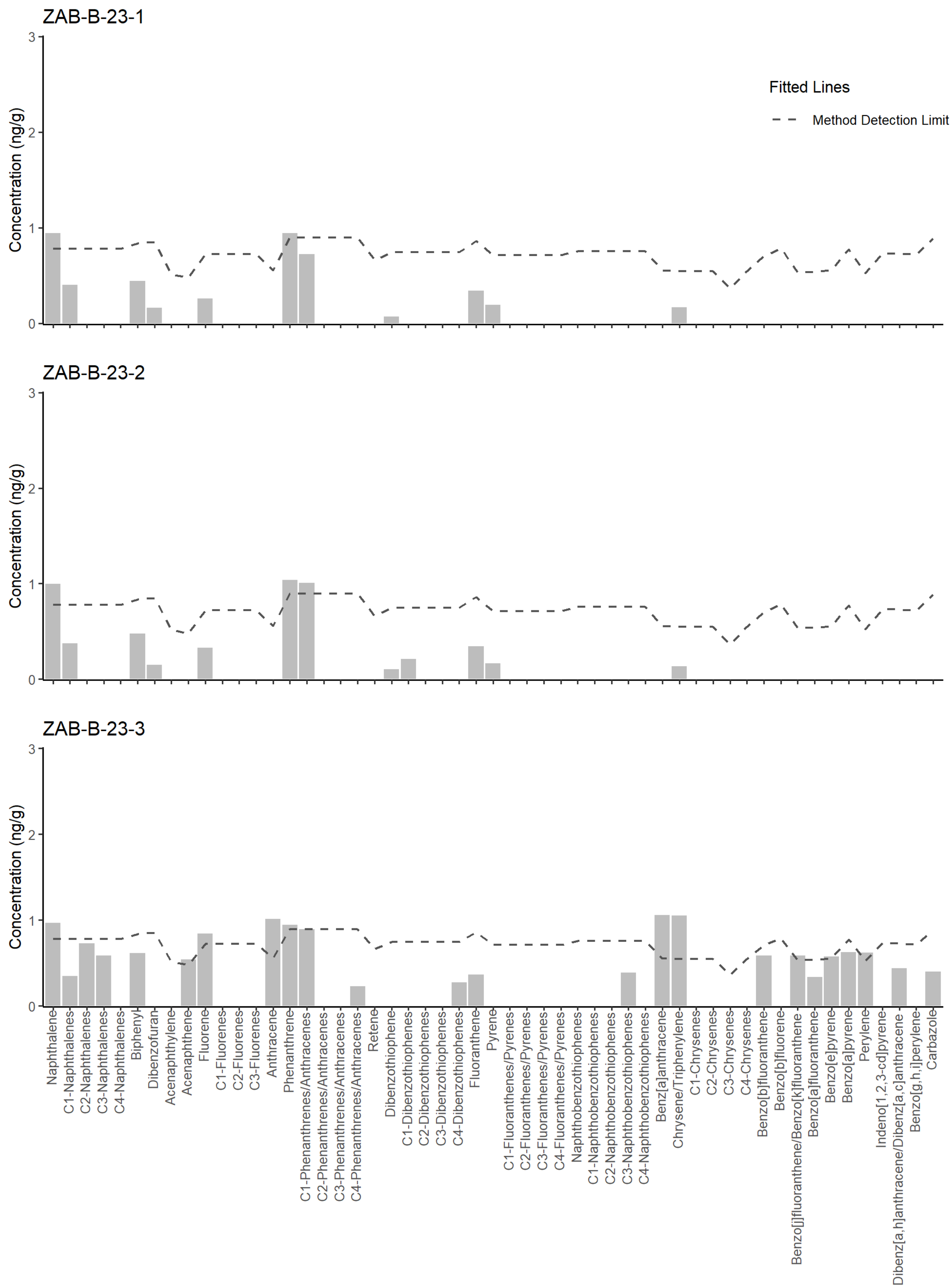


Figure 33. 2023 PAH profiles from individual mussel tissue samples Zaikof Bay (ZAB) with the analyte specific method detection limit superimposed as a dashed line.

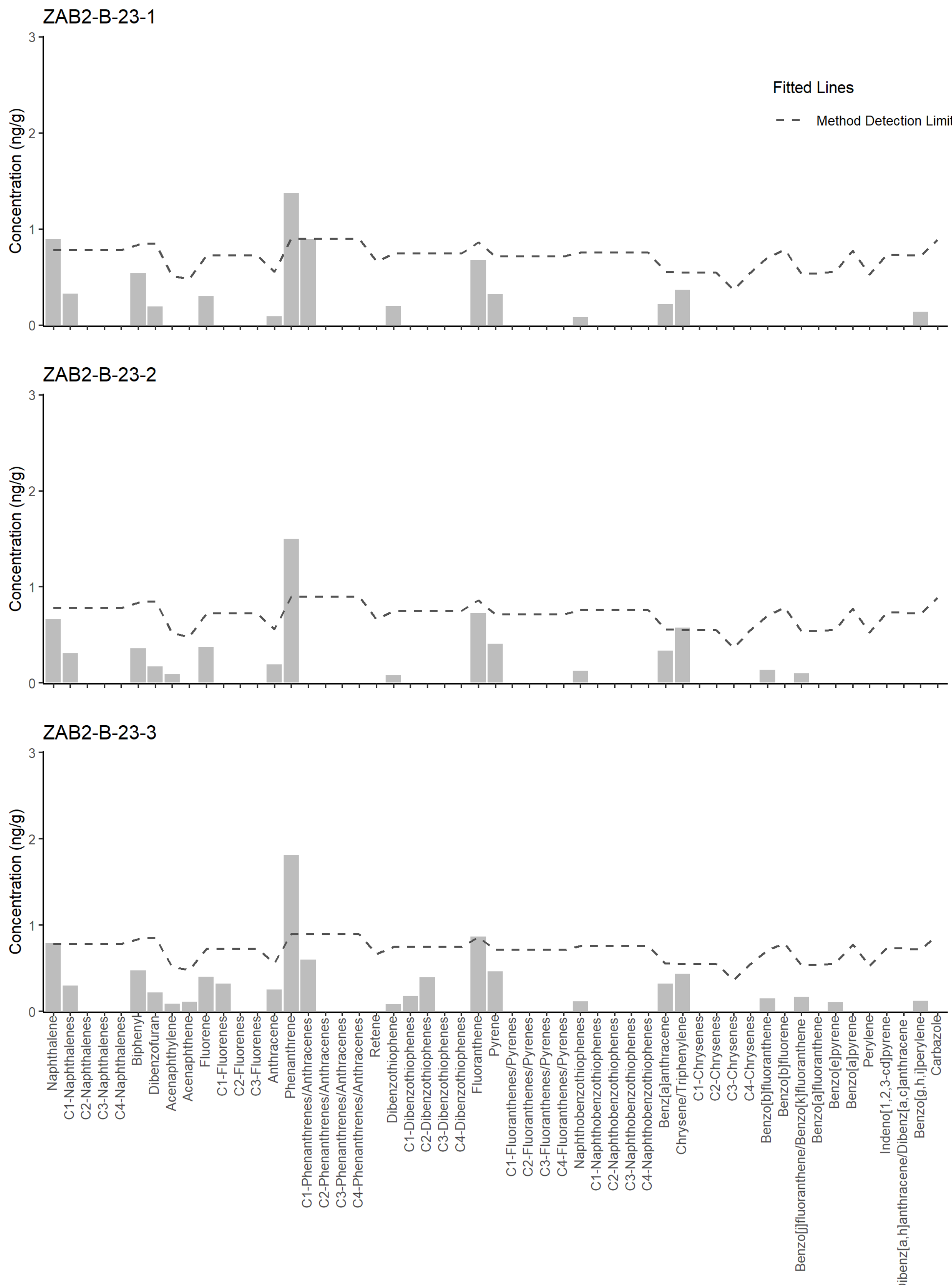


Figure 34. 2023 PAH profiles from individual mussel tissue samples at a new outer station in Zaikof Bay (ZAB) with the analyte specific method detection limit superimposed as a dashed line.

