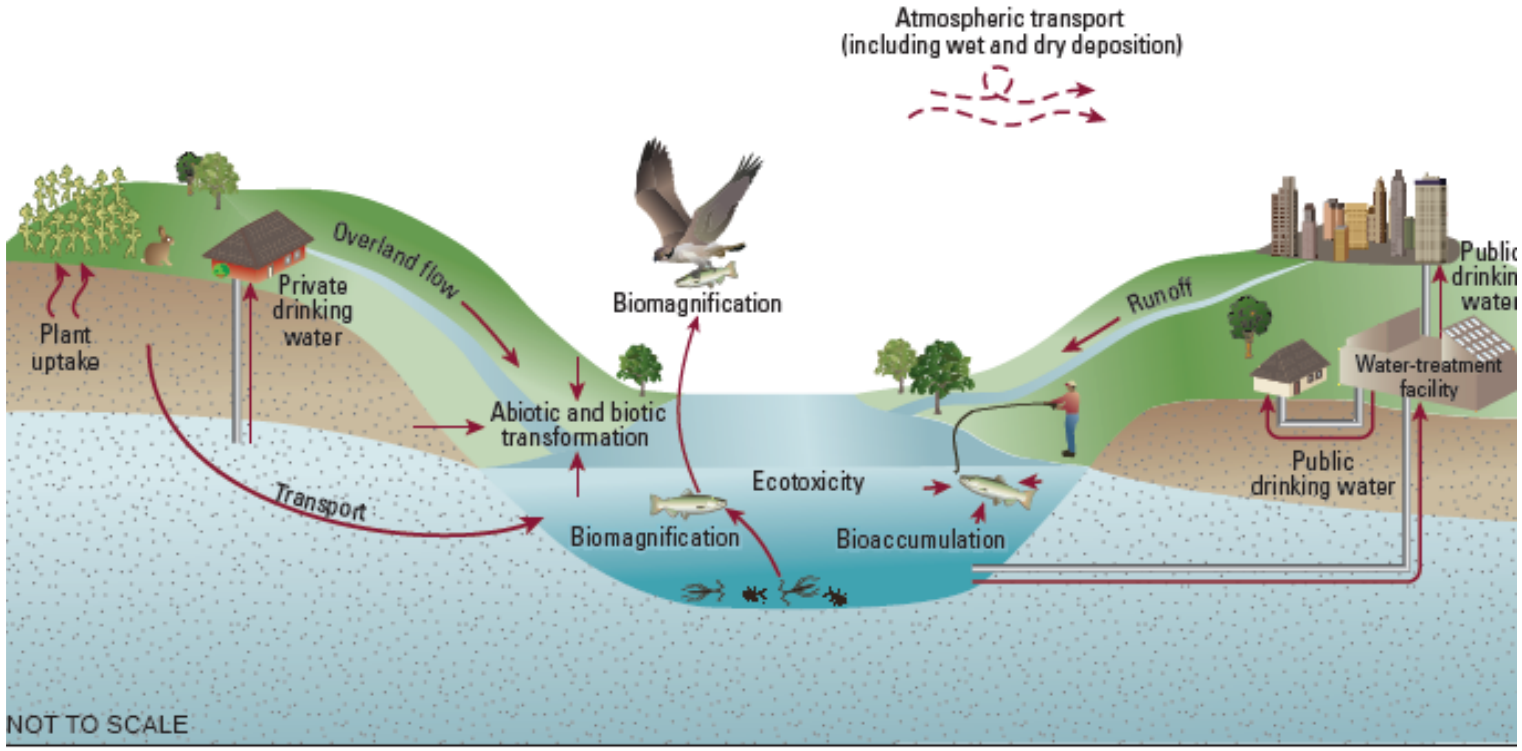
Ecological Effects of PFAS Across Trophic Levels
Research Updates and Considerations for the Chesapeake Bay

Quarterly TCW Meeting April 2024



(figure from Tokranov and others, 2021; USGS Circular 1490, https://pubs.usgs.gov/circ/1490/cir1490.pdf)

Objectives of quarterly meetings include:

- Knowledge transfer
- Discuss and identify priority areas for unified approaches across the watershed
- Identify tangible ways the CBP partnership (TCW) can assist with promoting consistency
- Maximize leveraging and collaboration

2024 Meetings

- April June September December

DRAFT- subject to revision

Improving Understanding and Coordination of Science Activities for PFAS in the CBW- *Ecotox and Ecological Effects*

- Better understanding of regional PFAS mixtures and ratios, with emphasis on AFFF, non-AFFF, and smaller watersheds.
- Need for more studies that look at the interface between aquatic and terrestrial ecosystems.
- Understanding of paternal/maternal transfer and differences in sensitivities between sexes and life-stages.
- Chronic toxicity for broader range of species and life-stages, including larval oysters and blue crabs
- Link between PFAS concentrations/exposures and cumulative effects of other contaminants and stressors.
- Use of uniform bioconcentration factors across the jurisdictions

