

Perfluoroalkyl Acids (PFAAs) in Plasma of the West Indian Manatee (*Trichechus manatus*)

6th Florida Marine Mammal Conference
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Hollings Marine Laboratory, Charleston, SC



Background

PFAA Exposure

Health Metric



- **National Metrology Institute**
- **Mission ...promote U.S. innovation and industrial competitiveness by **advancing measurement science, standards, and technology****

Hollings Marine Laboratory Improve environmental measurements

- Marine animal & human health
- Pollution
- Hazardous algal blooms
- Aquaculture
- Exposure science



My Research

Pursuant of innovative analytical strategies (mass spectrometry) for investigating the impact of the environment on wildlife and humans

- 70-90% of chronic disease mortality is from environmental influence
- Adapt exposure model (internal \leftrightarrow external measures \leftrightarrow health)

Chemical Strategies

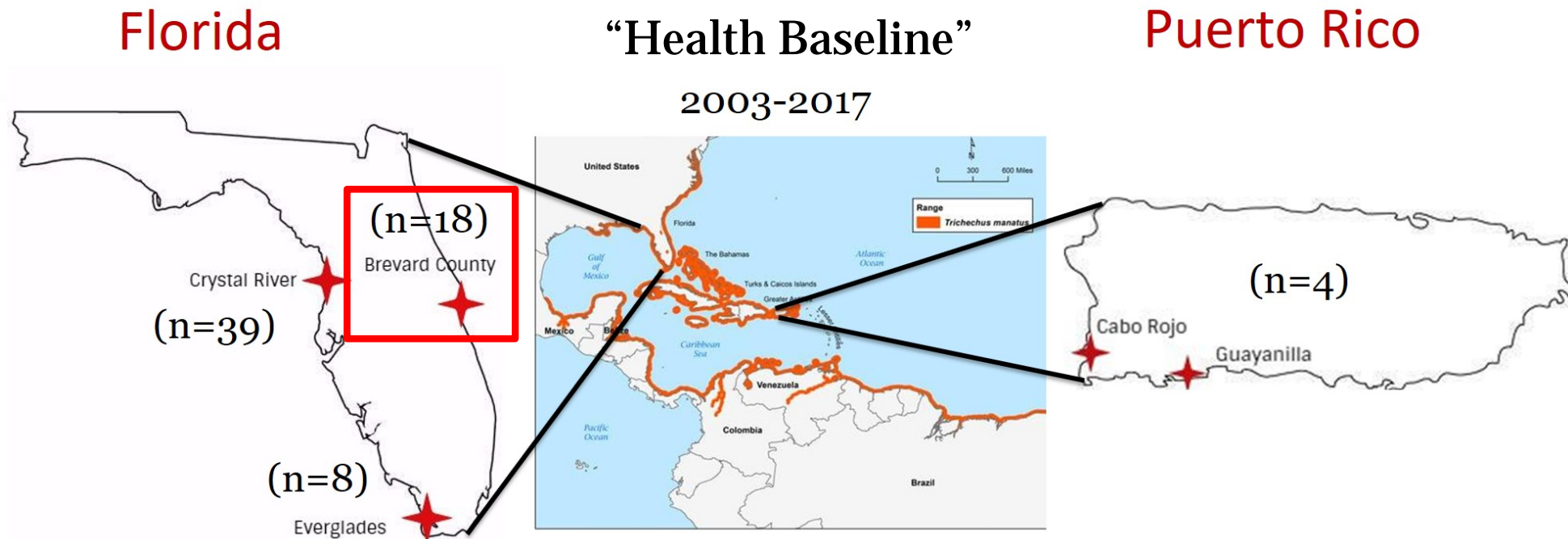
Targeted	Targeted	Untargeted	Species	Matrices
PFAAs	Hormones	Lipidomics	Manatee	Plasma
PAHs	Eicosanoids	Metabolomics	Dolphin	Tissues
OCs/BPA	Bile Acids	Proteomics	Various Fish	Skin
Trace Metals	Vitamins	Exposomics	Birds	DBS
Phthalates	Fatty Acids	Toxins	Crocodilians	Urine