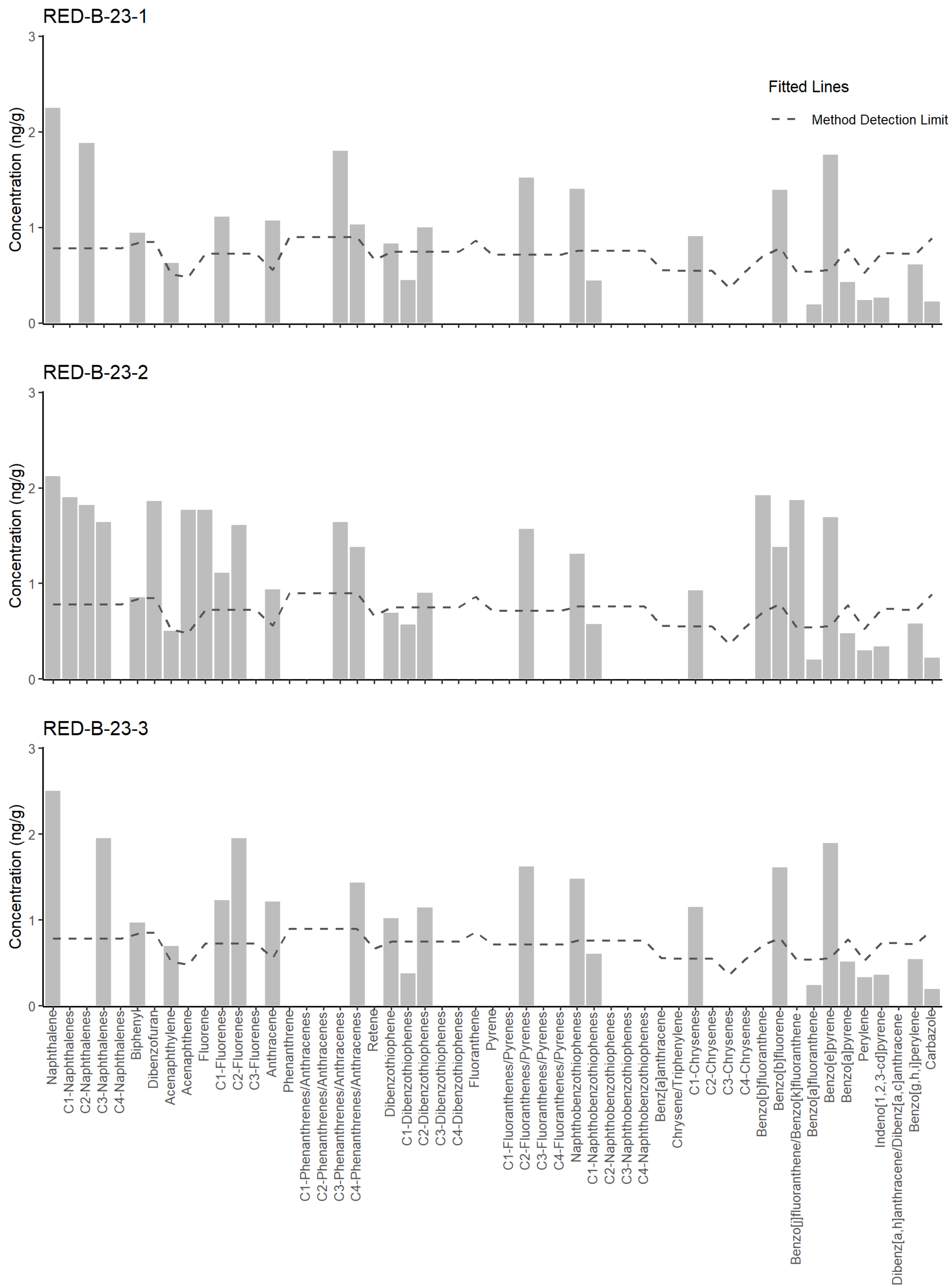


Figure 35. 2023 PAH profiles from individual mussel tissue samples at the Valdez Small Boat Harbor Red light (RED) with the analyte specific method detection limit superimposed as a dashed line.

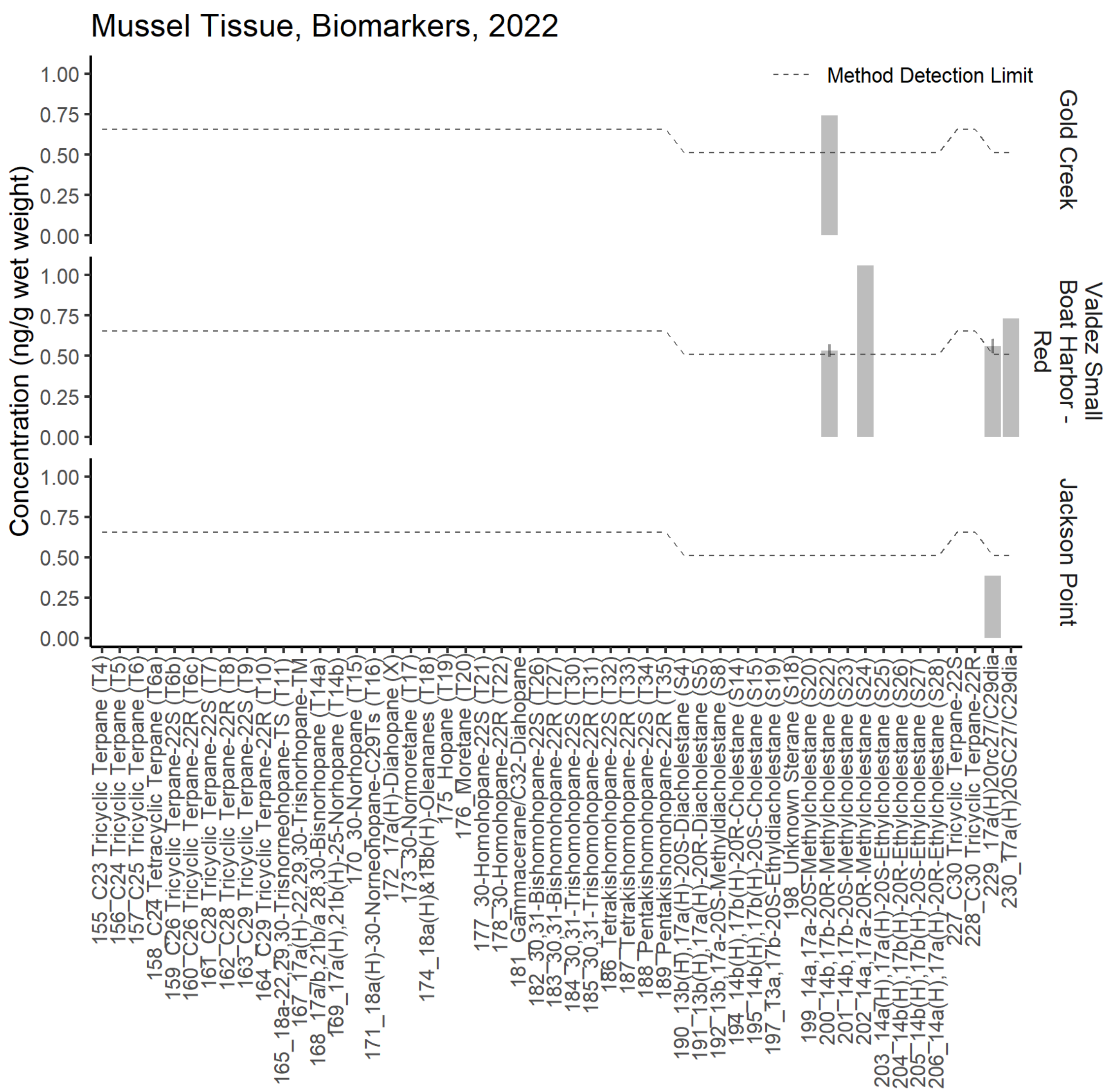


Figure 36. 2022 Petroleum chemical biomarker profiles from mussel tissue samples plotted by mean ± 1 standard deviation. The analyte specific method detection limit is superimposed as a dashed line.

