Testimony to MA PFAS Interagency Task Force July 6, 2021

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STEEP Superfund Research Program

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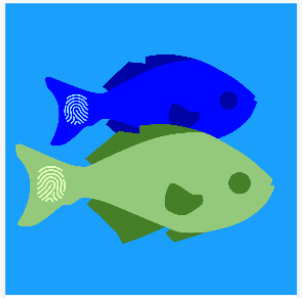
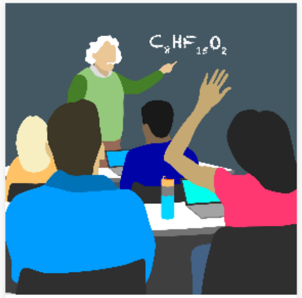


STEEP Research: Environmental Fate & Transport

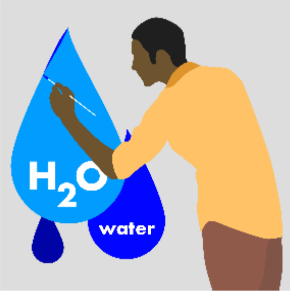
STEEP Research: Childhood Risk

STEEP Research: Metabolic Effects

STEEP Research: Detection Tools



STEEP Core: Next Generation



STEEP Core: Research Translation

STEEP Core: Community Engagement

STEEP Core: Administrative

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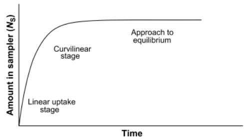
On today’s menu

(a) PFAS detection tools

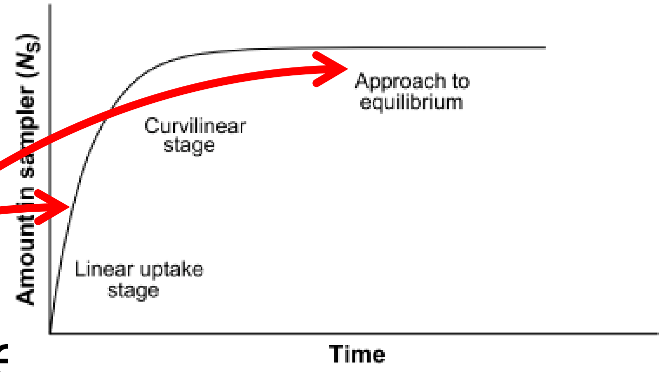
(b) PFAS in marine birds (Robuck et al., 2020, 2021)

(c) Grouping approaches for PFAS (Cousins et al., 2020)

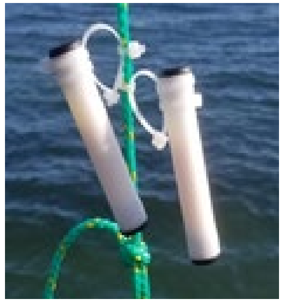
PFAS passive samplers in air/water



- Passive samplers measure activity of pollutants, *e.g.* the dissolved/gas phase



- uptake by diffusion
- advantage – no operational separation of particulate and dissolved phase
- need to know $K_{passive\text{-}water}$ (T, sal) or Rs, sampling rate
- **C_{diss} = $n_{passive}$ /[Rs x t]** **(linear uptake)**



- **C_{diss} = $C_{passive}$ / $K_{passive\text{-}w}$** **(equilibrium sampler)**

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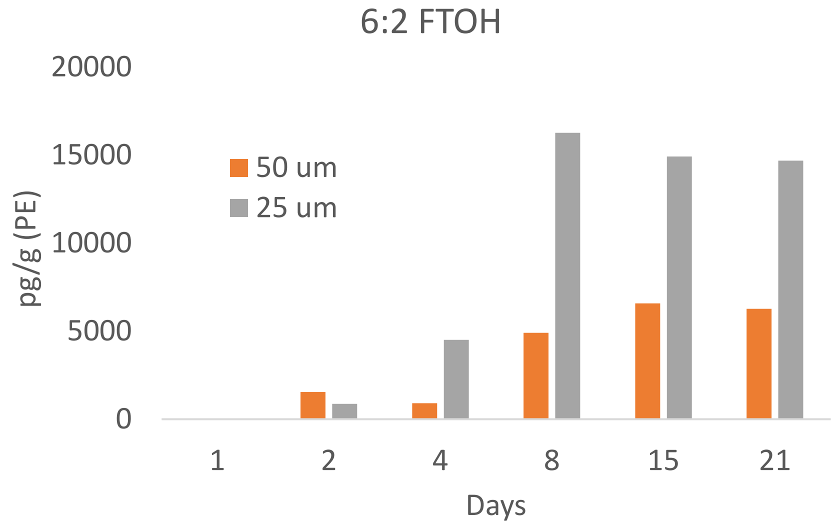
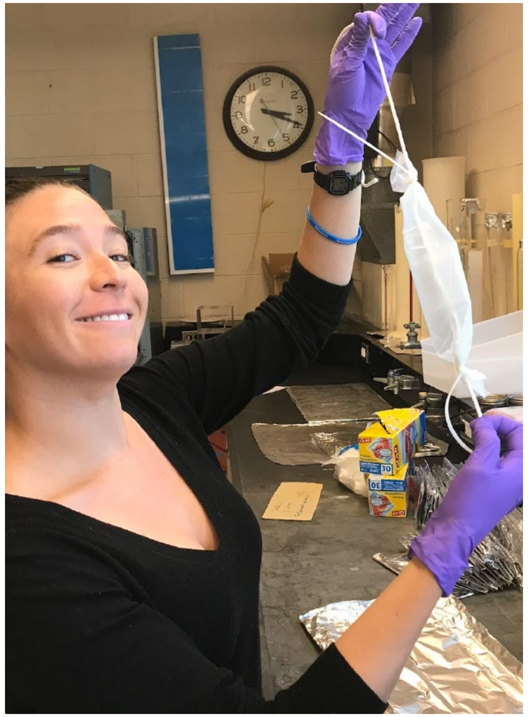
Testing of Polyethylene Sheets as Passive Samplers for Volatile PFAS in Indoor Air