Manatee Project

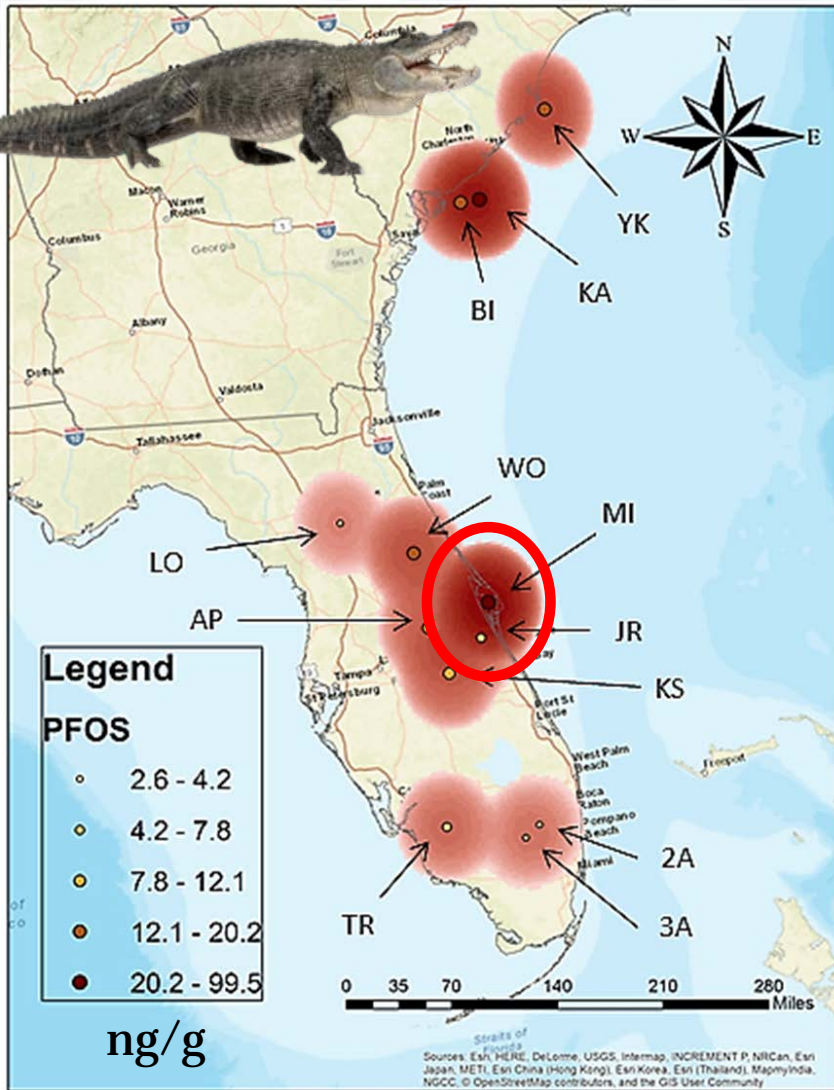
- Establish collaborations -> get access to samples -> pilot studies
- Wildlife ‘sentinels’ can be excellent models for assessing exposure



Photo from: Robert Bonde,
USGS Sirenia Project



Perfluoroalkyl Acids in Brevard County

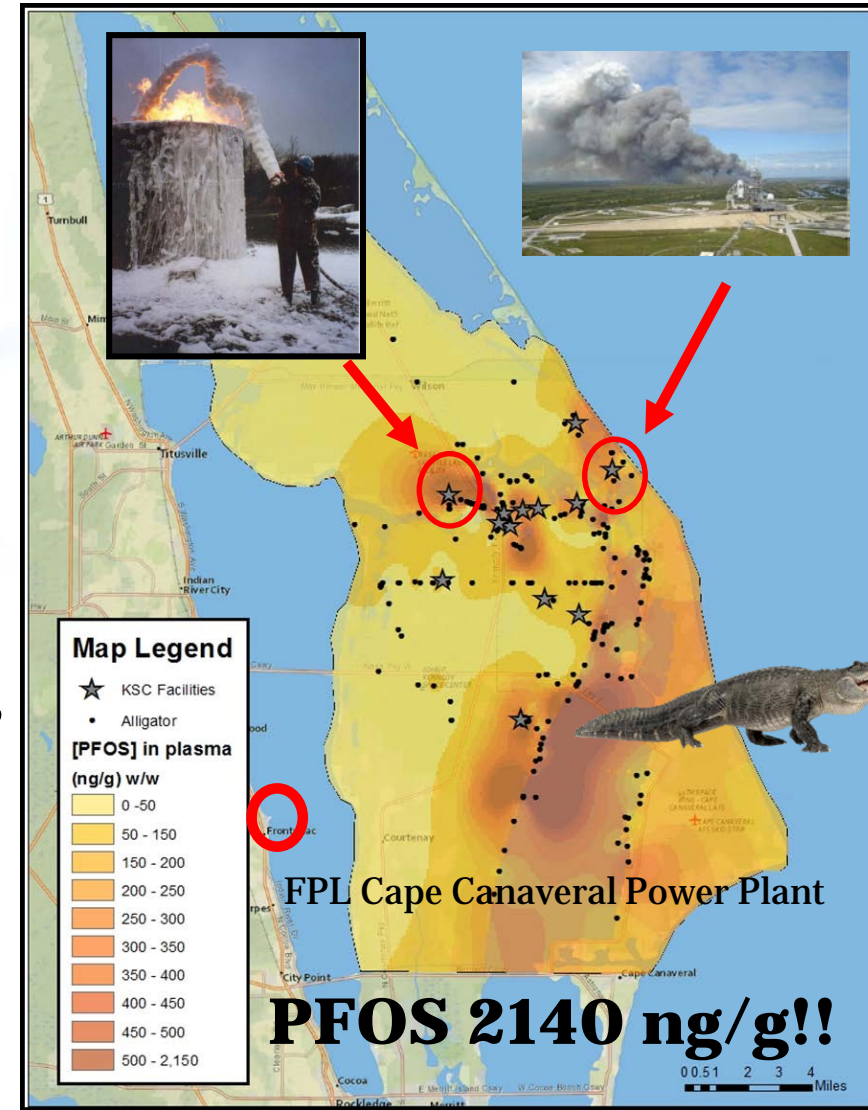


Environ Toxicol Chem. 2017;36(4):917-925

PFAA Burden in American Alligator at MINWR



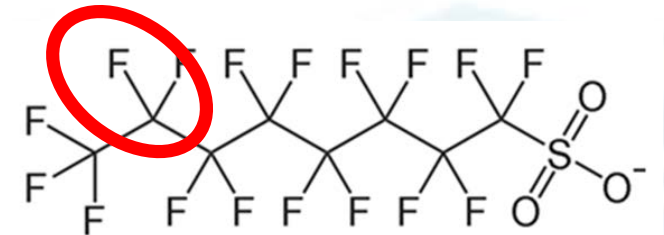
PFAA Burden in Manatees??



