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Battelle

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Management of Contaminated Sediments
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Potential Human Exposure to Perfluoroalkyl Substances (PFAS) via Consumption of Fish from U.S. and International Sources

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Overview

- Discuss results of recent study of PFAS in commercial finfish and shellfish
- Review PFAS levels in U.S. and imported seafood from different regions and aquatic environments
- Relate results to other studies and consumption advisories
- Compare to recent state monitoring data for PFAS in sportfish from waters without known sources



Study Background

- Fish consumption shown to be major pathway of exposure to PFAS
 - Limited data on U.S. “market basket” fish and shellfish
- *Phase 1: Commercial finfish of U.S. origin*
 - U.S. regions: Northeast, Southeast, Midwest, West
 - Mix of popular national and regional species
 - Primarily marine wild-caught, some farmed and freshwater, mostly fillet
- *Phase 2: U.S. shellfish and imported fish and shellfish*
 - Focus on countries with high imports to U.S.

Fish Sample Purchase Checklist			
Name of Collector:			
Name of Retailer:			
Retailer:	<input type="checkbox"/> Chain Store <input type="checkbox"/> Specialty Store/Fish Market		
Location of Purchase:			
Date of Purchase:			
Fish Species Purchased:			
Other Relevant Information:			
Purchased Fish Species Description:			
Fish Species:		Geographic Origin:	
<input type="checkbox"/> Freshwater	<input type="checkbox"/> Wild-caught	Time period typically sold:	<input type="checkbox"/> Seasonally
<input type="checkbox"/> Saltwater	<input type="checkbox"/> Farmed		<input type="checkbox"/> Year-Round
Sold: <input type="checkbox"/> Fresh	<input type="checkbox"/> Pre-Packaged	Type of Tissue:	<input type="checkbox"/> Fillet skinless <input type="checkbox"/> Fillet w/ skin
<input type="checkbox"/> Chilled	<input type="checkbox"/> Frozen		<input type="checkbox"/> Fillet boneless <input type="checkbox"/> Whole body
Name of Fish Supplier (Save Label):			
Brand/Batch/QR Code Details (Save Label):			
Type of Packaging Used by Store:			Amount Purchased (ounces):

