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Long-Term Environmental Monitoring Program

2021 Technical Supplement

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TABLE OF CONTENTS

List of Tables

List of Figures

ACRONYMS AND ABBREVIATIONS

AMT	Alyeska Marine Terminal
ANS	Alaska North Slope [Crude Oil]
BWTF	Ballast Water Treatment Facility
cm	centimeter
CV	calibration verification
DDT	dichloro-diphenyl-trichloroethane [legacy pesticide]
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
HCH	Hexachlorocyclohexane [pollutant]
HOT	Site of the April 2020 oil spill at the Valdez Marine Terminal
HMW	High molecular weight [PAH]
JAC	Jackson Point
LMW	Low Molecular Weight [PAH]
LTEMP	Long-Term Environmental Monitoring Program
m	meter
MDL	Method Detection Limit
ng/g	nanogram per gram
NOAA	National Oceanic and Atmospheric Administration
PAH	polycyclic aromatic hydrocarbons
PBDE	polybrominated diphenyl ethers [pollutant]
PCP	pentachlorophenol
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
SHC	saturated hydrocarbons
SIM	Specific ion monitoring
SOP	Standard Operating Procedure
UCM	unresolved complex mixture [UCM fraction]

EXECUTIVE SUMMARY

This technical supplement contains information on field sampling, 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 2021 campaign in Port Valdez. This document should function as an aid to the assertations made in the 2021 Long-Term Environmental Monitoring Program Summary Report (Owl Ridge 2022).

1. METHODS

1.1. Field Methods

1.1.1. Sediments and Mussel Tissue

In 2021, sediment sampling at Valdez Marine Terminal (Alyeska Marine Terminal (AMT)) took place on June 14–15 and at Gold Creek (GOC) on June 15 (Table 1, Figure 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 a small research vessel. For each replicate, a ~ 250 mL sample of the surface 1–5 mm 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 on July 16.

The 2021 Pacific blue mussel sampling was performed at GOC, Jackson Point (JAC), and Saw Island (SAW) on June 14, at the Valdez Small Boat Harbor – RED (RED) on June 15, and at the April 2020 Spill Site (HOT) on July 12. Three replicates of ~30 large mussels were collected by hand at each site. For LTEMP, 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 2021, the Passive Sampler Devices (PSDs) were deployed May 17 and retrieved June 14 at sites GOC, JAC, and SAW. 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 GOC, JAC, and SAW on June 14 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 was opened at JAC on May 17. A retrieval field blank was opened at SAW on June 14. 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 Analytics (NewFields) lab in Mansfield Massachusetts. Extractions used the ALPHA OP-018 method for tissues and ALPHA OP-013 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 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 triterpanes, regular and rearranged steranes, and triaromatic and monoaromatic steroids. Complete lists of PAH, SHC, and biomarkers analytes are presented in Table 2.

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 and 130 percent. 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 Analytical Laboratory's MDLs for hydrocarbons exceed the performance of most commercial labs, falling within the accepted stricter concentrations for forensic purposes. Duplicates of the first replicate of AMT sediments and GOC tissues 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 (MS/MS). 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 percent of the target analytes being within 30 percent of the known value. Instrument blanks were analyzed after each CV, 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. Average percent recovery was 85 percent, meeting FSES DQO's. To demonstrate instrument precision, a duplicate analysis was performed. Average relative percent difference was 3.1 percent, 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. 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. 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. Duplicate replicates were plotted when applicable to further assess method precision. Corrections for dry weight, total organic carbon, and lipid content are detailed in tables 2–5 and reported in the 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 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: ANS whole oil run as laboratory standard with 2021 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 crude oil whole sample and a heavily weathered diesel fuel spill collected opportunistically from Port Chalmers, Prince William Sound in 2006. 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).

Several diagnostic ratios were calculated for each replicate and sample and compared to known ratios for sources. Ratios included biomarkers norhopane/hopane (T15/T19) and saturated hydrocarbons, Pristane/n-C17and Phytane/n-C18 (Table 6).

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 43, 42, 34, 16, and 13 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 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 total organic carbon for sediments, or dry weight and lipid weight for mussel tissues to aid in cross study comparisons (Table 2, Table 3). 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 on 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 see higher sum PAH levels in the AMT sediments compared to GOC (Table 3; Figure 2). PAH profile patterns are largely petrogenic at AMT and pyrogenic at GOC with some weathered /water washed petrogenic patterns at the latter site. 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 (Figure 3, Figure 4). Elevated concentrations of higher molecular weight PAHs at both sites are indicative of combustion sources and could be related to exhaust, storm water, or runoff. Similar concentrations of total saturated hydrocarbons were seen at AMT and GOC. 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 (Figure 5–Figure 7).

In the biomarkers, the ratio of T15- Norhopane and T19-Hopane indicates a crude oil source for both AMT and GOC which supports the PAH pattern analysis findings (Figure 8–Figure 10). A spike at T32-tetrakishomohopane is likely a laboratory artifact and has been observed in previous years' samples (Payne and Driskell 2021).

PAH profiles did not match those of weathered diesel or Cook Inlet crude which were investigated as additional reference sources (not shown).

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 (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 2021 (see summary report, Owl Ridge 2022).

2.2. Pacific Blue Mussel Tissues

Relatively few compounds were detected in mussel tissue sampled from different locations in Port Valdez in 2021 and the majority of the concentrations of PAHs, saturated hydrocarbons and biomarkers were at or below the method level of detection (Table 4; Figure 11–Figure 28). The highest PAH concentrations were found at the Valdez Small Boat Harbor followed by Gold Creek, the April 2020 spill site at the terminal, Jackson Point, and Saw Island (Figure 11–Figure 16). There is also poor agreement between the duplicate replicates run for Gold Creek which further supports the conservative interpretation of the mussel data (Figure 14). PAH profiles, while sparse, do suggest a mostly pyrogenic source at all sites. High heterogeneity of PAH levels between replicates were seen at the April 2020 spill site (HOT) possibly indicative of patchy hydrocarbons distribution and persistence at this site.

Notably the pyrogenic compound dibenzofuran, a pyrogenic compound was found in relatively high concentrations (up to 6 ng/g wet weight) in SAW, JAC, RED, and HOT sites. While this dibenzofuran spike cannot be explained by a laboratory phenomenon (pers. comm Eric Litman at Alpha Analytical) it does warrant additional research effort such as the temporal and spatial extent of this spike and whether this may be related to the persistent, toxic, and biomagnifying polychlorinated or oxygenated homologs of dibenzofuran.

Biomarker ratios indicate more fresh pyrogenic sources in the Valdez Small Boat Harbor while greater biogenic sources are found at other stations (Table 6; Figure 17–Figure 22). The site of the April 2020 spill at the terminal (HOT) had less weathered sources than other sites.

Saturated hydrocarbons were similar in concentration across mussels from all sites (Figure 23–Figure 28). GOC and JAC mussels had greater representation of larger C23-32 compounds, showing greater weathering of sources while the Valdez Small Boat Harbor had greater concentrations of lower molecular weight saturated hydrocarbons compared to the other sites indicating a less weathered and more recent source.

2.3. Alpha Analytics Laboratory Blanks

Laboratory blanks run by Alpha Analytics show trace amounts of contamination of high molecular weight PAHs at or below the method detection limit (Figure 29). This contamination does reduce the confidence in our assessment of these compounds as similar concentrations are found in sediments and mussel tissue at similar concentrations. Naphthalene is also present with parent compounds of phenanthrene, fluorene, pyrene, naphthobenzothiophene and chrysene. Biomarkers were not present in the laboratory blanks and low levels of saturated hydrocarbons were reported and are not of note.

2.4. Passive Sampling Device

Many compounds in the 2021 passive sampling devices were not detected (Table 5). However, naphthalene was detected at all three sites, while other PAH concentrations were below 0.1 ng/L (Figure 30–Figure 33). 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 sites (P0/A0 > 30) (Stogiannidis and Laane 2015).

Perylene-D12, the method internal standard, had less than 9 percent variation across the entire project. Field and trip blanks run together with samples show low levels of naphthalene contamination, provided as pg/µL extract (parts per billion) and all naphthalene and fluorene samples were background corrected. Blanks reports from the lab are as follows:

- Retrieval Trip Blank deployment analyte detections: C1-naphthalenes 3.8 pg/µL extract.
- Deployment Trip Blank retrieval analyte detections: C1-naphthalenes 5.7 pg/µL extract.
- JAC Field Blank deployment analyte detections: C1-naphthalenes 1.8 pg/µL extract.
- SAW Field Blank retrieval analyte detections: C1-naphthalenes 3.6 pg/µL extract.

Generally, mussel tissues contained substantially higher concentrations (42–173 ng PAHs/g dry weight) compared to sediments (26–91 ng/g dry weight) at terminal and Gold Creek. The trend of elevated PAH concentrations seen in terminal sediment compared to Gold Creek was not seen in mussel tissue or in the passive sampling devices where the terminal adjacent sites were similar to Gold Creek. This is likely due to the multiple processes including the accumulation of PAHs in sediments over time, particulate and matrix-bound hydrocarbons, altered weathering and degradation, and the advection potential of suspended sediments.

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TABLES

Table 1. Long-Term Monitoring Program sites sampled in 2021 for sediments, Pacific blue mussels and deployment of the passive sampling devices.

Site	Latitude	Longitude	Datum	Matrix
AMT-S	61.09056	-146.3928	WGS84	Sediment
GOC-S	61.12417	-146.4906	WGS84	Sediment
RED	61.123719	-146.35315	WGS84	Pacific Blue Mussel Tissue
HOT	61.086217	-146.392639	WGS84	Pacific Blue Mussel Tissue
JAC-B	61.090051	-146.375706	WGS84	Pacific Blue Mussel Tissue
GOC-B	61.1243682	-146.4961415	WGS84	Pacific Blue Mussel Tissue
GOC-PSD	61.1242561	-146.4946931	WGS84	Passive Sampler Device
SAW-B	61.0903062	-146.4091853	WGS84	Pacific Blue Mussel Tissue
JAC-PSD	61.0906991	-146.3757111	WGS84	Passive Sampler Device
SAW-PSD	61.0913844	-146.4091726	WGS84	Passive Sampler Device

Table 2. Analytes reported for 2021 sample of sediments, mussel tissues, and passive sampling devices.

Saturated Hydrocarbons (Sediments and Mussel tissue samples)

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 2021 sample of sediments, mussel tissues, and passive sampling devices.

PAHs (Sediments and Mussel tissue samples)

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 2021 sample of sediments, mussel tissues, and passive sampling devices.

Biomarkers (Sediments and Mussel tissue samples)

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 2. Analytes reported for 2021 sample of sediments, mussel tissues, and passive sampling devices.

Passive Sampler Analytes
acenaphthene
acenaphthylene
anthracene
benz[a]anthracene
benzo[a]pyrene
benzo[b]fluoranthene
benzo[e]pyrene
benzo[ghi]perylene
benzo[k]fluoranthene
C1-benz[a]anthracenes & chrysenes & triphenylenes
C1-dibenzothiophenes
C1-fluoranthenes & pyrenes
C1-fluorenes
C1-naphthalenes
C1-phenanthrenes & anthracenes
C2-dibenzothiophenes
C2-fluorenes
C2-naphthalenes
C2-phenanthrenes & C2-anthracenes
C3-fluorenes
C3-naphthalenes
C4-naphthalenes
chrysene
Chrysene + Triphenylene
dibenzo[a,h]anthracene
dibenzothiophene
fluoranthene
fluorene
indeno[1,2,3-cd]pyrene
naphthalene
perylene
phenanthrene
pyrene
Pyrene
triphenylene
C3-phenanthrenes & anthracenes
1,4-dimethylnaphthalene
1,6 and 1,3-Dimethylnaphthalene
1-methylnaphthalene
1-methylphenanthrene
2-ethylnaphthalene
2-methylnaphthalene
2-methylphenanthrene
benzo[a]fluorene
benzo[b]fluorene
benzo[c]fluorene
Naphtho[2,3-j] and Naphtho[1,2-k]fluoranthene
retene
2-methylanthracene
C2-benz[a]anthracenes & chrysenes & triphenylenes
C2-fluoranthenes & pyrenes
C3-dibenzothiophenes
C4-phenanthrenes & C4-anthracenes
1,2-dimethylnaphthalene
1,5-dimethylnaphthalene
1,8-dimethylnaphthalene
1-methylpyrene
2,3-dimethylanthracene
2,6-diethylnaphthalene
2,6-dimethylnaphthalene
3,6-dimethylphenanthrene
5-methylchrysene
6-methylchrysene
7,12-dimethylbenz[a]anthracene
9,10-dimethylanthracene
9-methylanthracene
anthanthrene
benzo[a]chrysene
benzo[b]perylene
benzo[j]fluoranthene
coronene
cyclopenta[cd]pyrene
dibenzo[a,e]fluoranthene
dibenzo[a,e]pyrene
dibenzo[a,h]pyrene
dibenzo[a,i]pyrene
dibenzo[a,l]pyrene
dibenzo[e,l]pyrene
naphtho[1,2-b]fluoranthene
naphtho[2,3-a]pyrene
Naphtho[2,3-b]fluoranthene
naphtho[2,3-e]pyrene
naphtho[2,3-k]fluoranthene
A0/PA0 (Lab Calculated Ratios)
FLPY/(P2+P3+P4)
BaA/228
BaA/Ch0
FL0/FLPY
FL0/PY0
FLP1/FLPY0
FLP1/PY0
FLPY0/FLPY01
P0/A0
PA0/PA01
PA1/PA0

Table 3. Sediment PAH loads and toxicity calculations from 2021 samples.

Analyte (ng/g dry weight)	2021 Sediment Samples						Acute Toxicity Threshold (ng/g)*	Chronic Toxicity Threshold (ng/g)*
	AMT-S-21-1	AMT-S-21-2	AMT-S-21-3	GOC-S-21-1	GOC-S-21-2	GOC-S-21-3		
Naphthalene	1.38	1.24	1.28	1.22	1.25	1.58	1.6E+06	3.9E+05
C1-Naphthalenes	1.43	1.42	1.44	1.04	1.22	1.28	1.9E+06	4.4E+05
C2-Naphthalenes	2.84	2.96	3.3	1.79	1.65	2.49	2.1E+06	5.1E+05
C3-Naphthalenes	2.28	2.12	2.44	1.58	1.18	1.66	2.4E+06	5.8E+05
C4-Naphthalenes	1.98	1.84	1.97	-	1.02	1.18	2.7E+06	6.6E+05
Biphenyl	1.18	0.903	1.32	0.76	0.75	1.22	-	-
Acenaphthylene	0.172	0.189	0.144	0.171	0.211	0.195	1.9E+06	4.5E+05
Acenaphthene	0.382	0.414	0.338	0.451	0.49	0.519	2.0E+06	4.9E+05
Fluorene	0.96	1.12	1.04	0.916	1.07	1.09	2.2E+06	5.4E+05
C1-Fluorenes	1.33	1.26	1.48	0.875	0.808	1.13	2.5E+06	6.1E+05
C2-Fluorenes	2.08	1.94	2.16	1.18	1.13	1.77	2.9E+06	6.9E+05
C3-Fluorenes	3.77	3.46	3.91	-	-	-	3.2E+06	7.7E+05
Phenanthrene	0.348	0.349	0.33	0.268	0.29	0.335	2.5E+06	6.0E+05
Anthracene	3.62	3.86	3.25	2.68	3.12	3.78	2.5E+06	5.9E+05
C1-Phenanthrenes	2.76	2.52	2.84	1.19	1.15	1.5	2.8E+06	6.7E+05
C2-Phenanthrenes	3.47	2.8	3.39	1.07	0.934	1.15	3.1E+06	7.5E+05
C3-Phenanthrenes	3	2.33	3.91	0.705	0.616	0.773	3.5E+06	8.3E+05
C4-Phenanthrenes	1.78	1.83	2.72	0.56	0.543	0.66	3.8E+06	9.1E+05
Dibenzothiophene	0.425	0.449	0.484	0.304	0.34	0.371	-	-
C1-Dibenzothiophenes	0.648	0.545	0.636	0.317	0.21	0.349	-	-
C2-Dibenzothiophenes	2.27	1.64	2.57	-	-	-	-	-
C3-Dibenzothiophenes	2.96	2.1	3.63	-	-	-	-	-
C4-Dibenzothiophenes	2.48	2.18	3.13	-	-	-	-	-
Fluoranthene	2.58	2.49	2.32	1.84	2.16	3.3	2.9E+06	7.1E+05
Pyrene	1.8	1.63	1.67	1.08	1.2	1.94	2.9E+06	7.0E+05
C1-pyrene/fluoranthenes	1.87	1.96	2.36	0.988	0.974	1.35	3.2E+06	7.7E+05
C2-Fluoranthenes/Pyrenes	2.09	2.06	3.06	0.851	0.64	1.09	-	-
C3-Fluoranthenes/Pyrenes	3.18	2.88	4.74	-	-	-	-	-
C4-Fluoranthenes/Pyrenes	3.15	2.77	4.94	-	-	-	-	-
Benz(a)anthracene	0.562	0.734	0.546	0.53	0.449	0.623	3.5E+06	8.4E+05
Chrysene	1.63	1.5	1.83	0.822	0.686	1.34	3.5E+06	8.4E+05
C1-Chrysenes	1.88	1.58	2.49	0.552	0.508	0.701	3.9E+06	9.3E+05
C2-Chrysenes	2.91	2.88	4.66	-	-	-	4.2E+06	1.0E+06
C3-Chrysenes	5.86	6.17	9.4	-	-	-	4.6E+06	1.1E+06
C4-Chrysenes	-	-	-	-	-	-	5.0E+06	1.2E+06
Perylene	-	-	-	-	-	-	4.0E+06	9.7E+05
Benzo(b)fluoranthene	0.796	0.982	0.96	0.681	0.454	1.04	4.1E+06	9.8E+05
Benzo(k)fluoranthene	0.503	0.679	0.529	0.544	0.35	0.825	4.1E+06	9.8E+05
Benzo(e)pyrene	0.826	0.967	1.1	0.602	0.361	0.795	4.0E+06	9.7E+05
Benzo(a)pyrene	0.444	0.666	0.653	0.505	0.344	0.674	4.0E+06	9.7E+05
Indeno(1,2,3-cd)pyrene	0.397	0.688	0.545	0.515	0.202	0.582	4.6E+06	1.1E+06
Dibenz(a,h) anthracene	0.119	0.258	0.219	0.193	-	0.198	4.7E+06	1.1E+06
Benzo(g,h,i)perylene	0.663	1.1	1.01	0.728	0.294	0.772	4.5E+06	1.1E+06

Table 3. Sediment PAH loads and toxicity calculations from 2021 samples.

	AMT-S-21-1	AMT-S-21-2	AMT-S-21-3	GOC-S-21-1	GOC-S-21-2	GOC-S-21-3
Total Organic Carbon (% TOC)	0.567	0.566	0.544	0.658	0.437	0.661
Ratio of Acute Benchmark to	0.0061	0.006	0.0075	0.0028	0.0023	0.0048
Risk for Acute Toxic Effects	Low	Low	Low	Low	Low	Low
Ratio of Chronic Benchmark to TOC corrected concentrations	0.0138	0.0136	0.0163	0.0072	0.006	0.0123
Risk for Chronic Toxic Effects	Low	Low	Low	Low	Low	Low
Sum 43 PAHs (ng/g)[1]	74.81	71.46	90.74	27.51	26.60	38.26
Sum 42 PAHs (ng/g)[2]	73.63	70.56	89.42	26.75	25.85	37.04
Sum 34 PAHs (ng/g)[3]	56.42	55.94	66.23	25.28	24.66	35.23
Sum 16 PAHs (ng/g)[4]	17.06	18.61	17.55	13.55	12.93	19.39
Sum Low molecular weight (LMW) PAHs[5] (ng/g)	19.95	32.56	37.26	16.46	17.43	22.31
Sum High molecular weight (HMW) PAHs[6] (ng/g)	25.21	31.99	43.03	10.43	8.62	15.23
%LMW PAHs	31.60	0.50	0.46	0.61	0.67	0.59
%HMW PAHs	26.89	0.50	0.54	0.39	0.33	0.41
Sum of Carcinogenic PAHs [7] (ng/g)	16.20	5.51	5.28	3.79	2.49	5.28

* EPA Sediment Toxicity Benchmarks : https://archive.epa.gov/emergency/bpspill/web/html/sediment-benchmarks.html

[1] All PAHs listed

[2] All PAHs listed except for Biphenyl

[3] All PAHs where EPA toxicity threshold values are displayed

[4] 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

[5] Low Molecular Weight PAHs : Napthalenes - Phenanthrenes (2-3-ring PAH)

[6] High Molecular Weight PAHs: Fluoranthene - Benzo (g,h,i)perylene (3-6 ring PAH)

[7] 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 4. PAH concentrations in Pacific blue mussel tissues collected in 2021.

Analyte (ng/g wet weight)	GOC-B-21-1	GOC-B-21-2	GOC-B-21-3
Naphthalene	4.75	1.88	2.46
C1-Naphthalenes	1.59	0.481	0.519
C2-Naphthalenes	-	-	-
C3-Naphthalenes	-	-	-
C4-Naphthalenes	-	-	-
Biphenyl	5.18	0.642	0.816
Acenaphthylene	-	0.38	0.151
Acenaphthene	-	0.287	0.285
Fluorene	0.413	0.386	0.285
C1-Fluorenes	-	-	-
C2-Fluorenes	-	-	-
C3-Fluorenes	-	-	-
Anthracene	-	0.43	0.122
Phenanthrene	3.94	1.55	1.73
C1-Phenanthrenes/Anthracenes	1.74	0.644	0.544
C2-Phenanthrenes/Anthracenes	-	-	-
C3-Phenanthrenes/Anthracenes	-	-	-
C4-Phenanthrenes/Anthracenes	-	0.446	-
Dibenzothiophene	1.3	0.311	0.189
C1-Dibenzothiophenes	-	-	-
C2-Dibenzothiophenes	-	-	-
C3-Dibenzothiophenes	-	-	-
C4-Dibenzothiophenes	-	-	-
Fluoranthene	1.12	0.958	0.625
Pyrene	0.602	0.719	0.279
C1-Fluoranthenes/Pyrenes	-	0.83	-
C2-Fluoranthenes/Pyrenes	-	-	-
C3-Fluoranthenes/Pyrenes	-	-	-
C4-Fluoranthenes/Pyrenes	-	-	-
Benz[a]anthracene	0.274	0.688	0.132
Chrysene/Triphenylene	0.729	1.13	0.317
C1-Chrysenes	-	0.399	-
C2-Chrysenes	-	-	-
C3-Chrysenes	-	-	-
C4-Chrysenes	-	-	-
Perylene	-	-	-
Benzo[b]fluoranthene	-	1.32	0.26
Benzo[j]fluoranthene/Benzo[k]fluoranthene	-	1.04	0.189
Benzo[e]pyrene	-	1.23	0.203
Benzo[a]pyrene	-	0.836	-
Indeno[1,2,3-cd]pyrene	0.408	1.29	0.294
Dibenz[a,h]anthracene/Dibenz[a,c]anthracene	-	0.676	-
Benzo[g,h,i]perylene	0.492	1.6	0.408

Table 4. PAH concentrations in Pacific blue mussel tissues collected in 2021.