Chemosphere. 2017 Jan;166:72-79

What are Perfluoroalkyl acids PFAAs?

- High chemical and thermal stability
- Various uses/mechanisms enter environment
- Bioaccumulate, ubiquitous despite stopped production
- High publicity



Perfluorooctanesulfonic acid (PFOS)



Environmental Topics

Laws & Regulations

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Ground Water and Drinking Water

Ground Water and Drinking Water Home

Basic Information

Private Wells

Consumer Confidence Reports

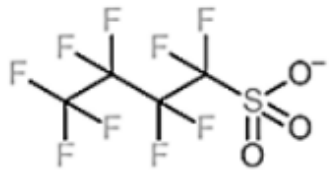
Drinking Water Health Advisories for PFOA and PFOS

Health Advisories

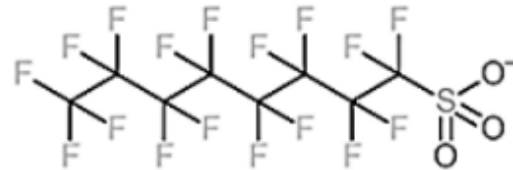
Additional PFOA and PFOS

PFAAs Measured

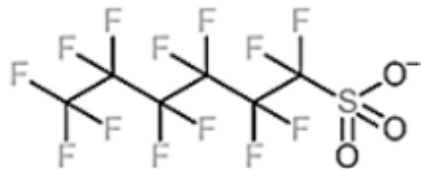
Perfluorinated Sulfonic Acids & Precursors



