PFAS occurrence and concentrations in Puget Sound aquatic life

Louisa Harding
Louisa.Harding@dfw.wa.gov
Research Scientist
WDFW Toxics Biological Observation System

Washington Department of FISH and WILDLIFE

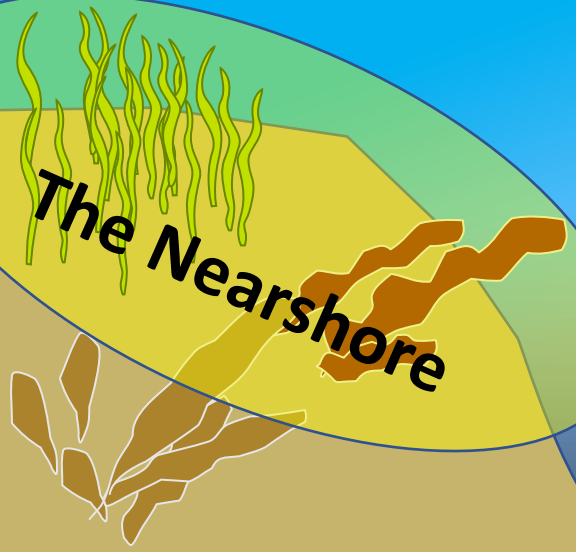
WDFW's Toxics Biological Observation System (TBiOS)

We evaluate the ***effects of toxic contaminants*** on marine and anadromous species in Puget Sound to:

- guide efforts to ***protect fish and shellfish health***,
- ***ensure seafood safety***, and
- ***promote ecosystem recovery***.

https://wdfw.wa.gov/species-habitats/science/marine-toxics/tbios

River/estuary



The Nearshore

Pelagic Food Web

TBiOS Species Indicator Strategy: Divide the ecosystem into manageable domains or habitats

Benthic Food Web/Sediments

juvenile Chinook salmon

transplanted mussels

Pacific herring

Chinook salmon

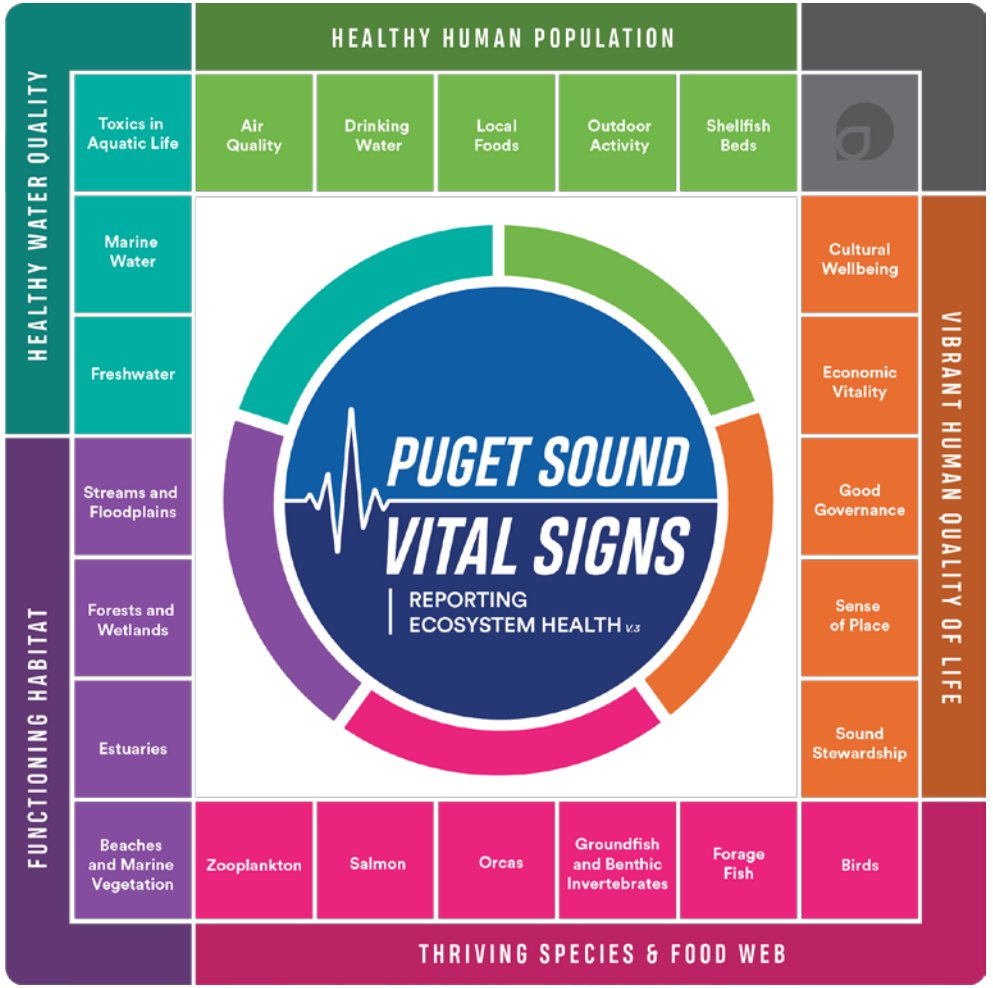
TBiOS Species Indicator Strategy: Divide the ecosystem into manageable domains or habitats