Analyte (ng/g wet weight)	HOT-B-21-1	HOT-B-21-2	HOT-B-21-3
Naphthalene	2	1.81	1.78
C1-Naphthalenes	0.435	0.345	0.388
C2-Naphthalenes	-	-	-
C3-Naphthalenes	-	-	-
C4-Naphthalenes	-	-	-
Biphenyl	0.65	0.6	0.725
Acenaphthylene	0.157	0.347	0.139
Acenaphthene	0.092	0.223	0.146
Fluorene	0.166	0.236	0.203
C1-Fluorenes	-	-	-
C2-Fluorenes	-	-	-
C3-Fluorenes	-	-	-
Anthracene	-	0.351	-
Phenanthrene	1.32	1.49	1.59
C1-Phenanthrenes/Anthracenes	0.563	0.641	0.58
C2-Phenanthrenes/Anthracenes	-	1.04	-
C3-Phenanthrenes/Anthracenes	-	0.933	-
C4-Phenanthrenes/Anthracenes	-	1.04	-
Dibenzothiophene	0.088	0.179	0.123
C1-Dibenzothiophenes	-	-	-
C2-Dibenzothiophenes	-	-	-
C3-Dibenzothiophenes	-	-	-
C4-Dibenzothiophenes	-	-	-
Fluoranthene	0.538	1.12	0.464
Pyrene	0.281	1.04	0.219
C1-Fluoranthenes/Pyrenes	-	1.02	-
C2-Fluoranthenes/Pyrenes	-	1.19	-
C3-Fluoranthenes/Pyrenes	-	1.14	-
C4-Fluoranthenes/Pyrenes	-	-	-
Benz[a]anthracene	0.135	0.827	0.081
Chrysene/Triphenylene	0.401	1.72	0.29
C1-Chrysenes	0.372	0.864	0.349
C2-Chrysenes	-	1.66	-
C3-Chrysenes	-	-	-
C4-Chrysenes	-	-	-
Perylene	-	-	-
Benzo[b]fluoranthene	0.404	1.27	0.232
Benzo[j]fluoranthene/Benzo[k]fluoranthene	0.29	1.26	-
Benzo[e]pyrene	0.438	1.13	0.145
Benzo[a]pyrene	0.221	0.655	-
Indeno[1,2,3-cd]pyrene	0.409	0.885	0.121
Dibenz[a,h]anthracene/Dibenz[a,c]anthracene	0.167	0.399	-
Benzo[g,h,i]perylene	0.448	1.05	0.19

Table 4. PAH concentrations in Pacific blue mussel tissues collected in 2021.

Analyte (ng/g wet weight)	JAC-B-21-1	JAC-B-21-2	JAC-B-21-3
Naphthalene	1.7	1.91	1.79
C1-Naphthalenes	0.487	0.504	0.432
C2-Naphthalenes	0.845	0.646	-
C3-Naphthalenes	0.616	0.665	0.514
C4-Naphthalenes	-	-	-
Biphenyl	0.551	0.593	0.58
Acenaphthylene	0.146	0.134	0.095
Acenaphthene	0.293	0.439	0.223
Fluorene	0.228	0.226	0.205
C1-Fluorenes	-	-	-
C2-Fluorenes	-	-	-
C3-Fluorenes	-	-	-
Anthracene	0.124	0.089	-
Phenanthrene	1.49	1.4	1.46
C1-Phenanthrenes/Anthracenes	0.497	0.498	0.434
C2-Phenanthrenes/Anthracenes	-	-	-
C3-Phenanthrenes/Anthracenes	-	-	-
C4-Phenanthrenes/Anthracenes	-	-	-
Dibenzothiophene	0.115	0.115	0.121
C1-Dibenzothiophenes	-	-	-
C2-Dibenzothiophenes	-	-	-
C3-Dibenzothiophenes	-	-	-
C4-Dibenzothiophenes	-	-	-
Fluoranthene	0.542	0.55	0.498
Pyrene	0.237	0.255	0.193
C1-Fluoranthenes/Pyrenes	-	-	-
C2-Fluoranthenes/Pyrenes	-	-	-
C3-Fluoranthenes/Pyrenes	-	-	-
C4-Fluoranthenes/Pyrenes	-	-	-
Benz[a]anthracene	0.086	0.13	0.058
Chrysene/Triphenylene	0.238	0.304	0.182
C1-Chrysenes	-	-	-
C2-Chrysenes	-	-	-
C3-Chrysenes	-	-	-
C4-Chrysenes	-	-	-
Perylene	-	-	-
Benzo[b]fluoranthene	0.174	0.41	0.125
Benzo[j]fluoranthene/Benzo[k]fluoranthene	0.123	0.298	-
Benzo[e]pyrene	0.212	0.41	-
Benzo[a]pyrene	-	0.193	-
Indeno[1,2,3-cd]pyrene	0.258	0.446	0.122
Dibenz[a,h]anthracene/Dibenz[a,c]anthracene	0.096	0.166	-
Benzo[g,h,i]perylene	0.349	0.586	0.2

Table 4. PAH concentrations in Pacific blue mussel tissues collected in 2021.

Analyte (ng/g wet weight)	RED-B-21-1	RED-B-21-2	RED-B-21-3
Naphthalene	1.88	2.76	1.95
C1-Naphthalenes	0.81	1.26	0.798
C2-Naphthalenes	1.36	1.51	1.2
C3-Naphthalenes	1.52	2.23	1.48
C4-Naphthalenes	2.39	4.22	2.34
Biphenyl	0.795	1.06	0.676
Acenaphthylene	0.3	0.524	0.357
Acenaphthene	1.09	1.77	1.14
Fluorene	1.23	1.92	1.11
C1-Fluorenes	0.728	1.58	0.768
C2-Fluorenes	1.82	3.26	1.7
C3-Fluorenes	-	-	-
Anthracene	0.467	0.756	0.604
Phenanthrene	8.65	12.3	7.87
C1-Phenanthrenes/Anthracenes	2.04	4.28	2.1
C2-Phenanthrenes/Anthracenes	2.18	3.12	1.9
C3-Phenanthrenes/Anthracenes	1.49	2.27	1.47
C4-Phenanthrenes/Anthracenes	0.926	1.48	1.02
Dibenzothiophene	0.572	0.917	0.563
C1-Dibenzothiophenes	0.268	0.953	0.436
C2-Dibenzothiophenes	-	1.6	1
C3-Dibenzothiophenes	-	-	-
C4-Dibenzothiophenes	-	-	-
Fluoranthene	13.4	18.6	10.4
Pyrene	4.92	6.29	3.74
C1-Fluoranthenes/Pyrenes	2.58	3.86	2.54
C2-Fluoranthenes/Pyrenes	1.1	1.62	1.26
C3-Fluoranthenes/Pyrenes	-	-	0.677
C4-Fluoranthenes/Pyrenes	-	-	-
Benz[a]anthracene	1.58	2.45	1.75
Chrysene/Triphenylene	3.35	4.76	3.49
C1-Chrysenes	0.678	1	0.774
C2-Chrysenes	-	-	-
C3-Chrysenes	-	-	-
C4-Chrysenes	-	-	-
Perylene	-	-	-
Benzo[b]fluoranthene	0.954	1.8	1.51
Benzo[j]fluoranthene/Benzo[k]fluoranthene	1.04	1.72	1.48
Benzo[e]pyrene	0.803	1.48	1.14
Benzo[a]pyrene	0.236	0.494	0.504
Indeno[1,2,3-cd]pyrene	0.165	0.521	0.648
Dibenz[a,h]anthracene/Dibenz[a,c]anthracene	-	0.186	0.268
Benzo[g,h,i]perylene	0.324	0.713	0.75

Table 4. PAH concentrations in Pacific blue mussel tissues collected in 2021.

Analyte (ng/g wet weight)	SAW-B-21-1	SAW-B-21-2	SAW-B-21-3
Naphthalene	2.49	1.62	1.79
C1-Naphthalenes	0.513	0.37	0.335
C2-Naphthalenes	-	-	-
C3-Naphthalenes	-	-	-
C4-Naphthalenes	-	-	-
Biphenyl	0.754	0.465	0.547
Acenaphthylene	0.161	0.103	0.1
Acenaphthene	0.267	0.189	0.171
Fluorene	0.222	0.146	0.172
C1-Fluorenes	-	-	-
C2-Fluorenes	-	-	-
C3-Fluorenes	-	-	-
Anthracene	0.13	-	-
Phenanthrene	1.51	1.32	1.16
C1-Phenanthrenes/Anthracenes	0.442	0.408	0.352
C2-Phenanthrenes/Anthracenes	-	-	-
C3-Phenanthrenes/Anthracenes	-	-	-
C4-Phenanthrenes/Anthracenes	-	-	-
Dibenzothiophene	0.135	0.078	0.092
C1-Dibenzothiophenes	-	-	-
C2-Dibenzothiophenes	-	-	-
C3-Dibenzothiophenes	-	-	-
C4-Dibenzothiophenes	-	-	-
Fluoranthene	0.493	0.403	0.373
Pyrene	0.218	0.143	0.127
C1-Fluoranthenes/Pyrenes	-	-	-
C2-Fluoranthenes/Pyrenes	-	-	-
C3-Fluoranthenes/Pyrenes	-	-	-
C4-Fluoranthenes/Pyrenes	-	-	-
Benz[a]anthracene	0.104	0.052	-
Chrysene/Triphenylene	0.259	0.172	0.127
C1-Chrysenes	-	-	-
C2-Chrysenes	-	-	-
C3-Chrysenes	-	-	-
C4-Chrysenes	-	-	-
Perylene	-	-	-
Benzo[b]fluoranthene	0.32	0.208	-
Benzo[j]fluoranthene/Benzo[k]fluoranthene	0.191	0.124	-
Benzo[e]pyrene	0.268	0.198	-
Benzo[a]pyrene	-	-	-
Indeno[1,2,3-cd]pyrene	0.323	0.224	0.112
Dibenz[a,h]anthracene/Dibenz[a,c]anthracene	0.153	0.062	-
Benzo[g,h,i]perylene	0.482	0.288	0.177

Table 4. PAH concentrations in Pacific blue mussel tissues collected in 2021.

	GOC-B-21-1	GOC-B-21-2	GOC-B-21-3
Percent Lipids	0.493	0.618	0.626
Percent Moisture	87.0	86.2	86.3
Sum 43 PAHs[1] (wet weight)	22.54	20.15	9.81
Sum 43 PAHs (dry weight)	173.37	146.04	71.59
Sum 42 PAHs[2] (wet weight)	17.36	19.51	8.99
Sum 42 PAHs (dry weight)	133.52	141.38	65.64
Sum 42 PAHs (lipid weight)	3520.89	3157.12	1436.42
Sum 34 PAHs[3] (wet weight)	16.06	19.20	8.80
Sum 34 PAHs (dry weight)	123.52	139.13	64.26
Sum 16 PAHs[4] (wet weight)	12.73	15.72	7.74
Sum 16 PAHs (dry weight)	97.91	113.94	56.50
Sum low molecular weight PAH[5]	17.61	7.13	6.91
Sum high molecular weight PAH[6]	3.63	12.72	2.71
Percent low molecular weight PAH	0.83	0.36	0.72
Percent high molecular weight PAH	0.17	0.64	0.28
Sum of Carcinogenic PAHs [7]	1.90	7.90	1.60

[1] All PAHs listed

[2] All PAHs listed except for biphenyl

[3] All PAHs except for biphenyl, dibenzothiophenes, and alkylated fluoranthenes/pyrenes greater than C1

[4] 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

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

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

[7]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 4. PAH concentrations in Pacific blue mussel tissues collected in 2021.

	HOT-B-21-1	HOT-B-21-2	HOT-B-21-3
Percent Lipids	0.512	0.501	0.622
Percent Moisture	83.3	83.6	83.9
Sum 43 PAHs[1] (wet weight)	9.58	26.47	7.77
Sum 43 PAHs (dry weight)	57.34	161.37	48.23
Sum 42 PAHs[2] (wet weight)	8.93	25.87	7.04
Sum 42 PAHs (dry weight)	53.44	157.71	43.73
Sum 42 PAHs (lipid weight)	1743.16	5162.67	1131.83
Sum 34 PAHs[3] (wet weight)	8.84	23.36	6.92
Sum 34 PAHs (dry weight)	52.92	142.41	42.96
Sum 16 PAHs[4] (wet weight)	7.30	15.41	5.60
Sum 16 PAHs (dry weight)	43.71	93.99	34.78
Sum low molecular weight PAH[5]	5.38	9.06	5.55
Sum high molecular weight PAH[6]	4.10	17.23	2.09
Percent low molecular weight PAH	0.57	0.34	0.73
Percent high molecular weight PAH	0.43	0.66	0.27
Sum of Carcinogenic PAHs [7]	2.31	7.67	0.91

[1] All PAHs listed

[2] All PAHs listed except for biphenyl

[3] All PAHs except for biphenyl, dibenzothiophenes, and alkylated fluoranthenes/pyrenes greater than C1

[4] 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

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

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

[7]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 4. PAH concentrations in Pacific blue mussel tissues collected in 2021.

	JAC-B-21-1	JAC-B-21-2	JAC-B-21-3
Percent Lipids	0.553	0.696	0.698
Percent Moisture	86.5	85.2	85.2
Sum 43 PAHs[1] (wet weight)	9.41	10.97	7.23
Sum 43 PAHs (dry weight)	69.68	74.10	48.86
Sum 42 PAHs[2] (wet weight)	8.86	10.37	6.65
Sum 42 PAHs (dry weight)	65.60	70.09	44.95
Sum 42 PAHs (lipid weight)	1601.45	1490.52	953.01
Sum 34 PAHs[3] (wet weight)	8.74	10.26	6.53
Sum 34 PAHs (dry weight)	64.75	69.32	44.13
Sum 16 PAHs[4] (wet weight)	6.20	7.78	5.15
Sum 16 PAHs (dry weight)	45.93	52.57	34.80
Sum low molecular weight PAH[5]	6.98	7.10	5.73
Sum high molecular weight PAH[6]	2.32	3.75	1.38
Percent low molecular weight PAH	0.75	0.65	0.81
Percent high molecular weight PAH	0.25	0.35	0.19
Sum of Carcinogenic PAHs [7]	1.23	2.37	0.69

[1] All PAHs listed

[2] All PAHs listed except for biphenyl

[3] All PAHs except for biphenyl, dibenzothiophenes, and alkylated fluoranthenes/pyrenes greater than C1

[4] 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

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

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

[7]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 4. PAH concentrations in Pacific blue mussel tissues collected in 2021.

	RED-B-21-1	RED-B-21-2	RED-B-21-3
Percent Lipids	0.395	0.523	0.529
Percent Moisture	87.6	83.6	85.5
Sum 43 PAHs[1] (wet weight)	61.65	95.26	61.41
Sum 43 PAHs (dry weight)	497.15	580.88	423.54
Sum 42 PAHs[2] (wet weight)	60.85	94.20	60.74
Sum 42 PAHs (dry weight)	490.73	574.41	418.88
Sum 42 PAHs (lipid weight)	15405.32	18012.24	11481.47
Sum 34 PAHs[3] (wet weight)	58.91	89.11	56.80
Sum 34 PAHs (dry weight)	475.09	543.38	391.73
Sum 16 PAHs[4] (wet weight)	40.39	58.86	38.44
Sum 16 PAHs (dry weight)	325.72	358.89	265.12
Sum low molecular weight PAH[5]	29.68	46.30	28.48
Sum high molecular weight PAH[6]	31.13	45.49	30.93
Percent low molecular weight PAH	0.49	0.50	0.48
Percent high molecular weight PAH	0.51	0.50	0.52
Sum of Carcinogenic PAHs [7]	7.65	12.46	10.13

[1] All PAHs listed

[2] All PAHs listed except for biphenyl

[3] All PAHs except for biphenyl, dibenzothiophenes, and alkylated fluoranthenes/pyrenes greater than C1

[4] 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

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

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

[7]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 4. PAH concentrations in Pacific blue mussel tissues collected in 2021.

	SAW-B-21-1	SAW-B-21-2	SAW-B-21-3
Percent Lipids	0.464	0.595	0.407
Percent Moisture	86.1	85.7	86.6
Sum 43 PAHs[1] (wet weight)	9.44	6.57	5.64
Sum 43 PAHs (dry weight)	67.88	45.97	42.05
Sum 42 PAHs[2] (wet weight)	8.68	6.11	5.09
Sum 42 PAHs (dry weight)	62.45	42.71	37.97
Sum 42 PAHs (lipid weight)	1870.91	1026.55	1250.12
Sum 34 PAHs[3] (wet weight)	8.55	6.03	5.00
Sum 34 PAHs (dry weight)	61.48	42.17	37.28
Sum 16 PAHs[4] (wet weight)	7.44	5.19	4.31
Sum 16 PAHs (dry weight)	53.51	36.29	32.16
Sum low molecular weight PAH[5]	6.49	4.62	4.63
Sum high molecular weight PAH[6]	2.81	1.87	0.92
Percent low molecular weight PAH	0.70	0.71	0.83
Percent high molecular weight PAH	0.30	0.29	0.17
Sum of Carcinogenic PAHs [7]	1.68	1.07	0.42

[1] All PAHs listed

[2] All PAHs listed except for biphenyl

[3] All PAHs except for biphenyl, dibenzothiophenes, and alkylated fluoranthenes/pyrenes greater than C1

[4] 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

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

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

[7]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 5. Passive sampling device results for 2021.

Analyte (ng/L)	GOC01	GOC02	GOC03	JAC01	JAC02	JAC03	SAW01	SAW02	SAW03
Naphthalene	1.3000	1.2800	0.9760	0.5690	0.5190	0.5190	0.4970	0.5480	0.4690
C1-Naphthalenes	2.0200	2.1600	2.0900	0.5490	0.5150	0.5780	0.4590	0.5940	0.4810
C2-Naphthalenes	5.2900	5.9600	5.7000	2.2600	2.8400	2.5700	2.2000	2.4800	2.2200
C3-Naphthalenes	19.6000	19.5000	23.0000	8.9800	9.9900	9.5500	7.4800	10.3000	9.1600
C4-Naphthalenes	38.4000	36.9000	49.9000	19.1000	18.7000	19.4000	14.3000	15.6000	15.5000
Biphenyl	-	-	-	-	-	-	-	-	-
Acenaphthylene	0.0278	0.0104	0.0310	0.0105	0.0104	0.0102	0.0144	0.0106	0.0104
Acenaphthene	0.2370	0.1760	0.2390	0.0051	0.0050	0.0049	0.0050	0.0051	0.0594
Fluorene	0.1170	0.1260	0.1190	0.0463	0.0415	0.0415	0.0355	0.0404	0.0388
C1-Fluorenes	0.2700	0.2350	0.2150	0.1100	0.0929	0.1250	0.0542	0.0788	0.0543
C2-Fluorenes	1.0100	0.6920	1.0200	0.2900	0.3400	0.3280	0.2780	0.2680	0.2270
C3-Fluorenes	0.7590	0.5320	0.6280	0.4360	0.3320	0.3460	0.2940	0.3260	0.3200
Anthracene	0.0014	0.0015	0.0014	0.0018	0.0018	0.0016	0.0017	0.0019	0.0018
Phenanthrene	0.3260	0.3050	0.3060	0.1430	0.1280	0.1210	0.1190	0.1300	0.1310
C1-Phenanthrenes/Anthracenes	0.2340	0.2020	0.2210	0.0846	0.0996	0.0803	0.0690	0.0820	0.0687
C2-Phenanthrenes/Anthracenes	0.4030	0.4140	0.4470	0.2090	0.1750	0.2520	0.2110	0.2020	0.2630
C3-Phenanthrenes/Anthracenes	-	-	0.5170	0.3420	-	-	-	-	-
C4-Phenanthrenes/Anthracenes	-	-	-	-	-	-	-	-	-
Dibenzothiophene	0.0148	0.0146	0.0148	0.0069	0.0066	0.0060	0.0061	0.0056	0.0059
C1-Dibenzothiophenes	0.0270	0.0258	0.0314	0.0198	0.0138	0.0182	0.0168	0.0156	0.0130
C2-Dibenzothiophenes	0.0524	0.0244	0.0279	0.0226	0.0151	0.0247	0.0192	0.0278	0.0210
C3-Dibenzothiophenes	-	-	-	-	-	-	-	-	-
C4-Dibenzothiophenes	-	-	-	-	-	-	-	-	-
Fluoranthene	0.2940	0.2960	0.2790	0.0692	0.0646	0.0549	0.0568	0.0639	0.0609
Pyrene	0.0824	0.0739	0.0743	0.0208	0.0196	0.0186	0.0143	0.0169	0.0148
C1-Fluoranthenes/Pyrenes	0.0731	0.0860	0.0719	0.0243	0.0183	0.0152	0.0204	0.0232	0.0168
C2-Fluoranthenes/Pyrenes	-	-	-	-	-	-	-	-	-
C3-Fluoranthenes/Pyrenes	-	-	-	-	-	-	-	-	-
C4-Fluoranthenes/Pyrenes	-	-	-	-	-	-	-	-	-
Benz[a]anthracene	0.0108	0.0110	0.0100	0.0008	0.0008	0.0007	0.0007	0.0008	0.0008
Chrysene/Triphenylene	0.0095	0.0106	0.0113	0.0004	0.0004	0.0004	0.0004	0.0004	0.0004
C1-Chrysenes	0.0103	0.0106	0.0084	0.0006	0.0005	0.0005	0.0005	0.0006	0.0005
C2-Chrysenes	0.0099	0.0065	0.0059	0.0064	-	0.0057	-	-	-
C3-Chrysenes	-	-	-	-	-	-	-	-	-
C4-Chrysenes	0.0035	0.0040	0.0035	0.0004	0.0004	0.0003	0.0004	0.0004	0.0004
Perylene	0.0008	0.0008	0.0008	0.0013	0.0013	0.0011	-	0.0013	0.0012
Benzo[b]fluoranthene	-	-	-	-	-	-	-	-	-
Benzo[j]fluoranthene/Benzo[k]fluoranthene	0.0044	0.0045	0.0039	0.0007	0.0006	0.0005	0.0006	0.0007	0.0006
Benzo[e]pyrene	0.0006	0.0007	0.0027	0.0010	0.0010	0.0009	0.0009	0.0010	0.0010
Benzo[a]pyrene	0.0009	0.0009	0.0008	0.0015	0.0014	0.0012	0.0013	0.0015	0.0014
Indeno[1,2,3-cd]pyrene	0.0003	0.0003	0.0002	0.0004	0.0004	0.0004	0.0004	0.0004	0.0004
Dibenz[a,h]anthracene/Dibenz[a,c]anthracene	0.0010	0.0011	0.0010	0.0017	0.0017	0.0015	0.0016	0.0018	0.0016
Benzo[g,h,i]perylene	0.0003	0.0003	0.0003	0.0005	0.0005	0.0005	0.0005	0.0005	0.0005
Sum 43 PAHs[1]	70.591	69.066	85.959	33.316	33.937	34.079	26.159	30.829	29.146
Sum 43 PAH w/o Naphthalene	1.560	1.495	2.041	0.960	0.551	0.606	0.542	0.578	0.606
Sum 42 PAHs[2]	70.591	69.066	85.959	33.316	33.937	34.079	26.159	30.829	29.146
Sum 34 PAHs[3]	70.497	69.001	85.885	33.266	33.902	34.030	26.117	30.780	29.106
Sum 16 PAHs[4]	2.412	2.297	2.055	0.871	0.795	0.776	0.749	0.822	0.791
Sum low molecular weight PAH[5]	69.995	68.494	85.410	33.136	33.790	33.928	26.018	30.667	29.004
Sum high molecular weight PAH[6]	0.502	0.507	0.474	0.130	0.111	0.102	0.099	0.113	0.101
Percent low molecular weight PAH	0.993	0.993	0.994	0.996	0.997	0.997	0.996	0.996	0.997
Percent high molecular weight PAH	0.007	0.007	0.006	0.004	0.003	0.003	0.004	0.004	0.003
Sum of Carcinogenic PAHs [7]	0.026	0.028	0.027	0.004	0.004	0.004	0.004	0.004	0.004
Analyte Count	33	33	34	34	32	33	31	32	32
Percent Naphthalene	0.944	0.953	0.950	0.944	0.960	0.957	0.953	0.958	0.955