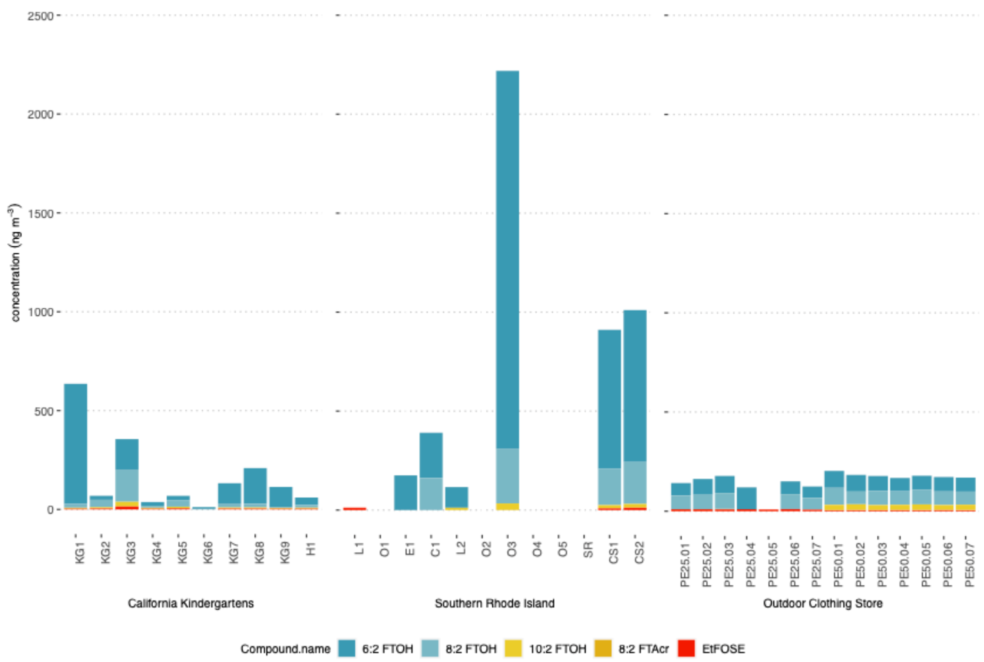
ME Morales-McDevitt, S Vojta, R Lohmann

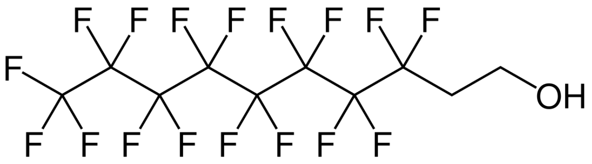


14 days are needed indoors



Testing different indoor environments





(Morales-McDevitt et al, in review)

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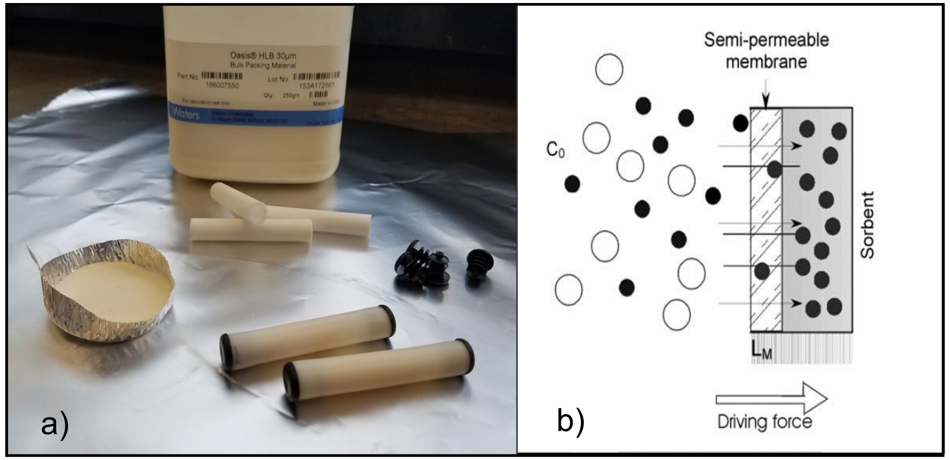
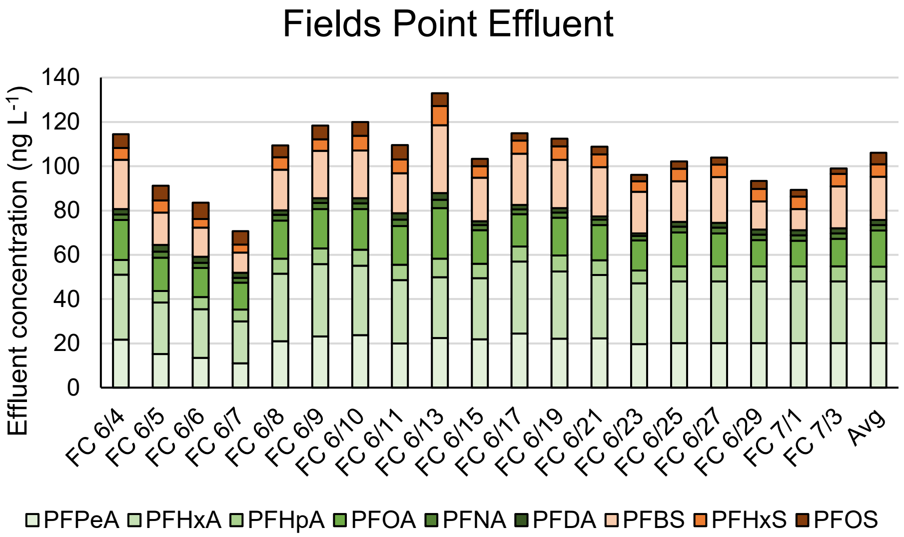
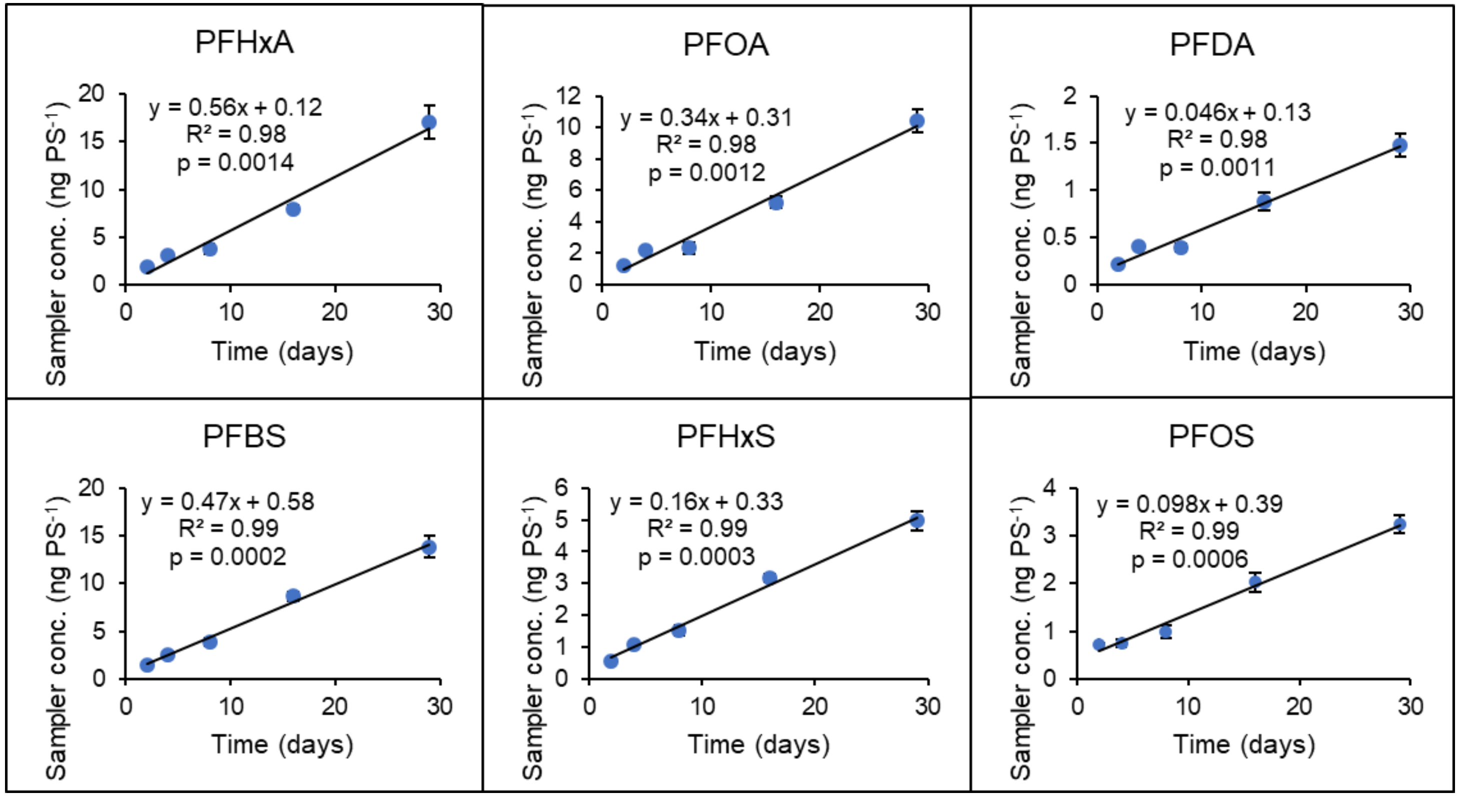
Fields Point Linear uptake and effluent