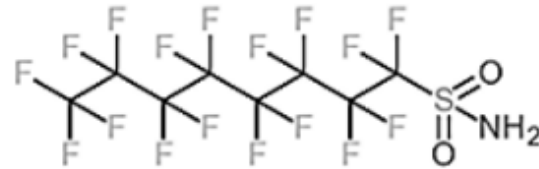
PFBS



PFOS

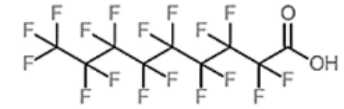


PFHxS

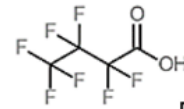


PFOSA

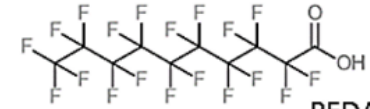
Perfluorinated Carboxylic Acids



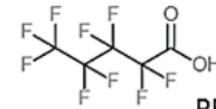
PFNA



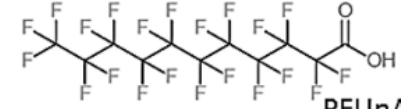
PFBA



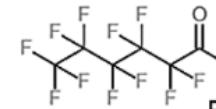
PFDA



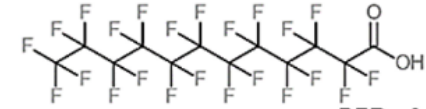
PFPeA



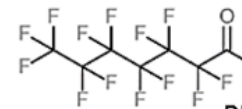
PFUnA



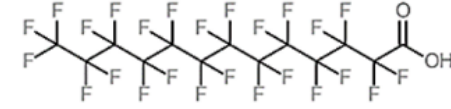
PFHxA



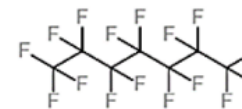
PFDoA



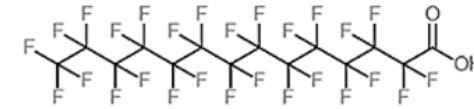
PFHpA



PFTriA



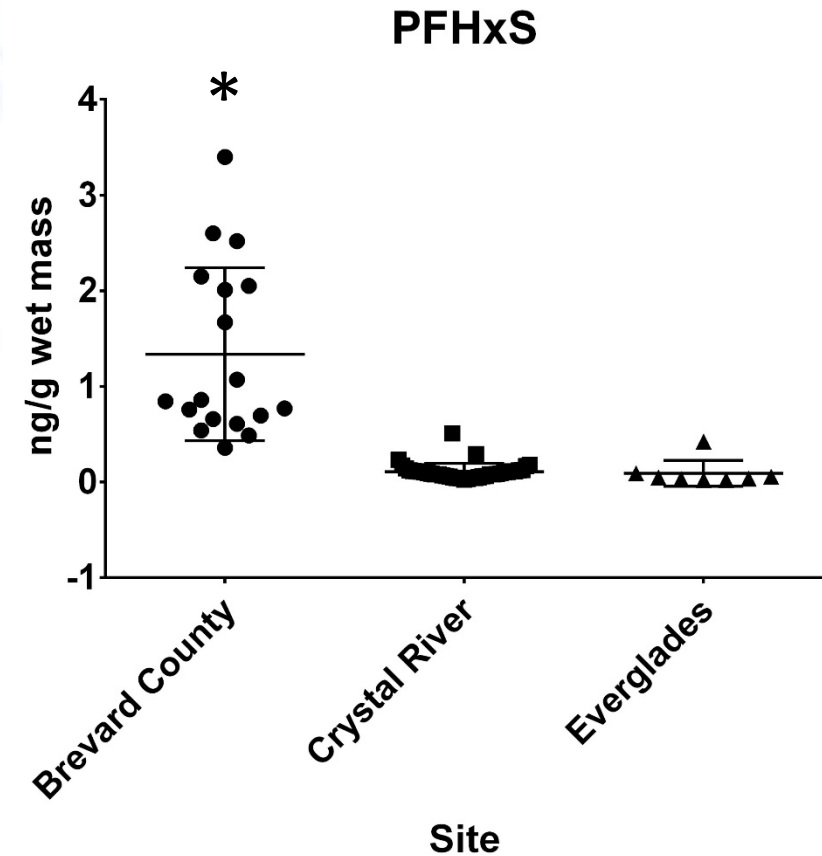
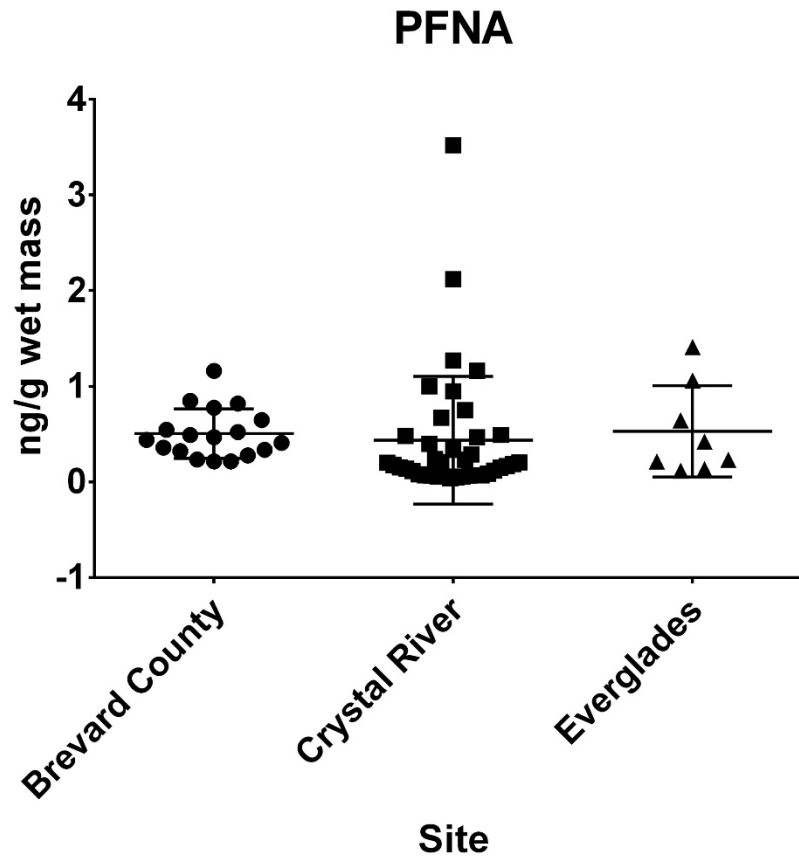
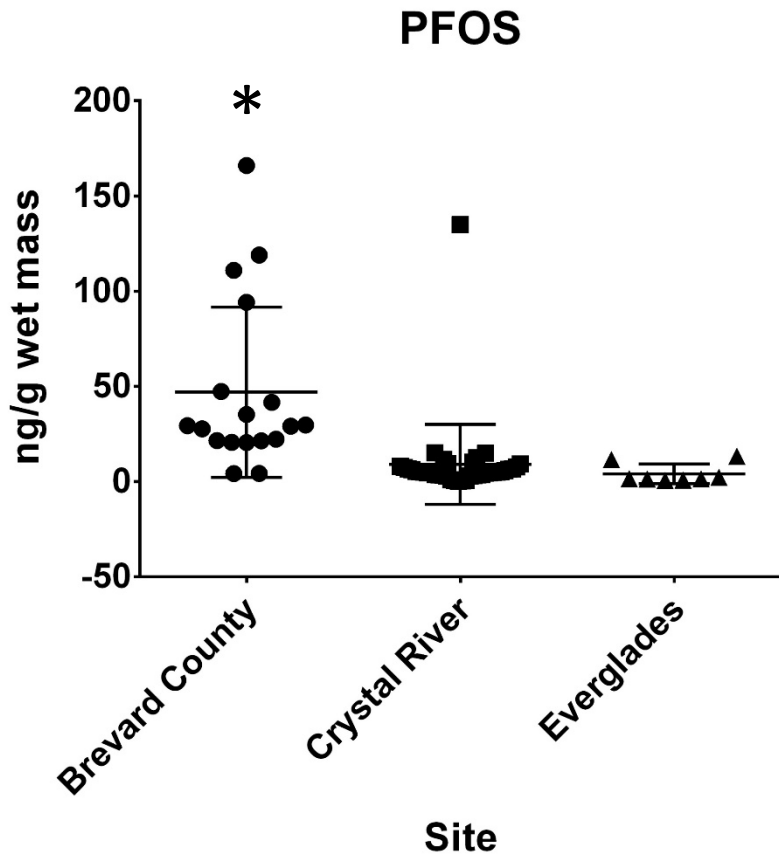
PFOA



