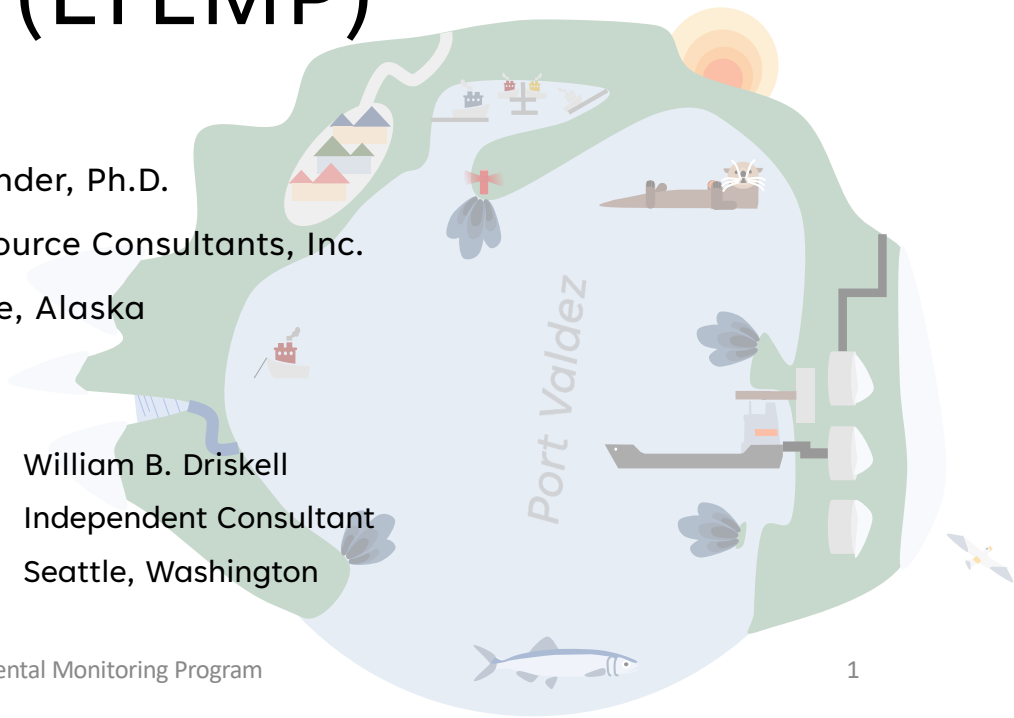
# 2021 Long-Term Environmental Monitoring Program (LTEMP)


Morgan Bender, Ph.D.

Owl Ridge Natural Resource Consultants, Inc.

Anchorage, Alaska


Contributors


James R. Payne, Ph.D.

Payne Environmental Consultants, Inc.

Encinitas, California

William B. Driskell

Independent Consultant

Seattle, Washington



# TABLE OF CONTENTS



# The Long-Term Environmental Monitoring Program (LTEMP)

- Managed by the Prince William Sound Regional Citizens' Advisory Council (PWSRCAC)
- In its 28th year monitoring hydrocarbons (1993) in the wake of the *Exxon Valdez* Oil Spill
- LTEMP aims to
  i. Determine the source of environmental hydrocarbons
  ii. Evaluate the potential adverse effects on the ecosystem
  iii. Understand the factors influencing hydrocarbon dynamics across Prince William Sound and the Gulf of Alaska

# Morgan Bender, Ph.D.

- Principle Investigator for the 2021 LTEMP Interpretation
- Ph.D. in Ecotoxicology – Petroleum effects on Arctic Fish from The Arctic University of Norway
- Bachelors from University of Alaska, Fairbanks
- Grew up in Prince William Sound (Whittier)
- Avid scientist, sailor, and sea kayaker



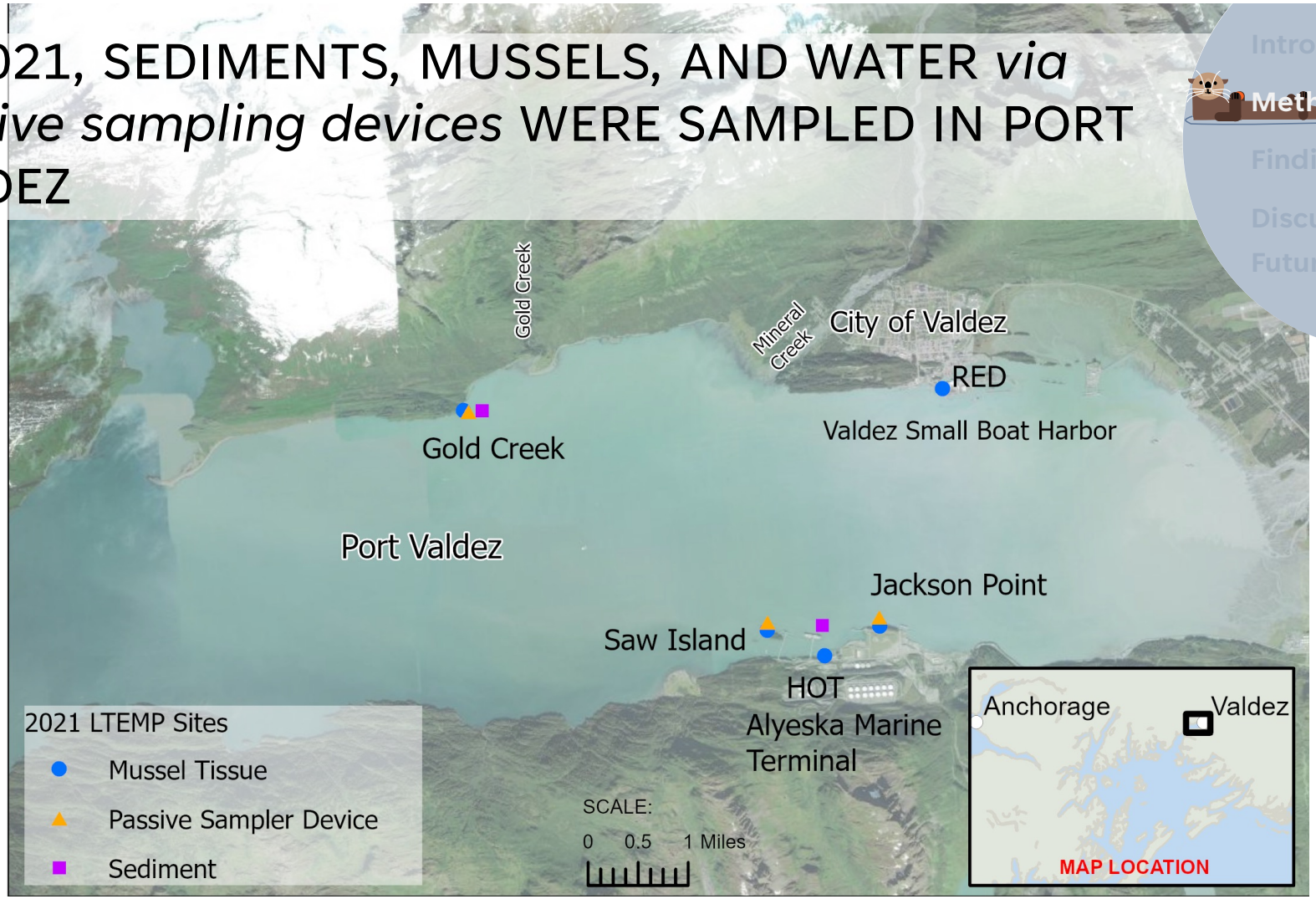

# The 2021 LTEMP Campaign

- Field work was carried out May-July 2021
- Chemical analysis was done by two separate labs
- Reporting was a collaborative effort
- 2021 reporting was divided into