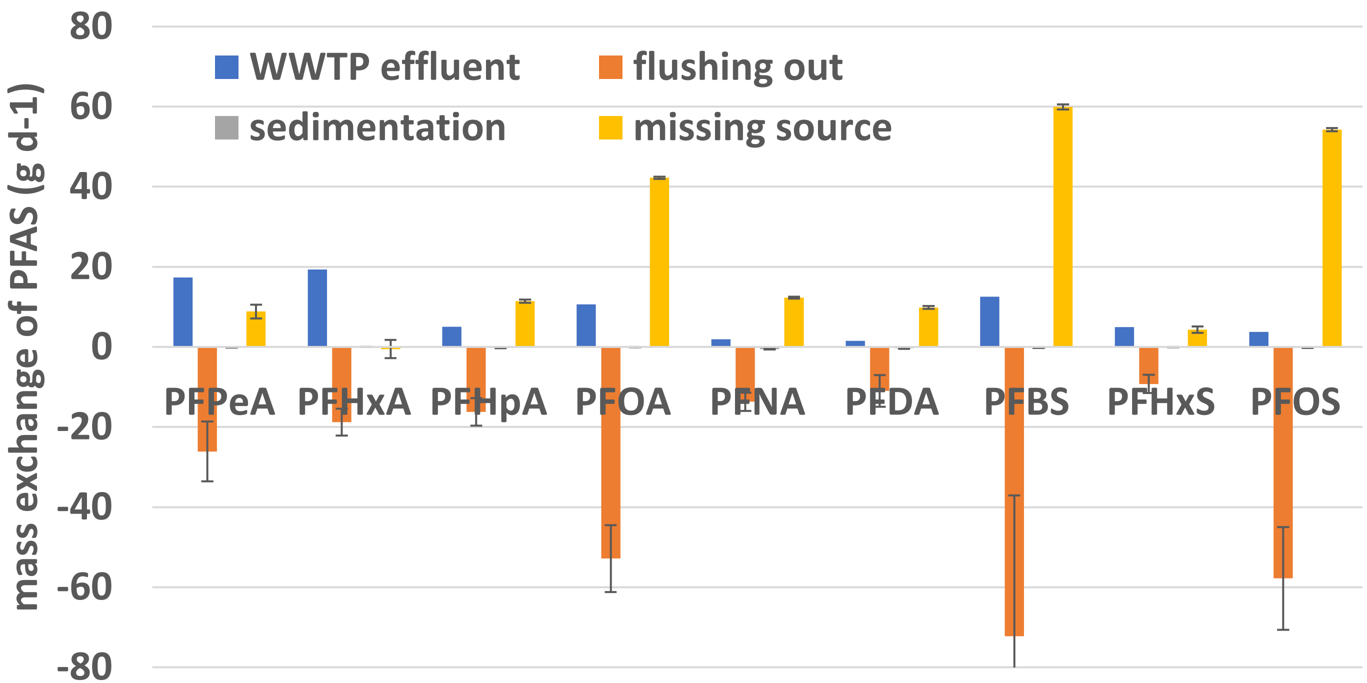


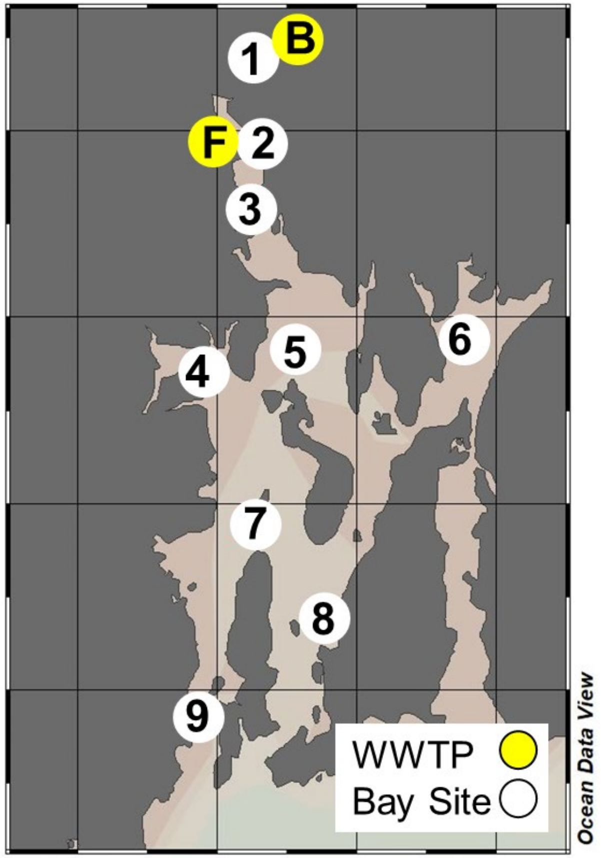


(Kaserzon et al., 2019; Gardiner et al., in review)

Our recent work in a Bay nearby

- WWTP effluents are important, but sufficient?