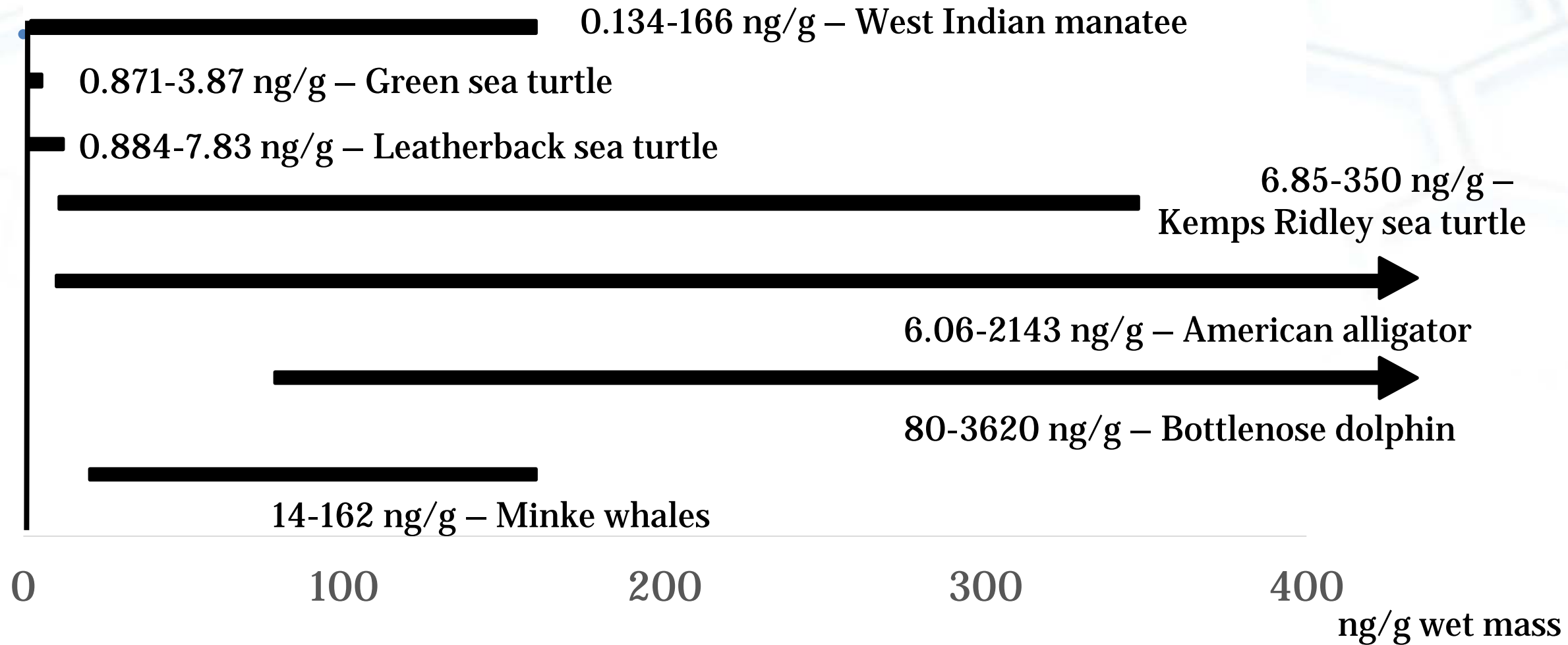
PFTA

PFAA Burden

- Seven PFAAs detected in manatees
- PFOS and PFNA 100%

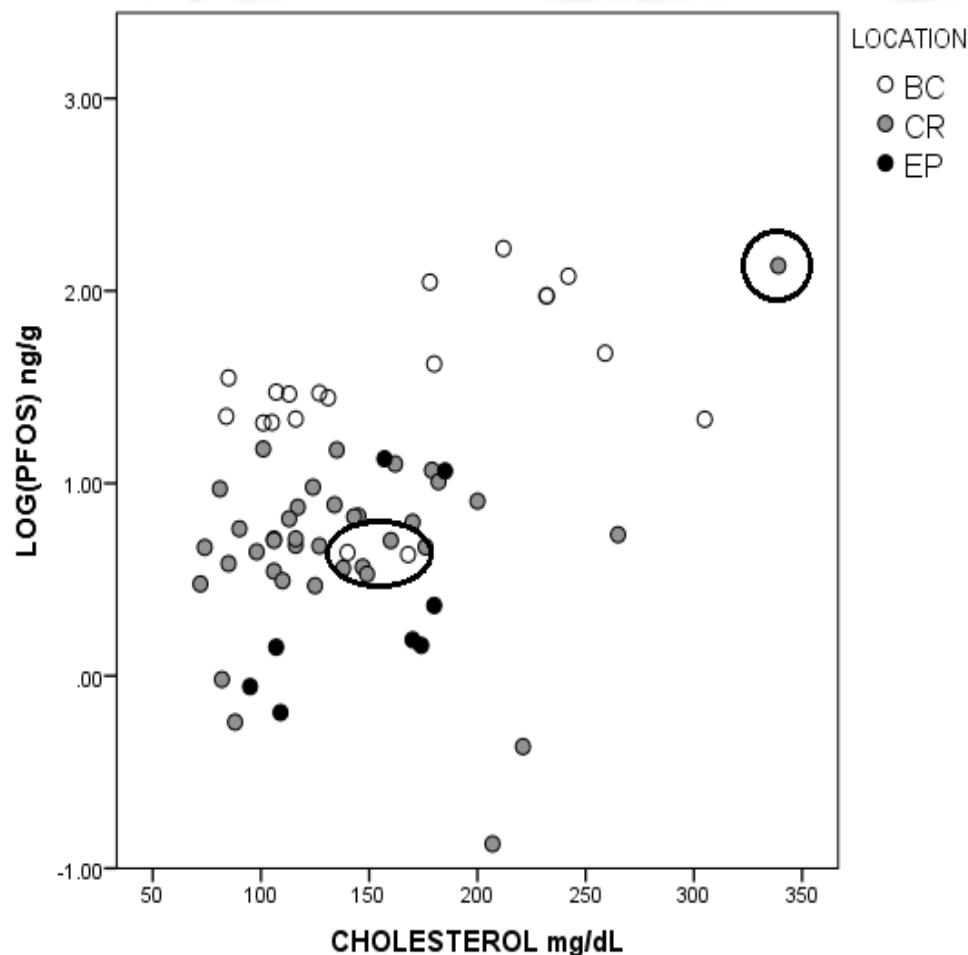


PFAA Burden (ex., PFOS Range)



Biomarkers of PFAA Exposure/Health Effects?

Cholesterol levels in manatees



Association between Plasma PFOA and PFOS Levels and Total Cholesterol in a Middle-Aged Danish Population

Exposure to Polyfluoroalkyl Chemicals and Cholesterol, Body Weight, and Insulin Resistance in the General U.S. Population