a brief **Summary Report** and a **Technical supplement**

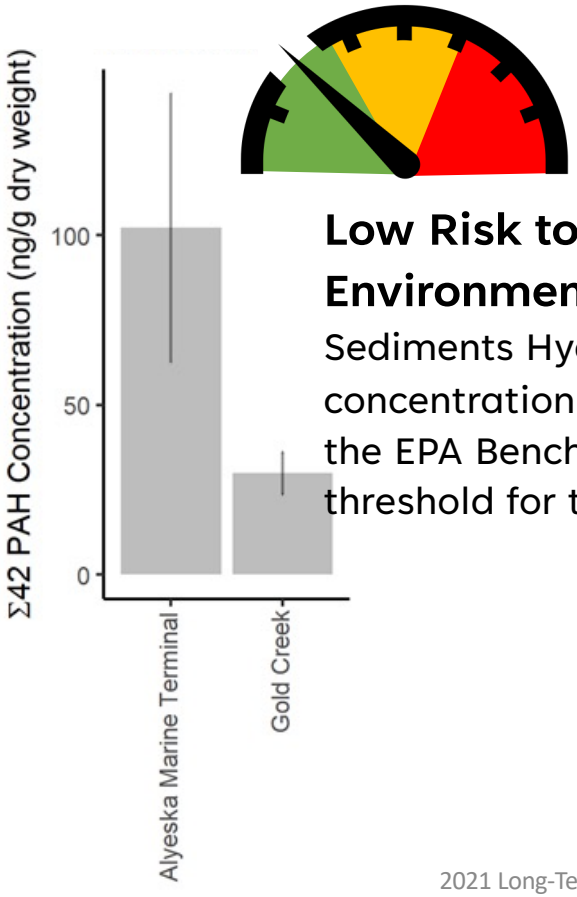
# IN 2021, SEDIMENTS, MUSSELS, AND WATER *via passive sampling devices* WERE SAMPLED IN PORT VALDEZ





# IN 2021, HYDROCARBONS WERE FOUND AT LOW LEVELS IN PORT VALDEZ SEDIMENTS







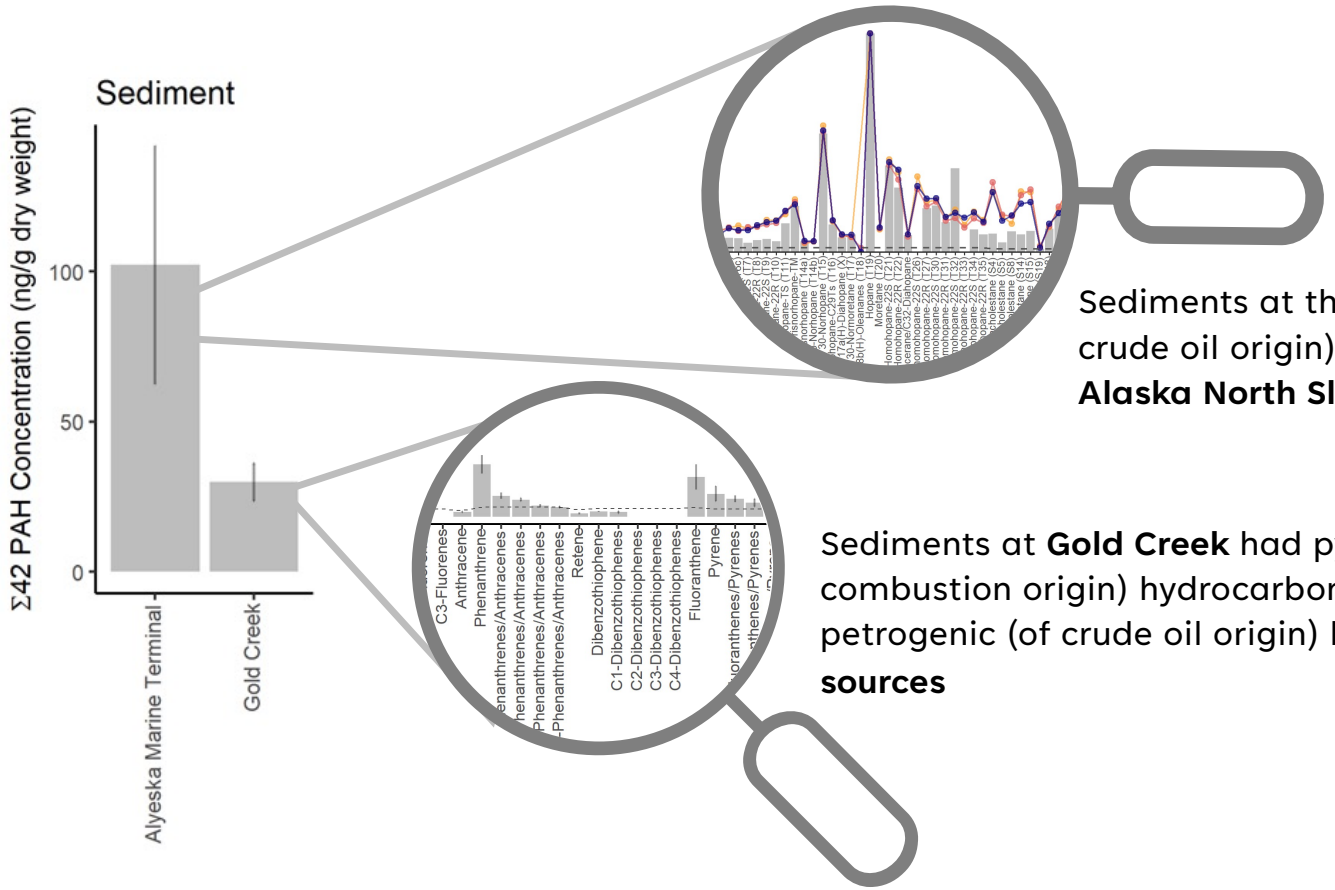

**Low Risk to Environment**

Sediments Hydrocarbon concentrations were <1% of the EPA Benchmark threshold for toxic effects