[1] All PAHs listed

[2] All PAHs listed except for Biphenyl

[3] All PAHs except for biphenyl, dibenzothiophenes, and alkylated fluoranthenes/pyrenes greater than C1

[4] 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

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

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

[7]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. Saturated hydrocarbon (SHC) totals and diagonistic ratios of sediment and mussel tissues sampled in 2021.

		Saturated Hydrocarbon Totals		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	AMT-S-21-1	21.00	2.26	0.485	1.857	0.342	0.875
	AMT-S-21-2	25.90	1.51	0.477	2.200	0.440	1.000
	AMT-S-21-3	42.40	2.37	0.542	3.500	0.519	1.000
	GOC-S-21-1	26.60	2.56	0.333	1.600	0.348	1.000
	GOC-S-21-2	18.10	1.10	0.552	2.333	0.389	0.600
	GOC-S-21-3	28.10	1.91	0.430	2.600	0.464	0.833
Pacific blue mussel tissue*	JAC-B-21-1	1.47	0.66	-	8.909	3.500	2.750
	JAC-B-21-2	2.13	0.85	-	6.667	3.214	3.375
	JAC-B-21-3	7.68	1.12	-	8.067	2.161	1.667
	SAW-B-21-1	6.69	0.60	-	6.308	1.822	1.625
	SAW-B-21-2	7.63	0.70	-	3.808	1.768	3.250
	SAW-B-21-3	4.62	0.42	-	5.778	1.238	2.250
	GOC-B-21-1	6.04	1.52	-	2.259	1.488	2.077
	GOC-B-21-2	1.24	0.54	-	3.105	1.553	1.900
	GOC-B-21-3	1.34	0.55	-	3.000	1.342	2.125
	HOT-B-21-1	4.99	0.52	-	4.750	0.475	0.571
	HOT-B-21-2	9.32	0.54	0.619	3.000	0.638	0.909
	HOT-B-21-3	6.91	0.48	-	4.000	0.545	1.200
	RED-B-21-1	24.10	0.85	1.119	1.795	1.646	2.750
	RED-B-21-2	28.20	1.07	0.831	1.750	2.579	6.000
	RED-B-21-3	19.80	0.67	0.745	2.034	1.229	2.900
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

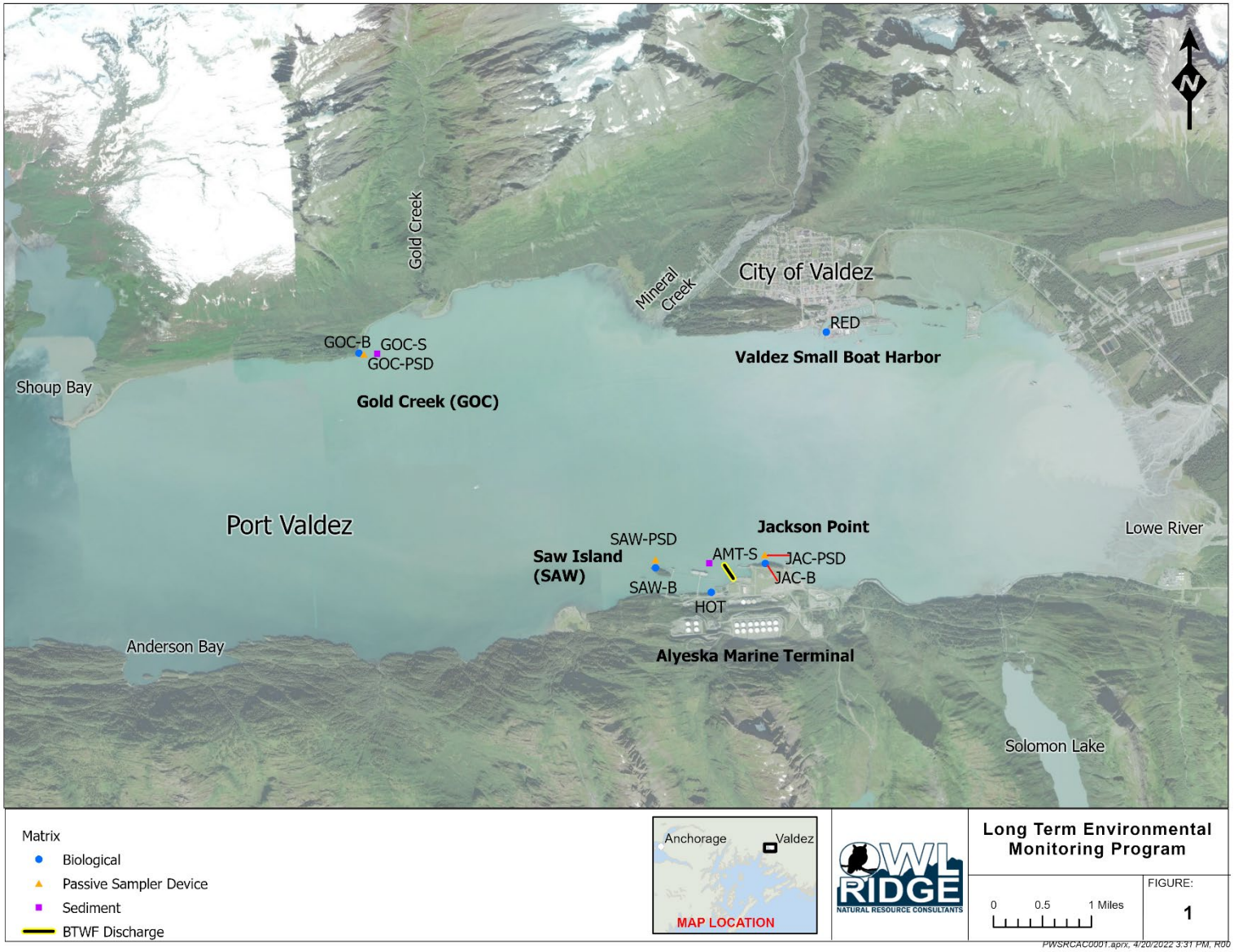

Figure 1. Long-term environmental monitoring program sites from 2021 campaign.

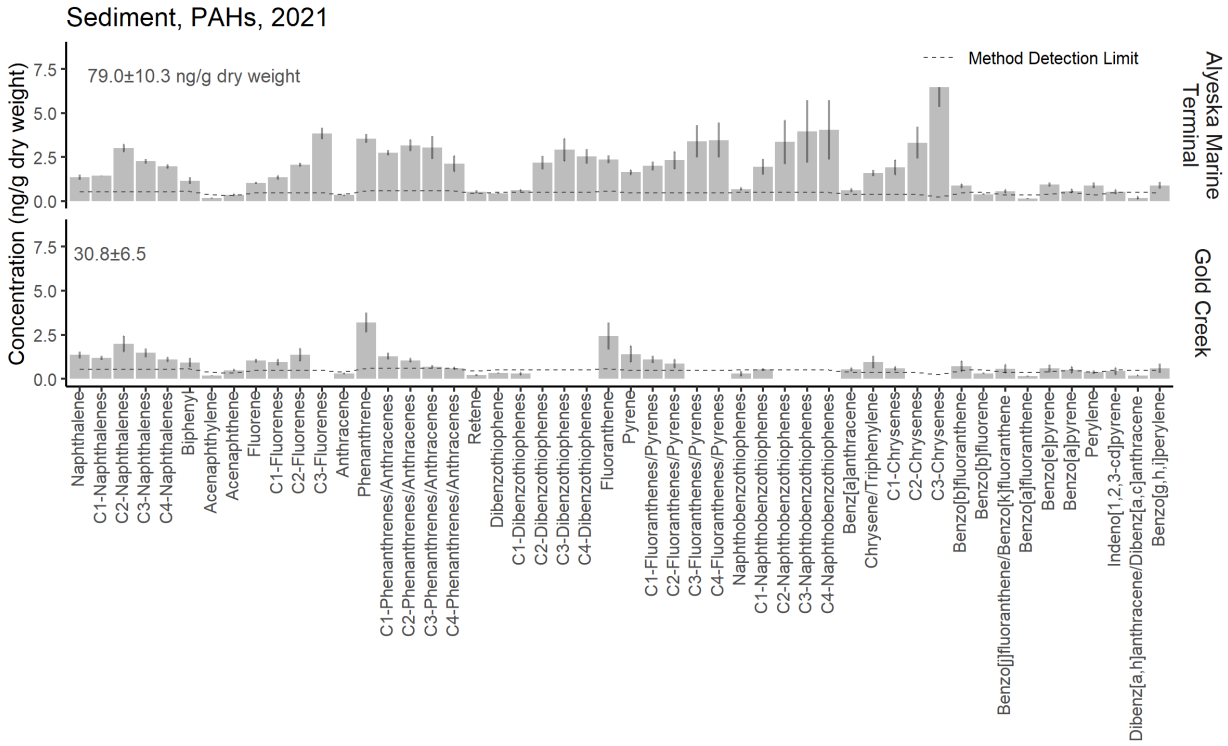

Figure 2. PAH profiles from 2021 sediment samples plotted by mean ± 1 standard deviation, The analyte-specific method detection limit is superimposed as a dashed line. Sum 43 PAH values (mean ± 1 standard deviation) are found in the upper left corner of each site profile.

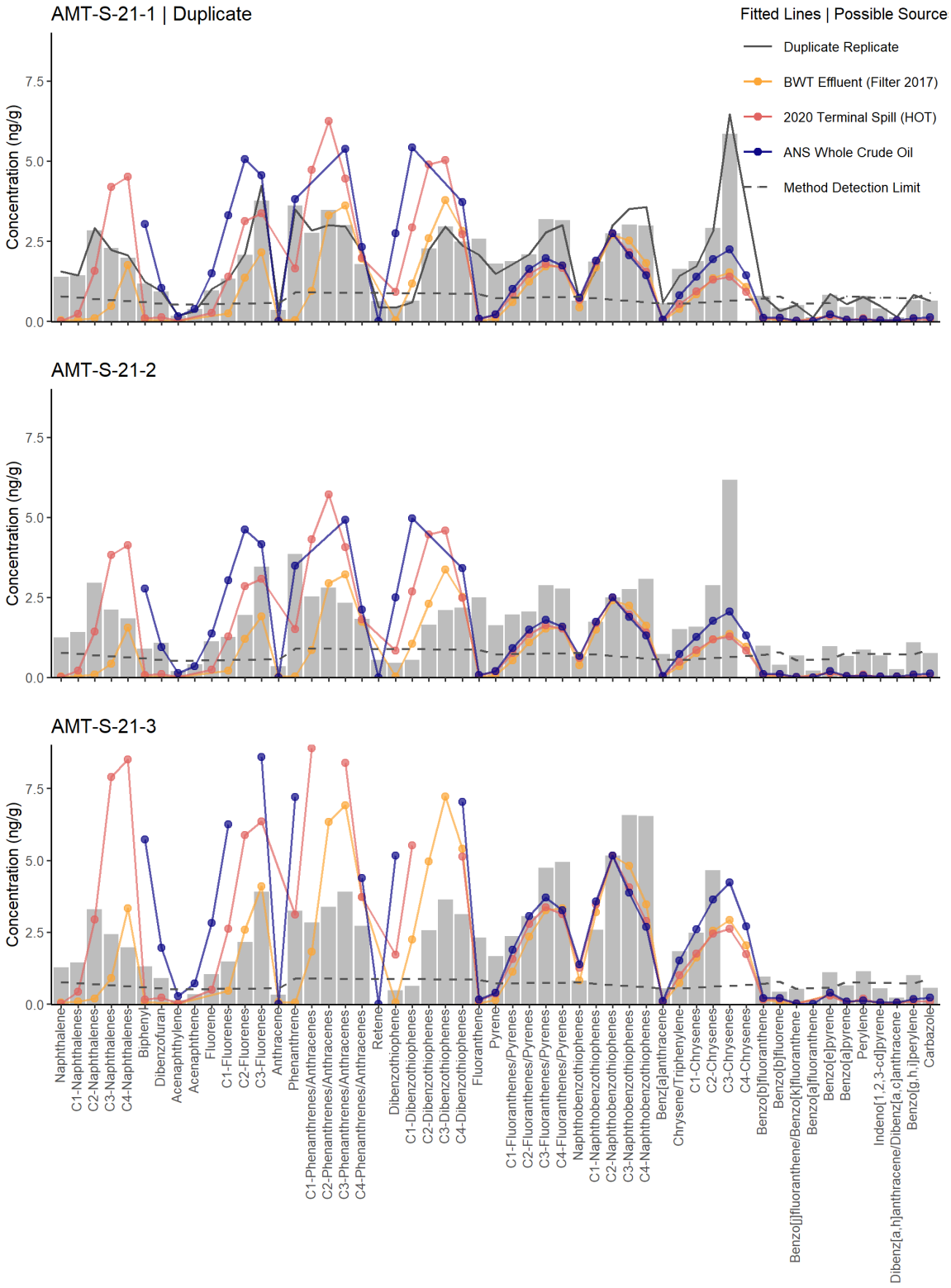

Figure 3. PAH profiles from individual sediment samples at the Valdez Marine Terminal with the duplicate replicate, three possible ANS related source profiles, and the analyte specific method detection limit superimposed as different lines.

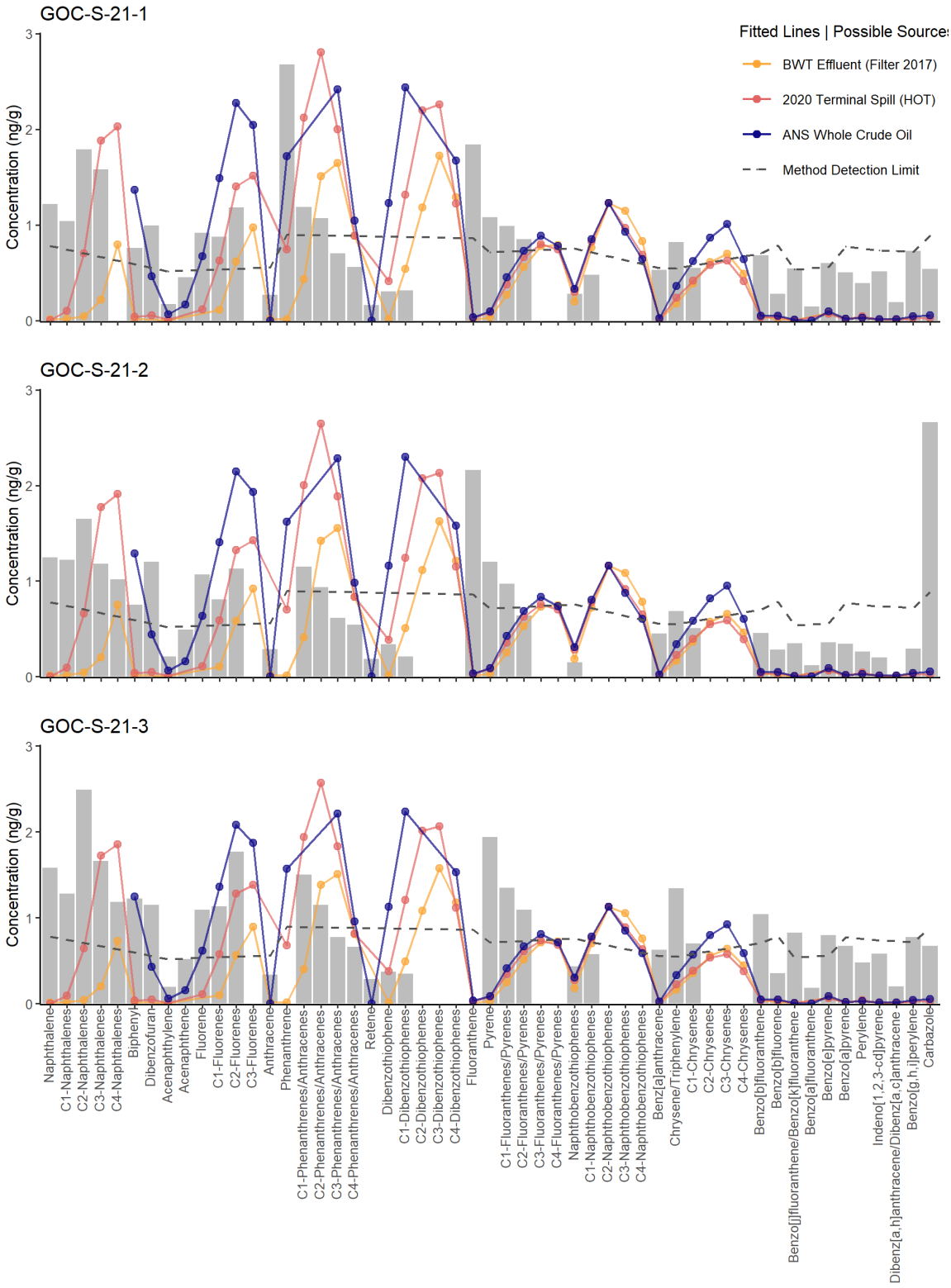

Figure 4. PAH profiles from individual sediment samples at Gold Creek with the three possible ANS-related source profiles, and the analyte specific method detection limit superimposed as different lines.

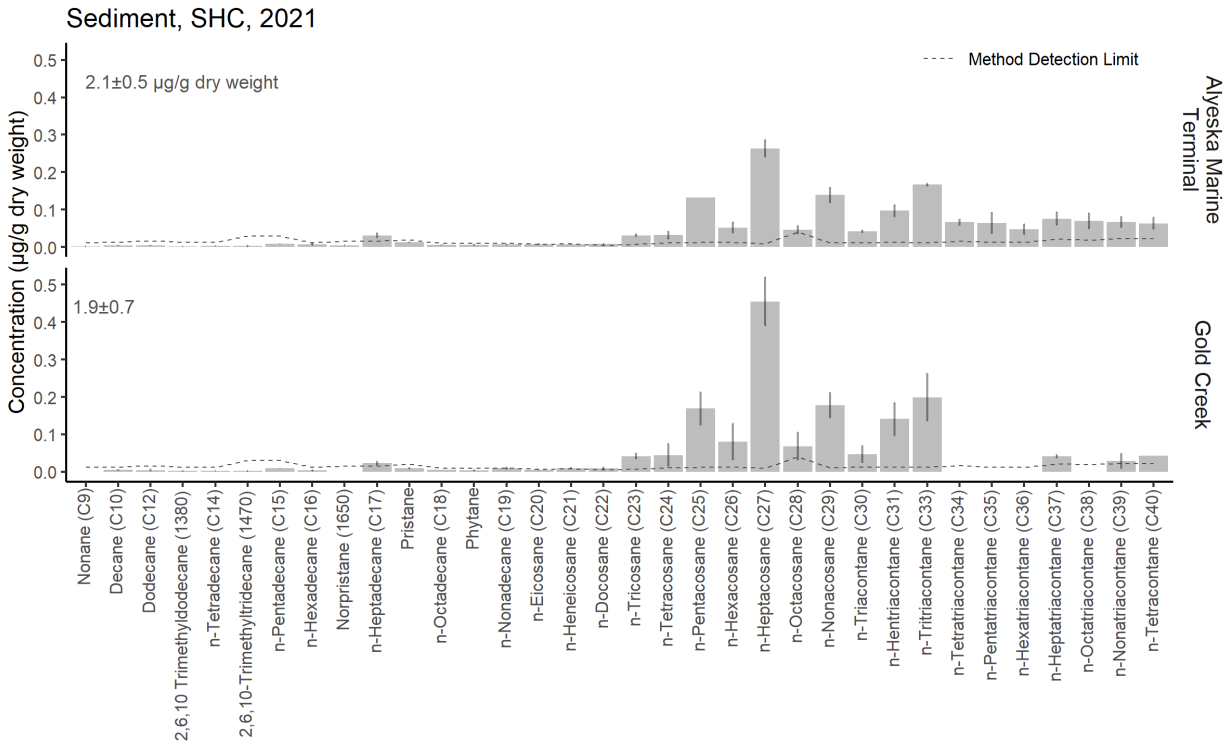

Figure 5. Saturated hydrocarbons (SHC) profiles from sediment samples plotted by mean ± 1 standard deviation. The analyte specific method detection limit is superimposed as a dashed line. Sum SHC values (mean ± 1 standard deviation) are found in the upper left corner of each site profile.