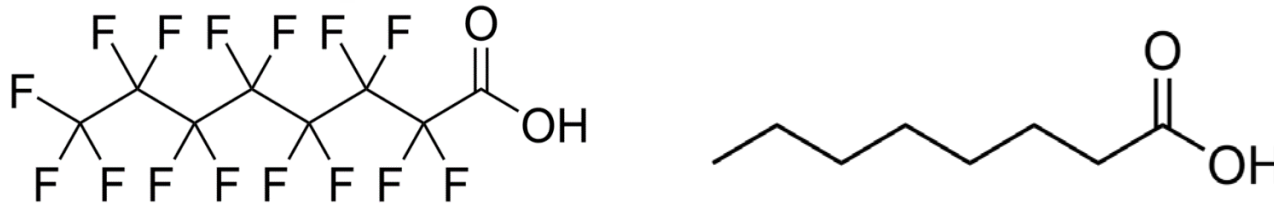
Associations between PFOA, PFOS and changes in the expression of genes involved in cholesterol metabolism in humans ☆

Lipids and PFAAs: Connection?

- Endocrine Disrupting Chemicals, MDCs, and obesogens

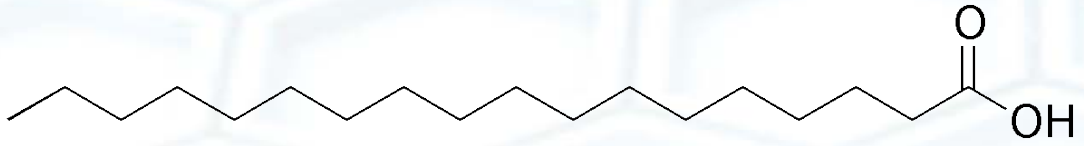


- Peroxisome proliferator-activated receptor (PPAR, α and γ)

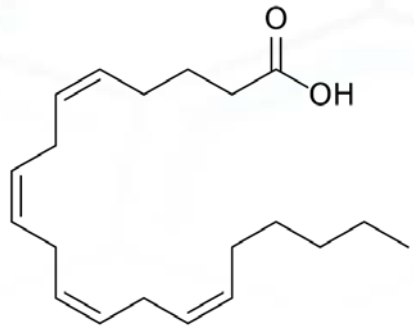


- Several exposure health outcomes (lab-based models)