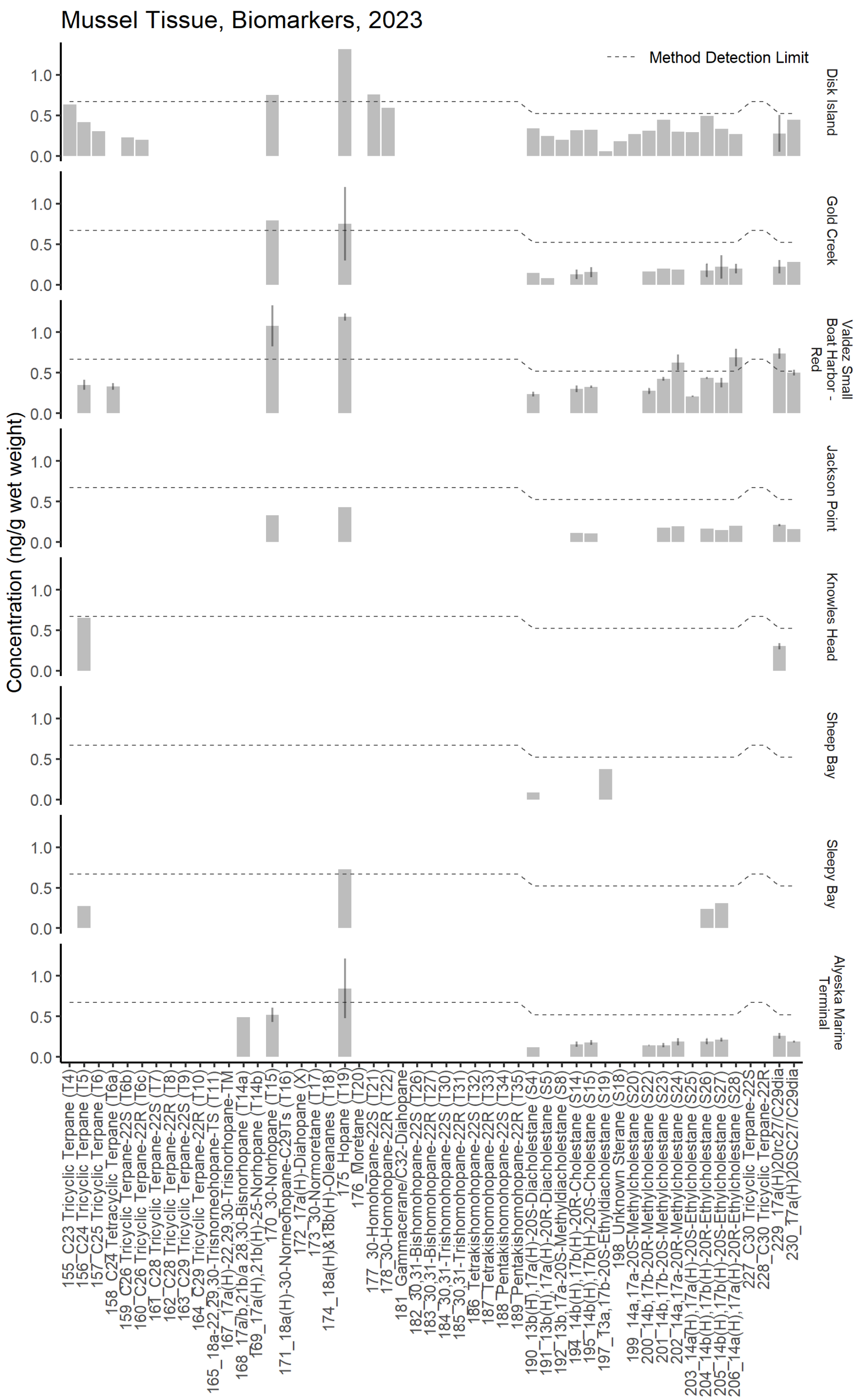


Figure 37. 2023 Petroleum chemical biomarker profiles from mussel tissue samples plotted by mean ± 1 standard deviation. The analyte specific method detection limit is superimposed as a dashed line.

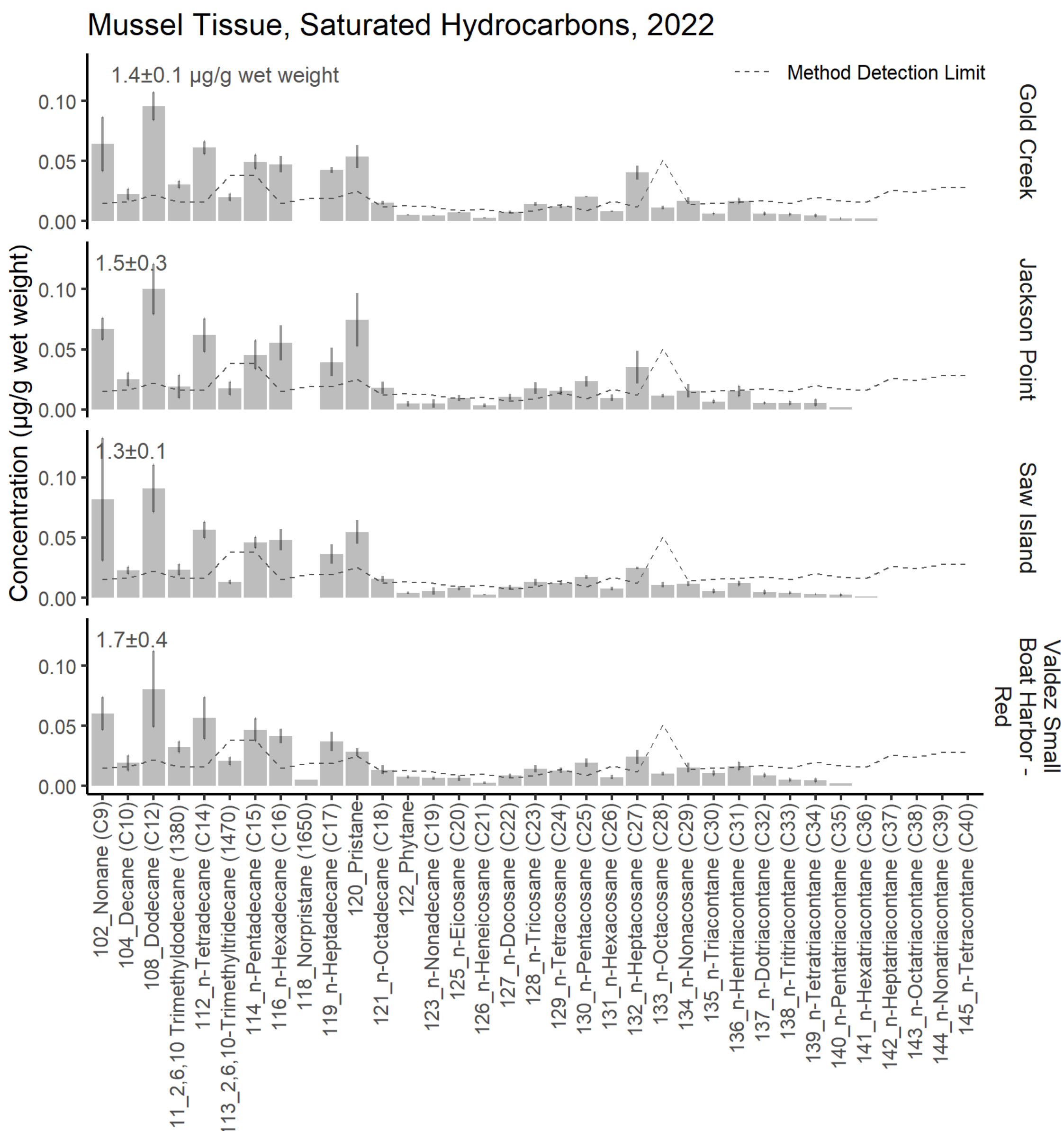


Figure 38. 2022 Saturated hydrocarbons (SHC) profiles from mussel tissue samples plotted by mean ± 1 standard deviation. The analyte specific method detection limit is superimposed as a dashed line. Sum SHC values (mean ± 1 standard deviation) are found in the upper left corner of each site profile.

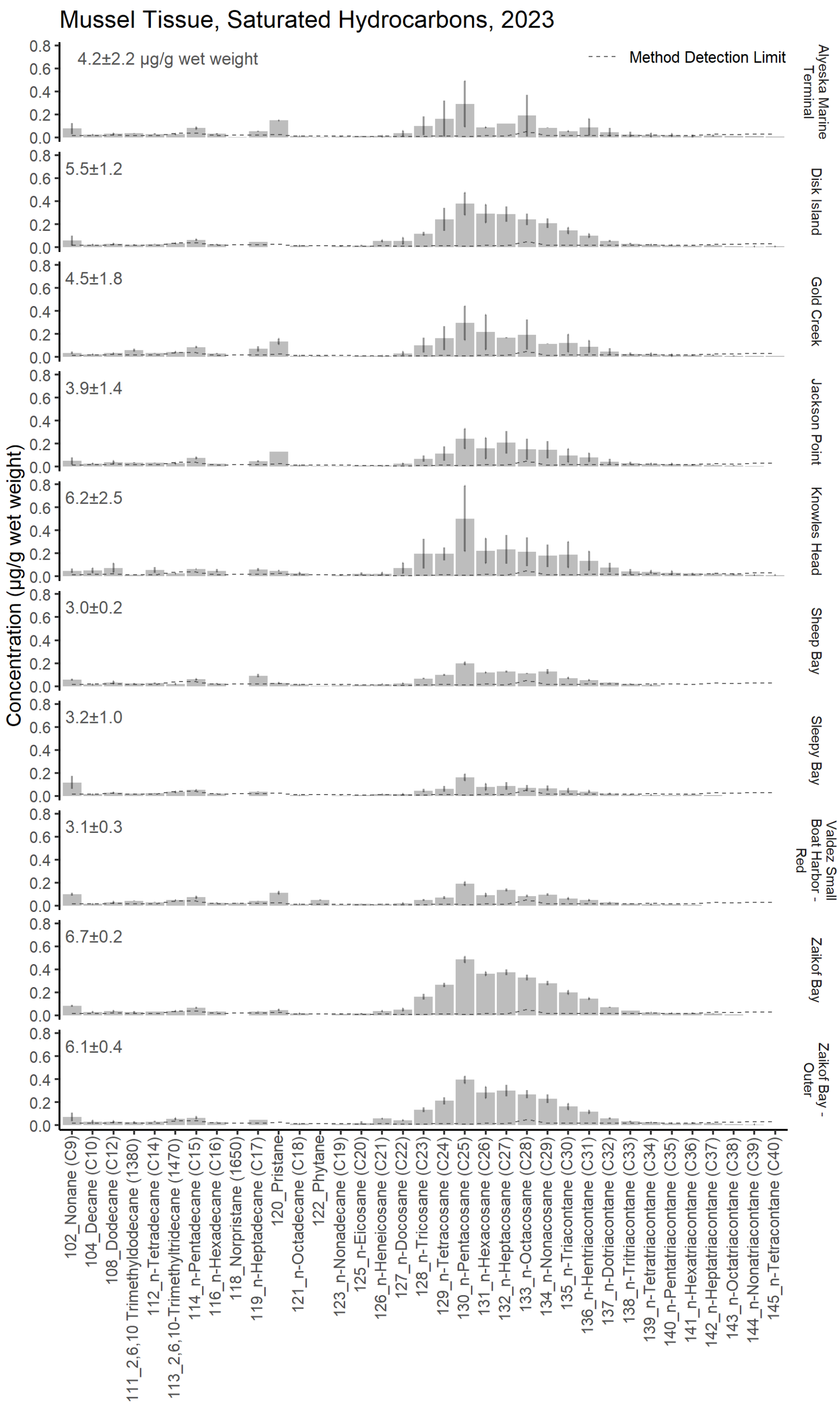


Figure 39. 2023 Saturated hydrocarbons (SHC) profiles from mussel tissue samples plotted by mean ± 1 standard deviation. The analyte specific method detection limit is superimposed as a dashed line. Sum SHC values (mean ± 1 standard deviation) are found in the upper left corner of each site profile.