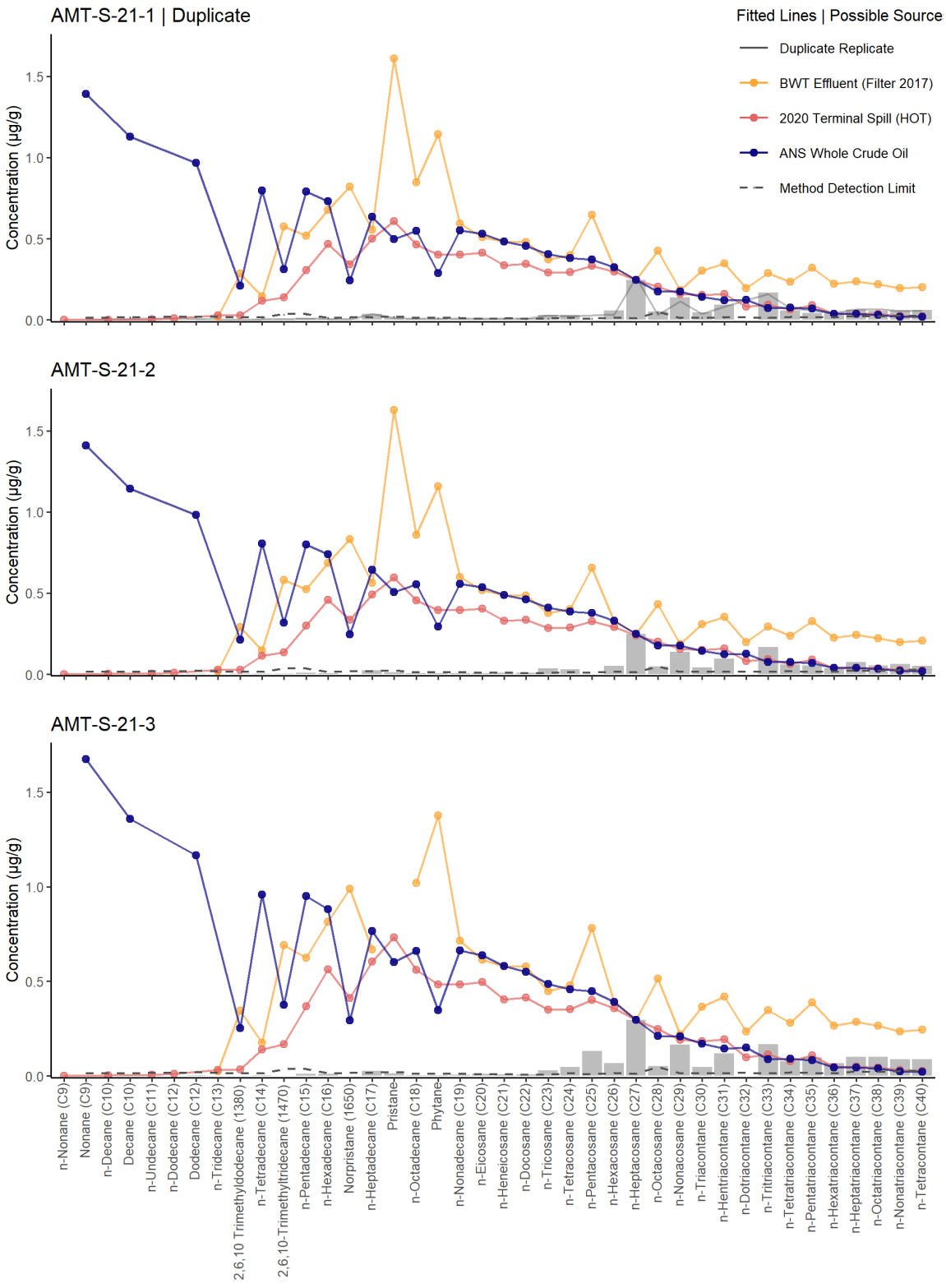

Figure 6. Saturated hydrocarbons (SHC) profiles from individual sediment samples at the Valdez Marine Terminal with the duplicate replicate, three possible ANS-related source profiles, and the analyte specific method detection limit superimposed as different lines.

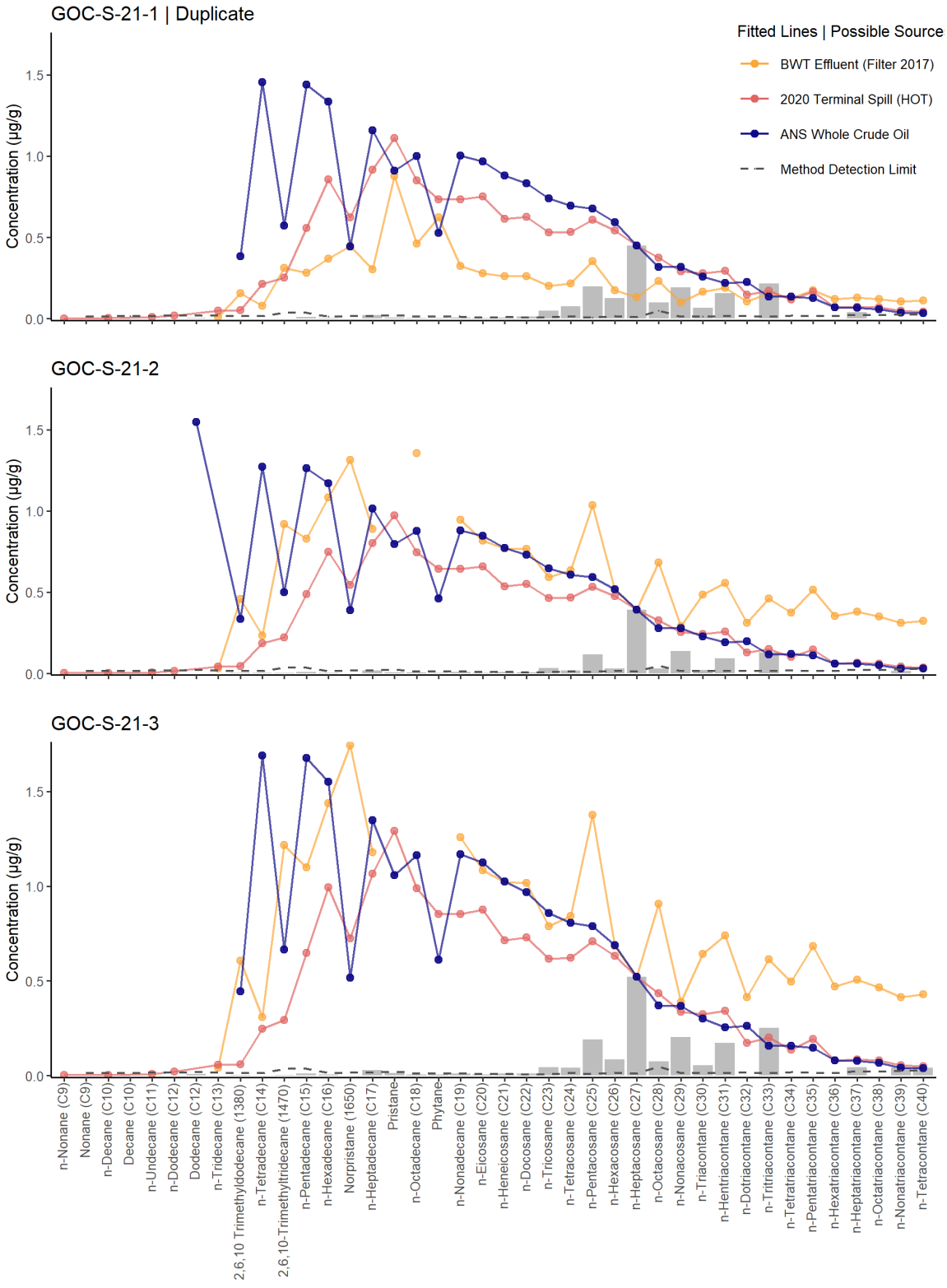

Figure 7. Saturated hydrocarbons (SHC) profiles from individual sediment samples at Gold Creek with three possible ANS-related source profiles, and the analyte specific method detection limit superimposed as different lines.

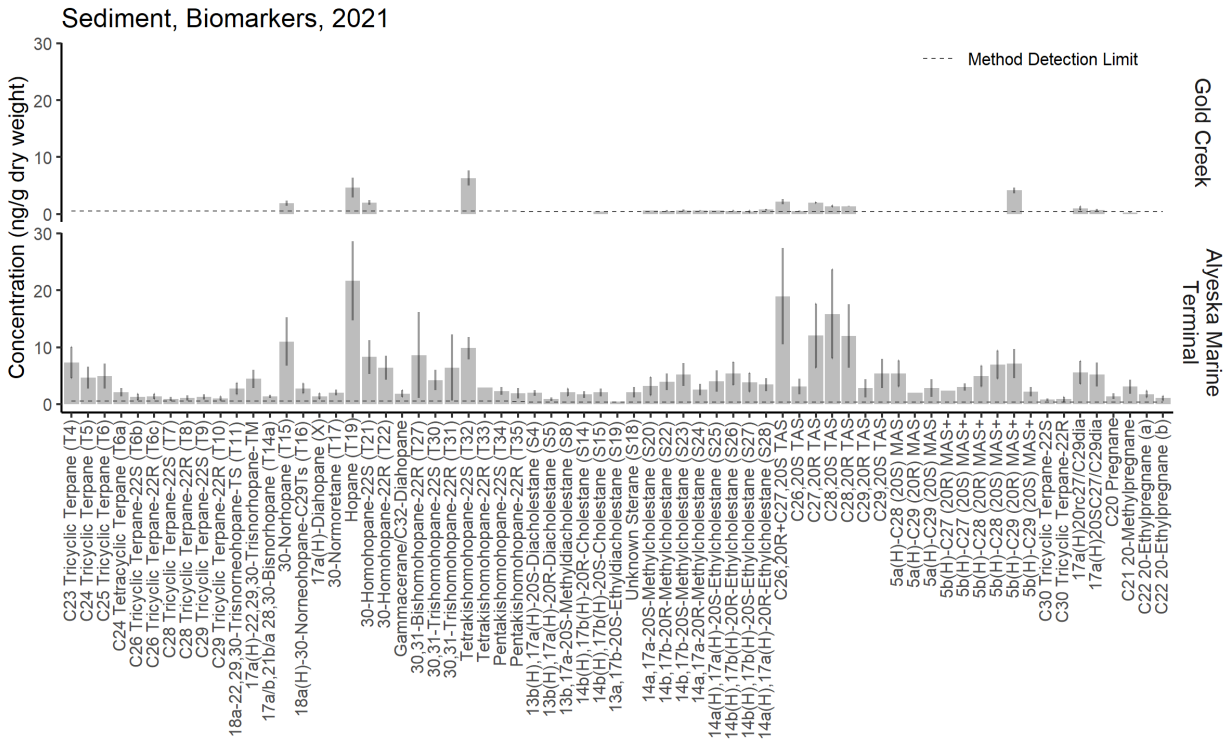

Figure 8. Petroleum chemical biomarker profiles from sediment samples plotted by mean ± 1 standard deviation. The analyte specific method detection limit is superimposed as a dashed line.

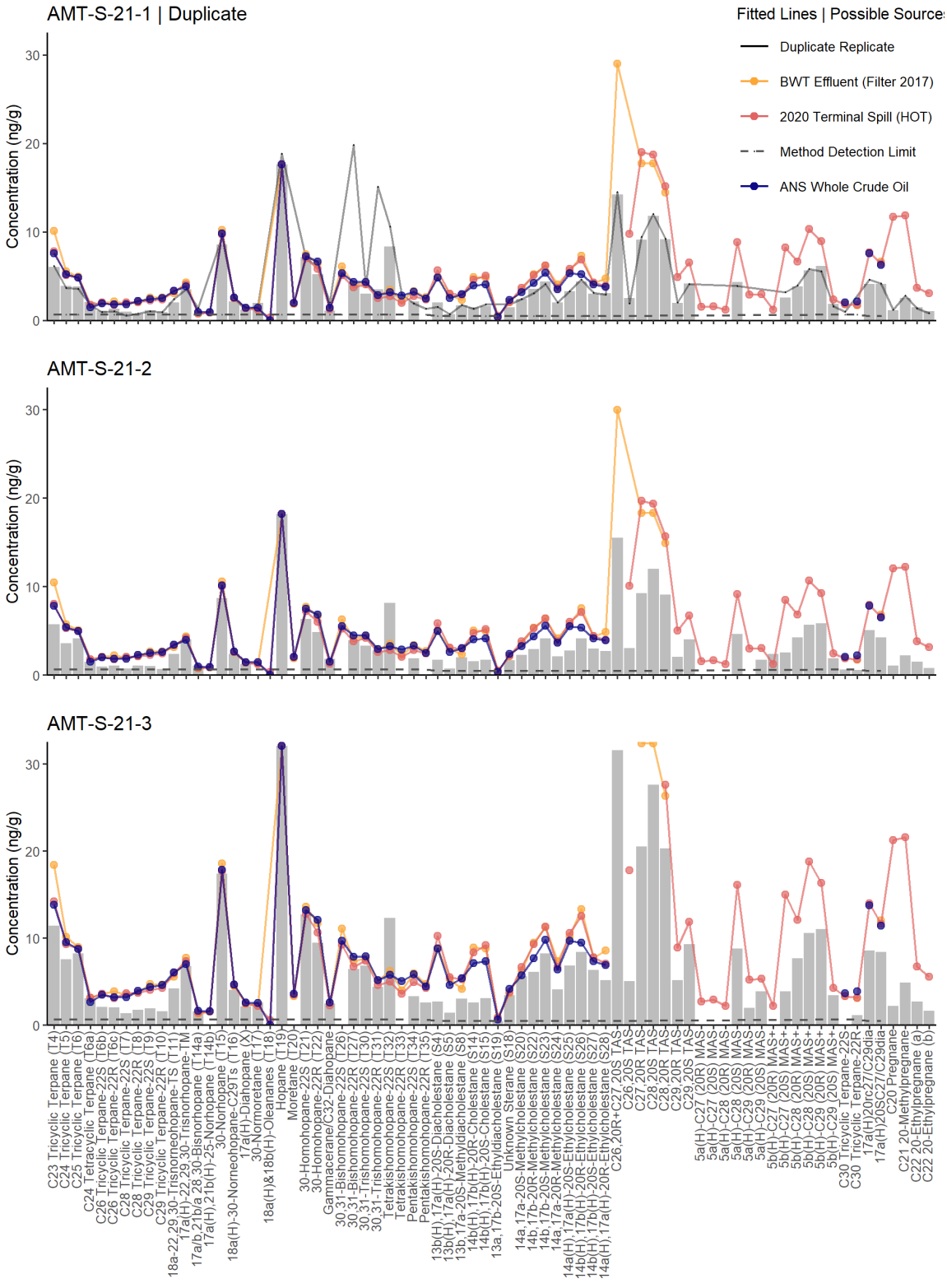

Figure 9. Petroleum chemical biomarker profiles from individual sediment samples at the Valdez Marine Terminal with the duplicate replicate, three possible ANS-related source profiles, and the analyte specific method detection limit superimposed as different lines.

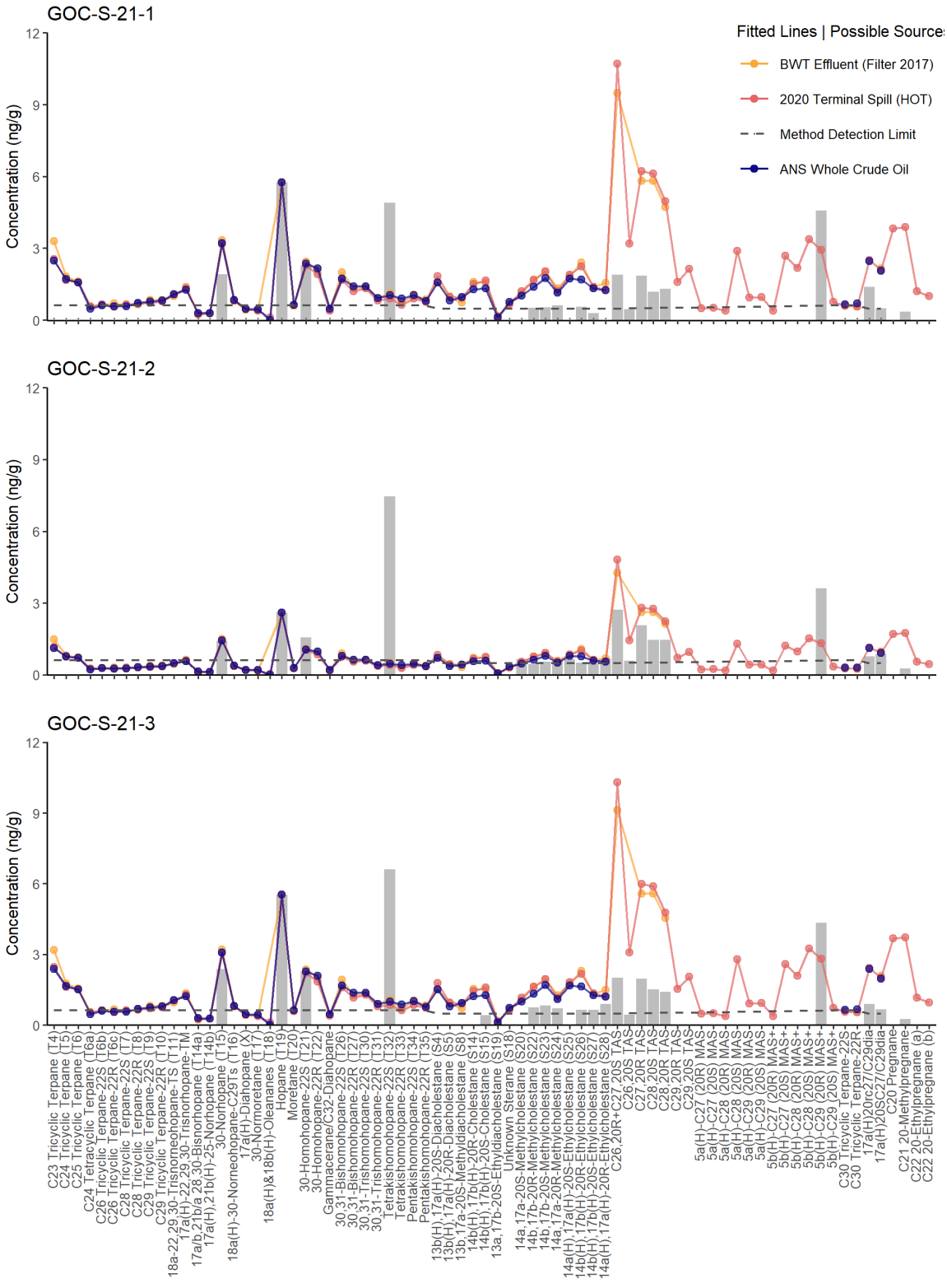

Figure 10. Petroleum chemical biomarker profiles from individual sediment samples at Gold Creek with three possible ANS-related source profiles, and the analyte specific method detection limit superimposed as different lines.

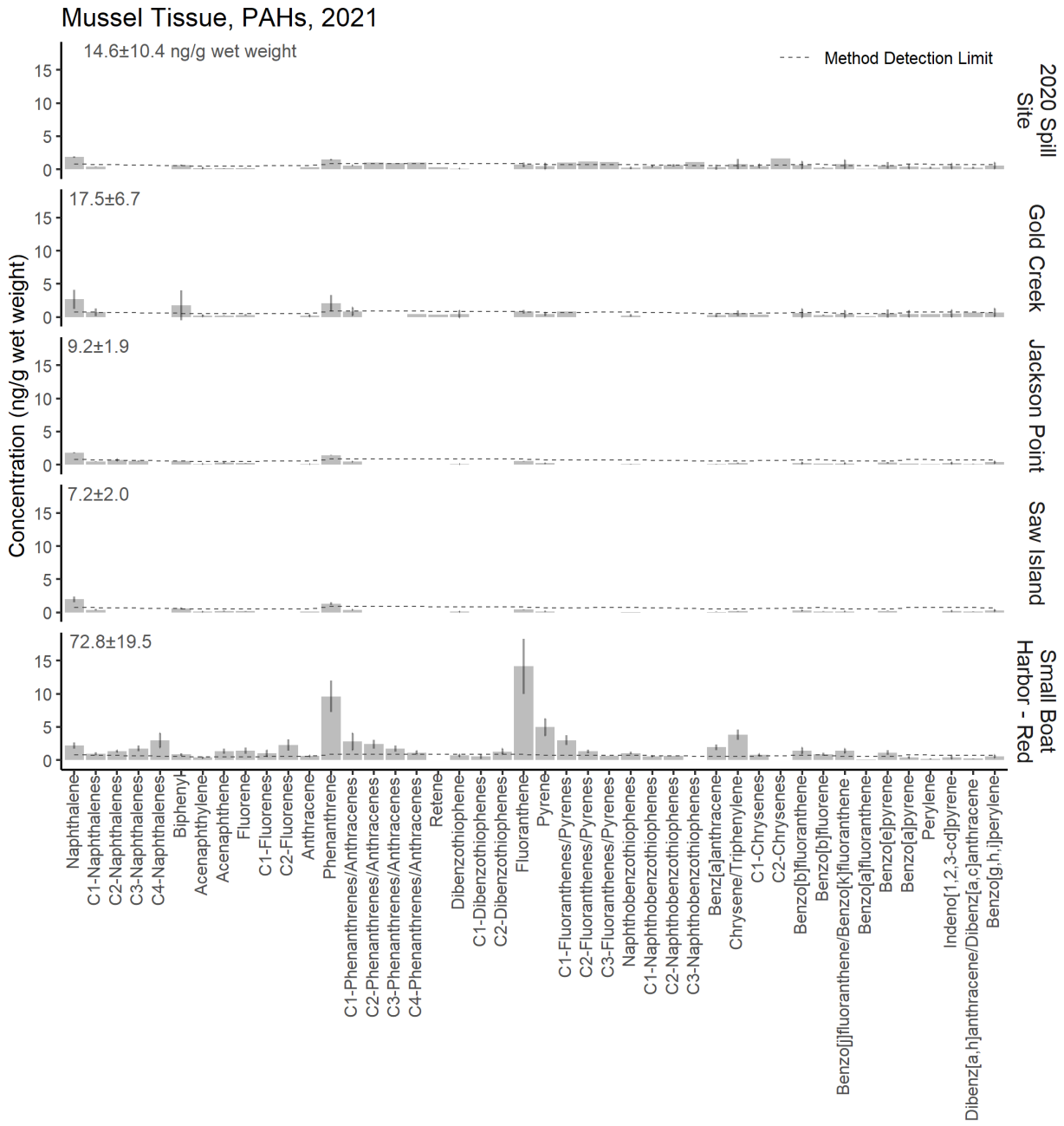

Figure 11. PAH profiles from 2021 mussel tissue samples plotted by mean ± 1 standard deviation, The analyte specific method detection limit is superimposed as a dashed line. Sum 43 PAH values (mean ± 1 standard deviation) are found in the upper left corner of each site profile.