English sole

Puget Sound Vital Signs

TBiOS data is reported on the Toxics in Aquatic Life Vital Sign
https://vitalsigns.pugetsoundinfo.wa.gov/VitalSign/Detail/28

Toxics in Aquatic Life		
Contaminants in adult salmon	INSUFFICIENT OR NO DATA	BELOW TARGET
Contaminants in caged mussels	INSUFFICIENT OR NO DATA	INSUFFICIENT OR NO DATA
Contaminants in English sole	MIXED RESULTS	BELOW TARGET
Contaminants in juvenile salmon	INSUFFICIENT OR NO DATA	BELOW TARGET
Contaminants in Pacific herring	MIXED RESULTS	BELOW TARGET



PFAS monitoring

2016

–122 samples analyzed at SGS AXYS

- English sole fillet (44)
- Pacific herring whole body (15) and liver (4)
- Adult Chinook salmon fillet (30)
- Juvenile Chinook salmon whole body (15)
- Bay mussel whole body (18)

2021

–65 samples analyzed at AXYS

- Juvenile Chinook whole body (37)
  - In depth analysis of Green/Duwamish watershed
  - 3 samples for re-analysis
- English sole liver (28)

–55 samples analyzed at TDI-Brooks in collaboration with NOAA-NCCOS

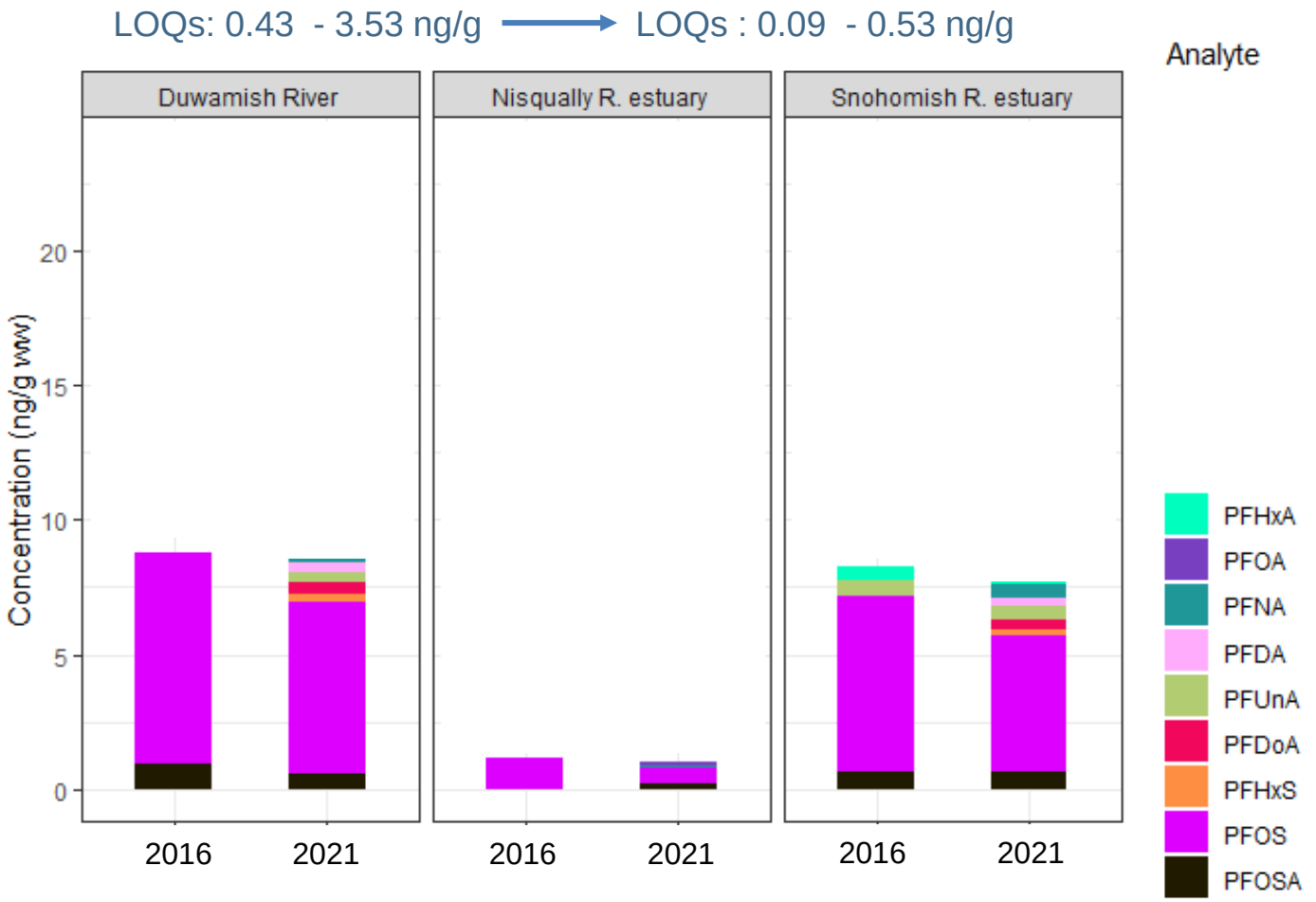
- Bay mussel whole body (55)

* Detection limits and measured compounds varied by year and lab

PFAS monitoring – sample re-analysis

If we compared the original 13 PFAS compounds:

- 4 vs 9 compounds were detected in juvenile Chinook whole body samples in 2016 and 2021, respectively
- Similar total Σ_{13}PFAS concentrations