Laboratory Data

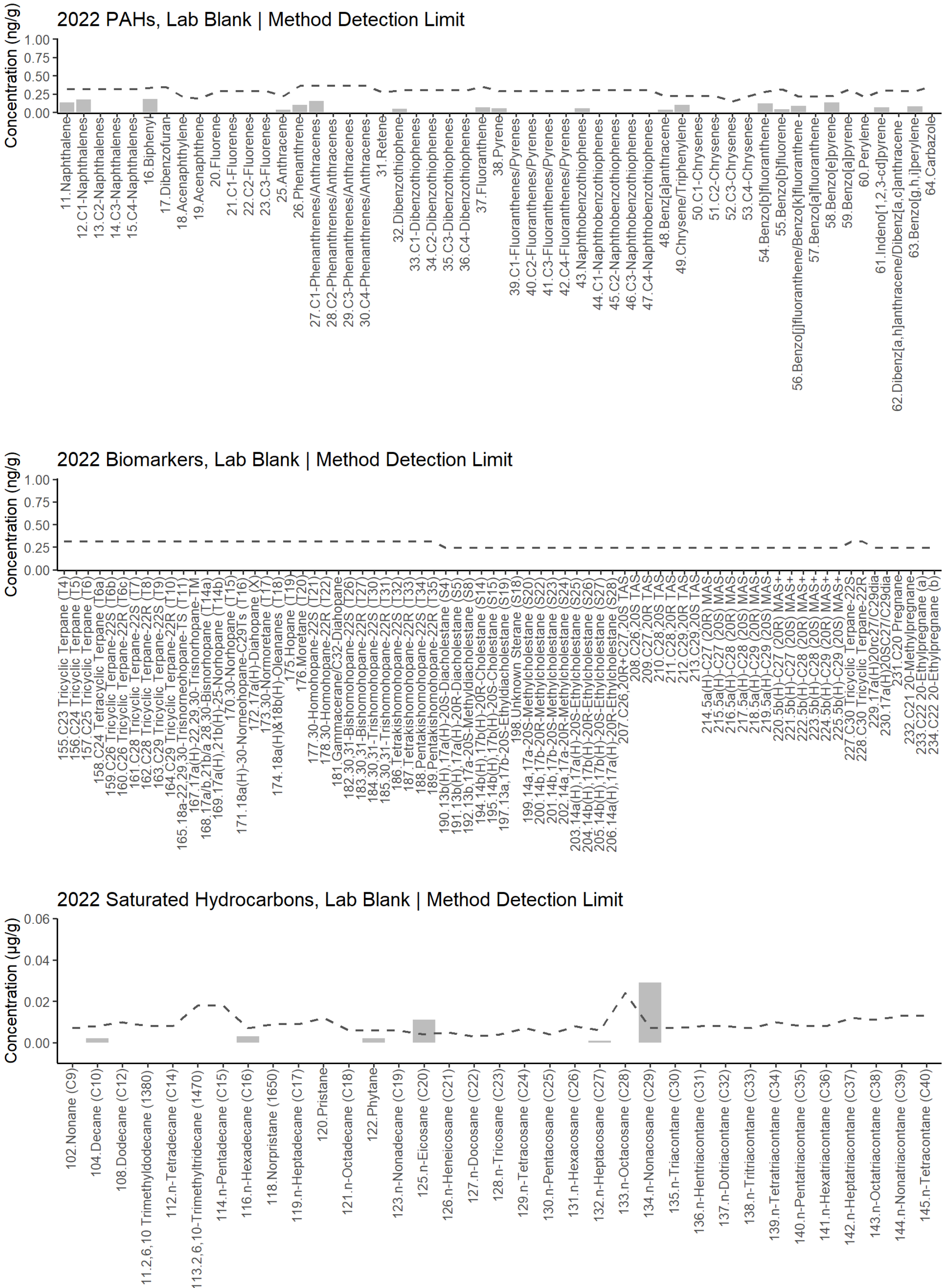


Figure 40. 2022 PAH, biomarker, and saturated hydrocarbon (SHC) profiles from the NewFields laboratory blanks with the analyte specific method detection limit superimposed as a dashed line.

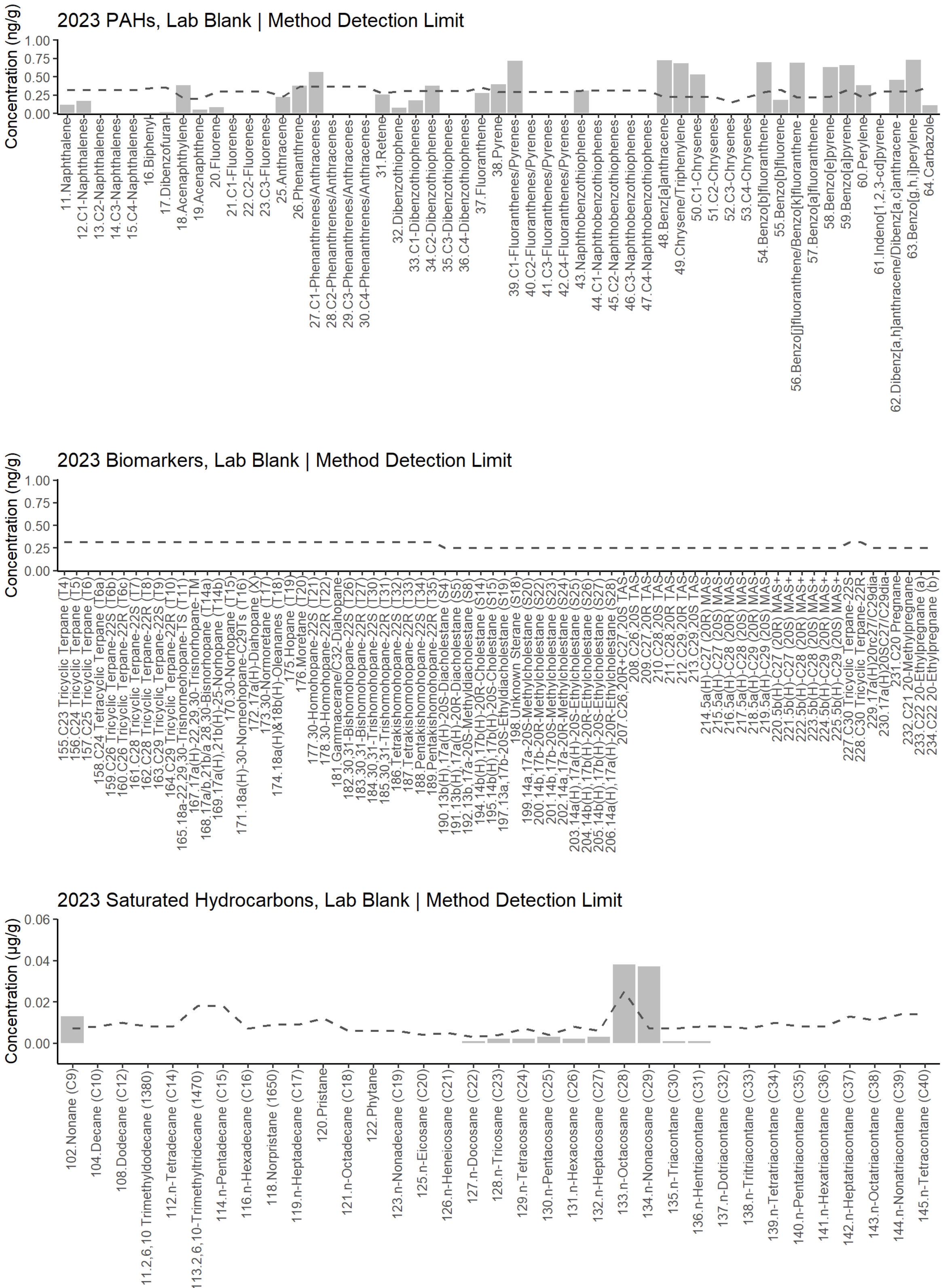


Figure 41. 2023 PAH, biomarker, and saturated hydrocarbon (SHC) profiles from the Alpha Analytical laboratory blanks with the analyte specific method detection limit superimposed as a dashed line.