**1 ng/g or 1 part per billion (ppb)** is equivalent to **50 drops of water** in **1 Olympic-sized swimming pool**

# HYDROCARBON FINGERPRINTING REVEALED DIFFERENT SOURCES AT EACH SITE



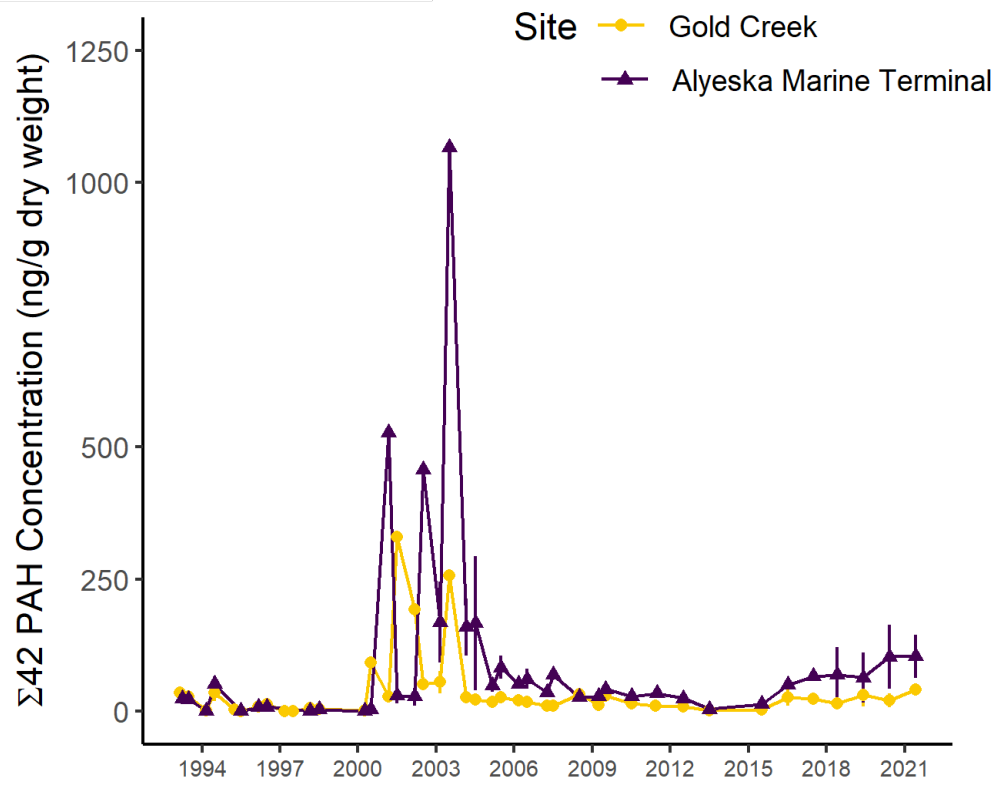



Sediments at the **Terminal** had petrogenic (of crude oil origin) hydrocarbons sourced from **Alaska North Slope Crude**

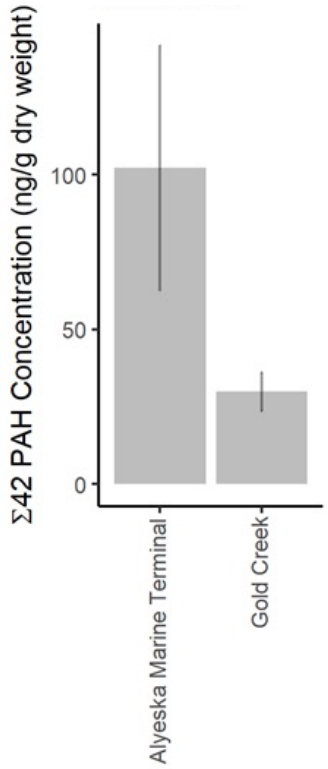
Sediments at **Gold Creek** had pyrogenic (of combustion origin) hydrocarbons and petrogenic (of crude oil origin) **likely from mixed sources**