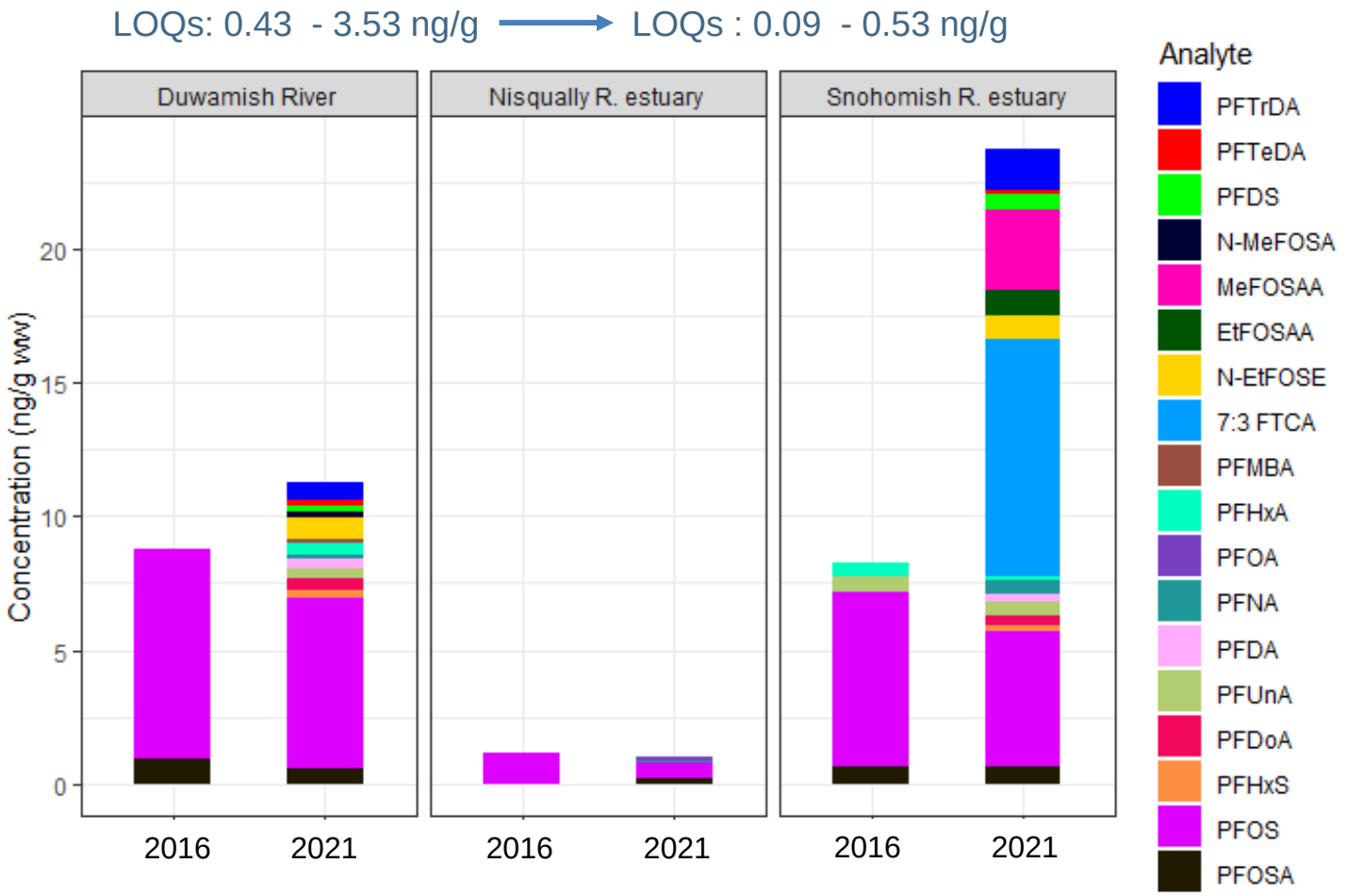


PFAS monitoring – sample re-analysis

If we compared the original 13 PFAS compounds:

- 4 vs 9 compounds were detected in juvenile Chinook whole body samples in 2016 and 2021, respectively
- Similar total Σ_{13}PFAS concentrations

However, if we include all 40 analytes measured in 2021, we see large discrepancies in total PFAS concentrations at *some* sites.