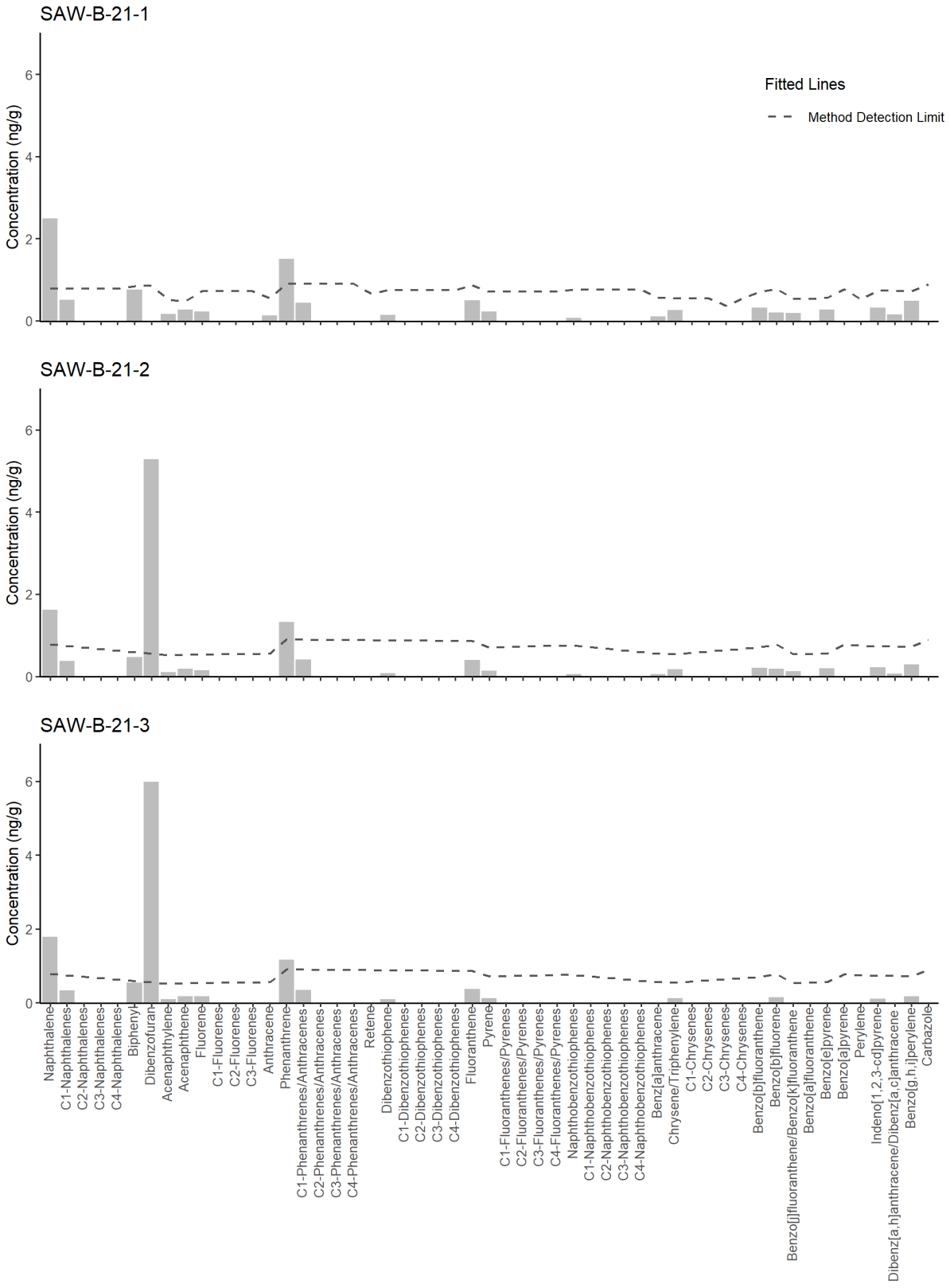

Figure 12. PAH profiles from individual mussel tissue samples at Saw Island with the analyte specific method detection limit superimposed as a dashed line.

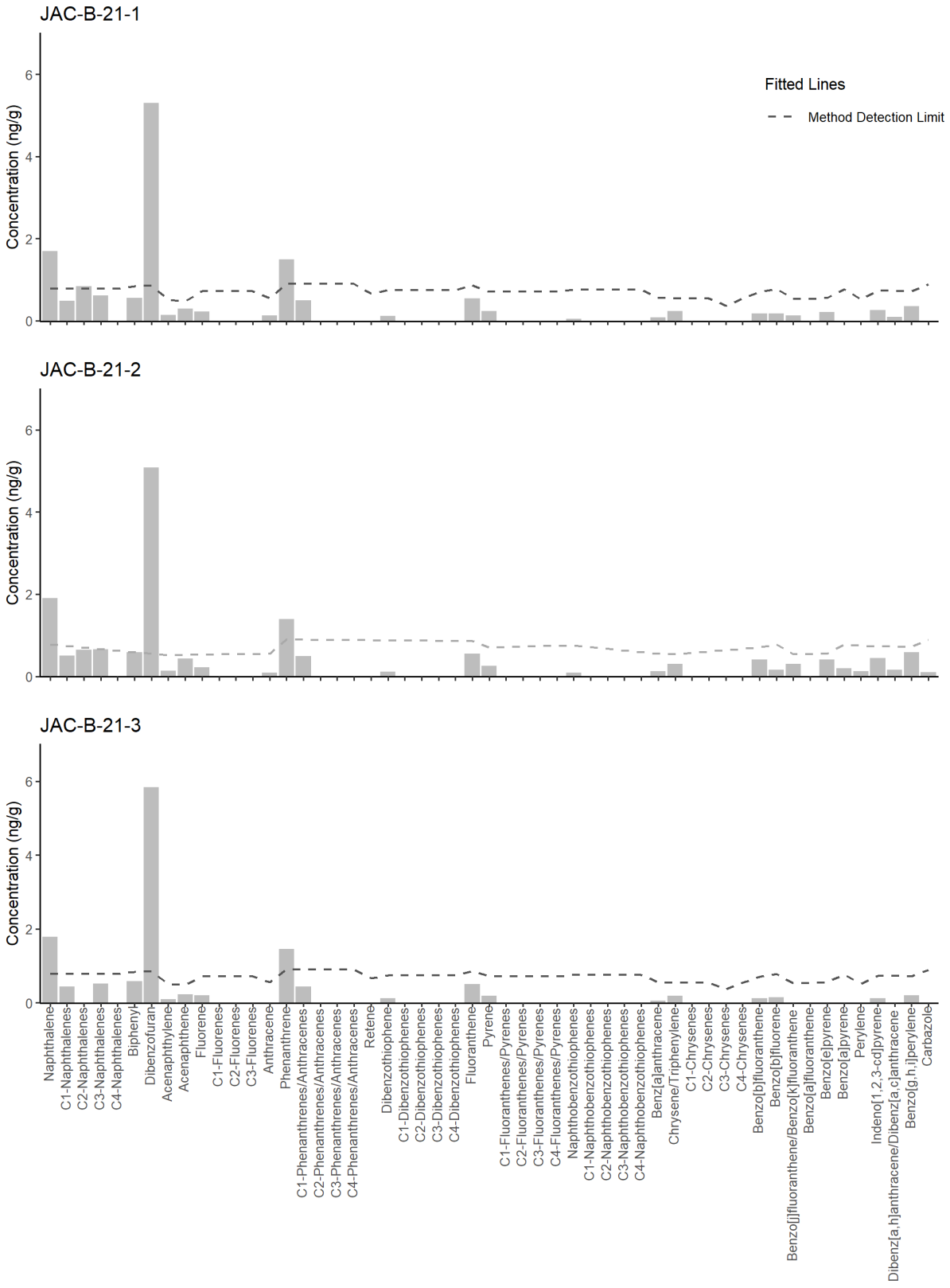

Figure 13. PAH profiles from individual mussel tissue samples at Jackson Point with the analyte specific method detection limit superimposed as a dashed line.

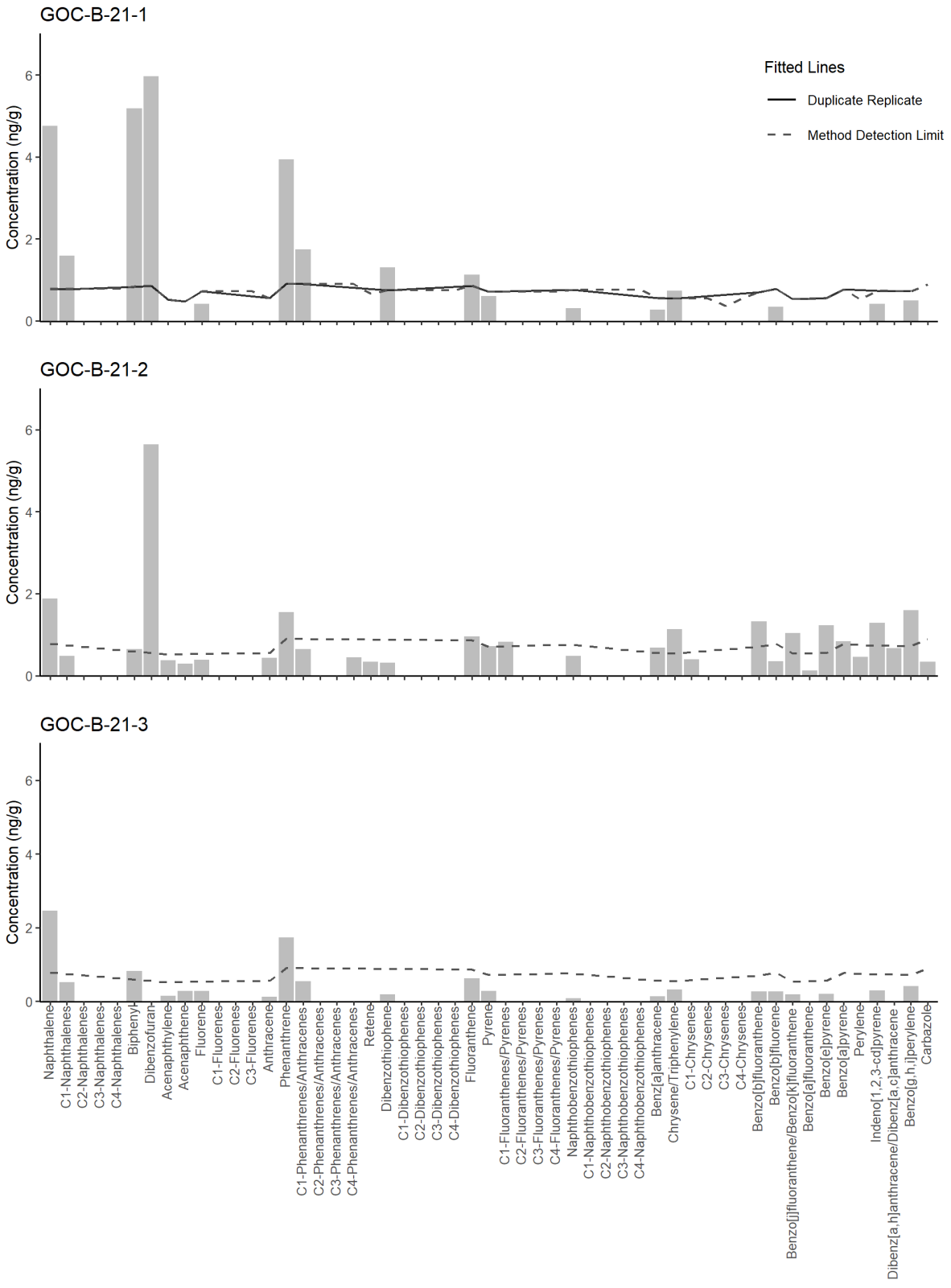

Figure 14. PAH profiles from individual mussel tissue samples at Gold Creek with duplicate replicate (with detected analytes are assigned the MDL) and the analyte specific method detection limit superimposed as different lines.

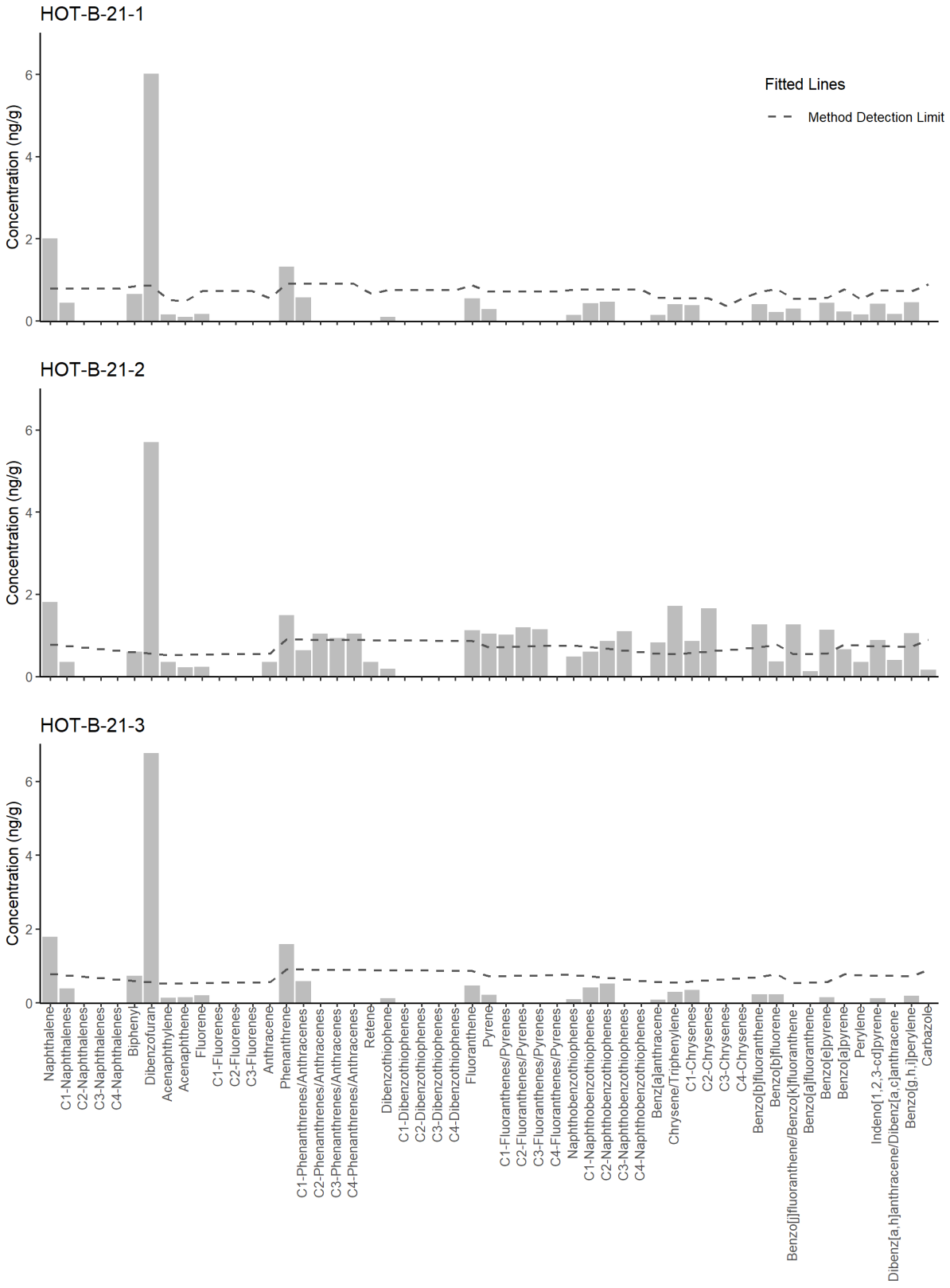

Figure 15. PAH profiles from individual mussel tissue samples at the April 2020 spill site (HOT) with the analyte specific method detection limit superimposed as a dashed line.

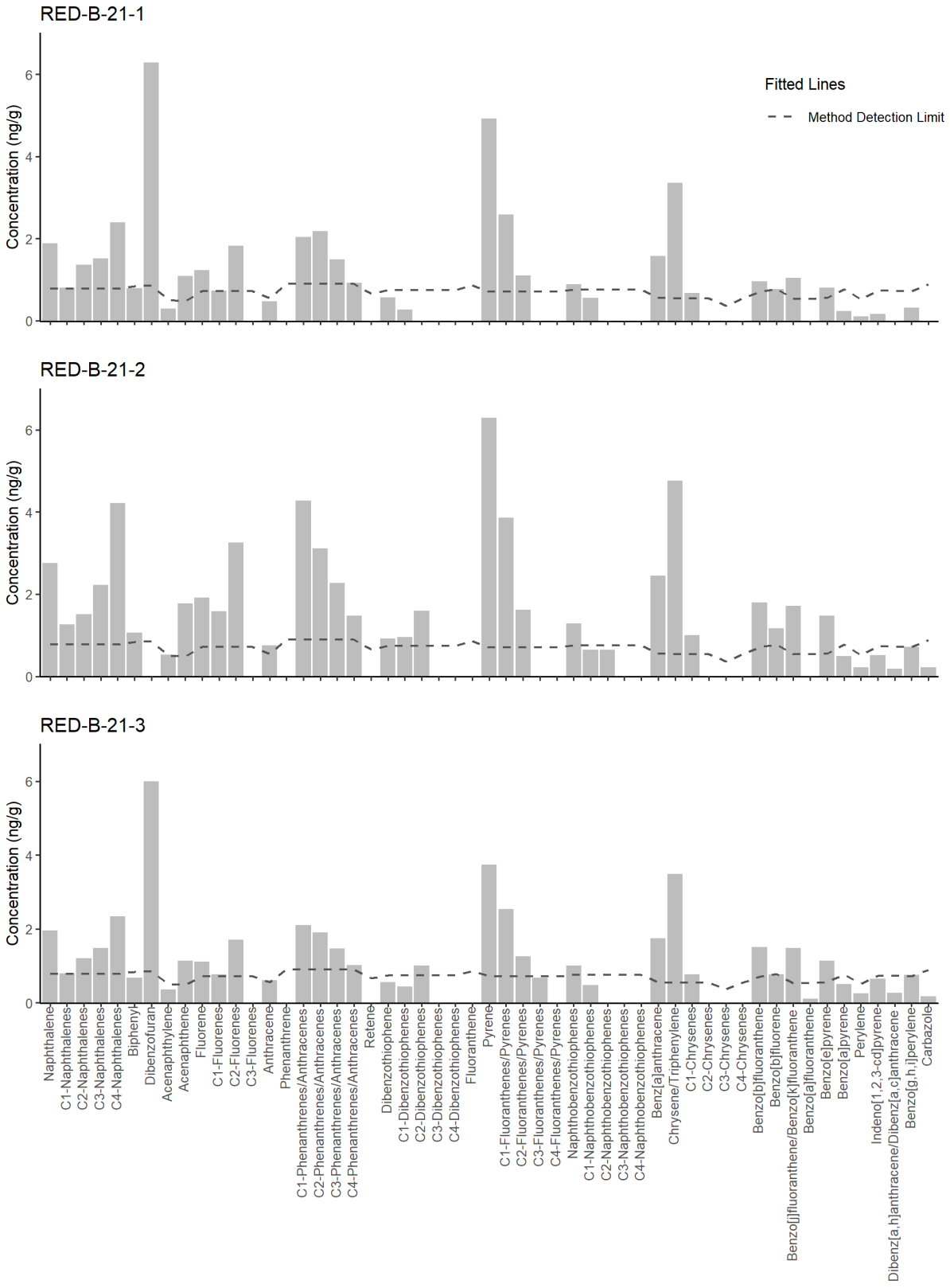

Figure 16. PAH profiles from individual mussel tissue samples at the Valdez Small Boat Harbor entrance (RED) with the analyte specific method detection limit superimposed as a dashed line.