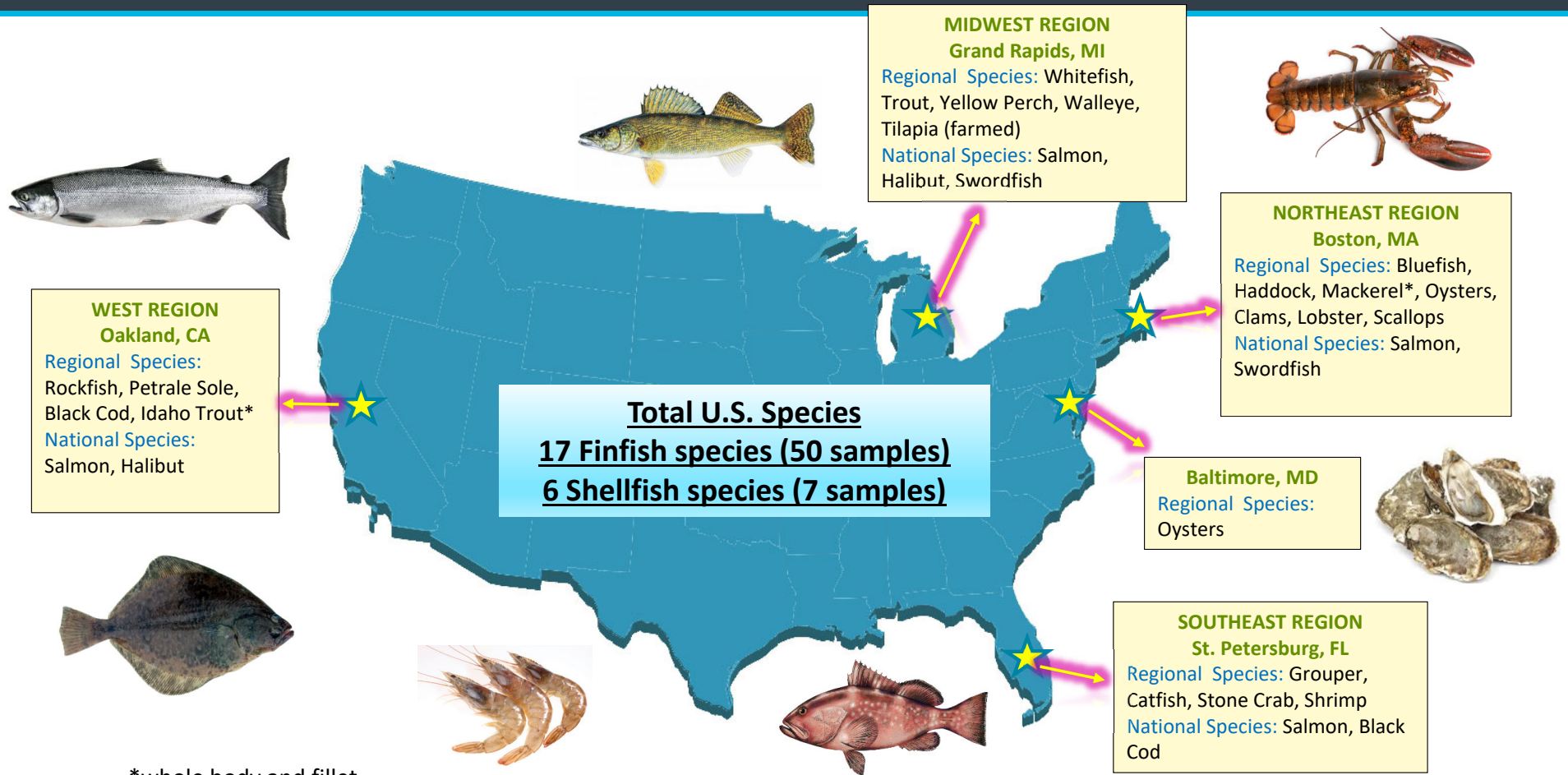


Methods

- Developed Sampling and Analysis Plan
 - Minimize potential for cross-contamination
- Purchased ½ pound sample at fish markets and grocery stores
 - *Phase 1*: 45 samples
 - *Phase 2*: 26 samples
- Collected clean sample of wrapping paper (Phase 1)
- Samples double-bagged (Ziploc), frozen, and shipped on ice to lab (Vista)
- Analysis of 26 PFAS compounds:
 - Short and long-chain PFCAs and PFSA, pre-cursors, and transient degradation intermediates
 - Method meets criteria of DoD Quality Standard Methods (QSM) Version 5.1