Improving Understanding and Coordination of Science Activities for Per- and Polyfluoroalkyl Substances (PFAS) in the Chesapeake Bay Watershed | U.S. Geological Survey (usgs.gov) (Smalling and others, 2023)

EPA Draft Aquatic Life Criteria (2022)

	Acute 1-Hour Average		Chronic 96-Hour Average	Instantaneous		
	Fresh water (mg/L)	Salt water* (mg/L)	Fresh water (mg/L)	Invertebrate Whole Body (mg/kg ww)	Fish Whole Body (mg/kg ww)	Fish Muscle (mg/kg ww)
PFOA	49	7	0.094	1.11	6.10	0.125
PFOS	3	0.55	0.0084	0.937	6.75	2.91

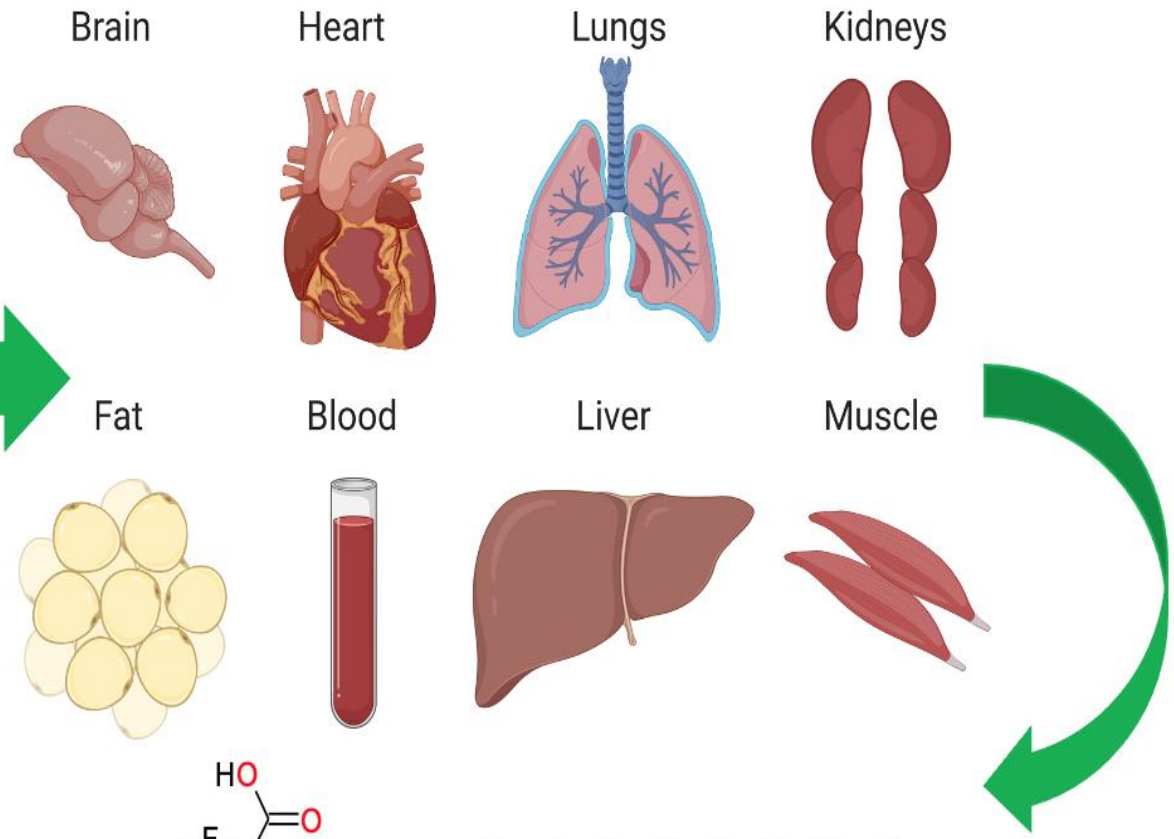
*New Approach Method – Available toxicity data and modeled estimates

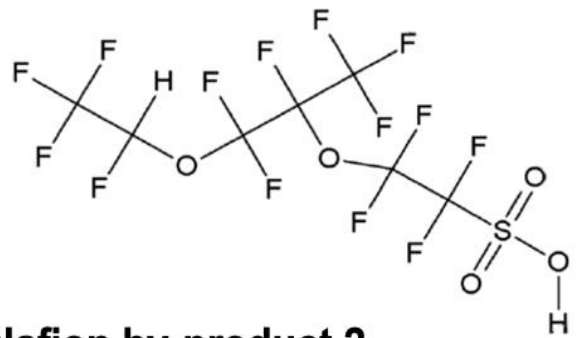
- Chronic criteria designed to be protective from bioaccumulation
  - Tissue Criteria = Chronic Water Column Criteria X BAF
- Marine criteria may likely change as new data comes in
  - Use of toxicity data preferred over ICE data
- Consumption of fish