Water via Passive Sampler Data

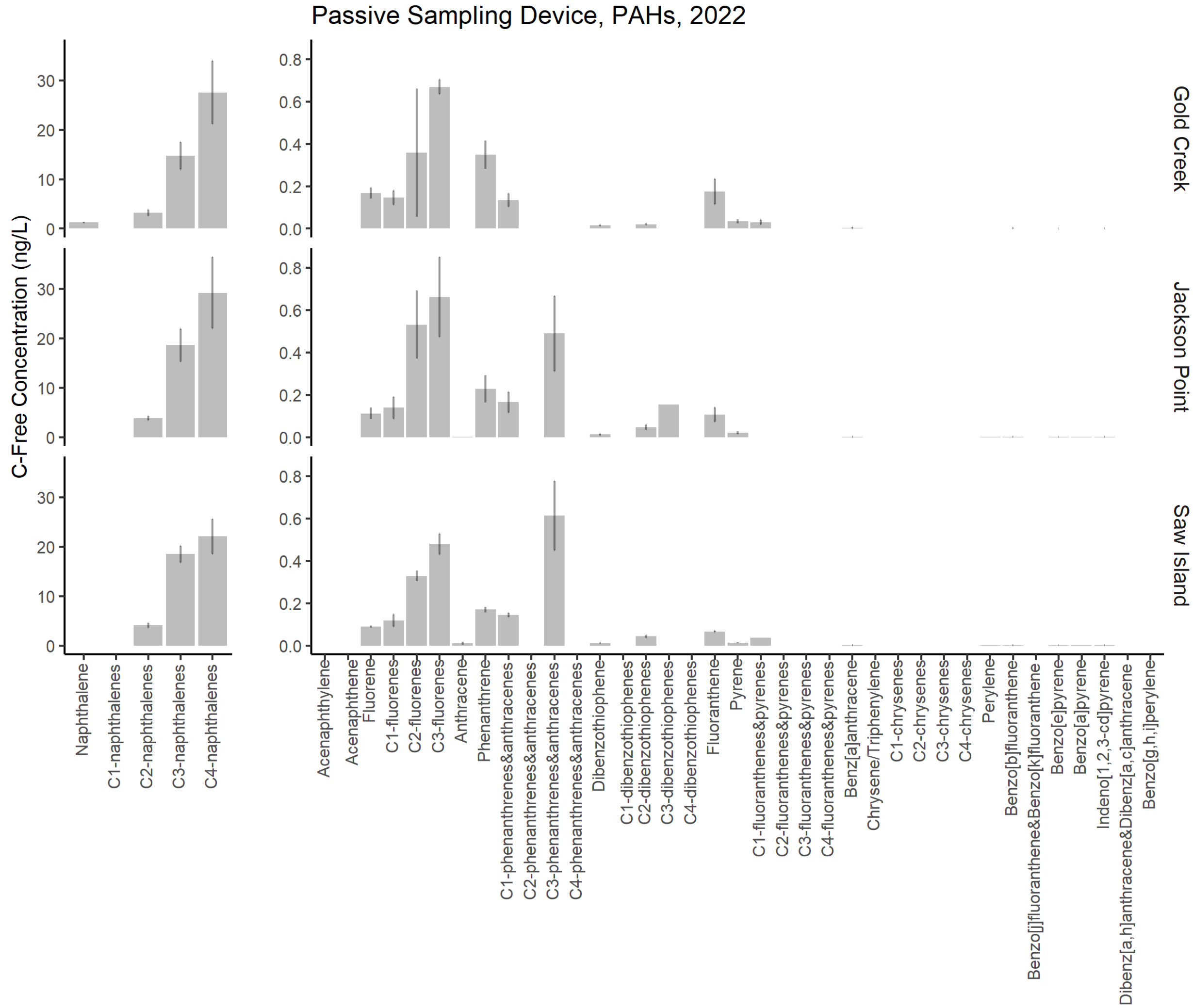


Figure 42. PAH profiles from water sampled via passive sampling devices deployed during LTEMP 2022 at Gold Creek, Jackson Point, and Saw Island plotted by mean value ± standard deviation.

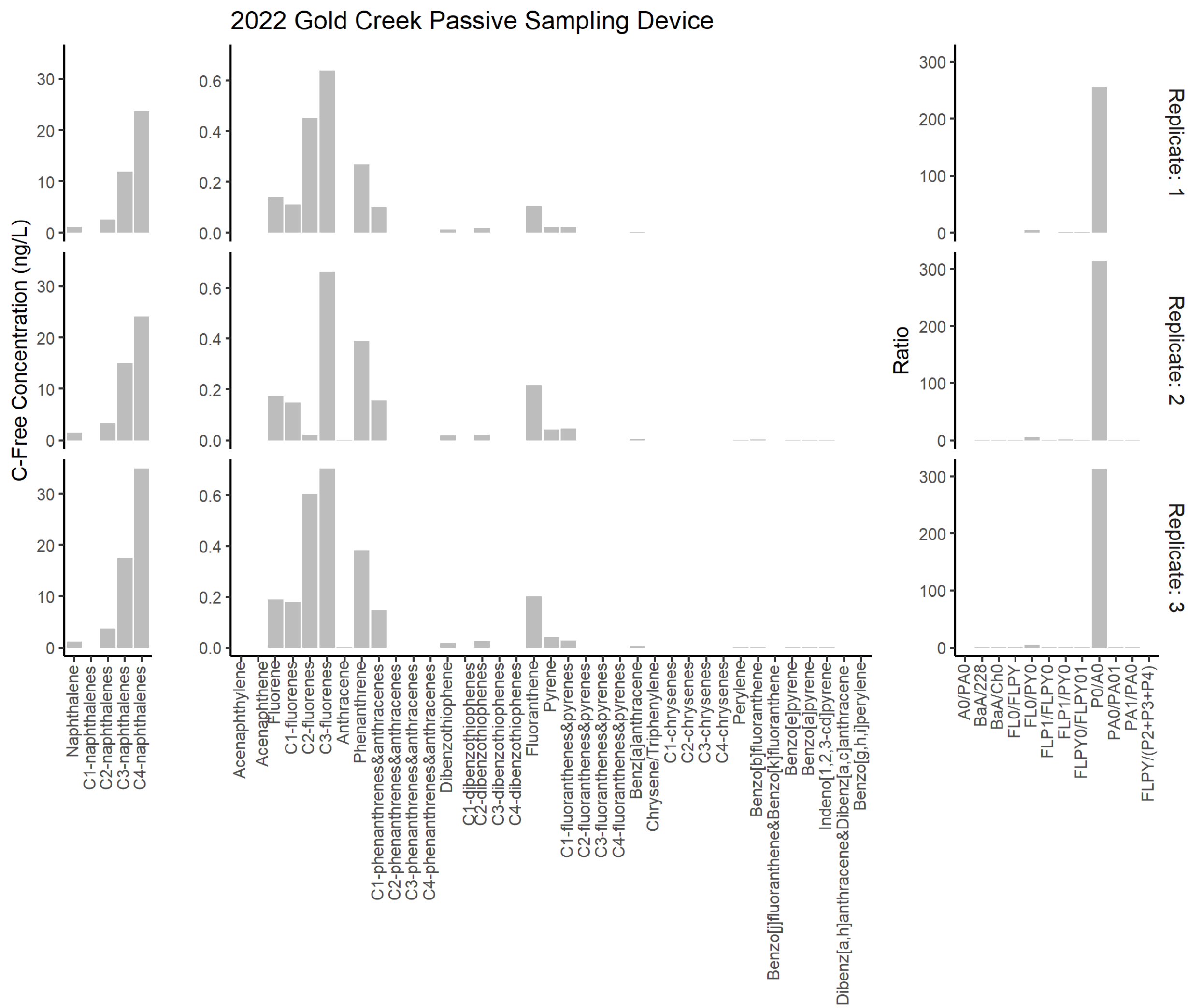


Figure 43. 2022 water PAH profiles and laboratory diagnostic ratios from individual passive sampling devices deployed at Gold Creek.