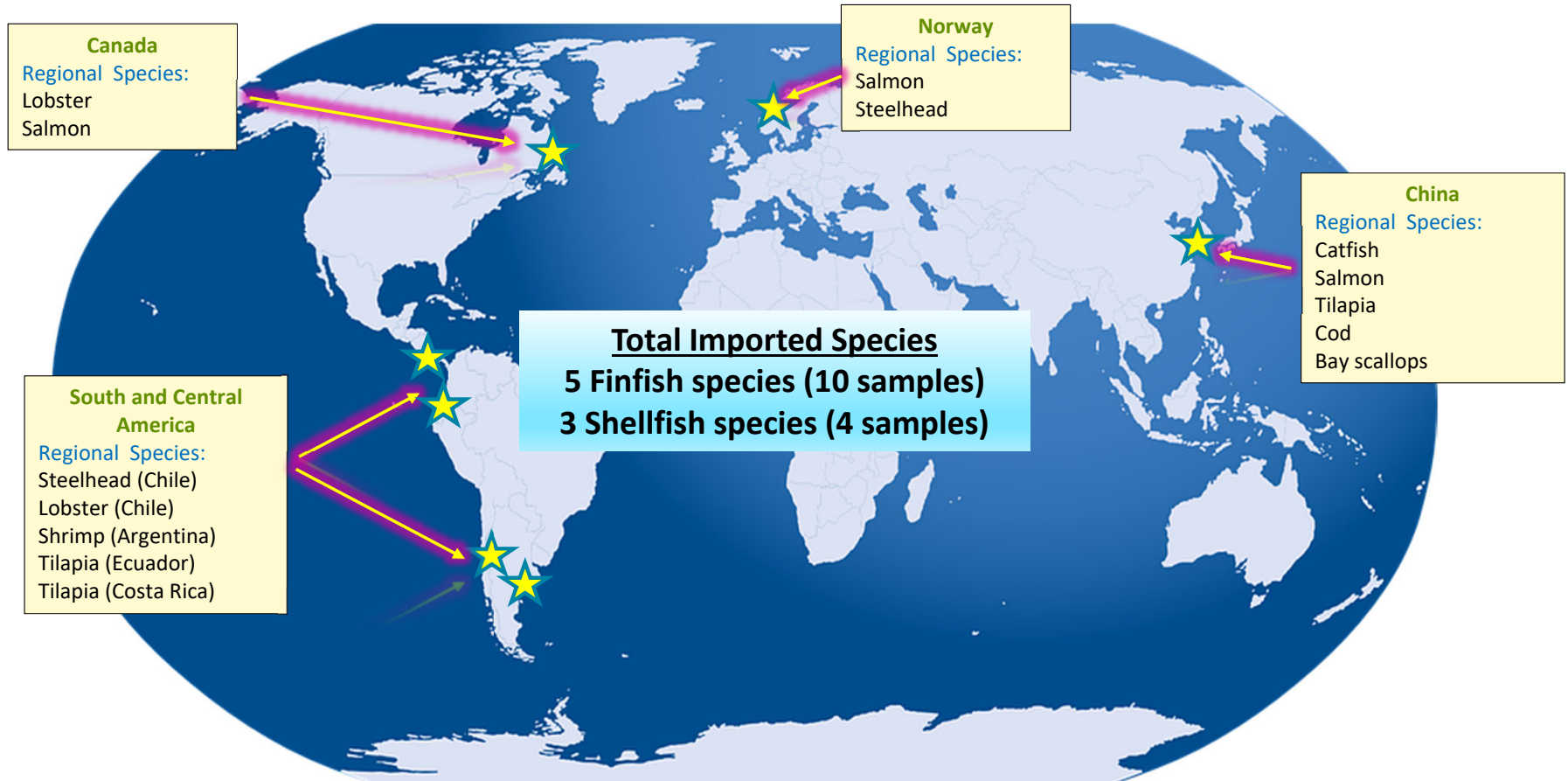
PFAS Tissue Analyte List		
Analyte	CASRN	(Carbon #) and Group
PFBA	375-22-4	(4), Short-chain PFCA
<u>PFPeA</u>	2706-90-3	(5), Short-chain PFCA
<u>PFHxA</u>	307-24-4	(6), Short-chain PFCA
<u>PFHpA</u>	375-85-9	(7), Short-chain PFCA
PFOA	335-67-1	(8), Long-chain PFCA
PFNA	375-95-1	(9), Long-chain PFCA
PFDA	335-76-2	(10), Long-chain PFCA
<u>PFUnDA</u>	2058-94-8	(11), Long-chain PFCA
<u>PFDoDA</u>	307-55-1	(12), Long-chain PFCA
<u>PFTrDA</u>	72629-94-8	(13), Long-chain PFCA
<u>PFTeDA</u>	376-06-7	(14), Long-chain PFCA
<u>PFHxDA</u>	67905-19-5	(16), Long-chain PFCA
PFODA	16517-11-6	(18), Long-chain PFCA
PFBS	375-73-5	(4), Short-chain PFSA
<u>PFPeS</u>	2706-91-4	(5), Short-chain PFSA
<u>PFHxS</u>	355-46-4	(6), Long-chain PFSA
<u>PFHpS</u>	375-92-8	(7), Long-chain PFSA
PFOS	1763-23-1	(8), Long-chain PFSA
PFNS	68259-12-1	(9), Long-chain PFSA
PFDS	335-77-3	(10), Long-chain PFSA
<u>PFUnA</u>	2058-94-8	(11), Long-chain PFCA
4:2 FTS	757124-72-4	(6), Precursor
6:2 FTSA	27619-97-2	(8), Precursor
8:2 FTSA	39108-34-4	(10), Precursor
<u>EtFOSAA</u>	2991-50-6	(10), Precursor
<u>MeFOSAA</u>	2355-31-9	(11), Precursor