Aquatic Life Criteria - Perfluorooctane Sulfonate (PFOS) | US EPA (Brown, 2023)

Tissue monitoring is vital because water patterns ≠ tissue patterns

Different PFAS display variable partitioning behavior into different tissues





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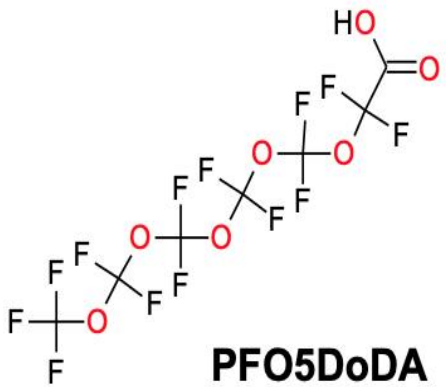
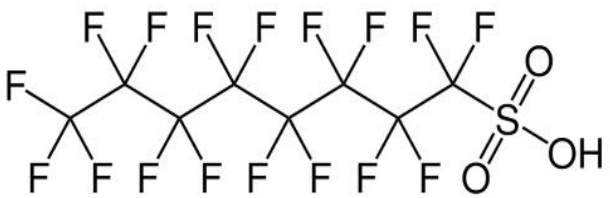
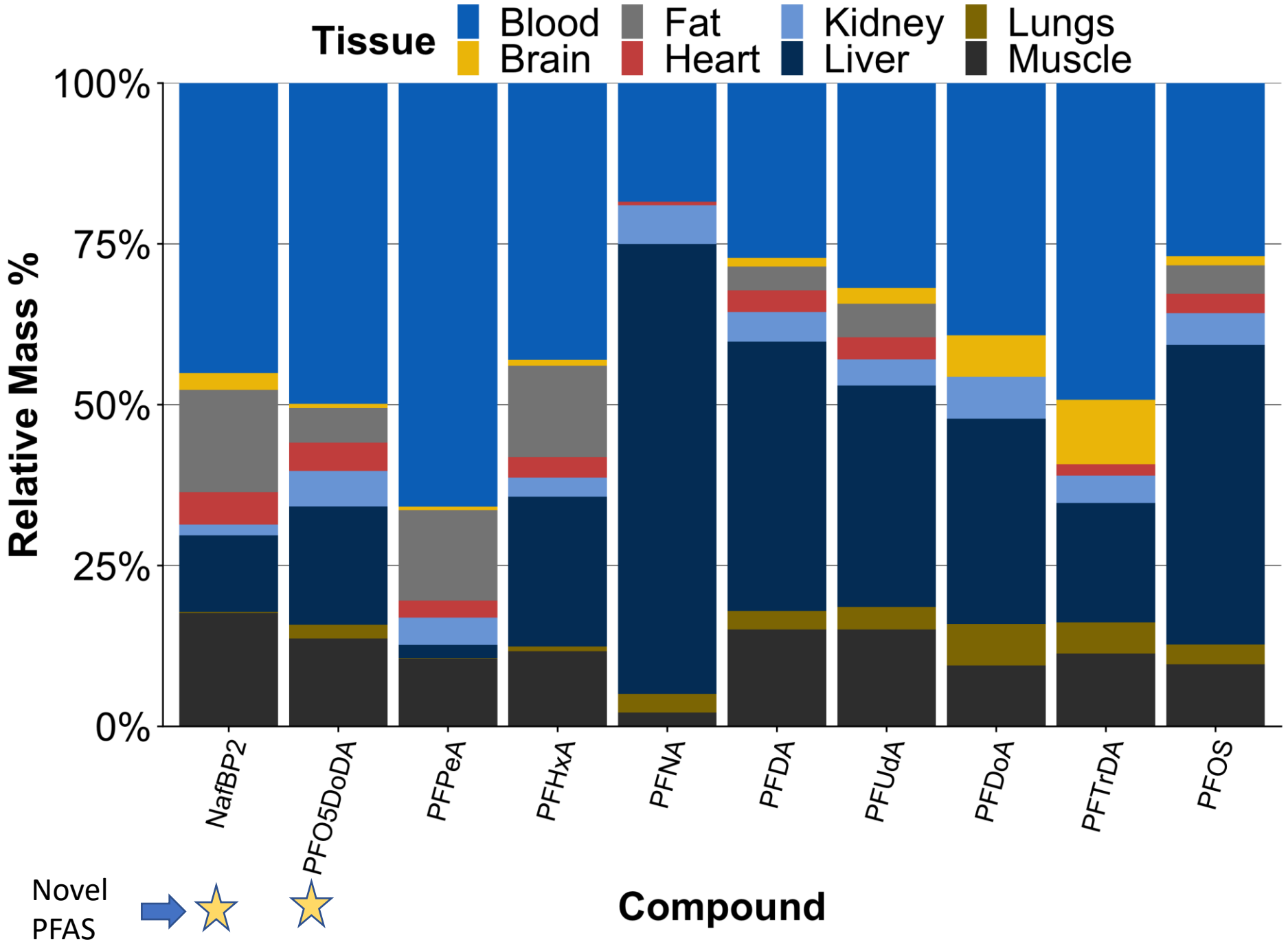