# SEDIMENT HYDROCARBON CONCENTRATIONS HAVE BEEN LOW FOR THE LAST 16 YEARS



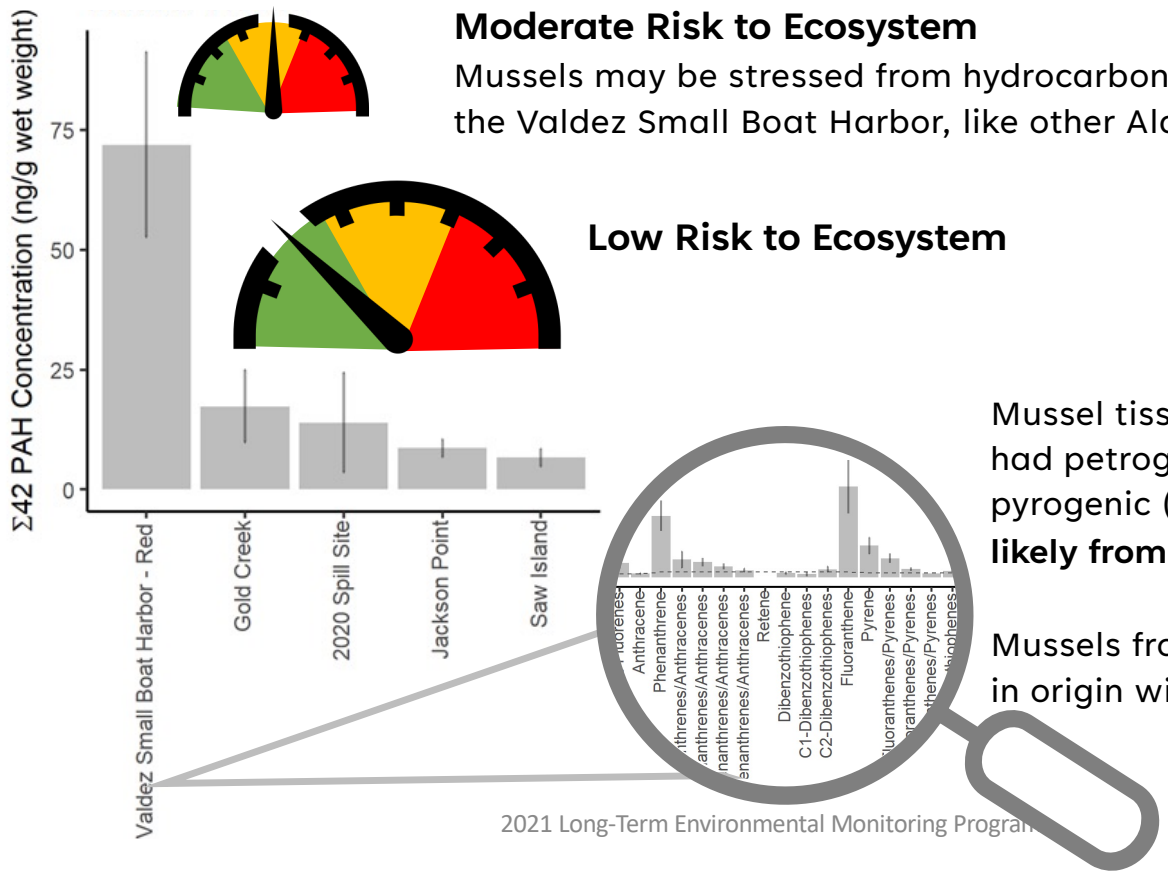



**2021 RESULTS**



# IN 2021, HYDROCARBONS WERE FOUND AT LOW-MODERATE LEVELS IN PORT VALDEZ PACIFIC BLUE MUSSEL TISSUE






**Moderate Risk to Ecosystem**

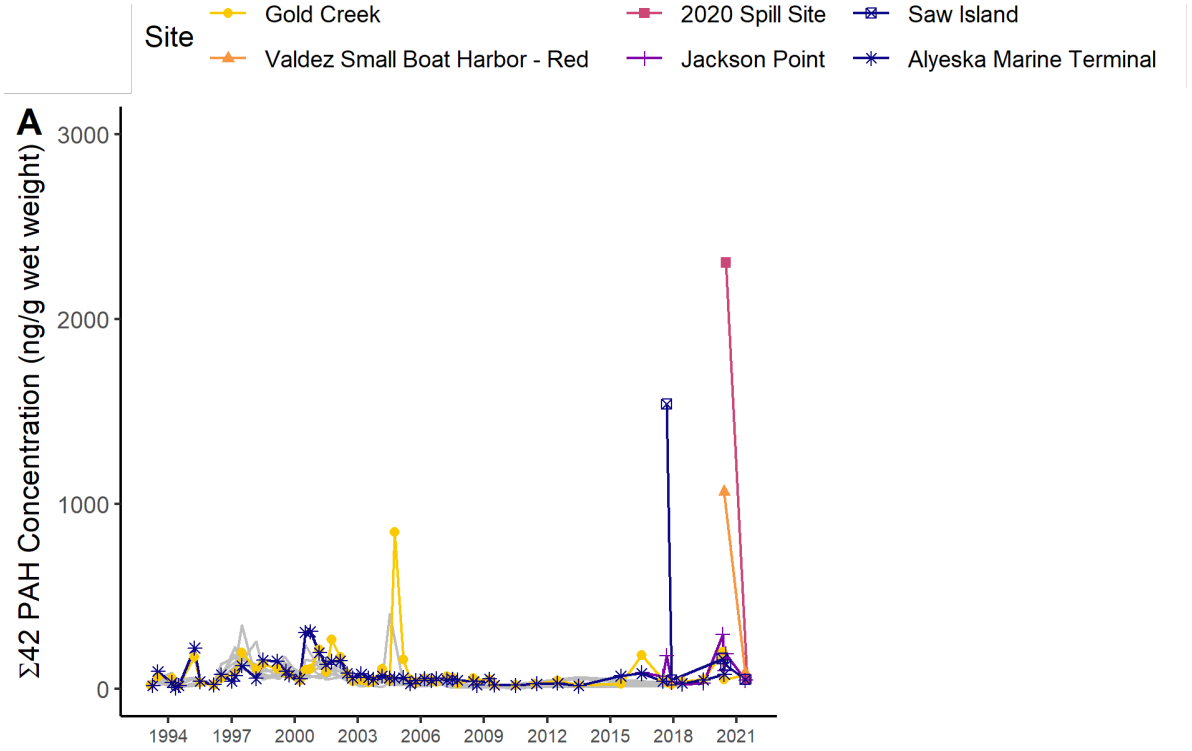
Mussels may be stressed from hydrocarbon exposure in the Valdez Small Boat Harbor, like other Alaskan harbors

**Low Risk to Ecosystem**

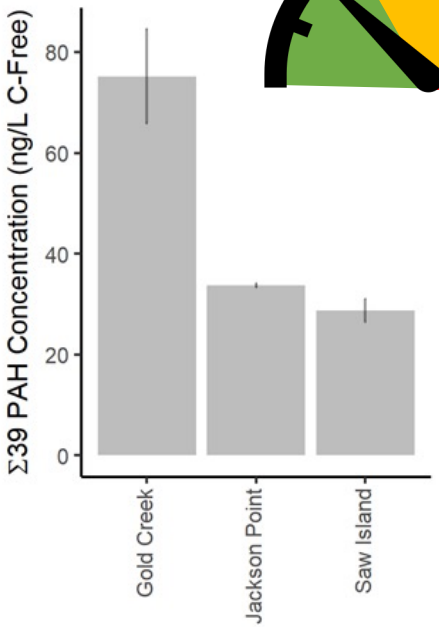
Mussel tissue at the **Valdez Small Boat Harbor** had petrogenic (of crude oil origin) and pyrogenic (of combustion origin) hydrocarbons **likely from mixed sources**

Mussels from all other sites were less distinct in origin with signs of **pyrogenic sources**

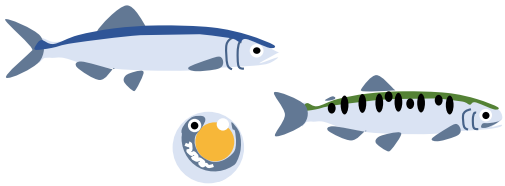
# HYDROCARBON CONCENTRATIONS IN MUSSEL TISSUE ARE LOW EXCEPT AFTER SPILL INCIDENTS

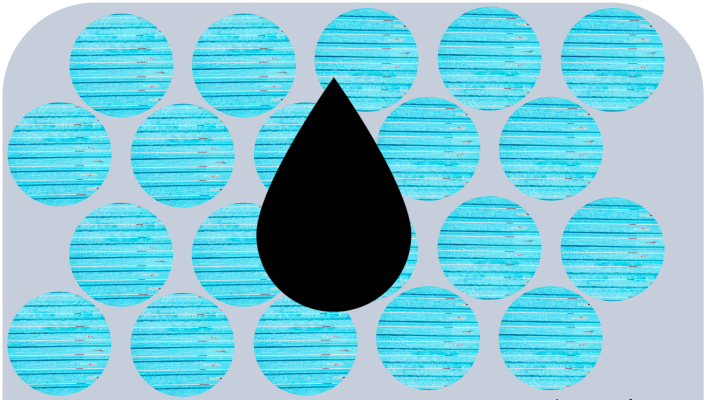


# IN 2021, DISSOLVED HYDROCARBON CONCENTRATIONS IN WATER *measured via passive sampling devices* WERE LOW



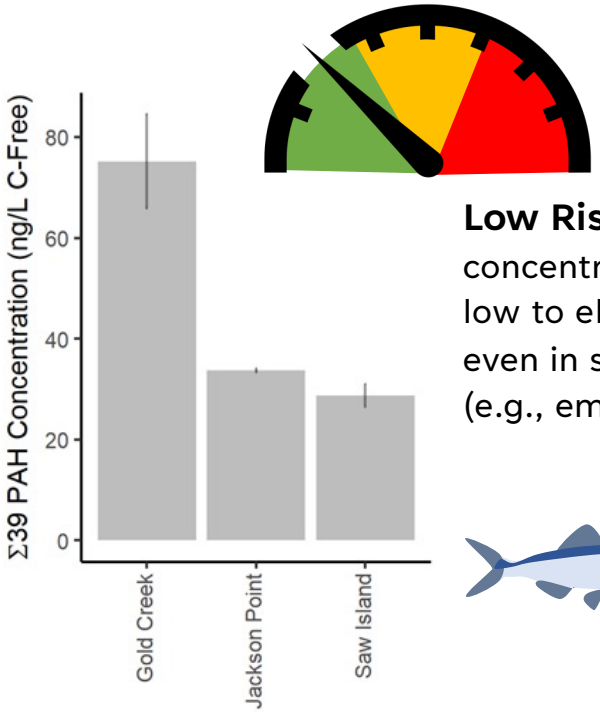

**Low Risk to Ecosystem** concentrations are likely too low to elicit adverse effects even in sensitive life stages (e.g., embryos and larvae)