(Gardiner et al, in review)

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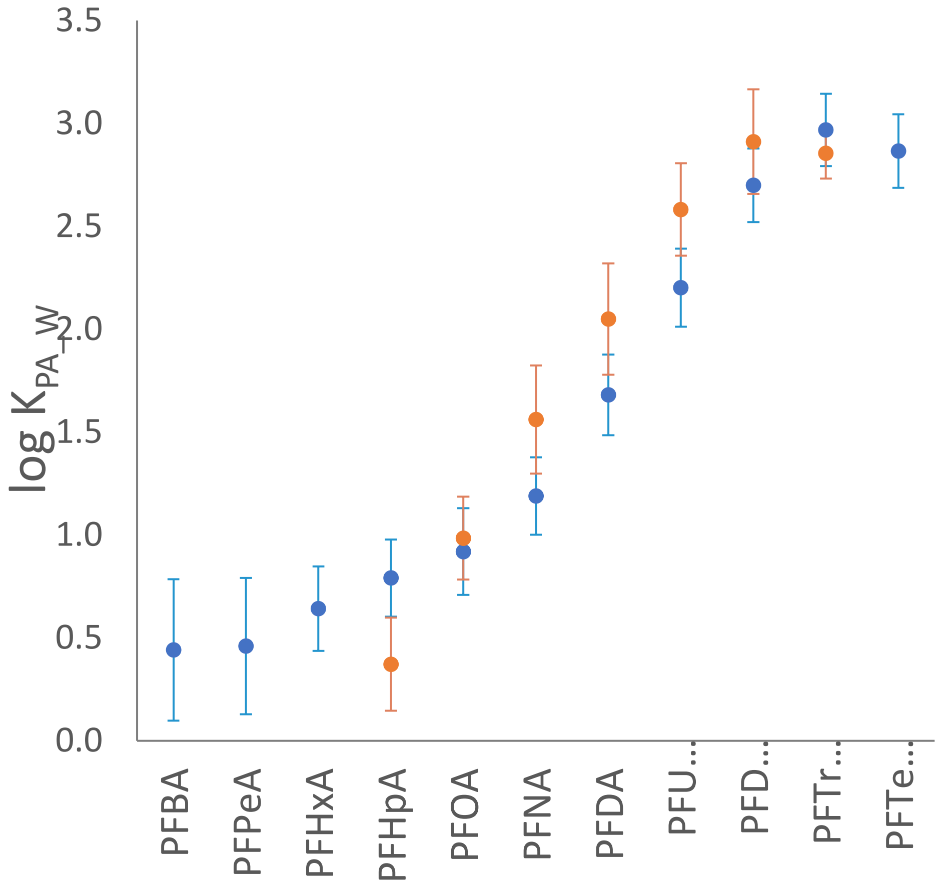
FIBER passive sampler (~ 100 ng/L LOD)



PFASs concentration	50 ng/mL	5 ng/mL
Fibers coating thickness	9 and 33 mm	33 mm
Fibers length	2 and 10 cm	5 cm
Exposure time	**24 hours**	**24 hours**
Replicates number	4	4

the K_{PA_W} **(partition coefficient)** at equilibrium (24 hours)

$$K_{PA\_W} = \frac{c_{PA}}{c_W}$$

(Becanova and Lohmann, in prep)

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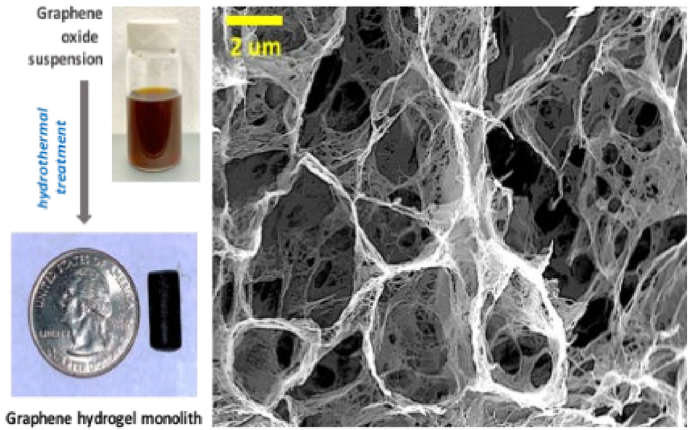
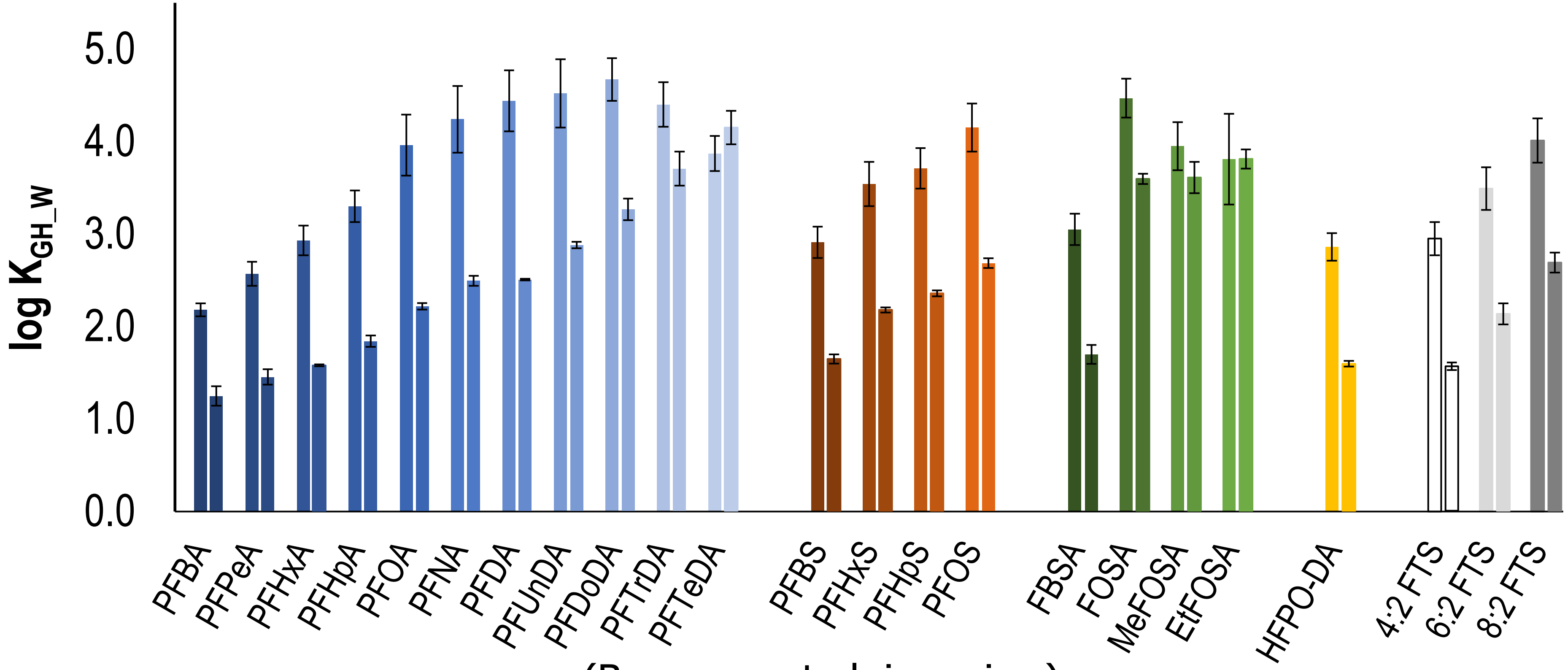
Nanographene passive sampler (URI/Brown)

- Improved partition coefficients - modified graphene vs. graphene in a pristine form
- Detection limits of single – tens of ng/L





(Becanova et al, in review)

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PFASs take to the air: trends in seabirds