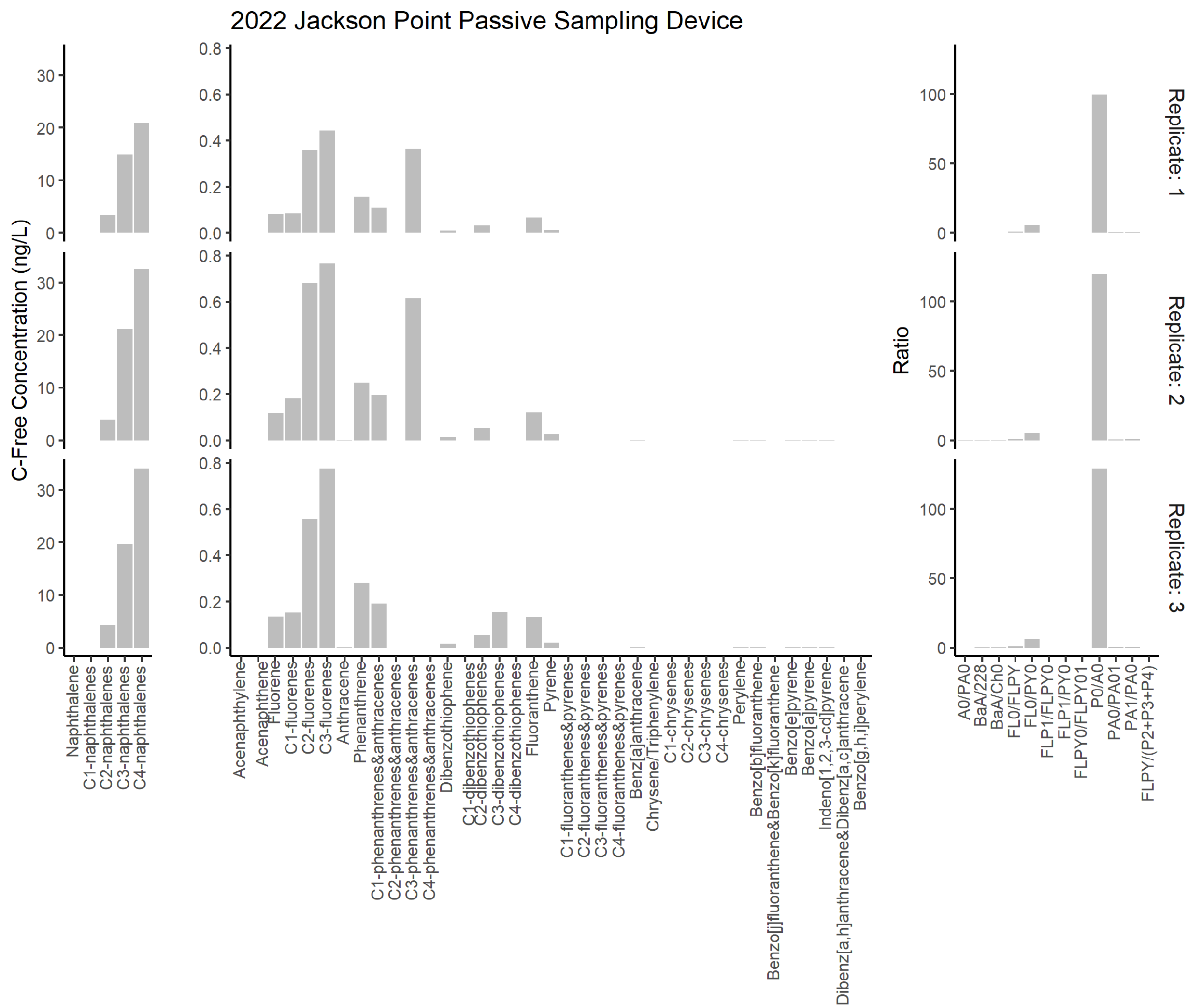


Figure 44. 2022 water PAH profiles and laboratory diagnostic ratios from individual passive sampling devices deployed at Jackson Point.

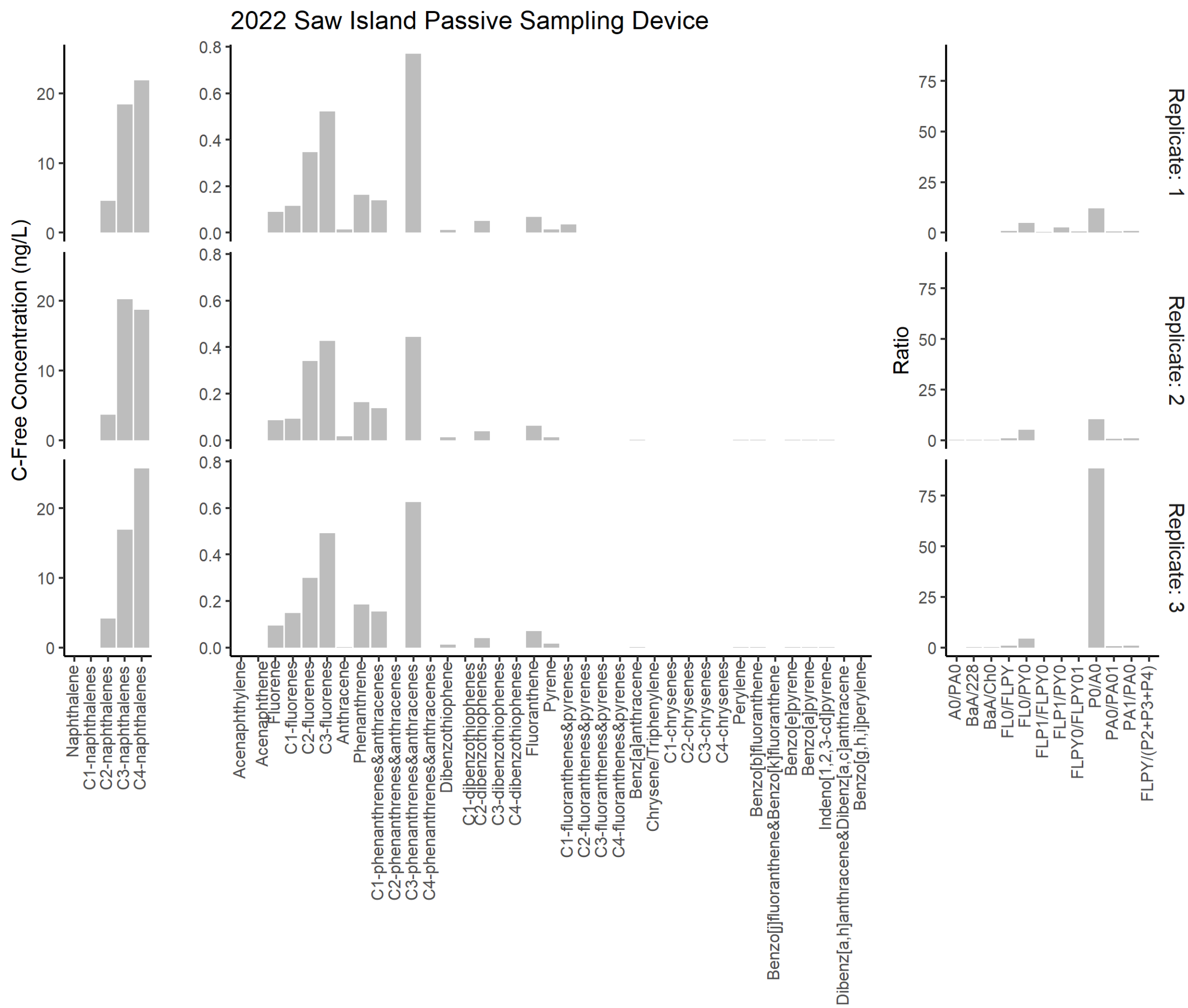


Figure 45. 2022 water PAH profiles and laboratory diagnostic ratios from individual passive sampling devices deployed at Saw Island.