U.S. Species Purchased and Region of Origin



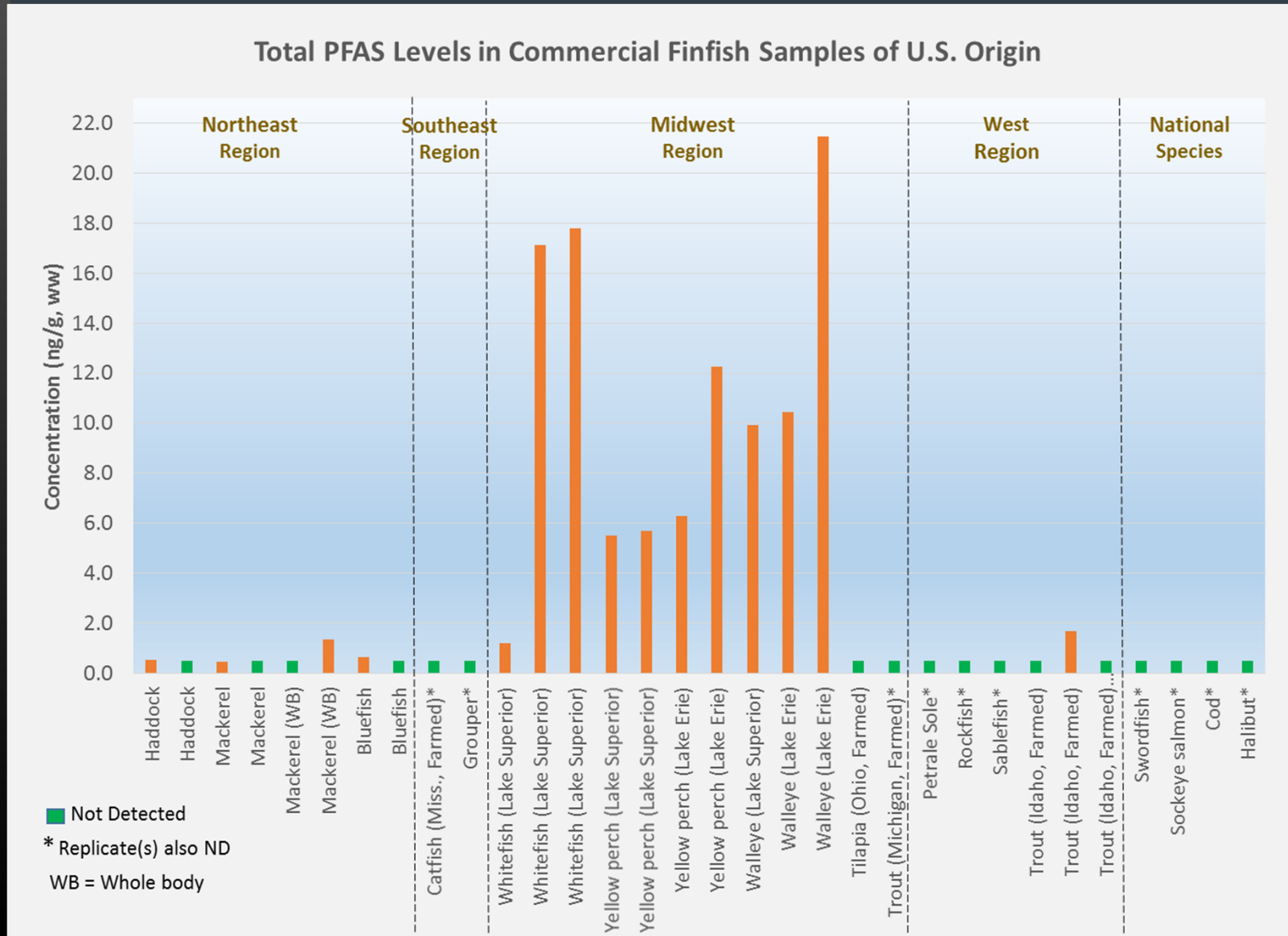
*whole body and fillet

Imported Species Purchased and Country of Origin



Results

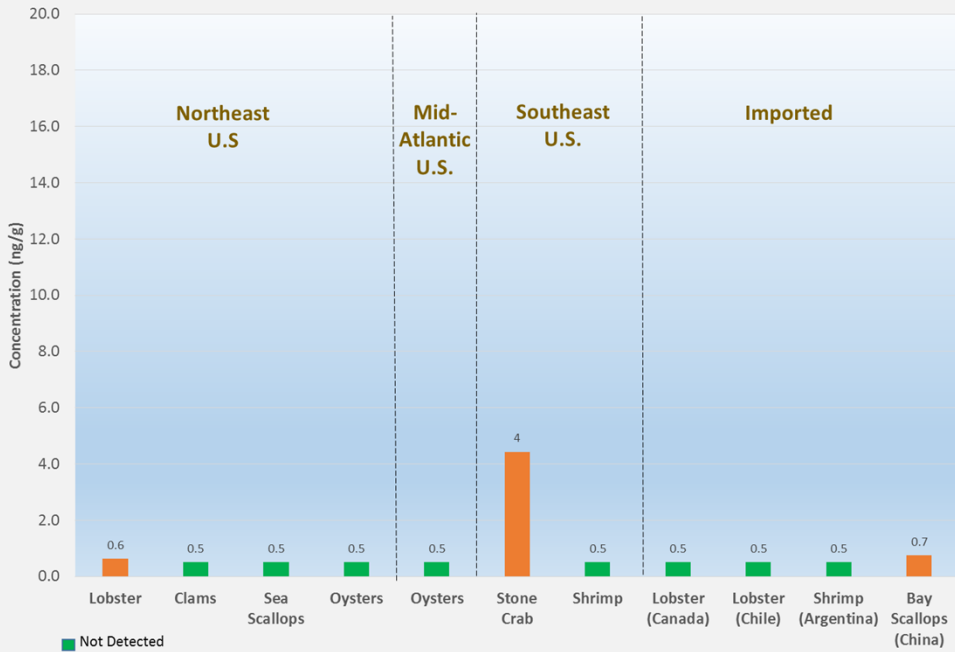
Finfish of U.S. Origin



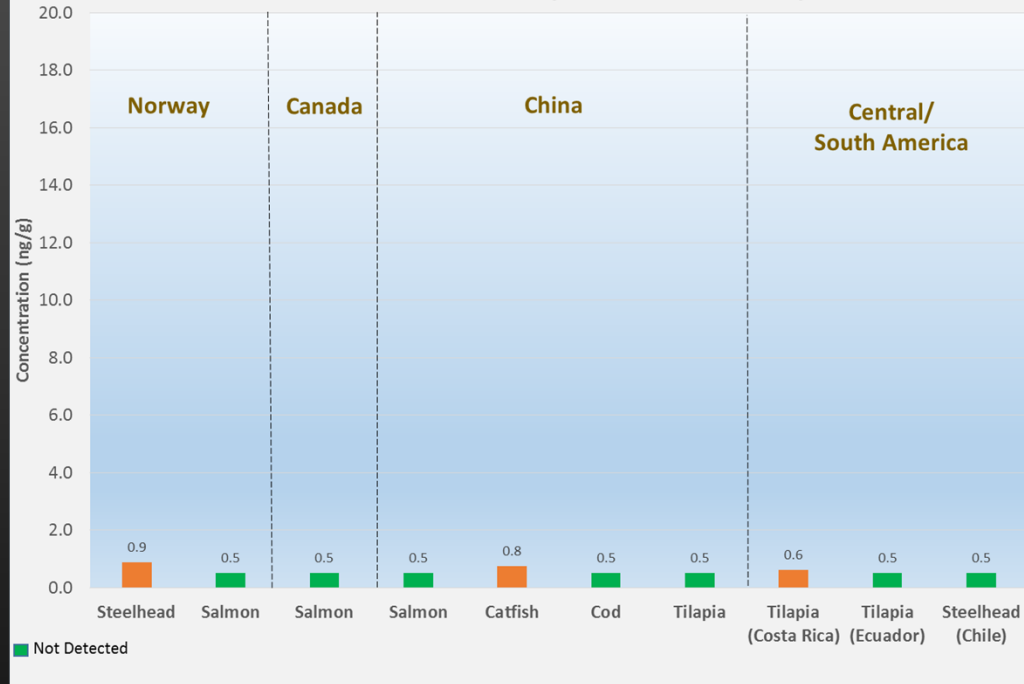
Results

Shellfish and Imported Finfish

Total PFAS Levels in U.S. and Imported Shellfish Samples