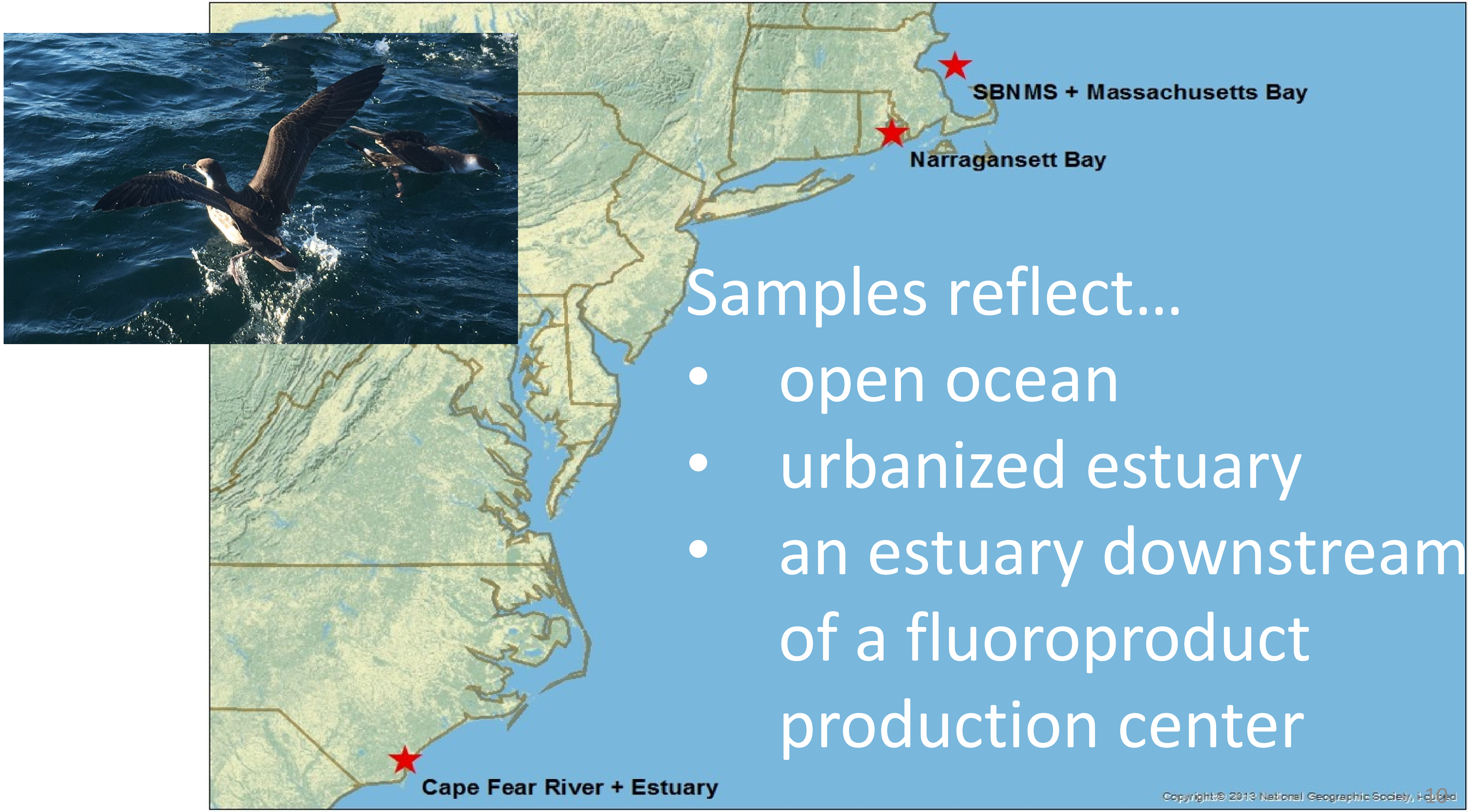

Image credit: Anna Robuck, URI-GSO

Samples reflect…

- open ocean
- urbanized estuary
- an estuary downstream of a fluoroproduct production center