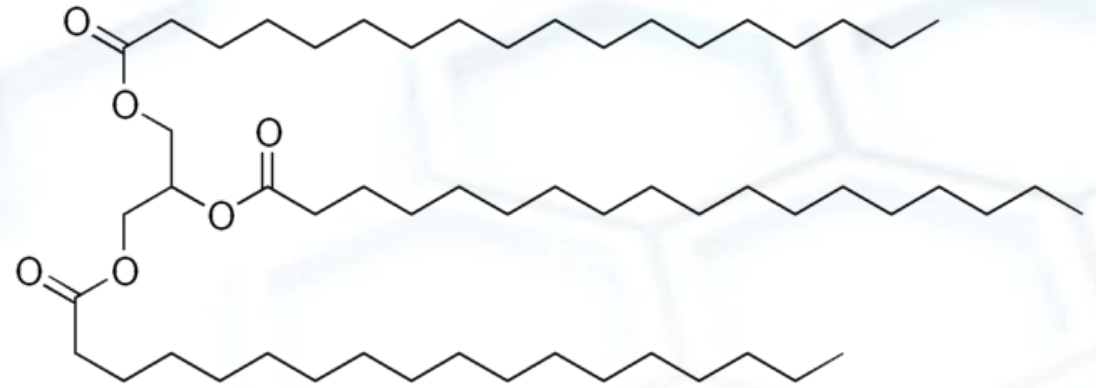
Utility of the lipidome



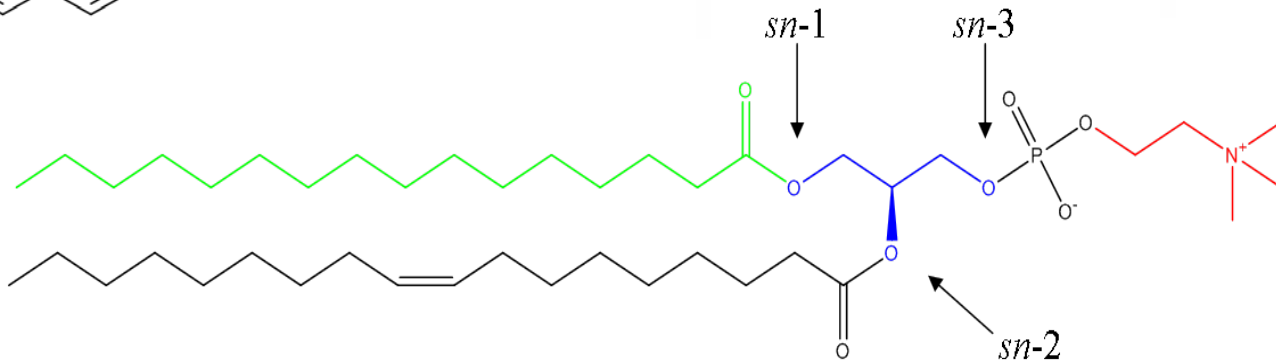
Stearic acid (18:0)



**Arachidonic acid
(20:4)**



Tristearin (18:0/18:0/18:0)



Phosphatidylcholine (16:0/18:1)

8 categories

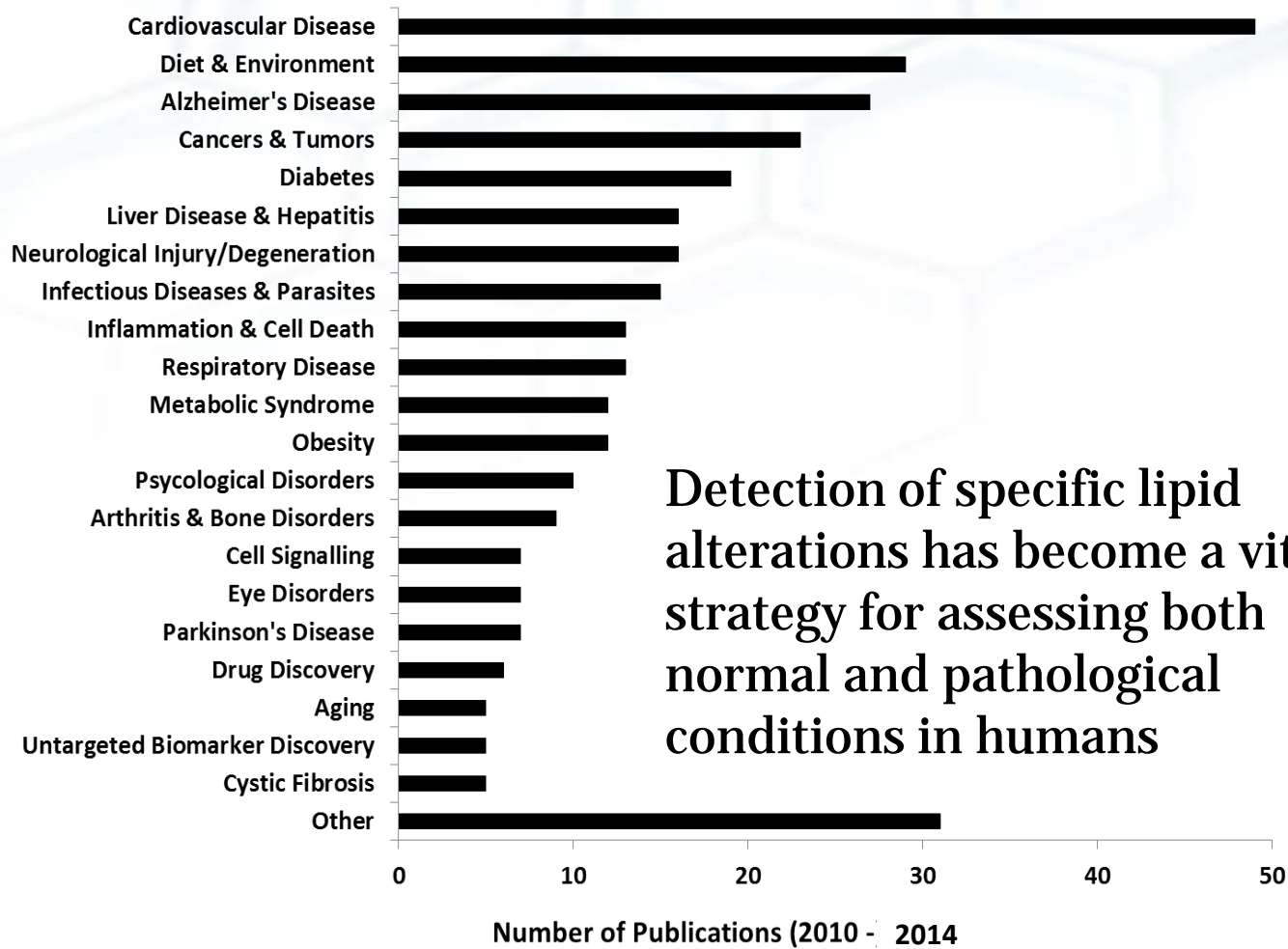
60 classes

254 subclasses

37,000 lipids in Lipid Maps

Utility of lipidomics?