Total PFAS Levels in Imported Finfish Samples



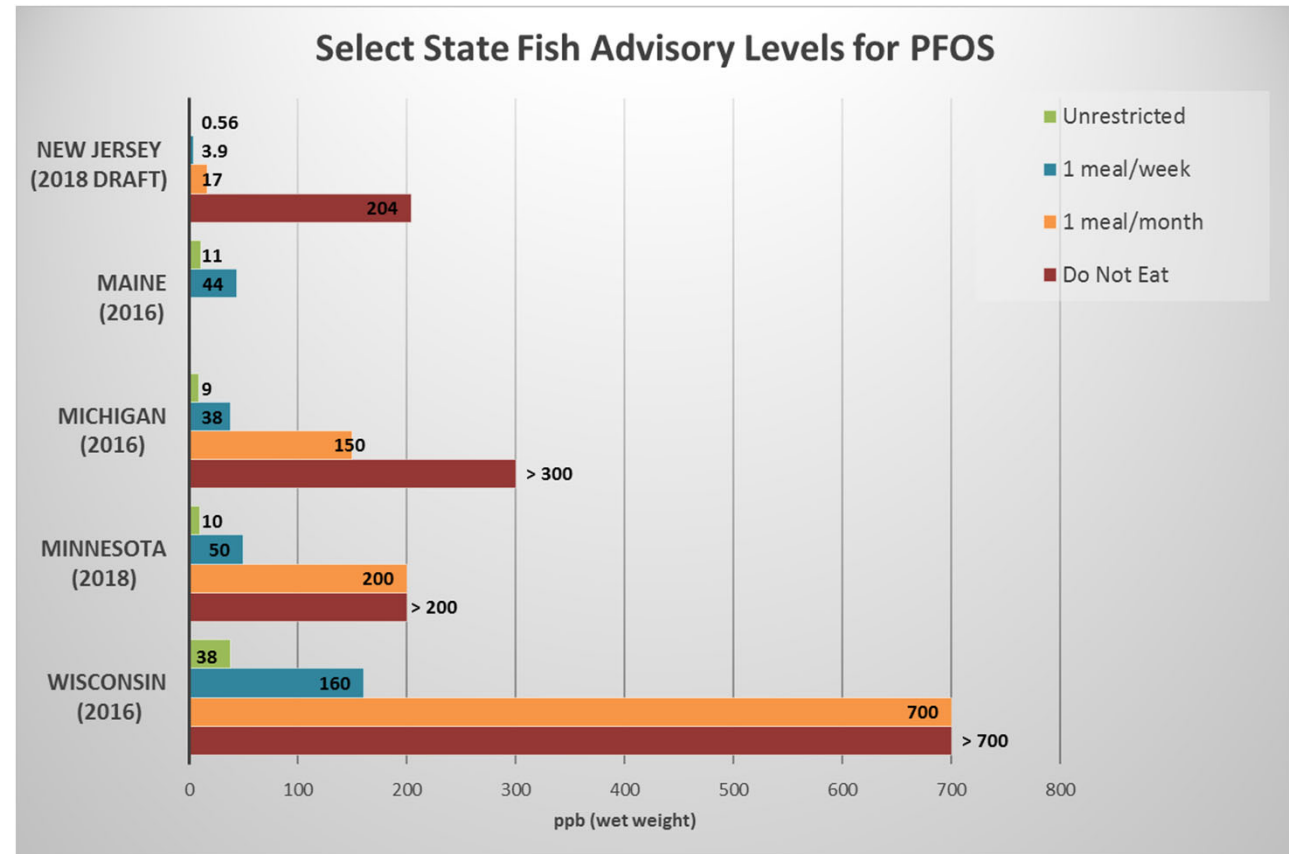
Summary of Results

- Most close to or below detection limit (~0.5 ppb)
- Highest levels observed in Midwest finfish
 - Maximum of ~22 ppb total PFAS (Lake Erie walleye)
- PFOS most frequently detected and contributes most to total PFAS (~70% or more), followed by long-chain PFCAs
- No detects in 12 samples of national species
 - Sockeye salmon, swordfish, halibut and cod
- Very low levels in imported finfish and shellfish samples
- Wrapping papers PFAS-free
- Lab noticed short peaks in ND chromatograms
 - Indicate occurrence of PFAS at concentrations below detection limit (~20-80 ppt)