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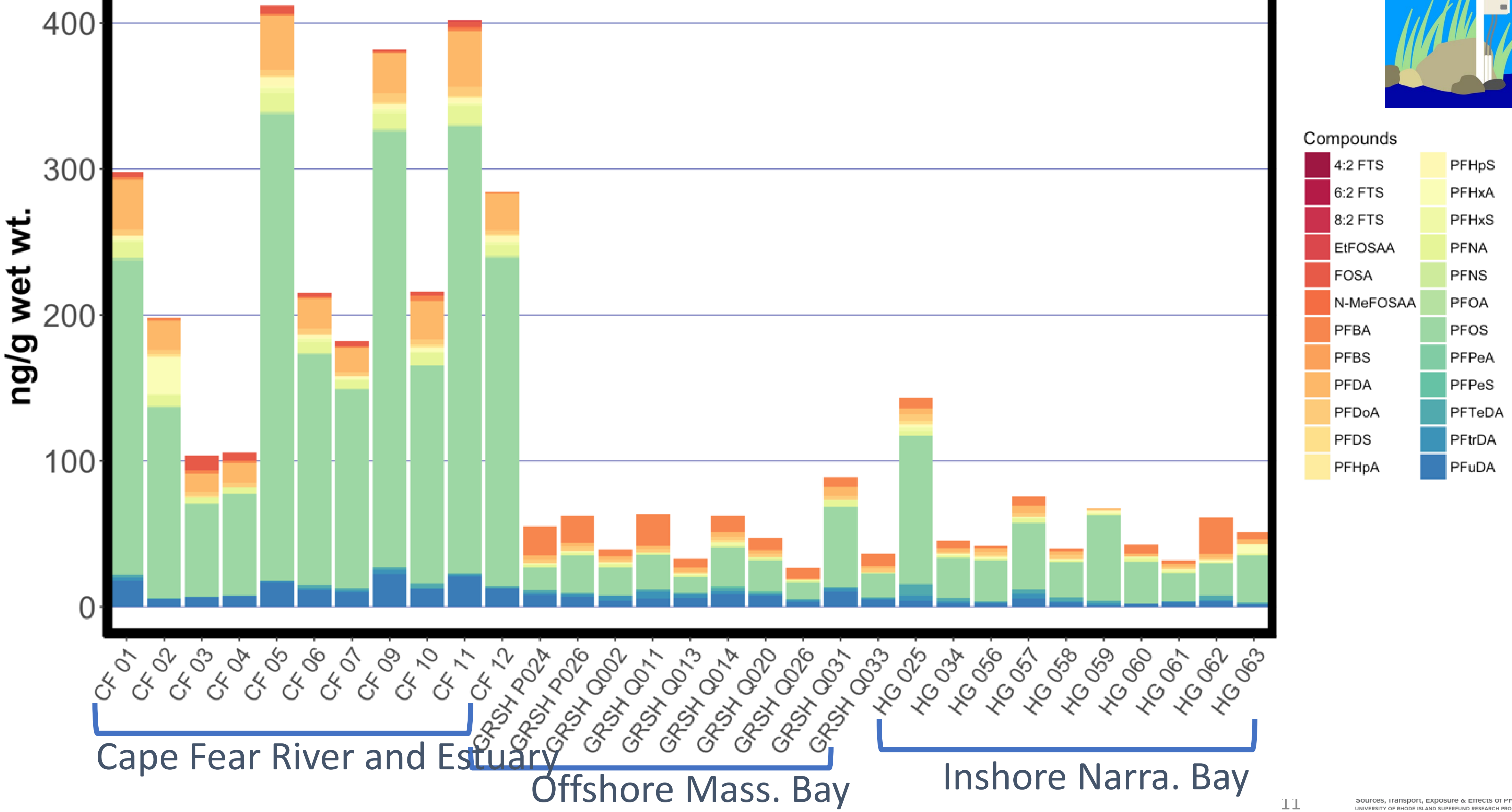
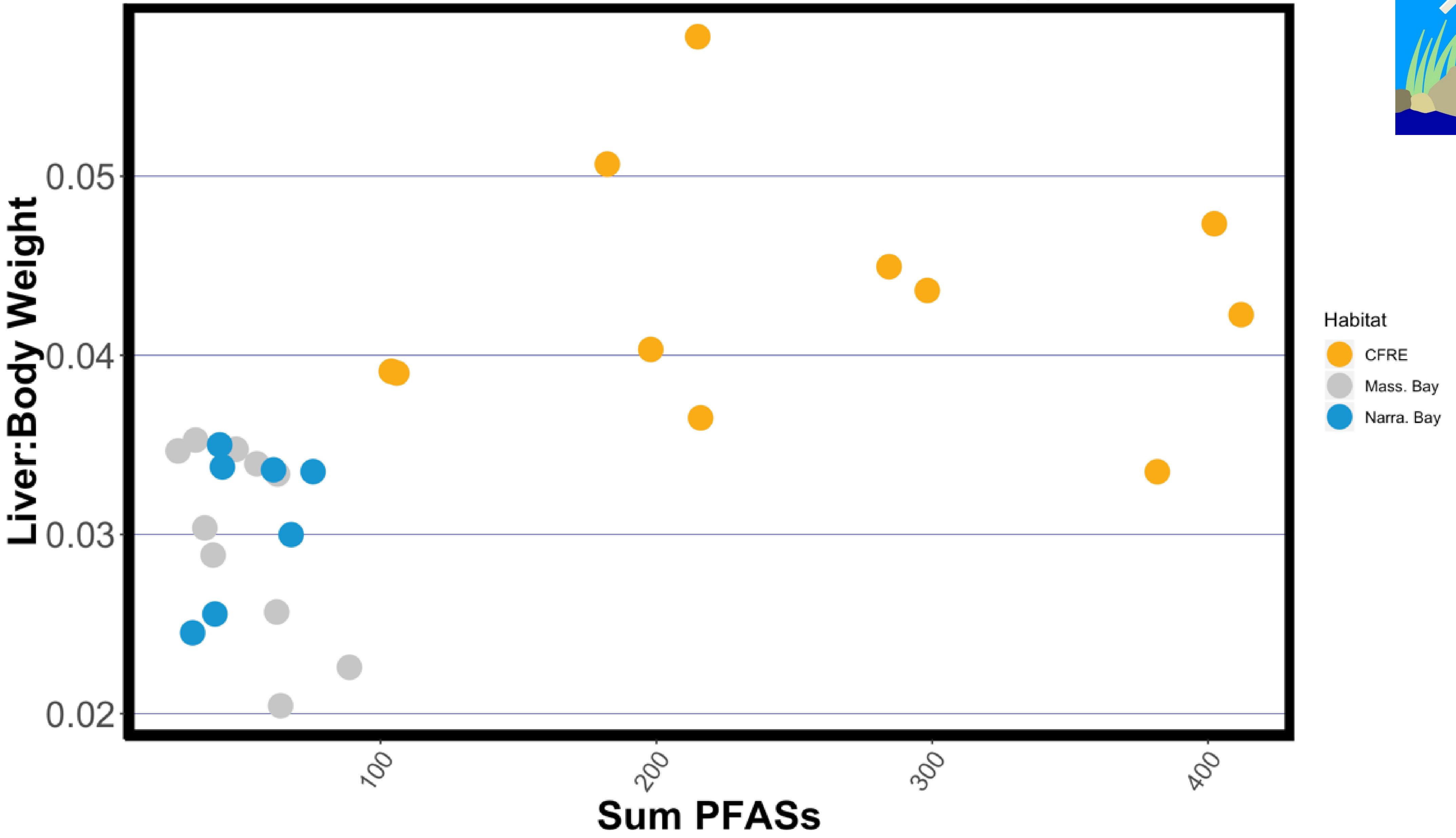
∑ PFAS Concentrations in Atlantic Seabirds



(Robuck et al, 2020)

Preliminary PFASs vs Liver:Body Weight Ratios



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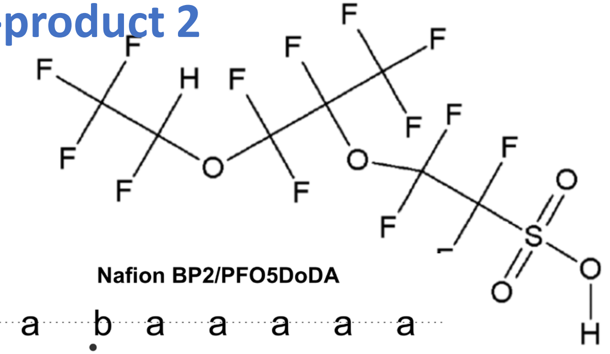
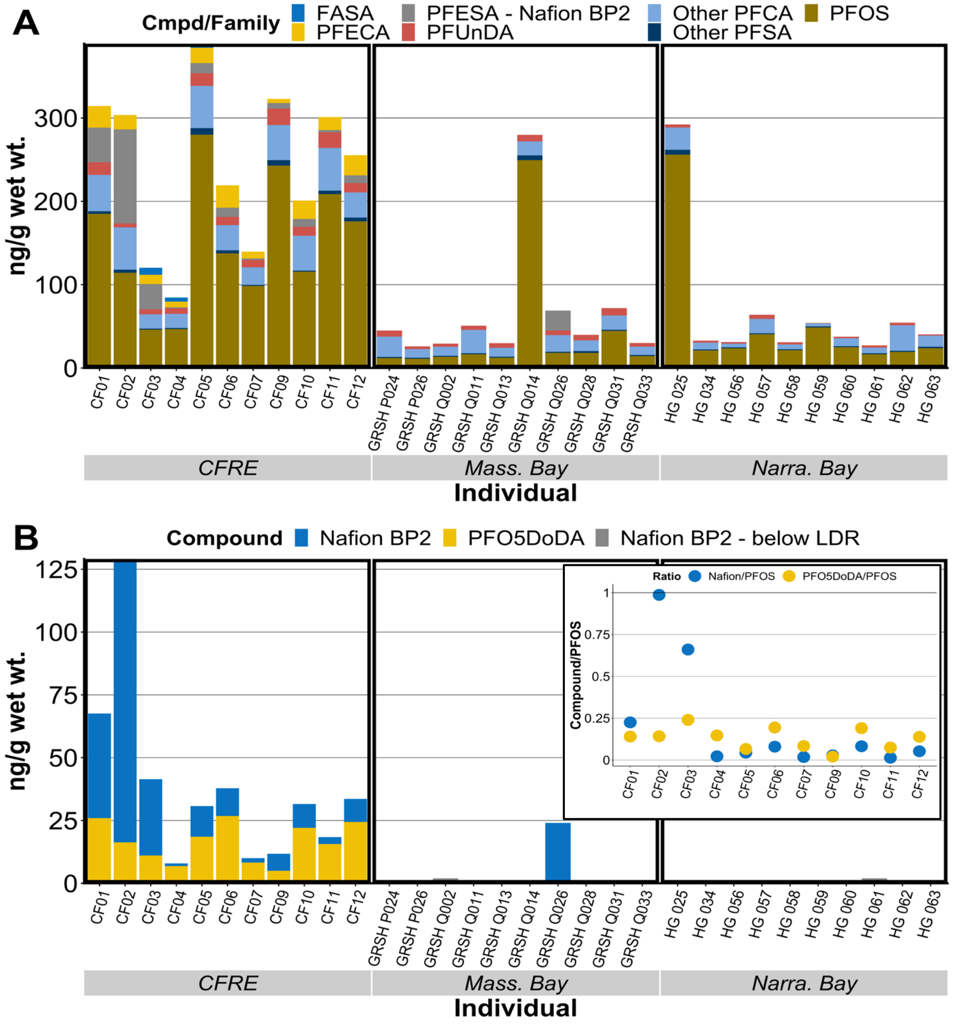
(Robuck et al, 2020)