PFAS monitoring

2016

- Perfluorobutanoic acid (PFBA)
- Perfluoropentanoic acid (PFPeA)
- Perfluorohexanoic acid (PFHxA)
- Perfluorodecanoic acid (PFDA)
- Perfluoroheptanoic acid (PFHpA)
- Perfluorooctanoic acid (PFOA)
- Perfluorononanoic acid (PFNA)
- Perfluorundecanoic acid (PFUnA)
- Perfluorododecanoic acid (PFDoA)
- Perfluorobutane sulfonic acid (PFBS)
- Perfluorohexane sulfonic acid (PFHxS)
- Perfluorooctane sulfonic acid (PFOS)
- Perfluorooctane sulfonamide (PFOSA)

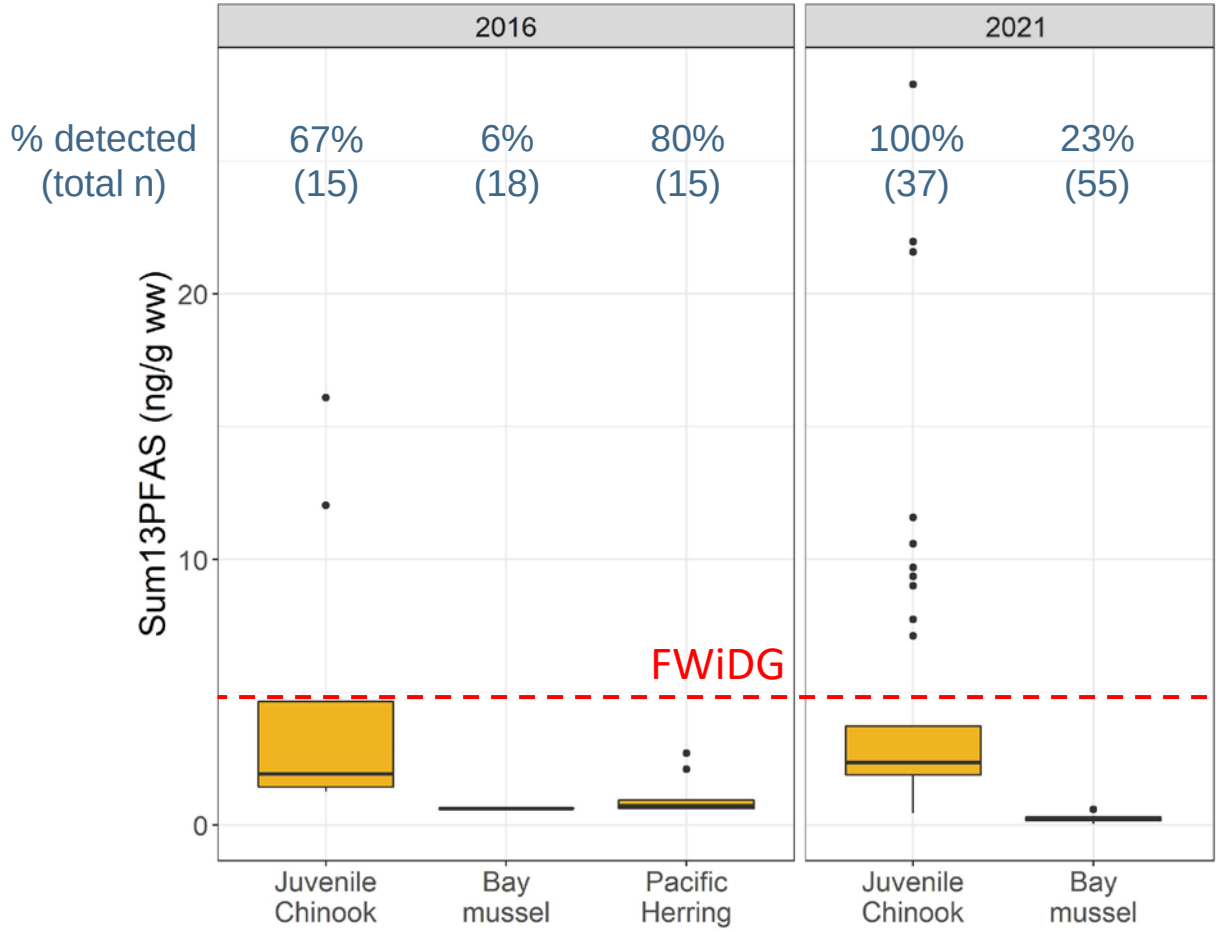
Most of the talk will focus on these 13 analytes