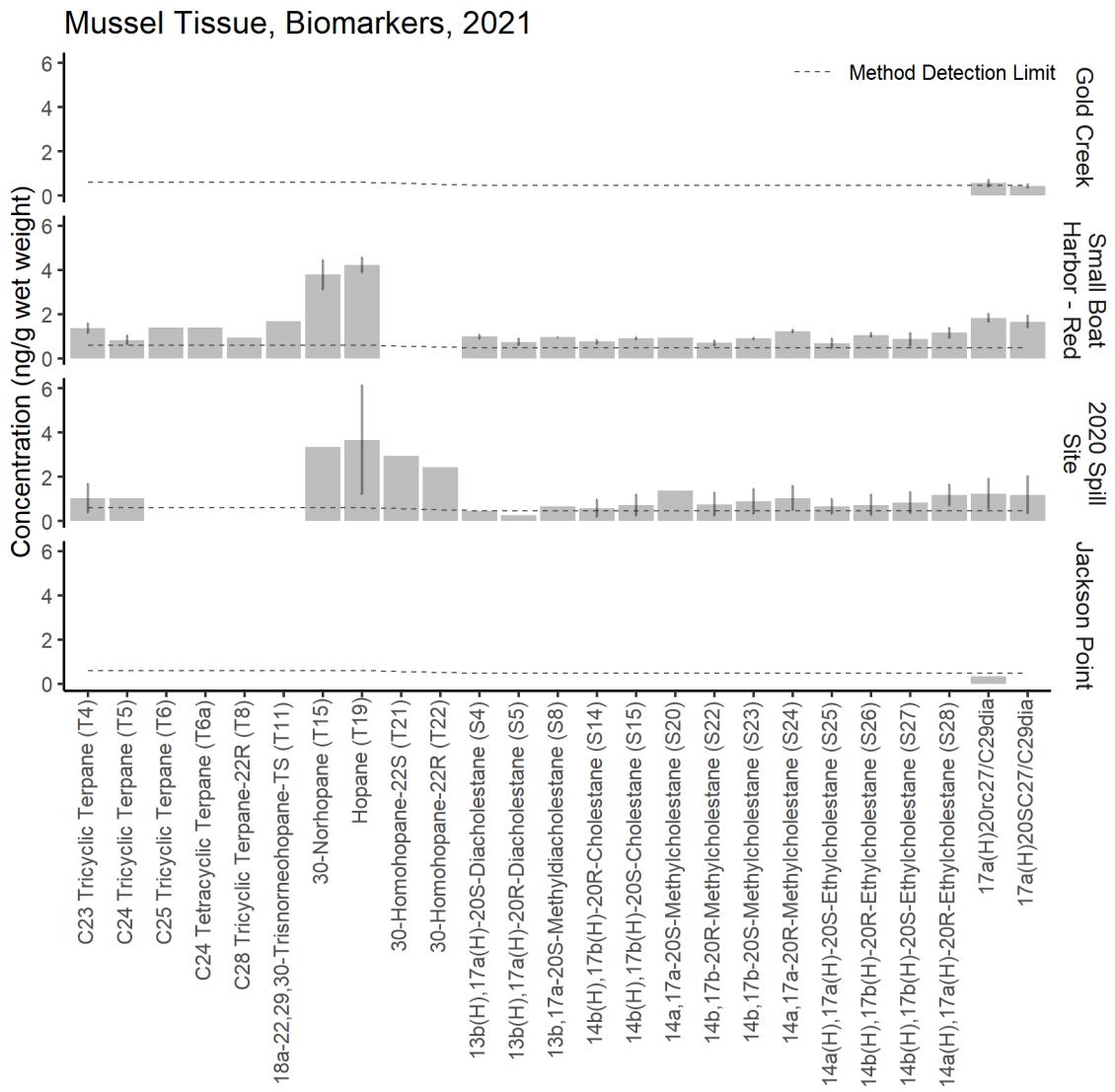

Figure 17. Petroleum chemical biomarker profiles from mussel tissue samples plotted by mean ± 1 standard deviation. The analyte specific method detection limit is superimposed as a dashed line.

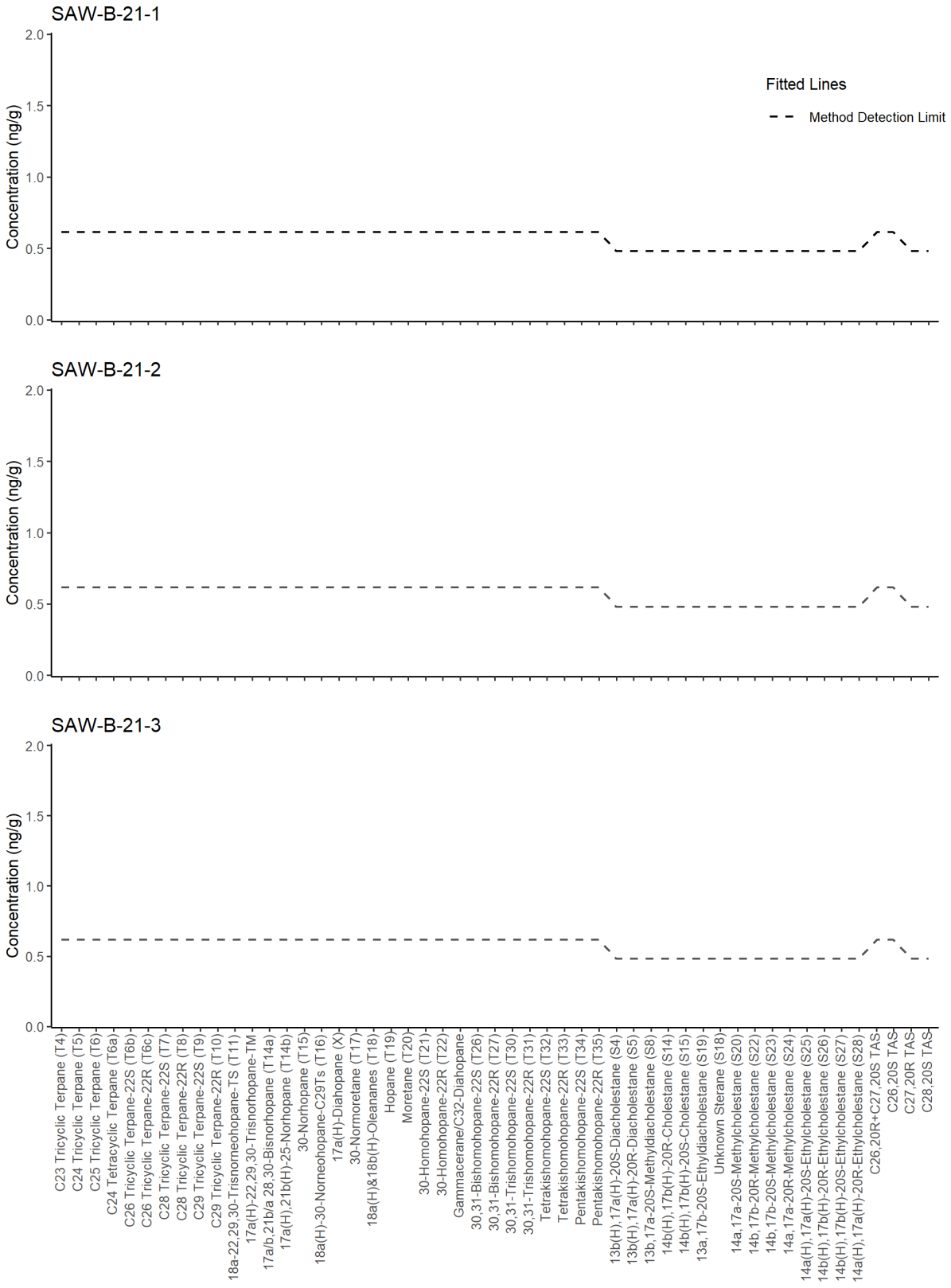

Figure 18. Biomarker profiles from individual mussel tissue samples at Saw Island with the analyte specific method detection limit superimposed as a dashed line.

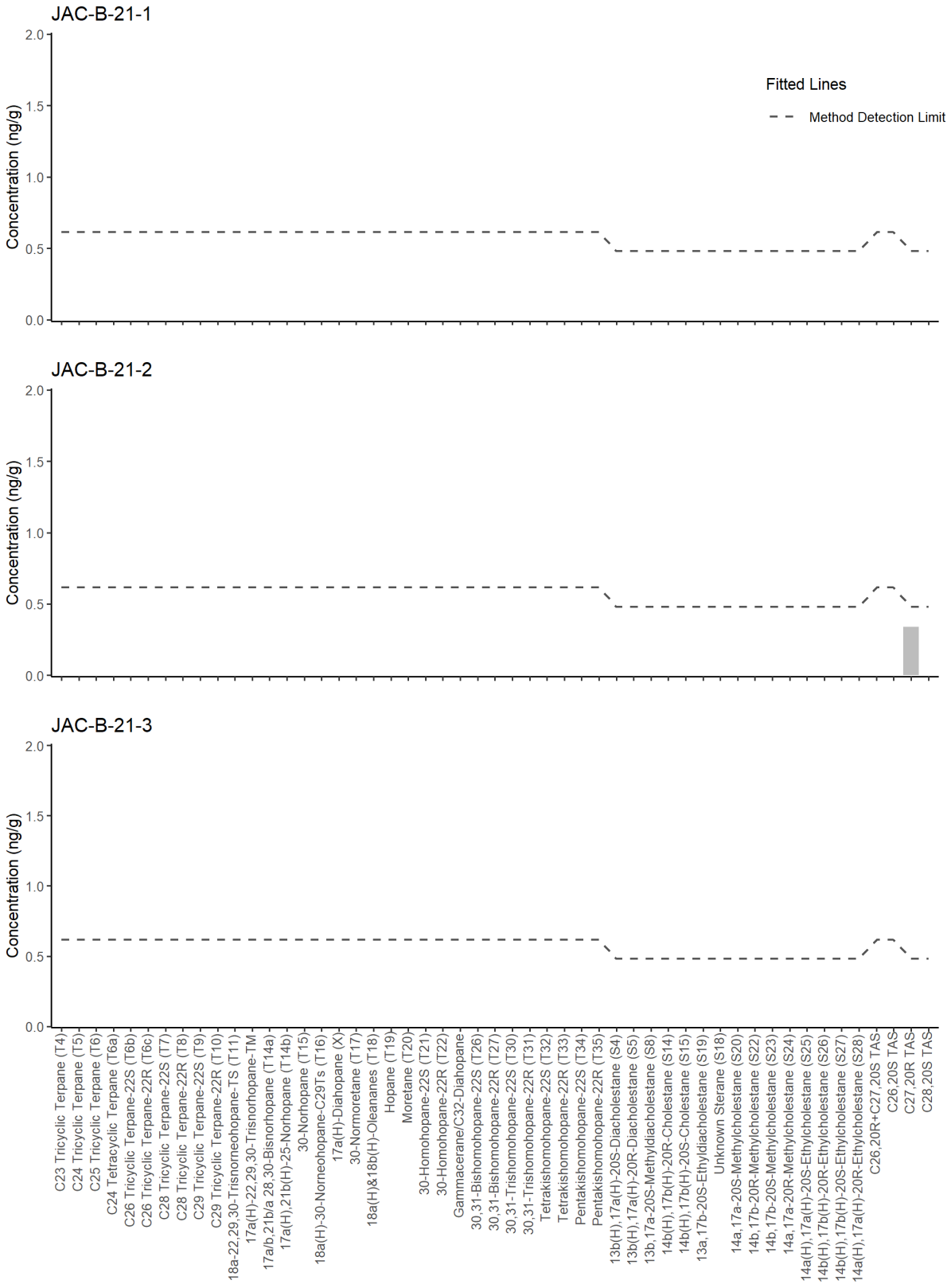

Figure 19. Biomarker profiles from individual mussel tissue samples at Jackson Point with the analyte specific method detection limit superimposed as a dashed line.

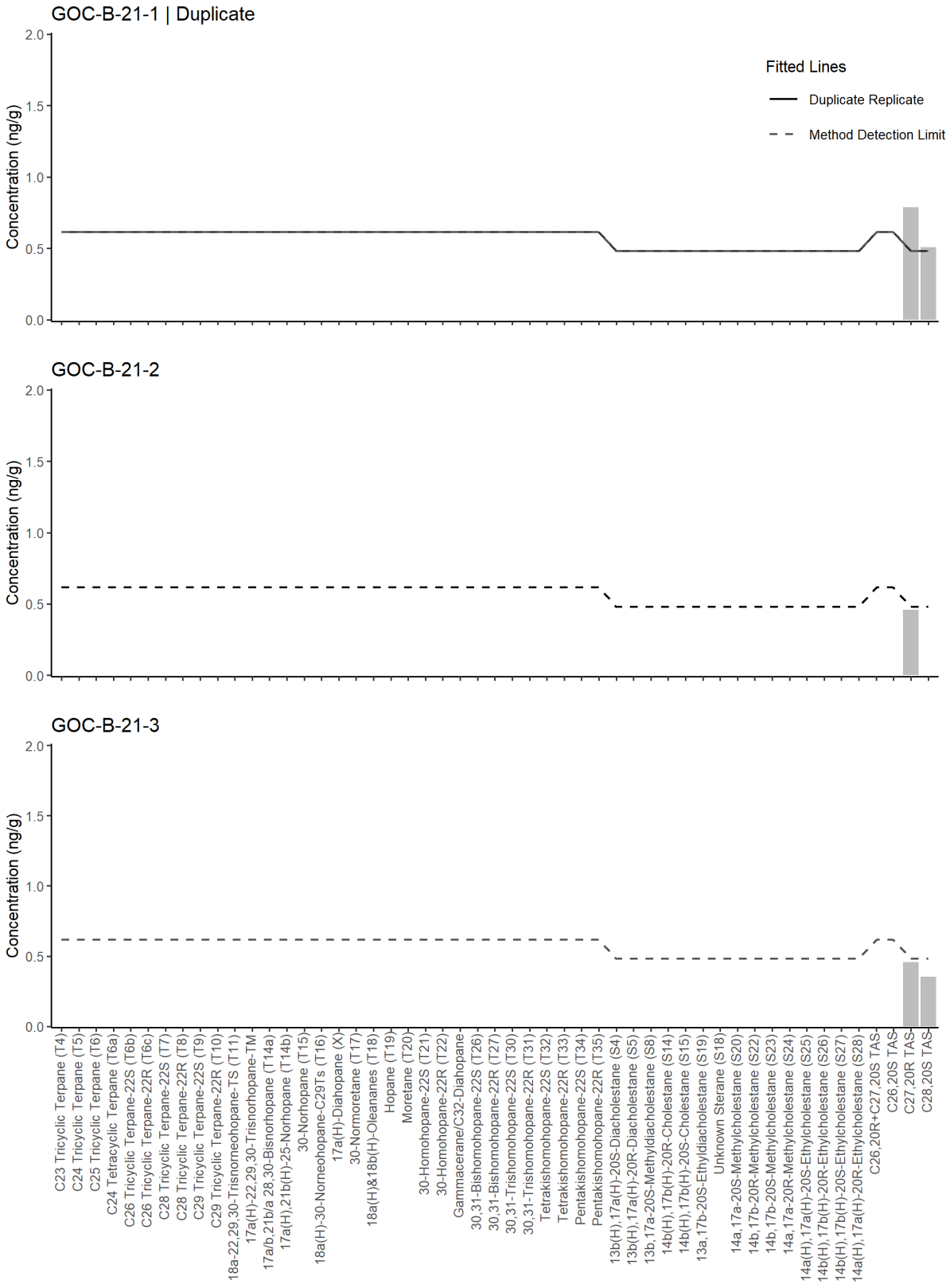

Figure 20. Biomarker profiles from individual mussel tissue samples at Gold Creek with the duplicate replicate and analyte specific method detection limit superimposed as different lines.

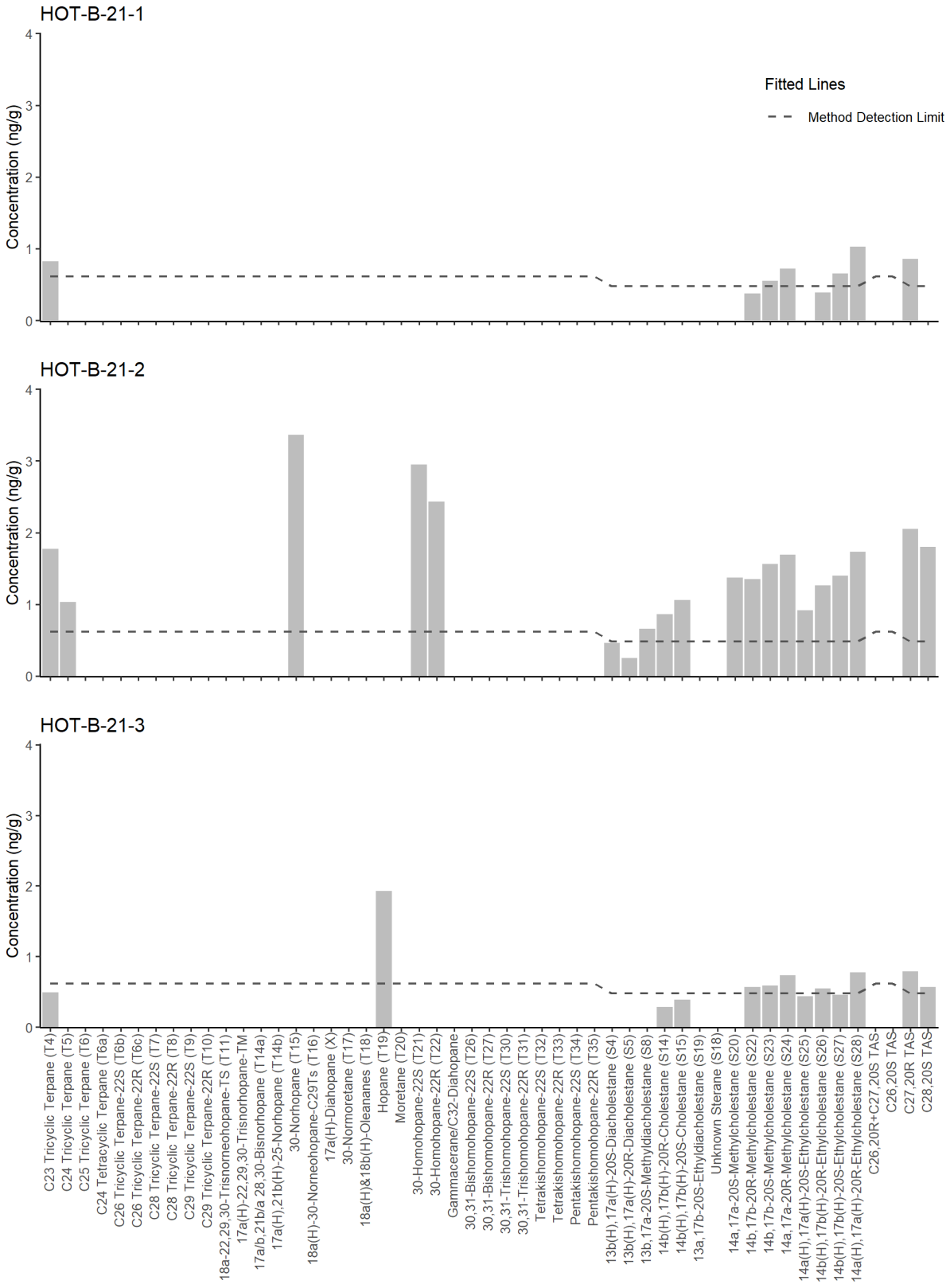

Figure 21. Biomarker profiles from individual mussel tissue samples at the April 2020 spill site (HOT) with the analyte specific method detection limit superimposed as a dashed line.

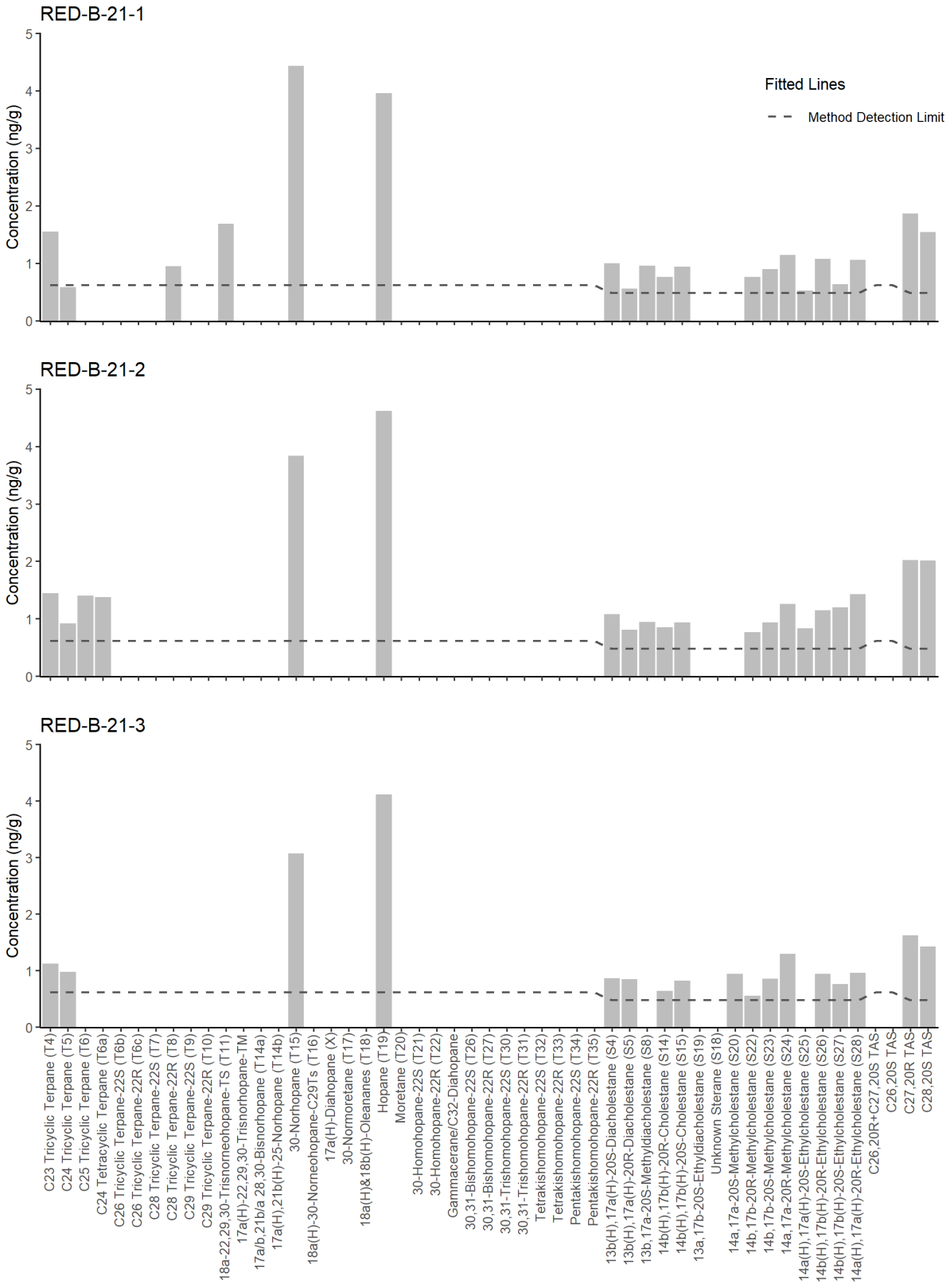

Figure 22. Biomarker profiles from individual mussel tissue samples at the entrance of the Valdez Small Boat Harbor (RED) with the analyte specific method detection limit superimposed as a dashed line.