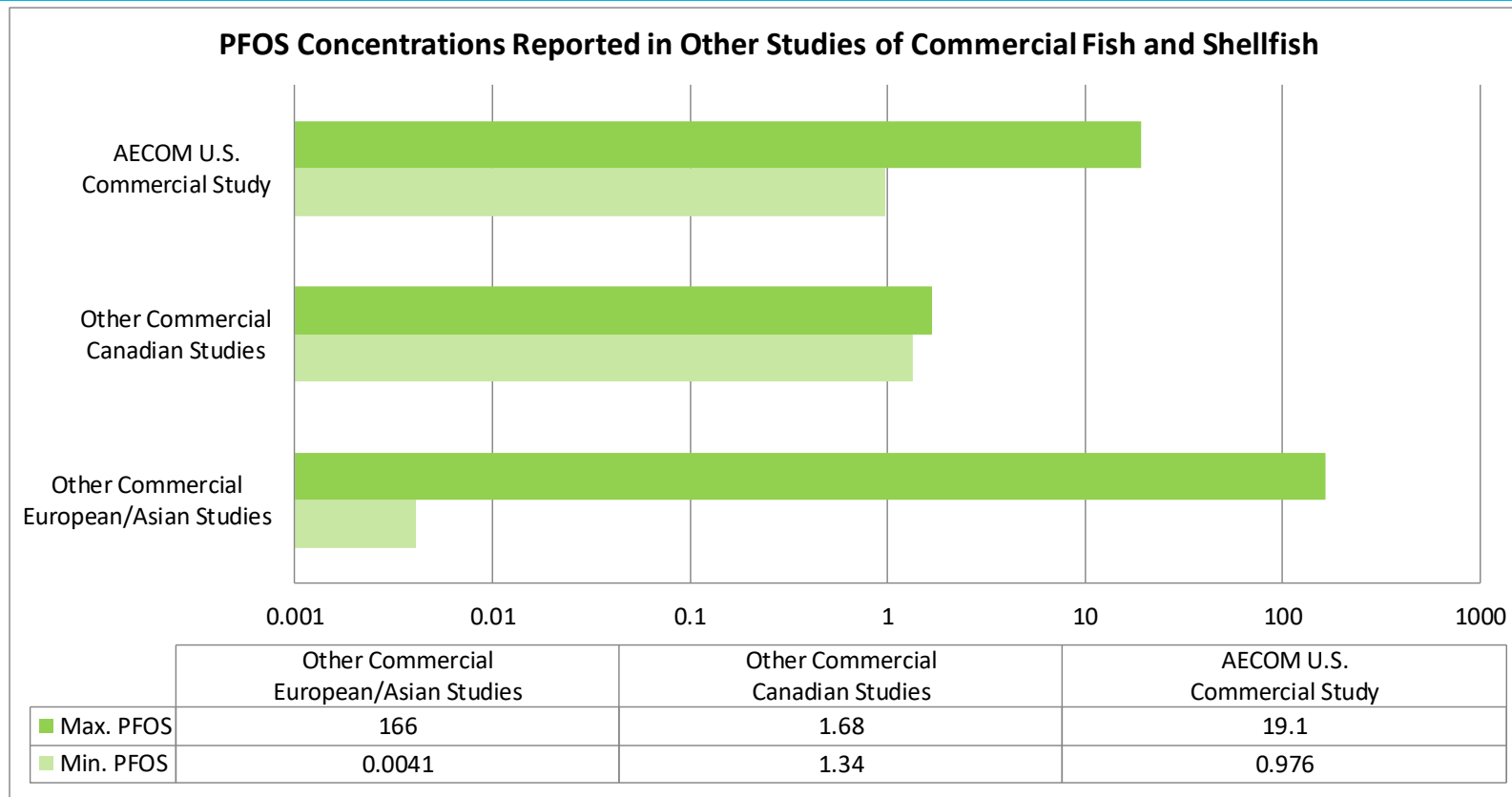


Comparison to Fish Consumption Advisories

- PFOS levels in most commercial fish samples below “unrestricted” fish consumption advisory
 - Exceptions include Great Lakes commercial fish
 - Intra-species variability
- New Jersey’s draft “unrestricted” advisory level at limit of detection (~0.5 ppb)
 - Based on NJDEP-specific reference dose