* Detection limits and measured compounds varied by year and lab

Σ_{13}PFAS concentrations in fish and shellfish whole bodies

LOQs: 0.43 - 3.53 ng/g

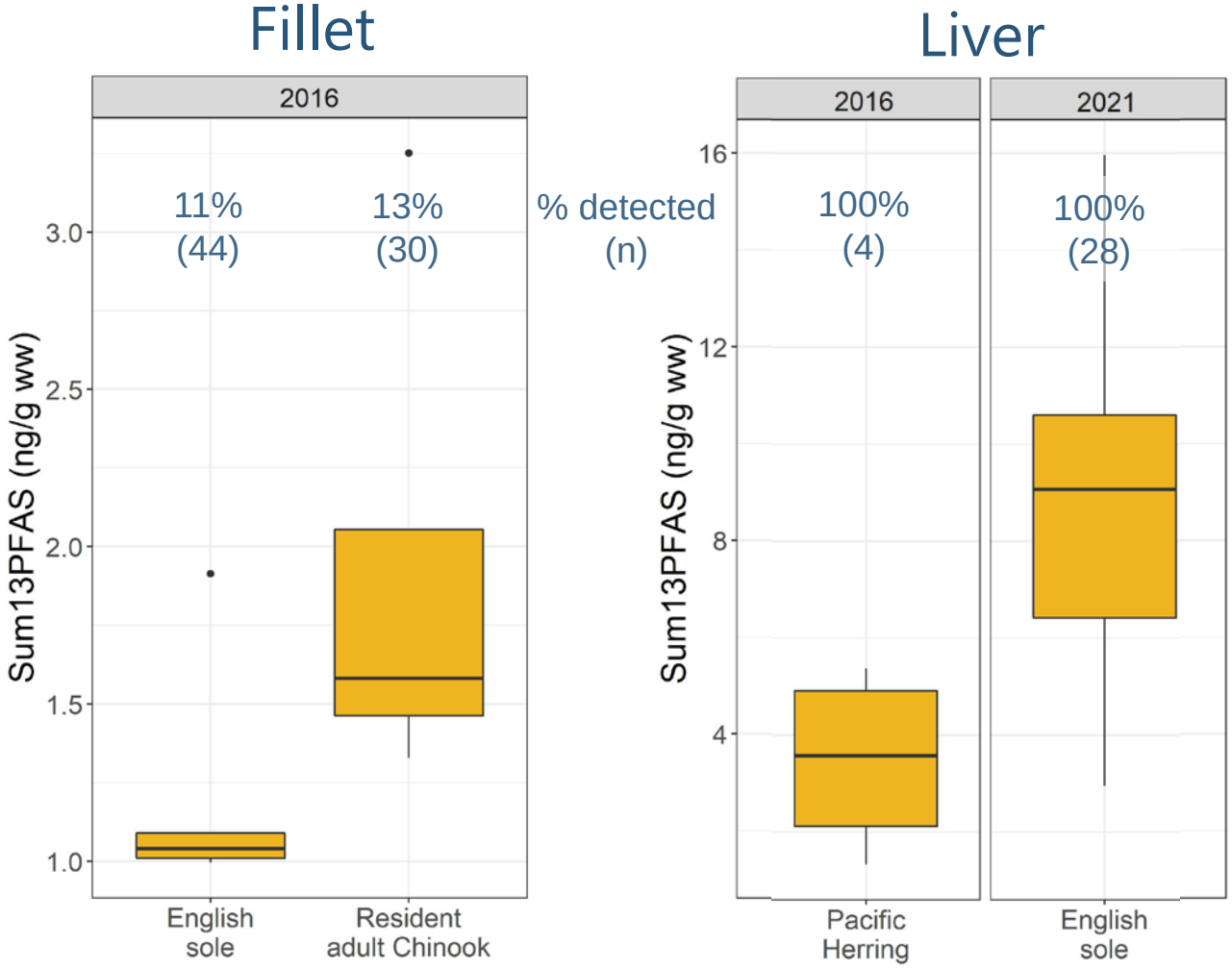
LOQs Chinook: 0.09 - 0.53 ng/g
LOQs mussels: 0.03 – 0.17 ng/g