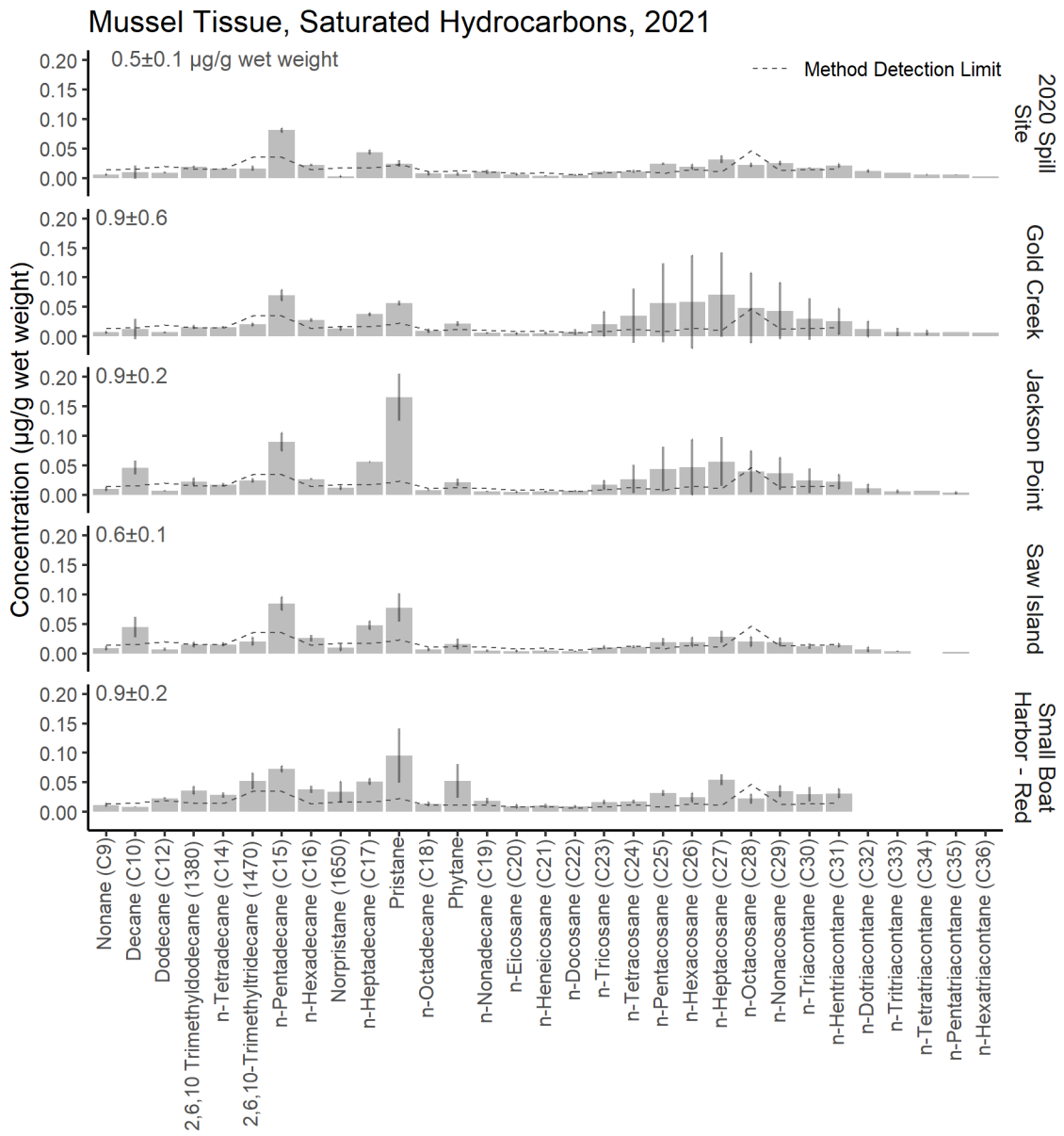

Figure 23. Saturated hydrocarbons (SHC) profiles from mussel tissue samples plotted by mean ± 1 standard deviation. The analyte specific method detection limit is superimposed as a dashed line. Sum SHC values (mean ± 1 standard deviation) are found in the upper left corner of each site profile.

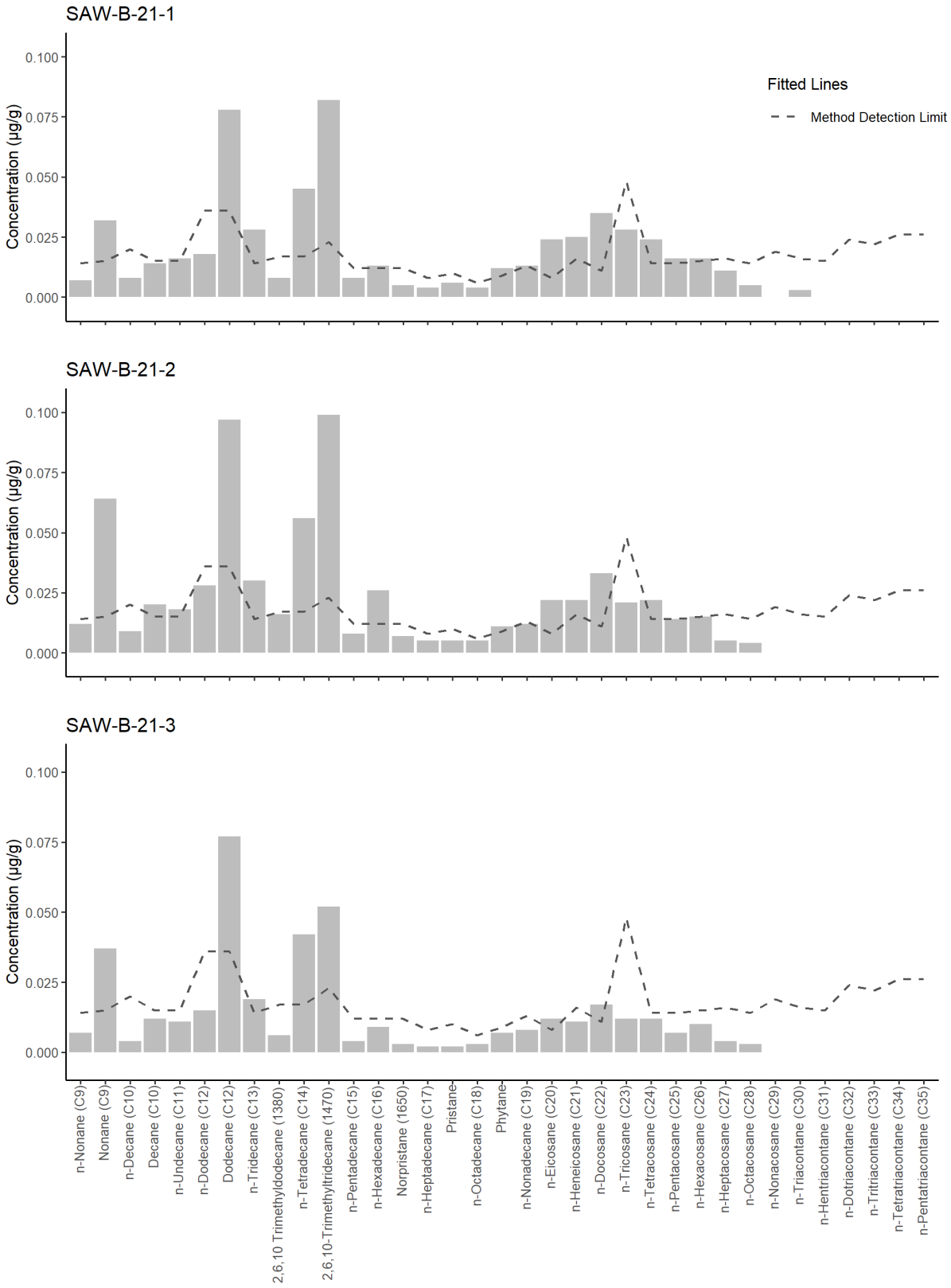

Figure 24. Saturated hydrocarbon (SHC) profiles from individual mussel samples at Saw Island with the analyte specific method detection limit superimposed as a dashed line.

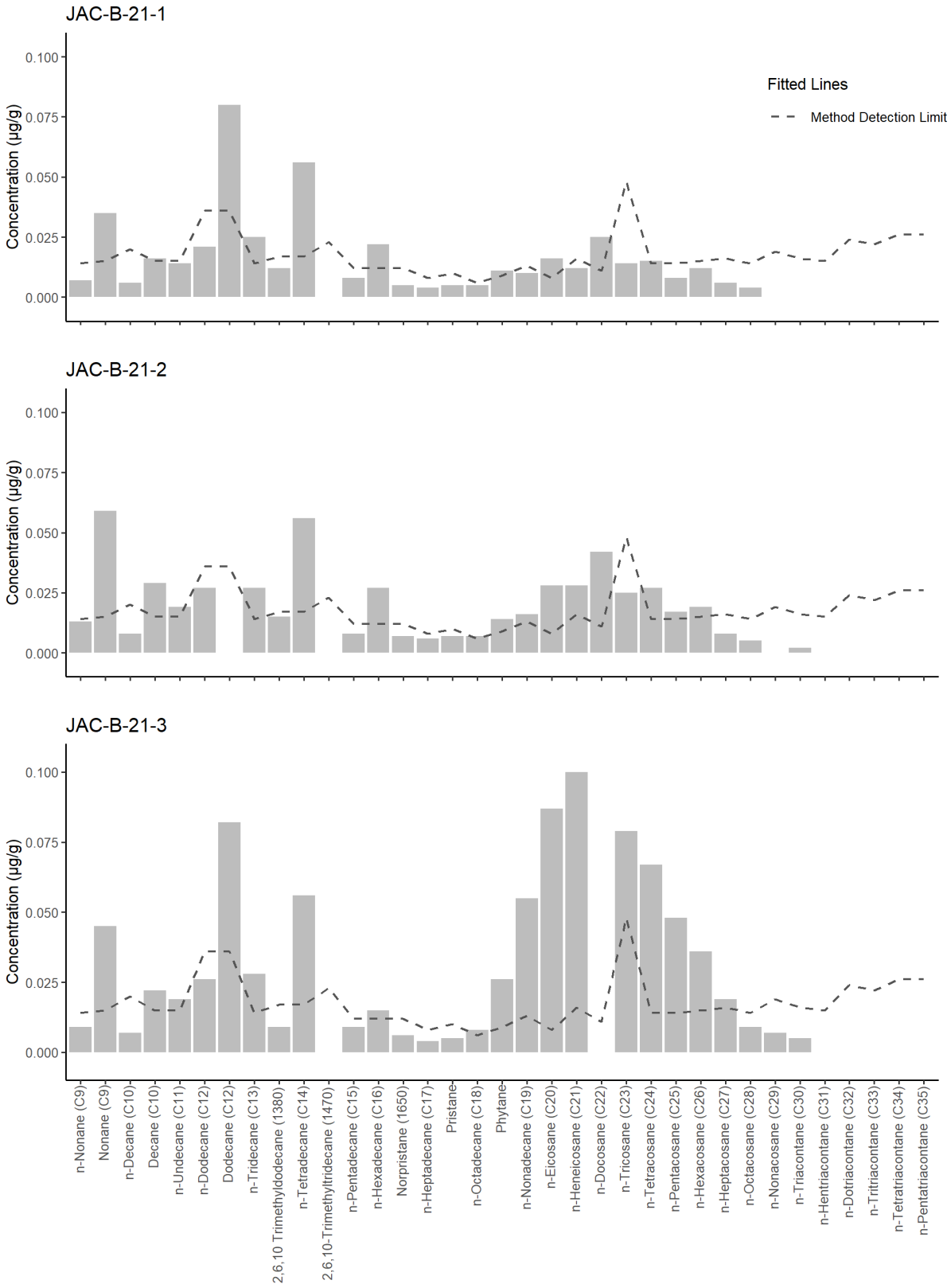

Figure 25. Saturated hydrocarbon (SHC) profiles from individual mussel samples at Jackson Point with the analyte specific method detection limit superimposed as a dashed line.

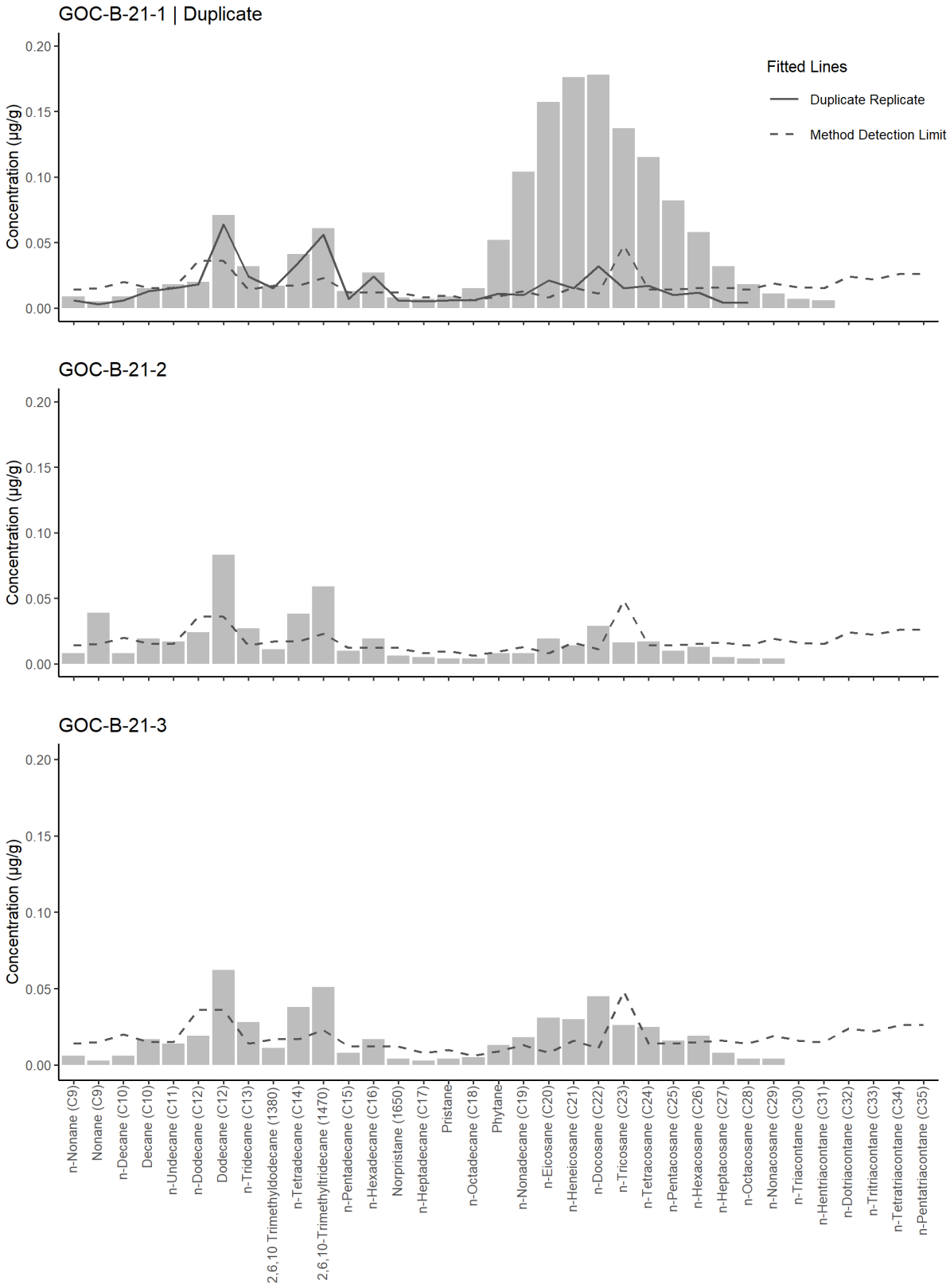

Figure 26. Saturated hydrocarbon (SHC) profiles from individual mussel samples at Gold Creek with the duplicate replicate and the analyte specific method detection limit superimposed as different lines.

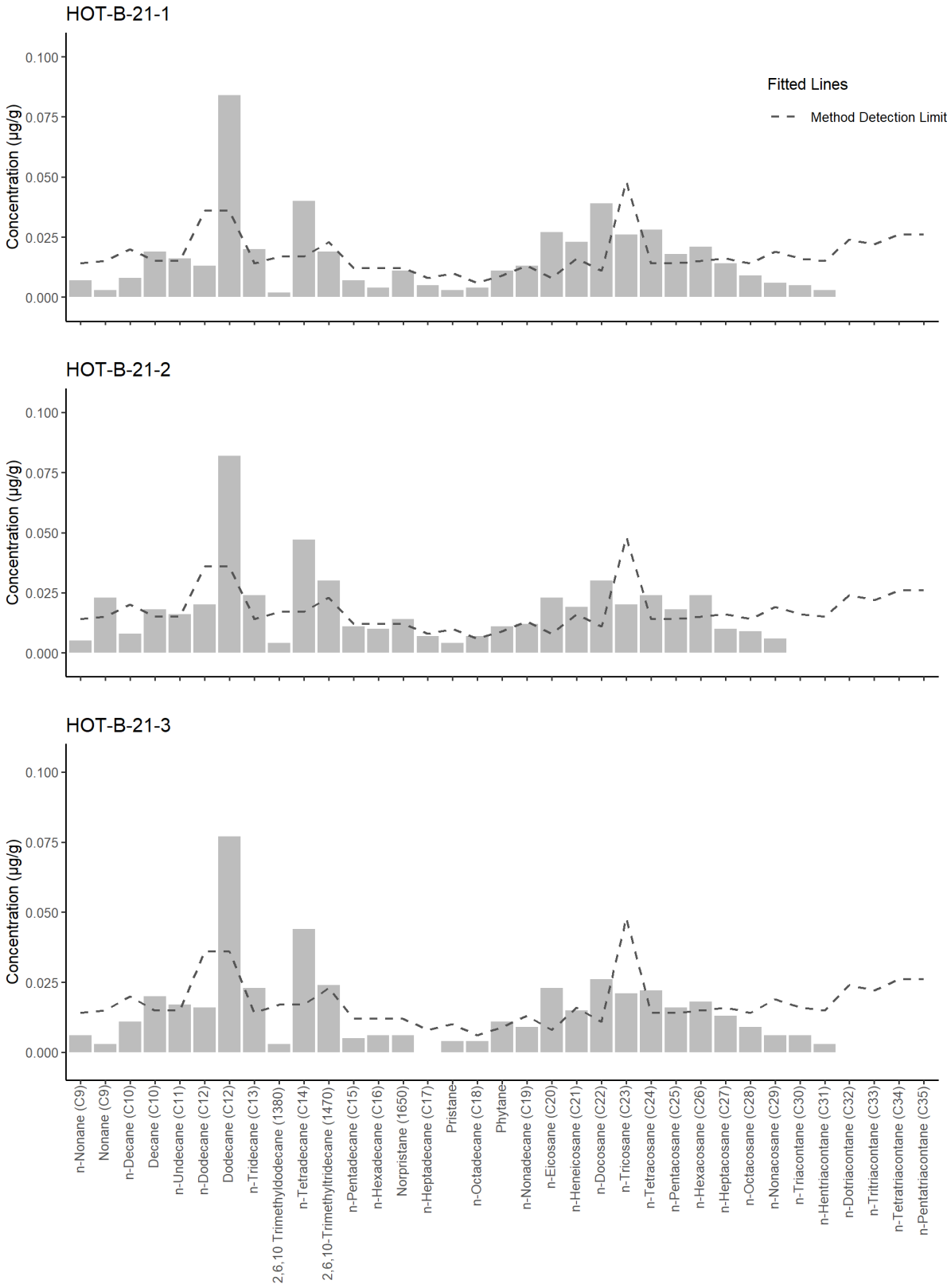

Figure 27. Saturated hydrocarbon (SHC) profiles from individual mussel samples at the April 2020 spill site (HOT) with the analyte specific method detection limit superimposed as a dashed line.