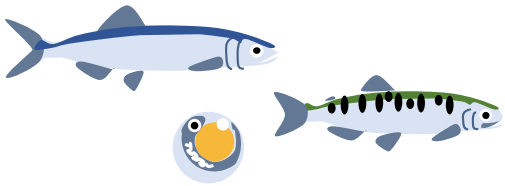


**1 ng/L or 1 part per trillion (ppt)** is equivalent to a single drop of water in **20 Olympic-sized swimming pools**

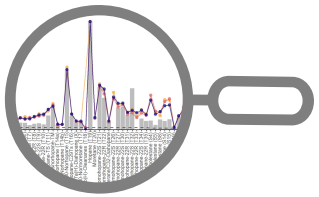
# SINCE 2016, DISSOLVED HYDROCARBON CONCENTRATIONS IN WATER *measured via passive sampling devices* WERE LOW



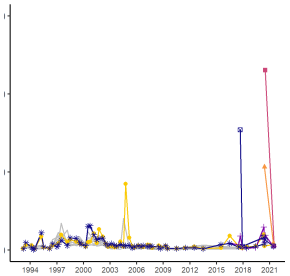

**Low Risk to Ecosystem**
concentrations are likely too low to elicit adverse effects even in sensitive life stages (e.g., embryos and larvae)



# THE 2021 LTEMP SUMMARY



**I.** The hydrocarbon fingerprints in the 2021 samples vary by site with those near the Alyeska Marine Terminal revealing Alaska North Slope Crude Oil and its associated products as the primary source for hydrocarbons.




**II.** Analysis of historical trends in hydrocarbon concentrations reveals generally low concentrations that spike locally after spill events.

**III.** The all-time low measured in sediments and mussels in 2013 has slowly increased across all sites.

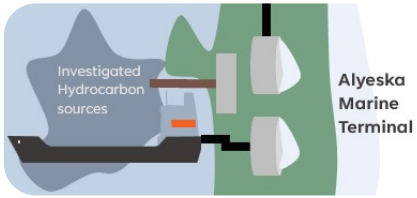
**IV.** Low potential environmental and toxicological risk is posed by hydrocarbons contributed by the Terminal and tankers in 2021.