River > nearshore > pelagic

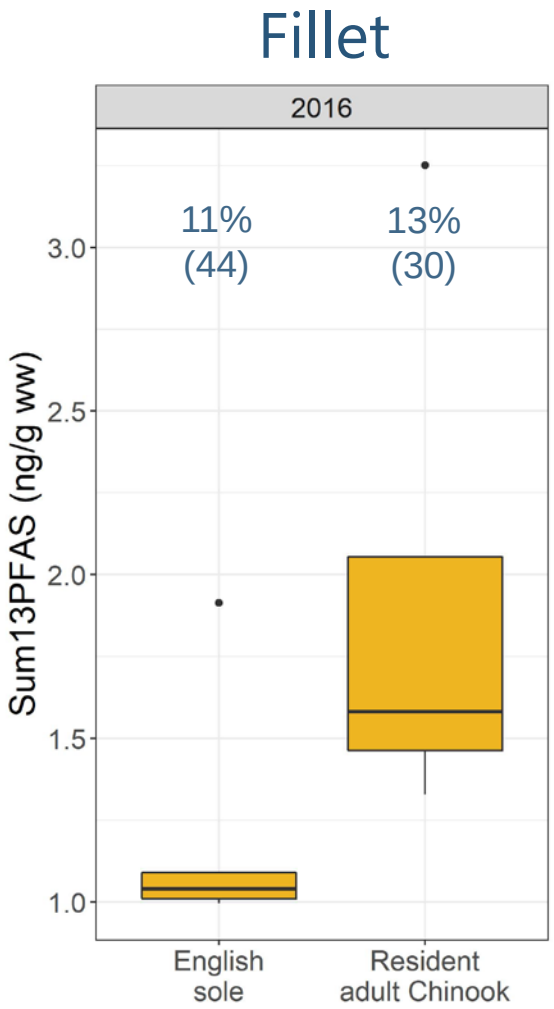
- Σ_{13}PFAS concentrations were highest in juvenile Chinook salmon
- PFOS and PFOSA were the predominant compounds
- US EPA's draft criterion for PFOS in freshwater species is
  - 6.75 mg/kg ww fish whole body
- Canadian federal wildlife dietary guideline (FWiDG) for PFOS
  - 4.6 µg/kg ww whole body

Σ_{13}PFAS concentrations in fish fillet and liver tissues



- PFOS and PFOSA are predominant compounds and were generally higher in liver
- Concentrations from marine species were generally lower than Washington freshwater fish which had median Σ_{13}PFAS concentrations of 3.92 and 19.8 ng/g wet weight in fillet and liver tissues respectively (Mathieu and McCall, 2017)