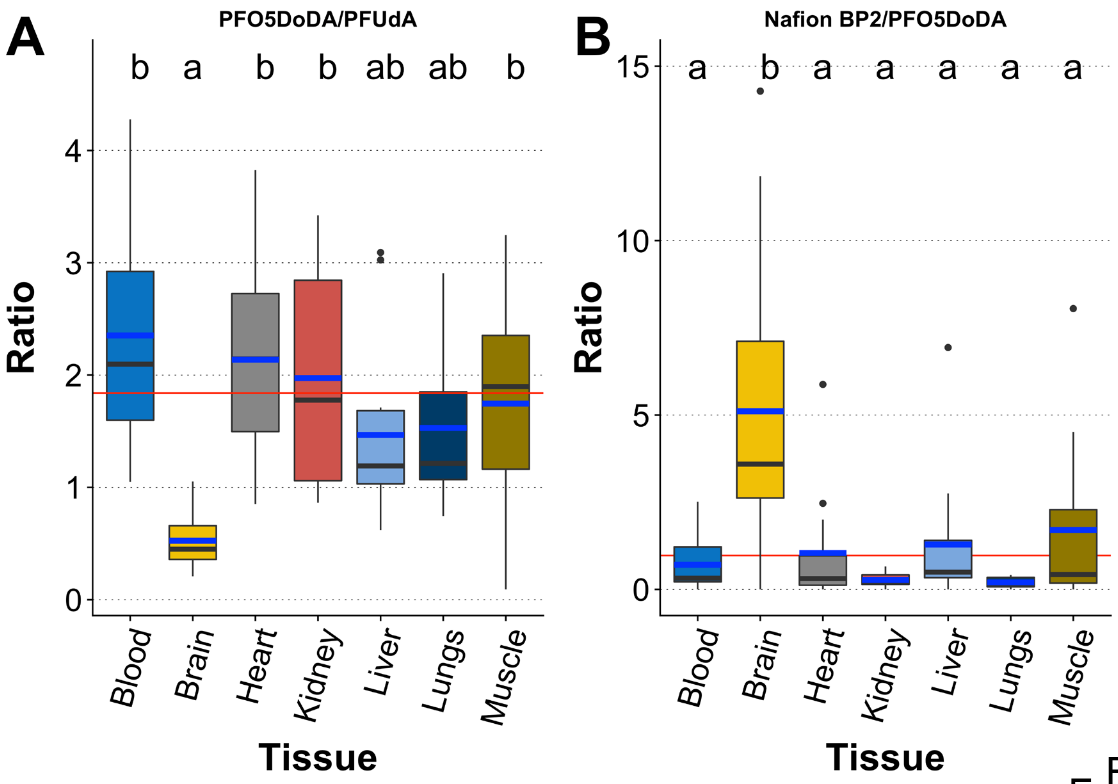
Novel PFAS - A no-brainer?

Nafion by-product 2



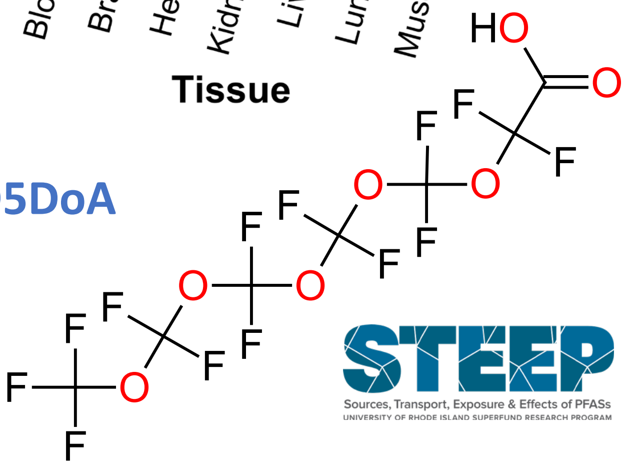


(Robuck et al, 2020)



(Robuck et al, 2021)

PFO5DoA



How to deal with PFAS?

- Grouping (e.g., Cousins et al., 2020)
- Class approach (e.g., Kwiatkowski et al., 2021)
- Essential use (e.g., Cousins et al., 2019)

Grouping

	Individual approaches*	PFAS grouped	Data requirements	Advantages	Limitations	Note
Approaches based on intrinsic properties	P-sufficient approach	all PFAS	none	easy to understand; simple; for all PFAS	legal basis for its uses under specific regulation may need to be explored	here PFAS with persistent transformation products are treated as persistent, according to the identification of PBT/vPvB substances under REACH
	According to PBT/vPvB	PFAS that are bioaccumulative	bioaccumulation potential	consistent with existing PBT (and vPvB) paradigms; expandable to a larger range of PFAS	limited to long-chain PFCAs and PFSAs now; data intensive; focus on humans/fauna; few PFAS-applicable models	in silico and non-target tools are being developed
	According to PMT/vPvM	PFAS that are mobile in water	Water solubility, K_{OW} or K_{OC}	easy to understand; addresses the concern of possible drinking water contamination	no commonly agreed criteria; limited data availability	UBA proposed criteria for PMT & vPvM substances under REACH
	Polymers of low concern (PLC)	some fluoropolymers	polymer composition, molecular weight, leachable residuals, reactive groups, particle size, stability	commonly agreed criteria by OECD countries exist	criteria biased to the use phase; may not consider exposure during production & after end of life; different implementations of the OECD criteria in different countries	
Approaches that inform risk assessment	Arrowhead approach	specific PFAA(s) + precursors	degradation schemes	addresses all exposure sources to specific PFAA(s); potential link to TOP assay	TOP assay not standardised; TOP assay simulates degradation poorly	
	Total organofluorine approach	extractable or adsorbable PFAS	none	relatively fast and cheap measurements; can be used to screen samples to determine if low or high levels of PFAS may present	high uncertainty for risk assessment as unknown which PFAS are represented; inclusion of organofluorine compounds other than PFAS; quantification limits	may be enforced using EOF/AOF measurements
	Simple additive toxicity approach	from 2 to 20 PFAS, primarily PFAAs (under current practice)	toxicity	based on cumulative risk assessment; easily enforceable using target analysis; simple and protective	no common procedure to determine the scopes & guideline values; limited to PFAS for which analytical methods & standards available; assumes same endpoints & kinetics; many PFAS neglected	
	Relative potency factor approach	multiple PFAAs	toxicity (including potency), toxicokinetics	cumulative risk assessment approach that accounts for differences in toxicokinetics & toxic potencies	limited to increasing liver size and to PFAAs now, while other endpoint(s) may be more important; resource & data intensive	high throughput testing methods being explored for potential expansion of the scope
	Grouping only PFAS with similar adverse effects, mode/mechanism of action and toxicokinetics	limited PFAAs	toxicity, modes/ mechanisms of action, toxicokinetics	cumulative risk assessment that is scientifically stringent	resource & data very intensive; variabilities of these properties across PFAS not well understood	