# THE LTEMP POSSIBLE FUTURE DIRECTIONS

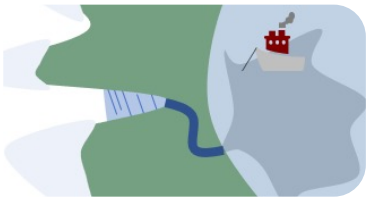


**I.** Add biological indicators of early warning signs of stress on organisms (i.e., Biological Biomarkers)

**II.** Incorporate contemporary and non-Alaska North Slope sources of hydrocarbons

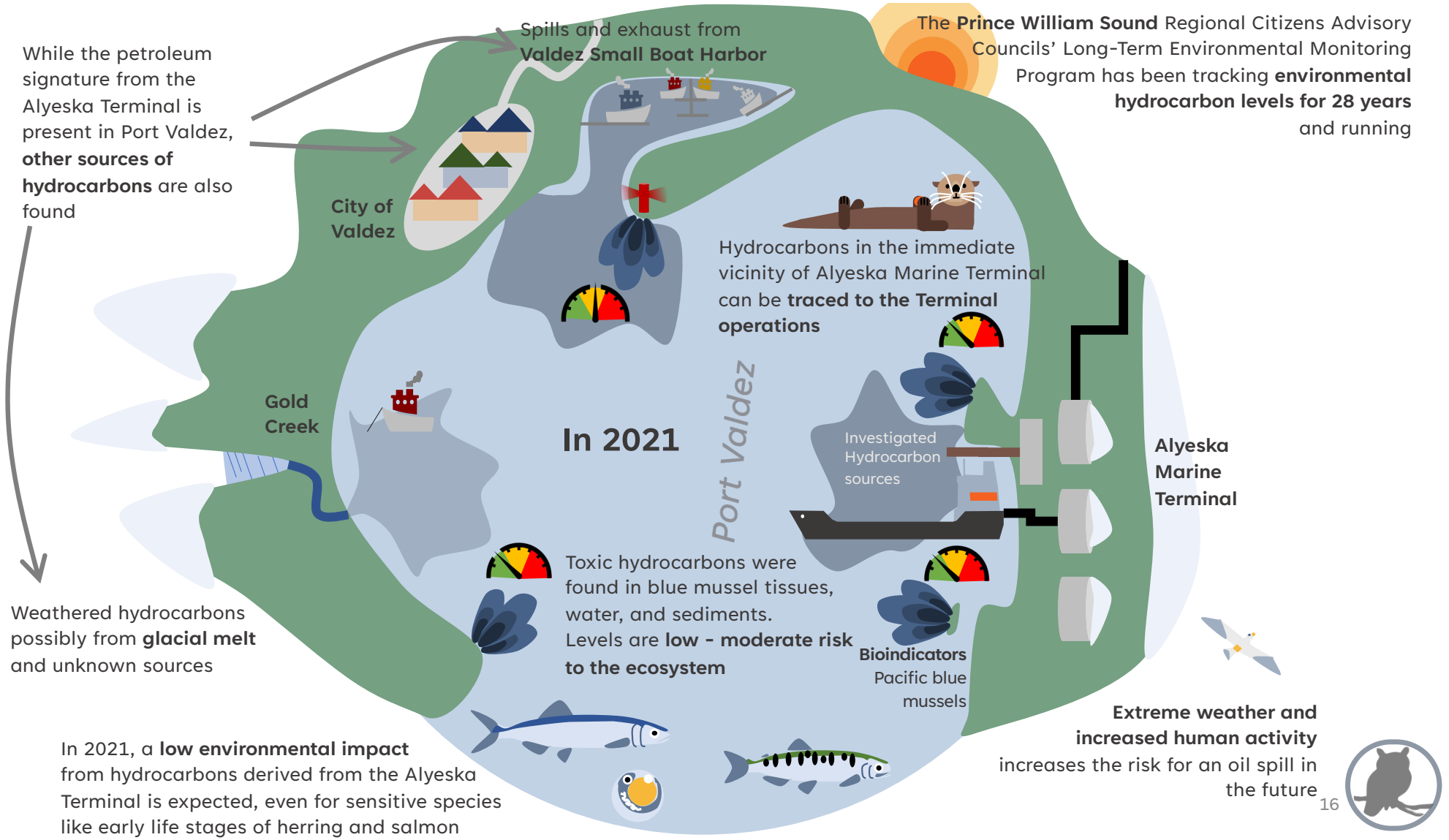


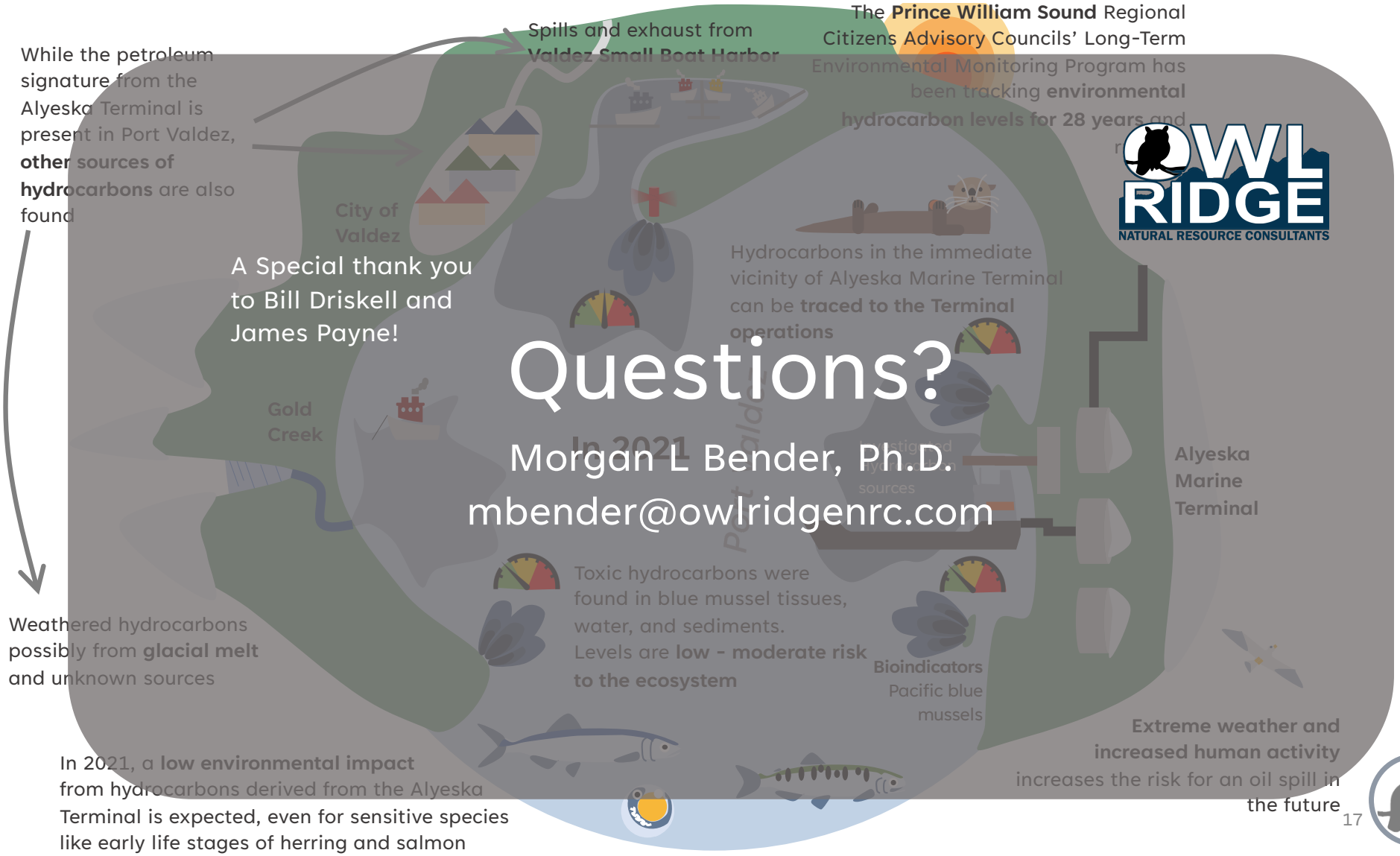

**III.** Expand sampling at the Ballast Water Treatment Facility



**IV.** Integrate relevant environmental/ anthropogenic/Terminal operation covariates into the LTEMP interpretation

Maintain program with annual sampling and data management

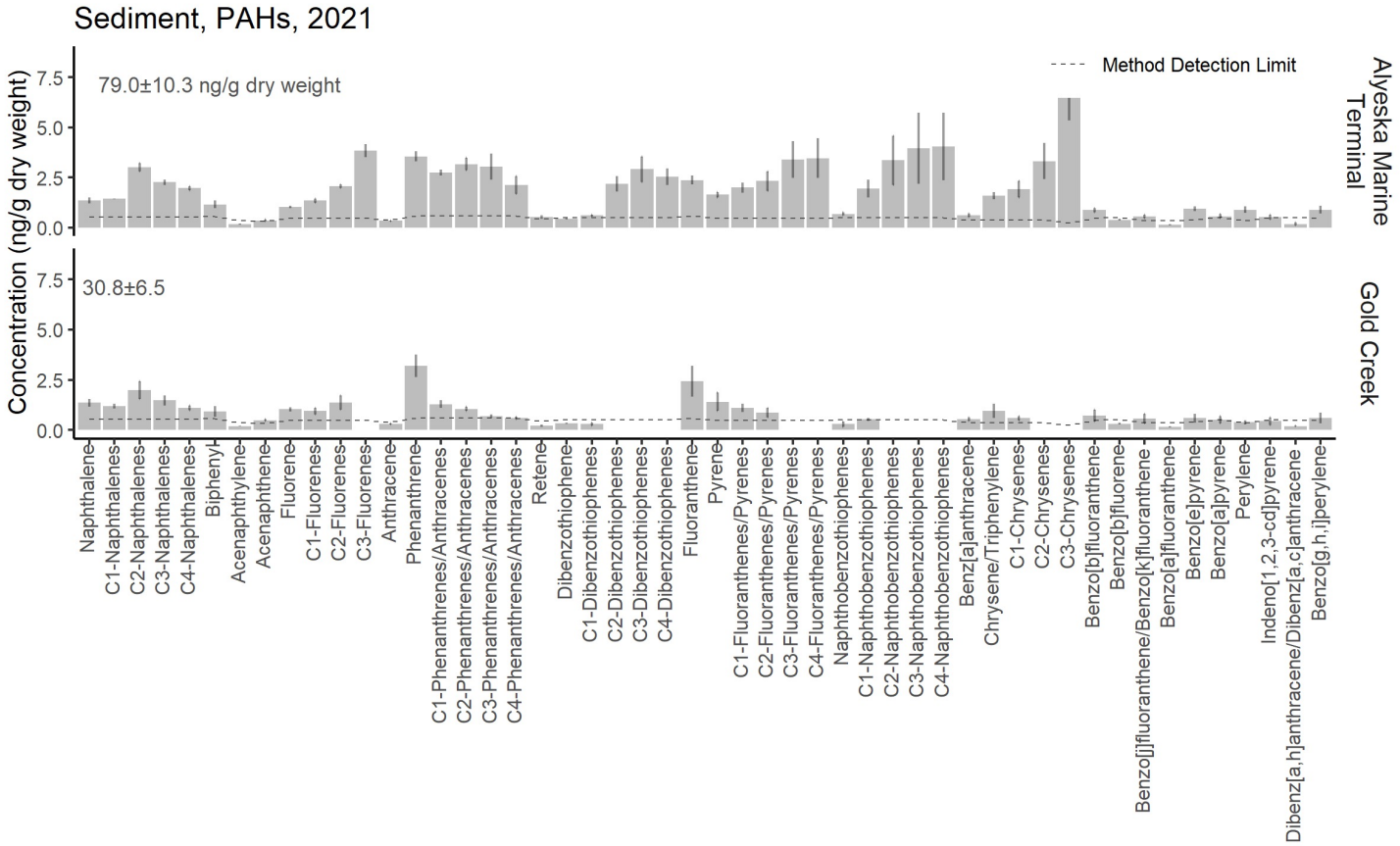

While the petroleum signature from the Alyeska Terminal is present in Port Valdez, **other sources of hydrocarbons** are also found
Spills and exhaust from **Valdez Small Boat Harbor**
The **Prince William Sound** Regional Citizens Advisory Councils' Long-Term Environmental Monitoring Program has been tracking **environmental hydrocarbon levels for 28 years** and running
City of Valdez
Hydrocarbons in the immediate vicinity of Alyeska Marine Terminal can be **traced to the Terminal operations**
Gold Creek
In 2021
Port Valdez
Investigated Hydrocarbon sources
Alyeska Marine Terminal
Weathered hydrocarbons possibly from **glacial melt** and unknown sources
Toxic hydrocarbons were found in blue mussel tissues, water, and sediments. Levels are **low - moderate risk to the ecosystem**
**Bioindicators** Pacific blue mussels
In 2021, a **low environmental impact** from hydrocarbons derived from the Alyeska Terminal is expected, even for sensitive species like early life stages of herring and salmon
**Extreme weather and increased human activity** increases the risk for an oil spill in the future