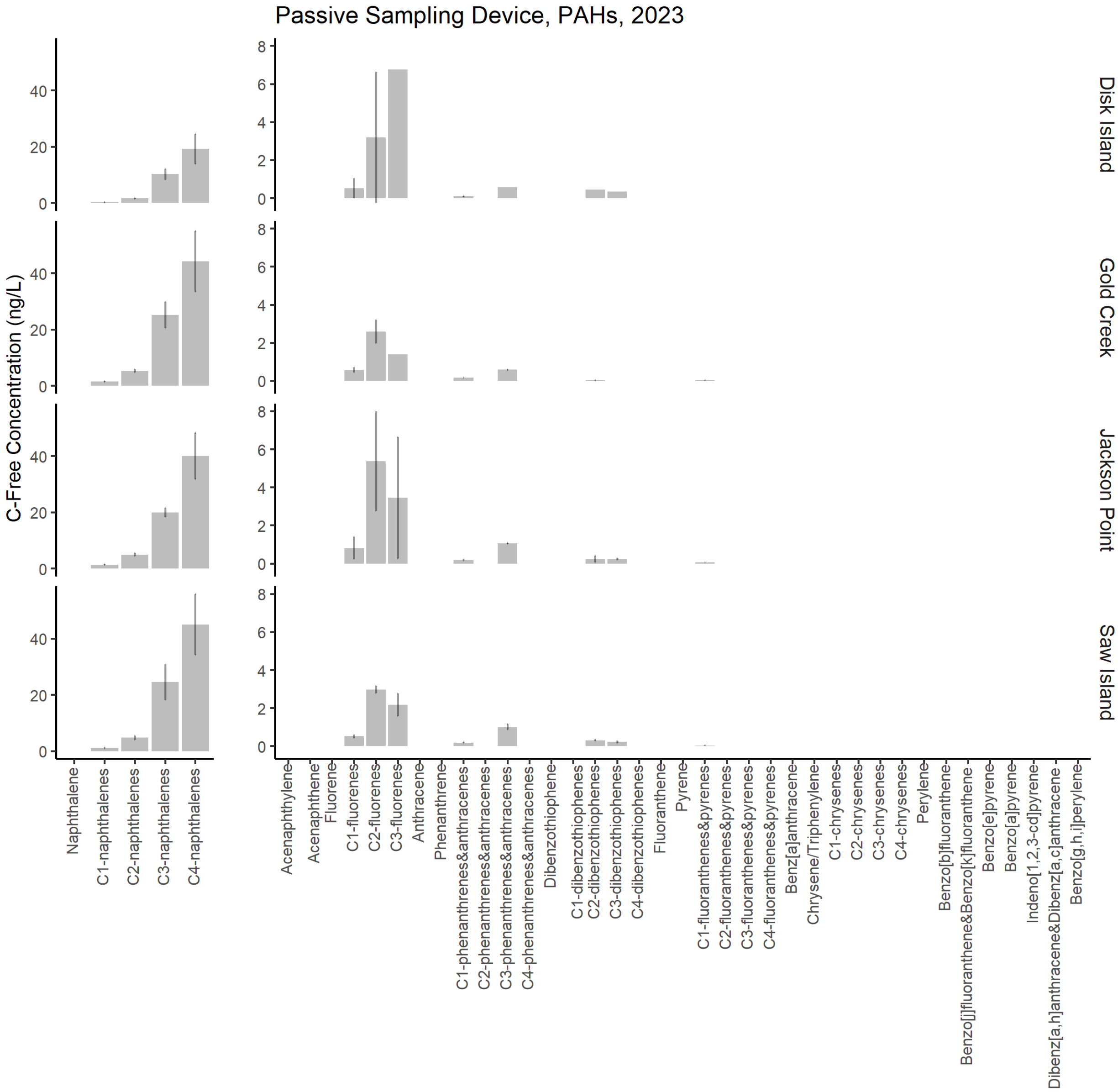


Figure 46. PAH profiles from water sampled via passive sampling devices deployed during LTEMP 2023 at Disk Island, Gold Creek, Jackson Point, and Saw Island plotted by mean value ± standard deviation.

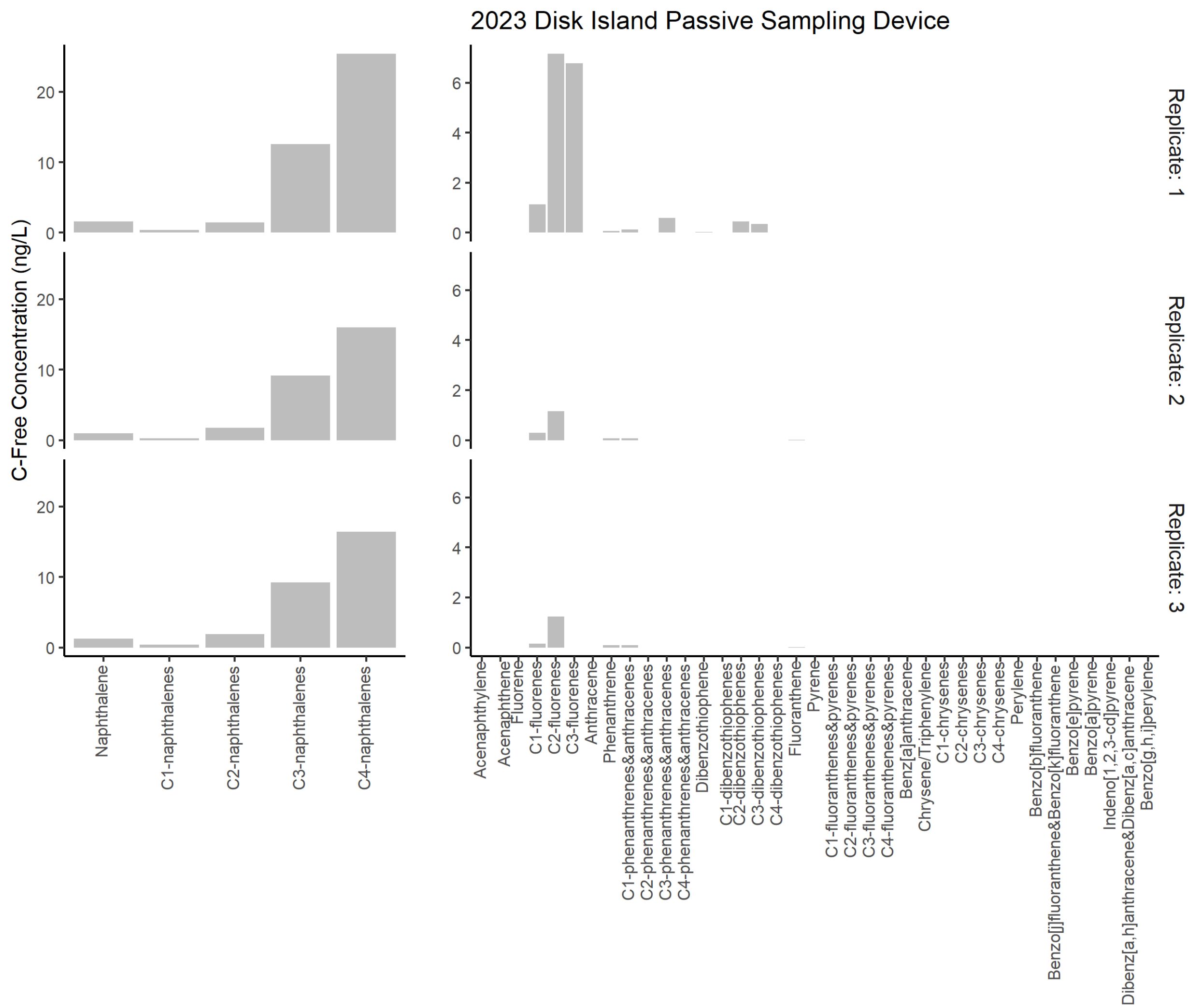


Figure 47. 2023 water PAH profiles from individual passive sampling devices deployed at Disk Island.

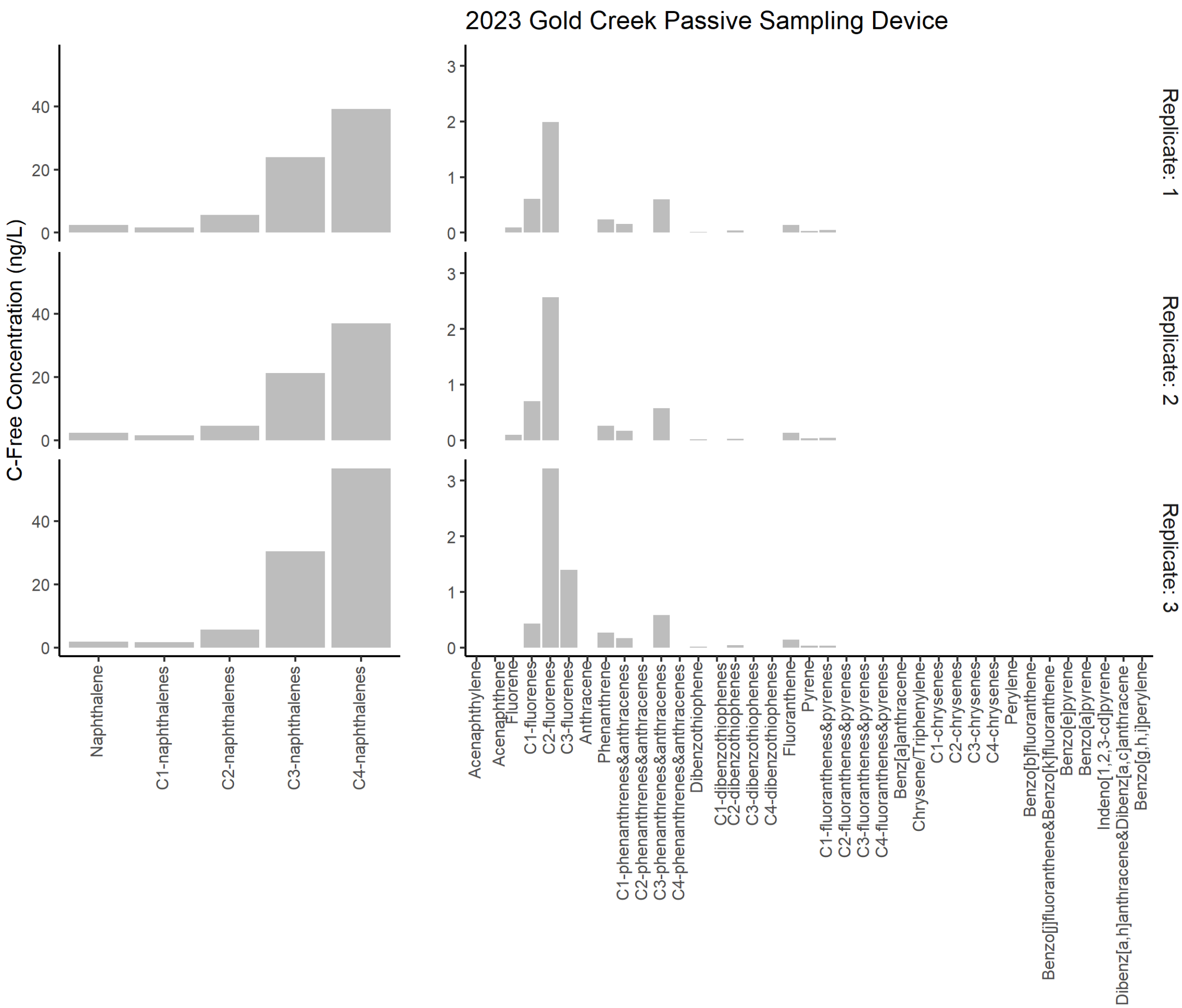


Figure 48. 2023 water PAH profiles from individual passive sampling devices deployed at Gold Creek.