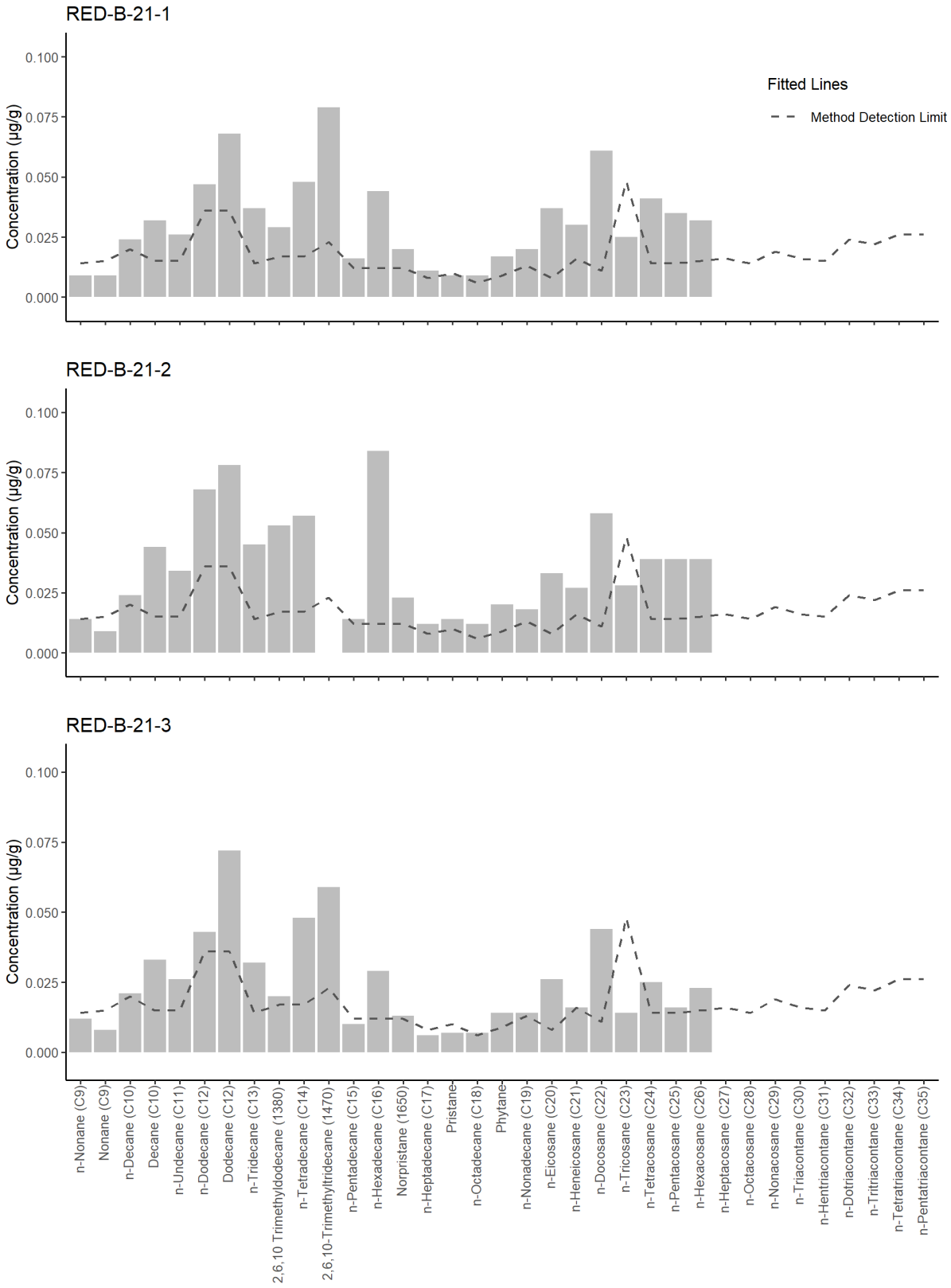

Figure 28. Saturated hydrocarbon (SHC) profiles from individual mussel samples at the Valdez Small Boat Harbor entrance (RED) with the analyte specific method detection limit superimposed as a dashed line.

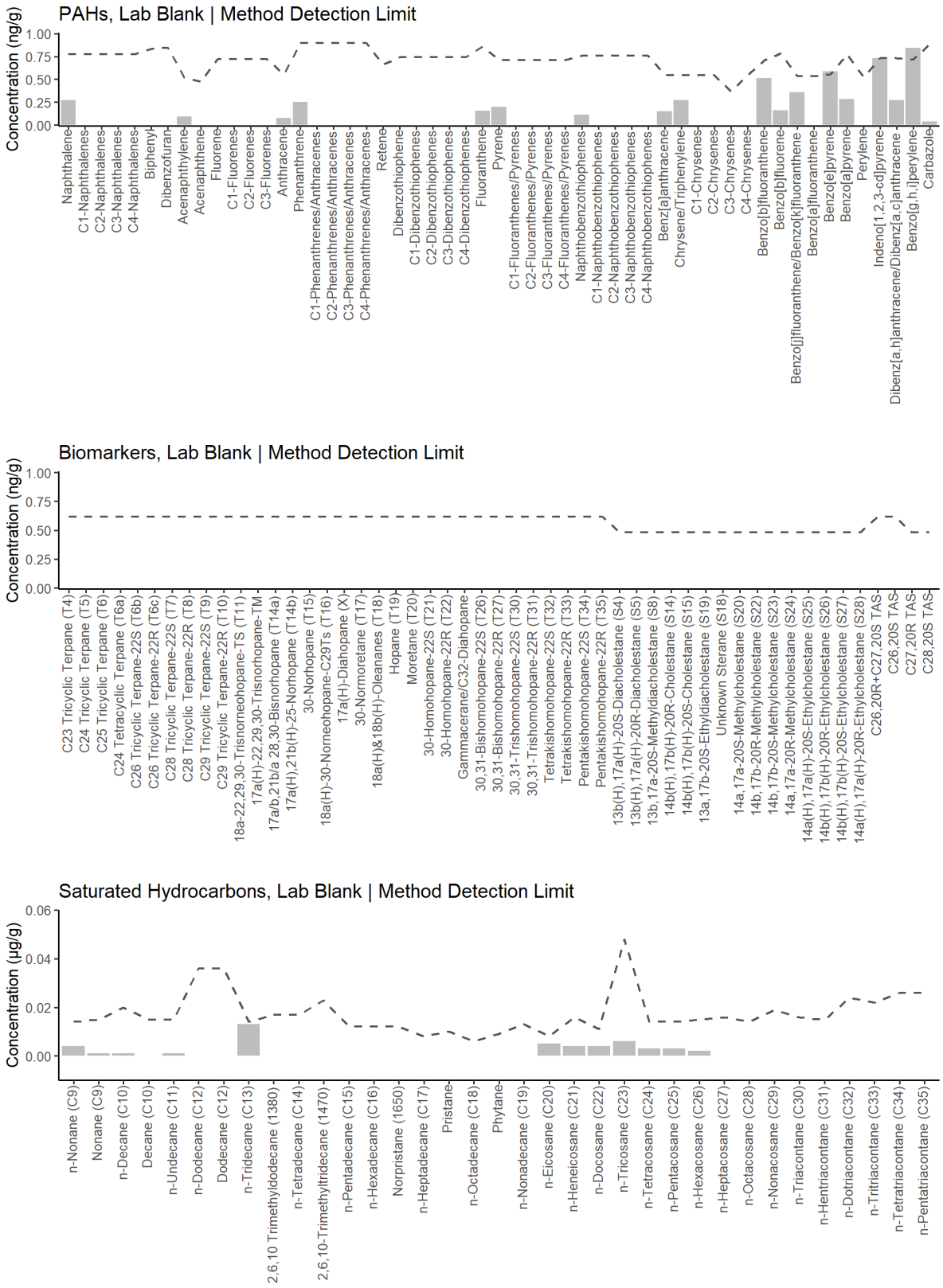

Figure 29. PAH, biomarker, and saturated hydrocarbon (SHC) profiles from the NewFields laboratory blanks with the analyte specific method detection limit superimposed as a dashed line.

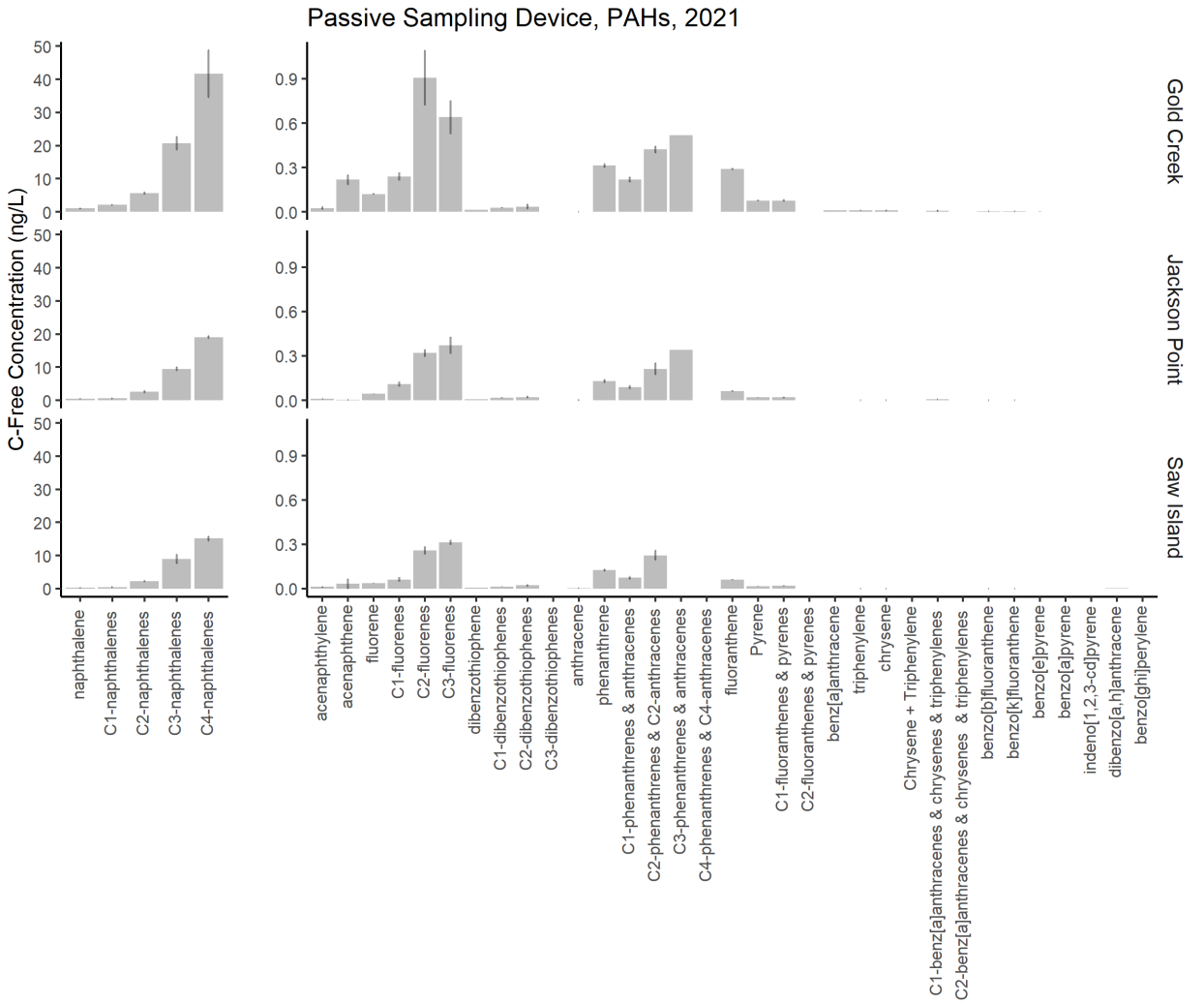

Figure 30. PAH profiles from passive sampling devices deployed during LTEMP 2021 at Gold Creek, Jackson Point, and Saw Island plotted by mean value ± standard deviation.

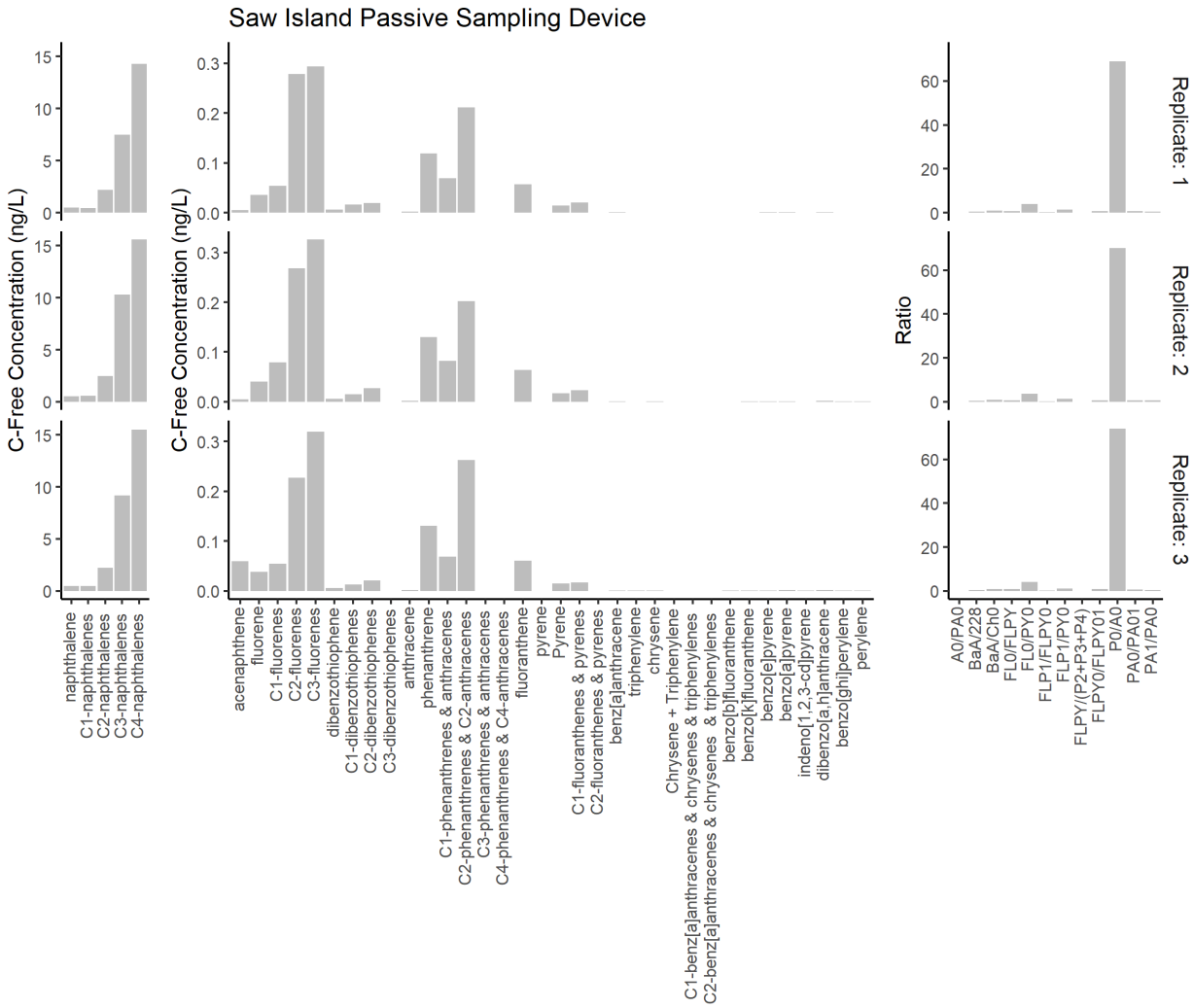

Figure 31. PAH profiles and laboratory diagnostic ratios from individual passive sampling devices deployed at Saw Island.

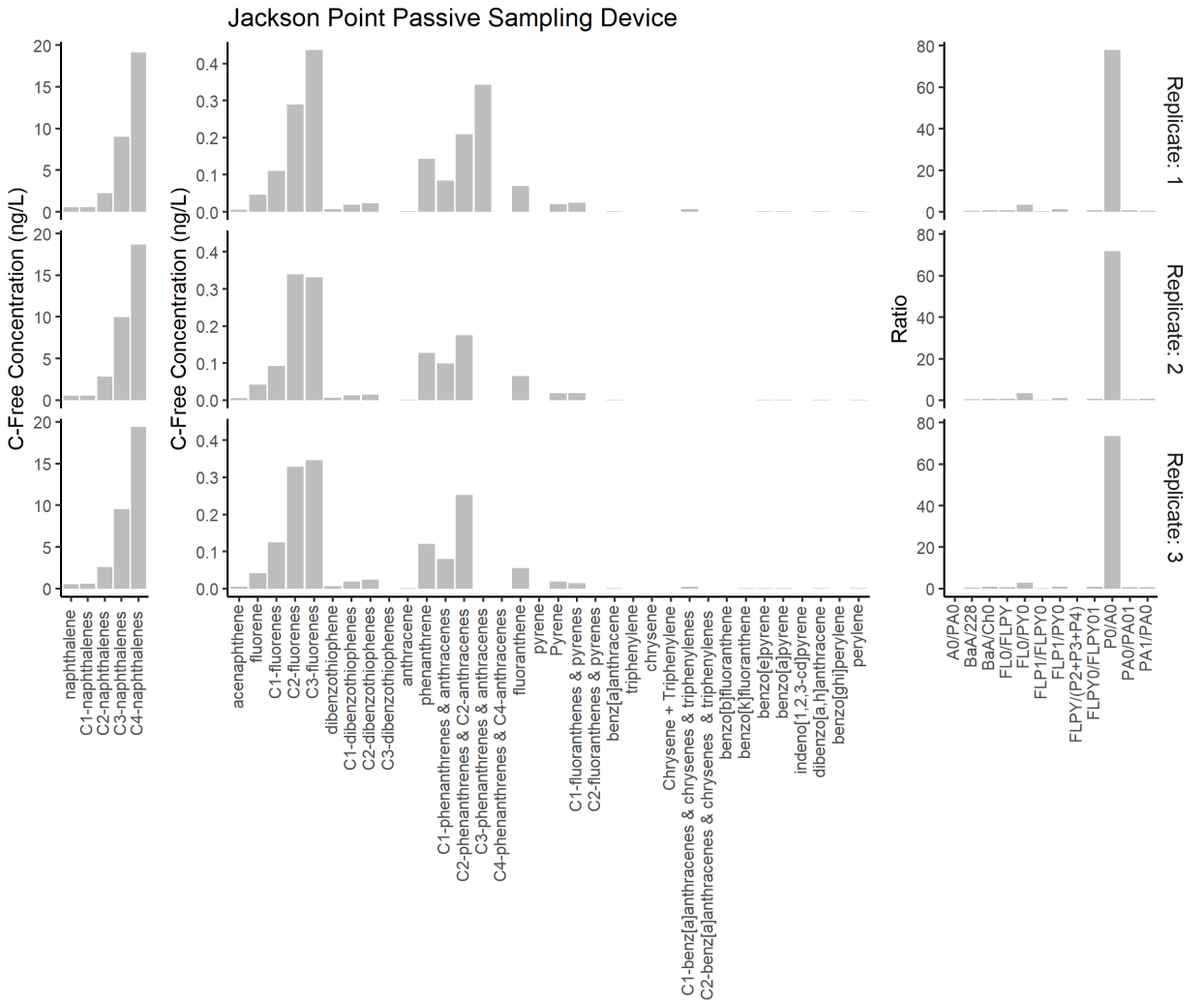

Figure 32. PAH profiles and laboratory diagnostic ratios from individual passive sampling devices deployed at Jackson Point.

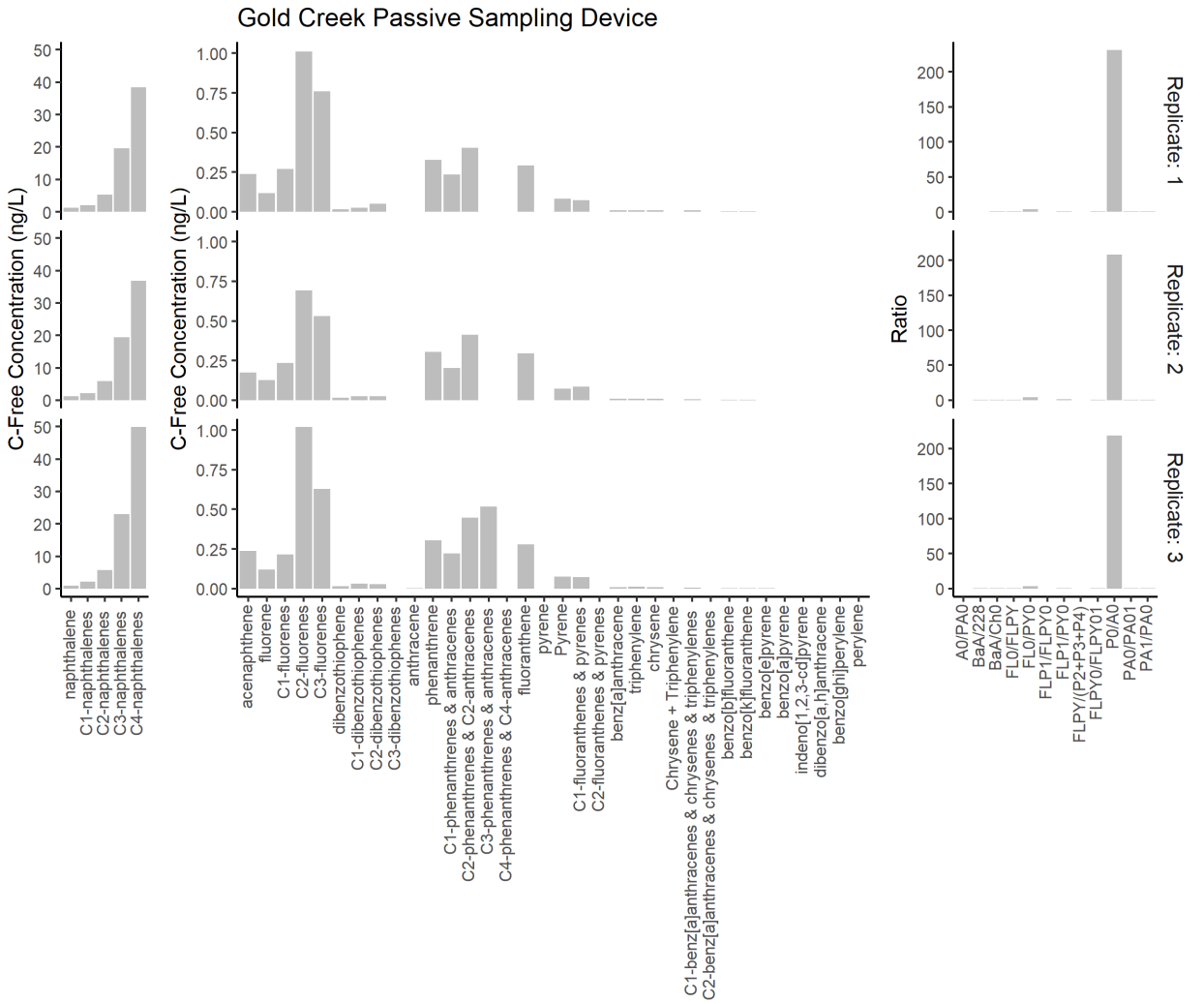

Figure 33. PAH profiles and laboratory diagnostic ratios from individual passive sampling devices deployed at Gold Creek.