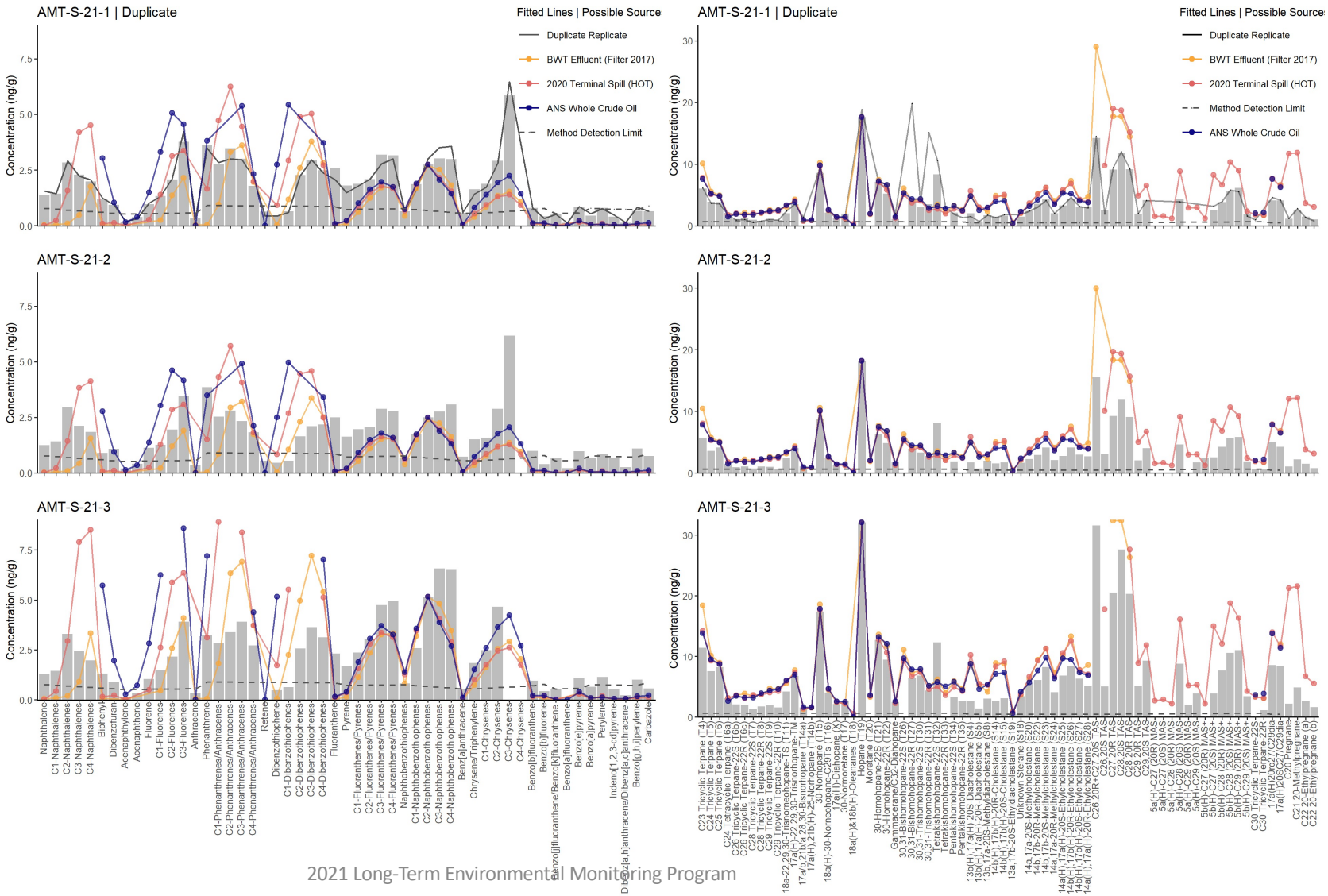

# Questions?

Morgan L Bender, Ph.D.
mbender@owlridgenrc.com

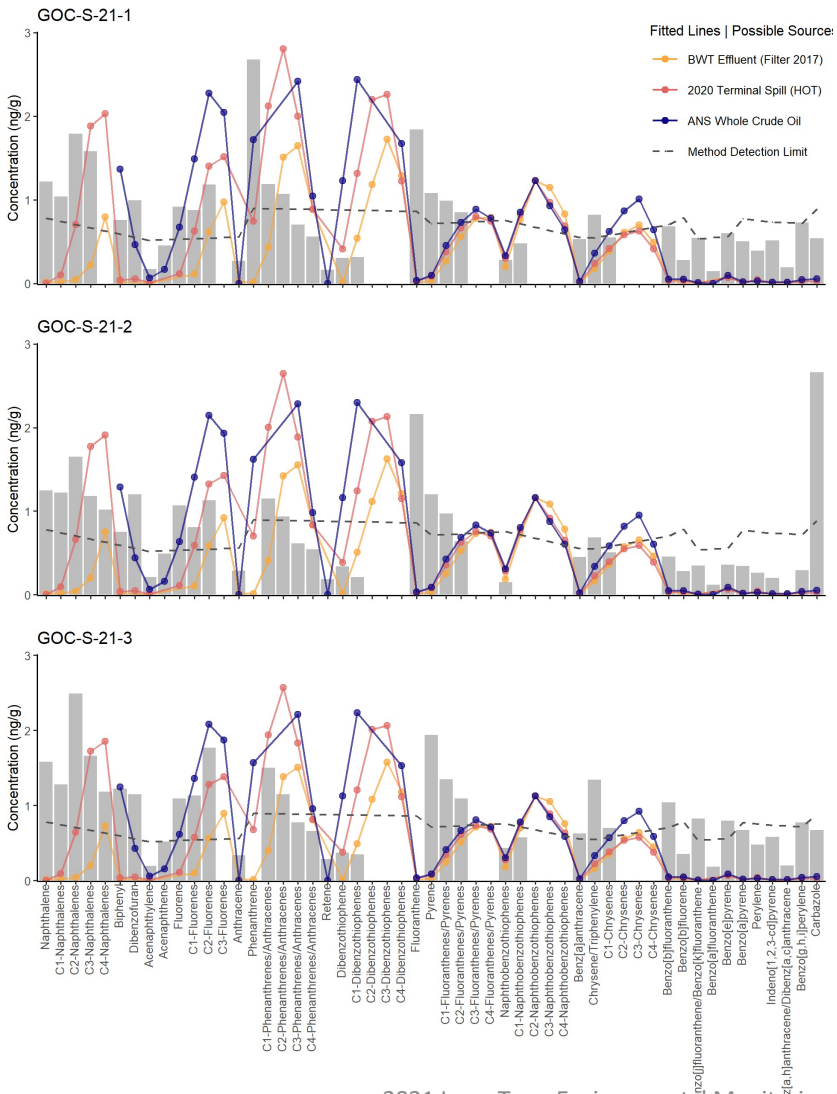
# PAH profiles from 2021 Sediments

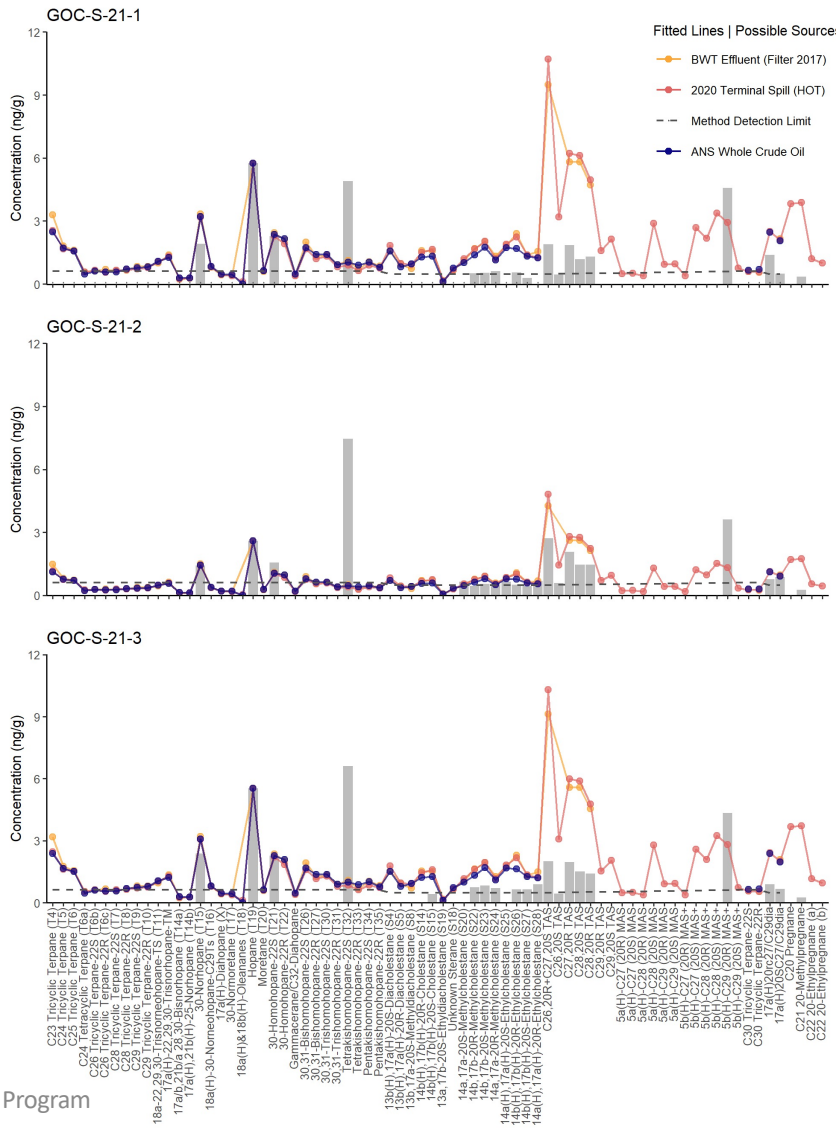