PFO5DoDA



PFOS

[Tissue-Specific Distribution of Legacy and Novel Per- and Polyfluoroalkyl Substances in Juvenile Seabirds | Environmental Science & Technology Letters (acs.org)](#)
Robuck and others, 2022)



Fat = largest compartment

Blood = 2nd largest volume

Liver = highest concentrations

Tissue-Specific Distribution of Legacy and Novel Per- and Polyfluoroalkyl Substances in Juvenile Seabirds | Environmental Science & Technology Letters (acs.org)

Maryland Fish Consumption Advisories

- Samples were analyzed for many of the various PFAS compounds including 5 of the 6 PFAS, PFOA, PFOS, PFHxS, PFBS and PFNA, proposed by EPA for National Primary Drinking Water regulation (these have proposed MCLs).
- Data appear to indicated certain PFAS, most specifically PFOS, have **significant variability between fish species and do not appear to accumulate in certain mollusks and crustaceans**, *additional data is necessary to validate and define these cursory findings*
  - Species like channel catfish had significantly less PFAS than largemouth bass, sunfish and perch, *questions on species diet and food chain dynamics exist*
- The **dominant compound identified in fish tissue is PFOS**

Maryland and PFAS
(Laliberte, May 2023)

Technical Presentations:

- Dr. Chris Salice, Towson University, PFAS Associated with AFFF sites: What we have learned with respect to exposure, ecotoxicity, and bioaccumulation.
- Dr. Vicki Blazer, USGS EESC Leetown, Spatial Temporal Assessment and Tissue Distribution of PFAS in Smallmouth Bass in the mid-Atlantic
- Dr. Natalie Karouna, USGS EESC Patuxent, PFAS Accumulation and Association with Immune Parameters in Juvenile Osprey (*Pandion haliaetus*)

Work Session:

- Regulatory update – eco relevance
- Methods inquiry
- Panel questions

DRAFT- subject to revision

EPA Regulatory Updates – Region 3

- Draft Aquatic Life Criteria: Implementation Workgroup finalizing guidance. No further updates on the criteria at this time.
- EPA Method 1633 (January 2024): Finalized for the analysis of 40 PFAS in non-potable water, soil, biosolids, landfill leachate, and tissue.
  - EPA now recommends use in NPDES permits and encourages lab, regulatory authorities, and others to use the method
  - Still pending: Propose for adoption to CFR, and promulgate for CWA use (no timeline)

Birds Eye View of EPA Methods

Method	No. of Analytes	Detection Range	Matrix Type	Pro's and Con's	Approximate Costs Per Sample ($)
537.1	18	ng/L (ppt)	Drinking- and Surface Water	• Not as effective with short chain PFAS • Widely established method	$ 300-420
533	25	ng/L (ppt)	Drinking- and Surface Water	• Effective with short chain PFAS • Widely established method	$ 150-420
8327	24	ng/L (ppt)	Drinking-, Surface, Wastewater	• Widely established method • Laboratory cleanup and accuracy issues • Method update proposed • Not Accepted by DoD	$ 350-450
1621	NA	µg/L (ppb)	Aqueous (water/blood)	• Quick and relatively affordable* • Can't ID specific PFAS and Interference from organofluorines	$ 500 ($250)*
1633	40	ng/L(kg) (ppt)	Aqueous, solid, biosolid, tissue	• Single method that tests a variety of matrices • Tests for PFAS included in Methods 537.1, 533, 8327, and 8 more • Fully validated but needs CWA promulgation	Water: $ 350-450 Sediment: $ 350-470 Fish tissue: $ 350-590

*Expected price drop as more labs adopt procedure

Discussion Questions Ecotox/Ecological Effects

- How can monitoring best inform ecological effects?
  - How critical is sediment sampling to understanding ecological effects of PFAS? Co-located sampling?
  - Mixtures/co-contaminants? Targeted, non-targeted?
  - Opportunities for leveraging/collaborations?
- What other PFAS do you think warrant attention from ecotoxicity perspective other than PFOS and PFOA?
  - Replacement, Genx
  - Ultra-short
  - Other?
- Biggest remaining gaps for CB ecological effects of PFAS?