(Cousins et al, 2020)

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Grouping – intrinsic properties

i) P-sufficient

ii) PBT/ vPVB

iii) PMT/vPvM

iv) PLC-status

Approaches based on intrinsic properties

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(Cousins et al, 2020)

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Grouping – risk assessment

i) Arrowhead approach (e.g., with TOP for presurcors)

ii) Total organofluorine

iii) Simple additive toxicity

iv) Relative potency (TEF)

v) Same mode of action and toxikokinetics

Approaches that inform risk assessment

Arrowhead approach	specific PFAA(s) + precursors	degradation schemes	addresses all exposure sources to specific PFAA(s); potential link to TOP assay	TOP assay not standardised; TOP assay simulates degradation poorly	
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(Cousins et al, 2020)

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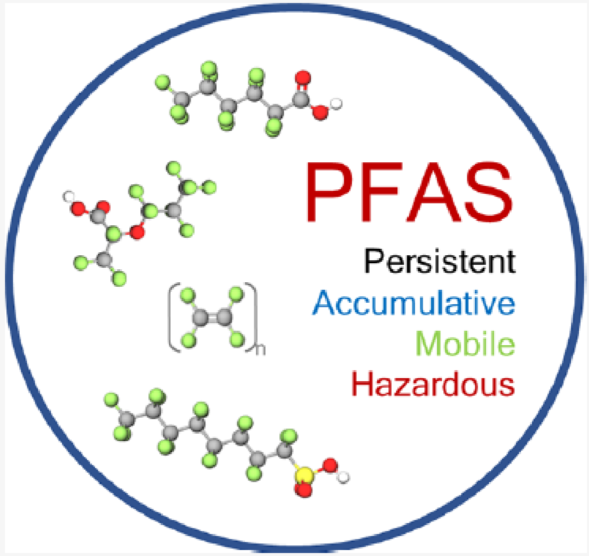
Scientific Basis for Managing PFAS as a Chemical Class

Carol F. Kwiatkowski,* David Q. Andrews, Linda S. Birnbaum, Thomas A. Bruton, Jamie C. DeWitt, Detlef R. U. Knappe, Maricel V. Maffini, Mark F. Miller, Katherine E. Pelch, Anna Reade, Anna Soehl, Xenia Trier, Marta Venier, Charlotte C. Wagner, Zhanyun Wang, and Arlene Blum

Cite This: https://dx.doi.org/10.1021/acs.estlett.0c00255 Read Online

ABSTRACT: This commentary presents a scientific basis for managing as one chemical class the thousands of chemicals known as PFAS (per- and polyfluoroalkyl substances). The class includes perfluoroalkyl acids, perfluoroalkylether acids, and their precursors; fluoropolymers and perfluoropolyethers; and other PFAS. The basis for the class approach is presented in relation to their physicochemical, environmental, and toxicological properties. Specifically, the high persistence, accumulation potential, and/or hazards (known and potential) of PFAS studied to date warrant treating all PFAS as a single class. Examples are provided of how some PFAS are being regulated and how some businesses are avoiding all PFAS in their products and purchasing decisions. We conclude with options for how governments and industry can apply the class-based approach, emphasizing the importance of eliminating non-essential uses of PFAS, and further developing safer alternatives and methods to remove existing PFAS from the environment.



(Kwiatkowski et al, 2021)

Environmental Science Processes & Impacts

CRITICAL REVIEW

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Cite this: DOI: 10.1039/c9em00163h

The concept of essential use for determining when uses of PFASs can be phased out

Ian T. Cousins,†*[a] Gretta Goldenman,[b] Dorte Herzke,[c] Rainer Lohmann,[d] Mark Miller,[e] Carla A. Ng,[f] Sharyle Patton,[g] Martin Scheringer,[h] Xenia Trier,[i] Lena Vierke,[j] Zhanyun Wang[k] and Jamie C. DeWitt[l]

Based on these definitions, how many use categories can we define for PFAS?

Based on the Montreal Protocol, which defined the concept of essential use for chlorofluorocarbons (CFCs).

- An essential use is a use necessary for health or safety or for the functioning of society.
- An essential use is a use for which there are no available technically and economically feasible alternatives.

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Essential use concept for PFAS

Table 1 Three essentiality categories to aid the phase out of non-essential uses of chemicals of concern, exemplified with PFAS uses

Category	Definition	PFAS examples
(1) "Non-essential"	Uses that are not essential for health and safety, and the functioning of society. The use of substances is driven primarily by market opportunity	Dental floss, water-repellent surfer shorts, ski waxes
(2) "Substitutable"	Uses that have come to be regarded as essential because they perform important functions, but where alternatives to the substances have now been developed that have equivalent functionality and adequate performance, which makes those uses of the substances no longer essential	Most uses of AFFFs, certain water-resistant textiles
(3) "Essential"	Uses considered essential because they are necessary for health or safety or other highly important purposes and for which alternatives are not yet established[a]	Certain medical devices, occupational protective clothing

[a] This essentiality should not be considered permanent; rather, a constant pressure is needed to search for alternatives in order to move these uses into category 2 above.

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Table from: Cousins et al. 2019. Environmental Science: Processes & Impacts. DOI: 10.1039/c9em00163h

Some final thoughts

- STEEP renewal..☺
- Marine biota as good sentinels for persistent, bioaccumulative PFAS
- Beyond drinking water – with passive sampling
  - in-house products containing PFAS ("near field")
  - Foodweb exposure to PFAS ("far field")
- Too many PFASs… and (un)known (un)knowns)
  - Reason to consider PFAS as group, and use total PFAS/EOF/TOF
  - Can Essential use considerations help reduce exposure?

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Thanks to

- NIEHS, of course
- RI C-AIM for HPLC-MS/MS;
- RI STAC and SERDP for passive sampling tube work
- Partners/collaborators
- Faroe Islands

Deildin fyri Arbeiðs- og Almannaheilsu

Denmark (lab support)

Syddansk Universitet

SDU

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Department of Environmental Health

SILENT SPRING INSTITUTE
Researching the Environment and Women's Health

NIH National Institute of Environmental Health Sciences
Superfund Research Program

STEEP is funded under award number P42ES027706.
More information about STEEP is available at: www.uri.edu/steep/

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Questions?

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