# 2021 PAH and biomarker profiles from Terminal sediments with ANS overlay

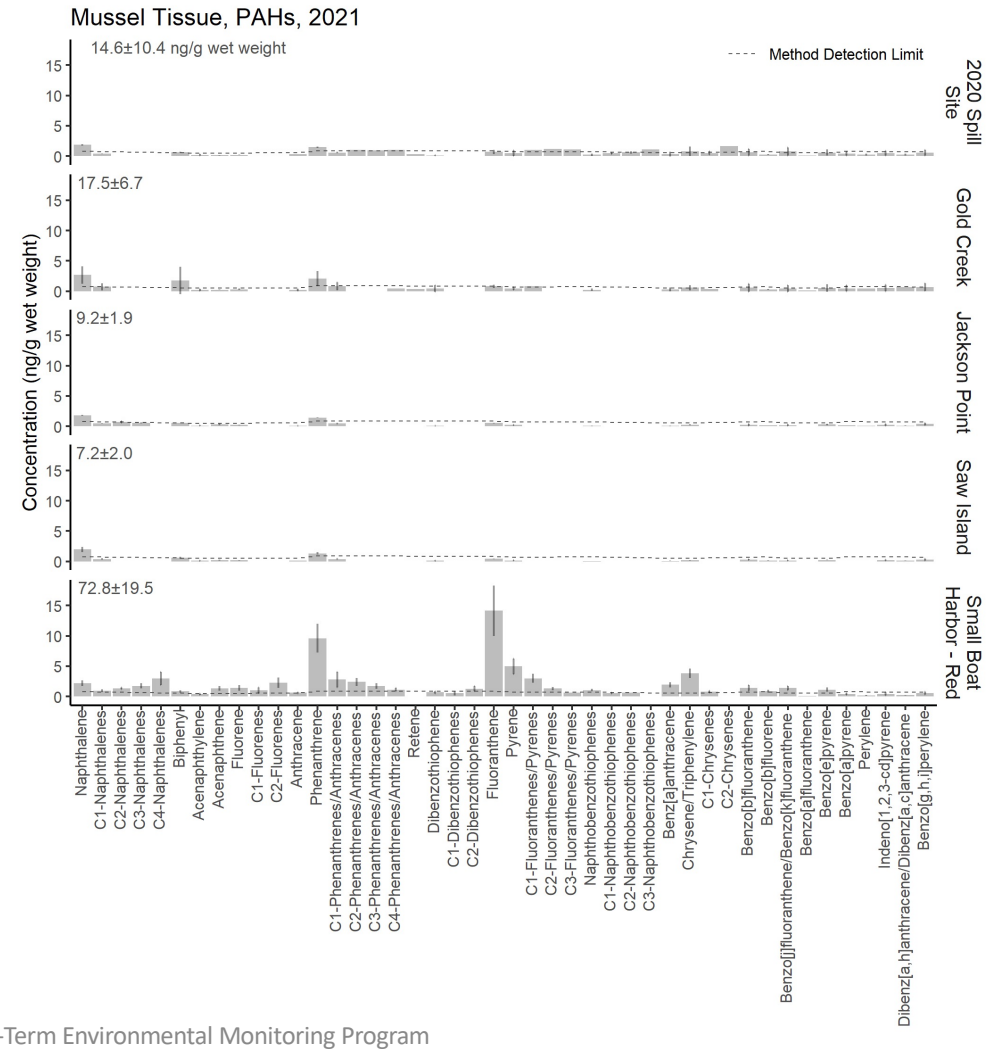


# 2021 PAH and biomarker profiles from Gold Creek sediments with ANS overlay



# PAH profiles from 2021 Mussel Tissues



# PAH profiles from 2021 Passive Sampling Devices