Comparison with Other Studies of Commercial Fish/Shellfish



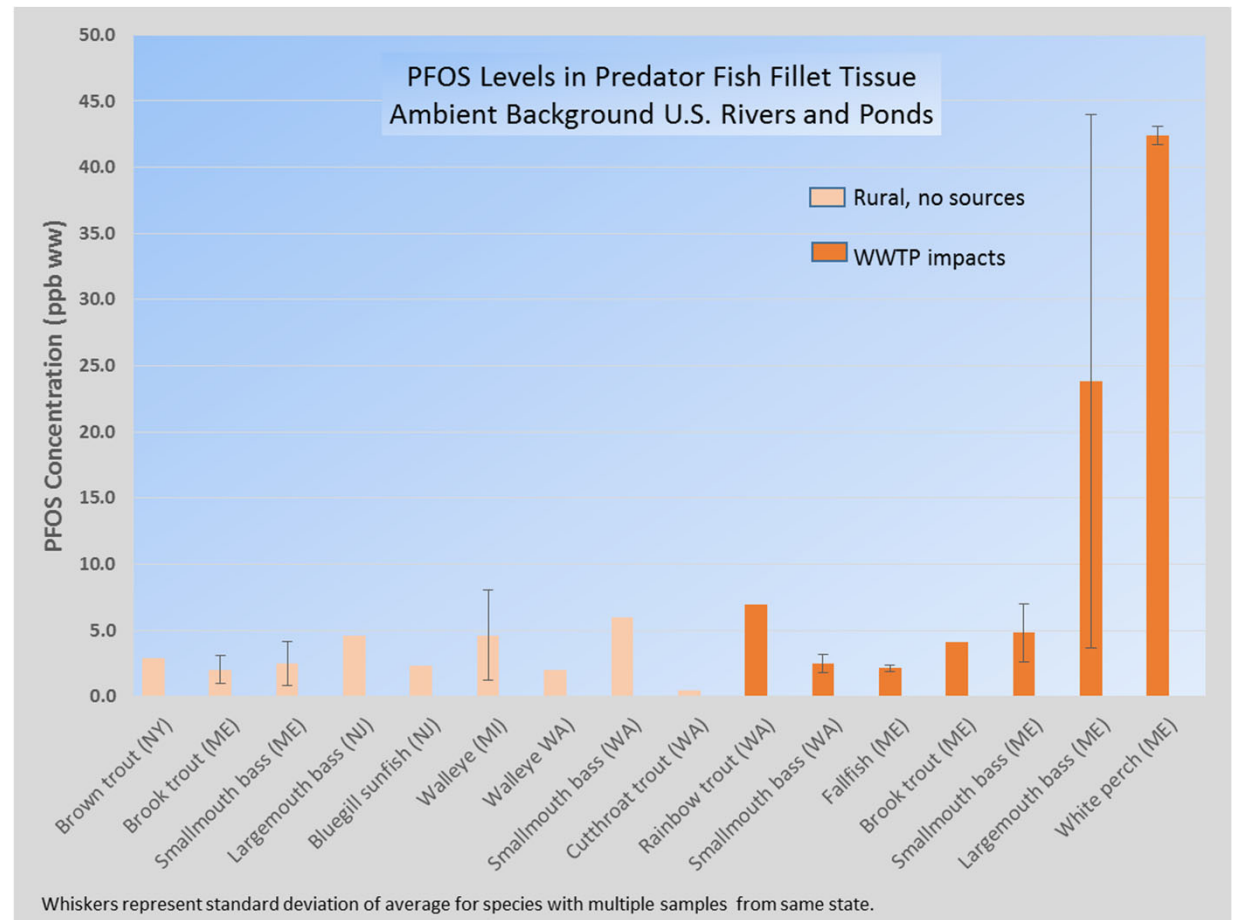
Concentrations are in parts per billion (ppb)

The minimum value shown from the other relevant studies is the lowest reported value.

The minimum value shown for the AECOM U.S. commercial study is the highest non-detect reporting limit (0.976 ppb).

Comparison with Levels in U.S. Wild Fish (Background)

- PFOS detected in fish from rural lakes, ponds and rivers (no sources)
 - ND to single digit ppb levels (predator fillet)
 - Lower levels in benthic species
- Higher tissue levels observed near waste water treatment plants
 - ~2 to 40 ppb



Summary

- Performed focused empirical study of PFAS levels in commercial fish/shellfish from different regions of the U.S. and countries that import to U.S. (n=71)
- Analyzed for 26 PFAS using state-of-the-art method
 - Includes the most widespread and commonly reported in biotic and abiotic media
- Majority of domestic and imported finfish and shellfish were ND or had very low ppb levels; below most state advisory levels for “unrestricted” consumption
- Exception appears to be fish from Great Lakes area
 - Somewhat higher levels than rest of U.S. (lower than 2010 EPA study of Lake Erie)
- Lab results indicate occurrence of part per trillion levels (below detection limits)
- Study findings suggest PFAS exposure not of concern for consumer of commercial fish and shellfish

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Thank You!

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