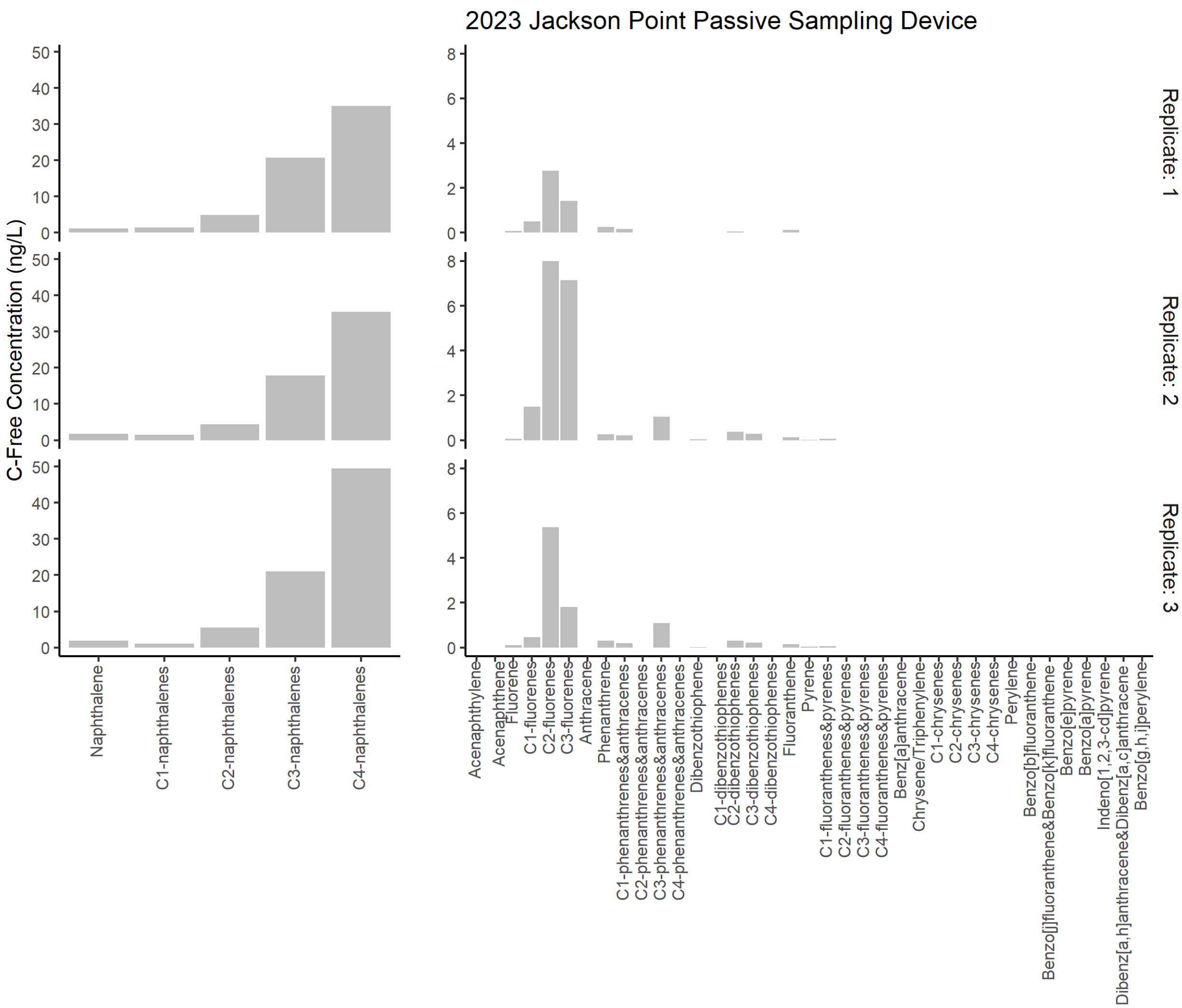


Figure 49. 2023 water PAH profiles from individual passive sampling devices deployed at Jackson Point.

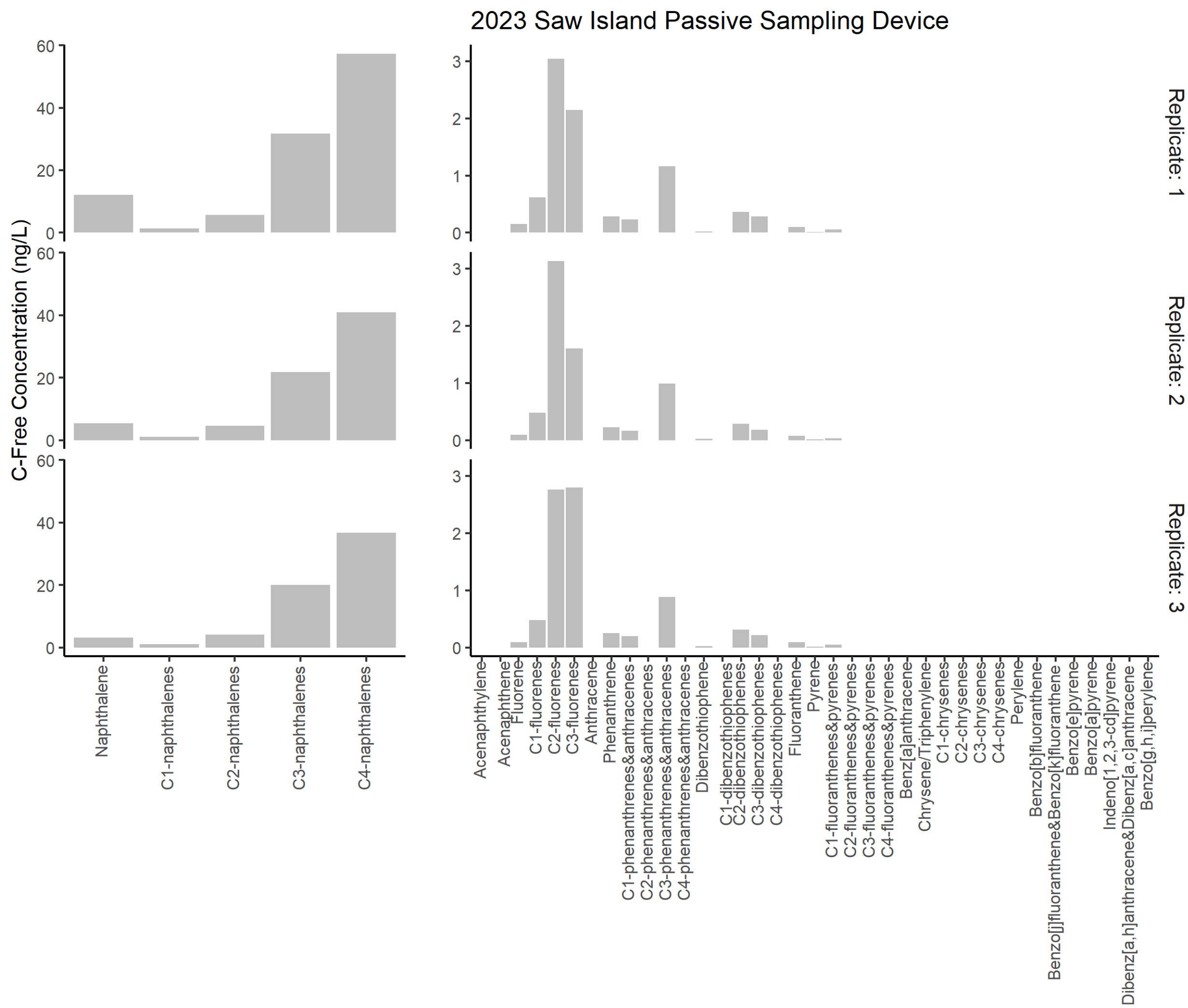


Figure 50. 2023 water PAH profiles from individual passive sampling devices deployed at Saw Island.