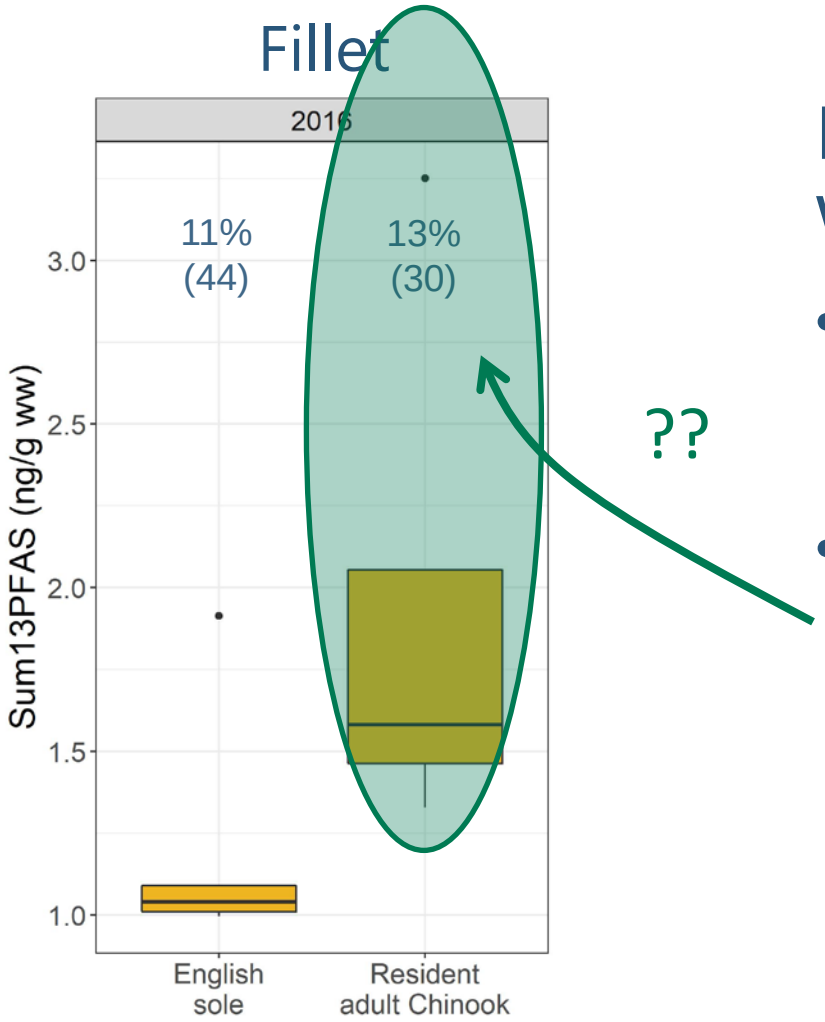
Σ_{13}PFAS concentrations in fish fillet



Considerations for human consumption?

- Current advisory values range from 3.9 to 200 ppb
- New draft reference doses for PFOS could result in sub ng/g screening levels.
- Diversity and equity concerns for subsistence fishers and high seafood consumers.

Σ_{13}PFAS concentrations in fish fillet



Risks to endangered Southern Resident Orca Whales?

- Whole body total PFAS concentrations are 1.4 – 2.5x higher than fillet concentrations (Fair et al., 2019, Environmental Research 171: 266-277)
- Estimated resident adult Chinook whole body concentrations could exceed the Canadian FWiDG for PFOS (4.6 µg/kg ww)

Acknowledgements

TBiOS Team

Jim West

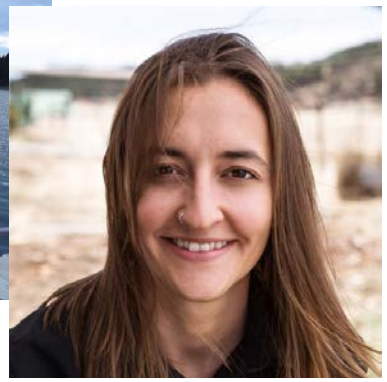
Sandie O'Neill

Andrea Carey

Mariko Langness

Danielle Nordstrom

Rob Fisk



Molly Shuman Goodier

Andrew Beckman

Collaborators

Dennis Apeti
Mary Rider

Emerson Christie

Callie Mathieu
Siana Wong

References

Fair et al., 2019, Environmental Research 171: 266-277

Mathieu and McCall, 2017. Ecology Publication No. 17-03-021
https://apps.ecology.wa.gov/publications/documents/1703021.pdf