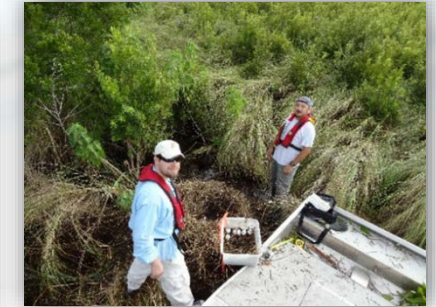
Human <-> Environment



Detection of specific lipid alterations has become a vital strategy for assessing both normal and pathological conditions in humans



Exposure



Development



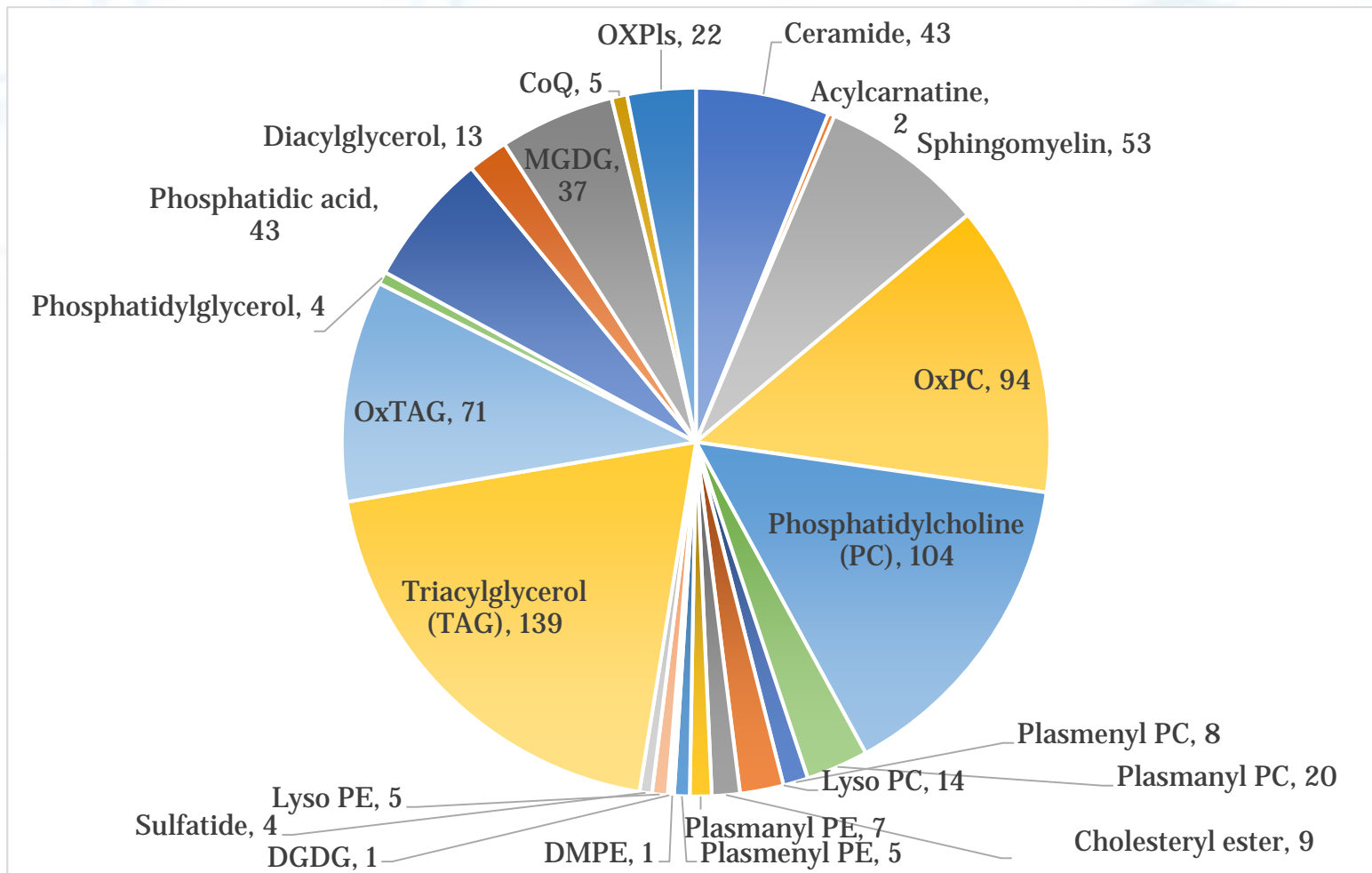
HABs



Health

Manatee Plasma Lipidome

- Establish baseline
- 2,136 features (25 μ L)
- 224 confirmed lipids
- 704 in progress lipids
- What do with profile?



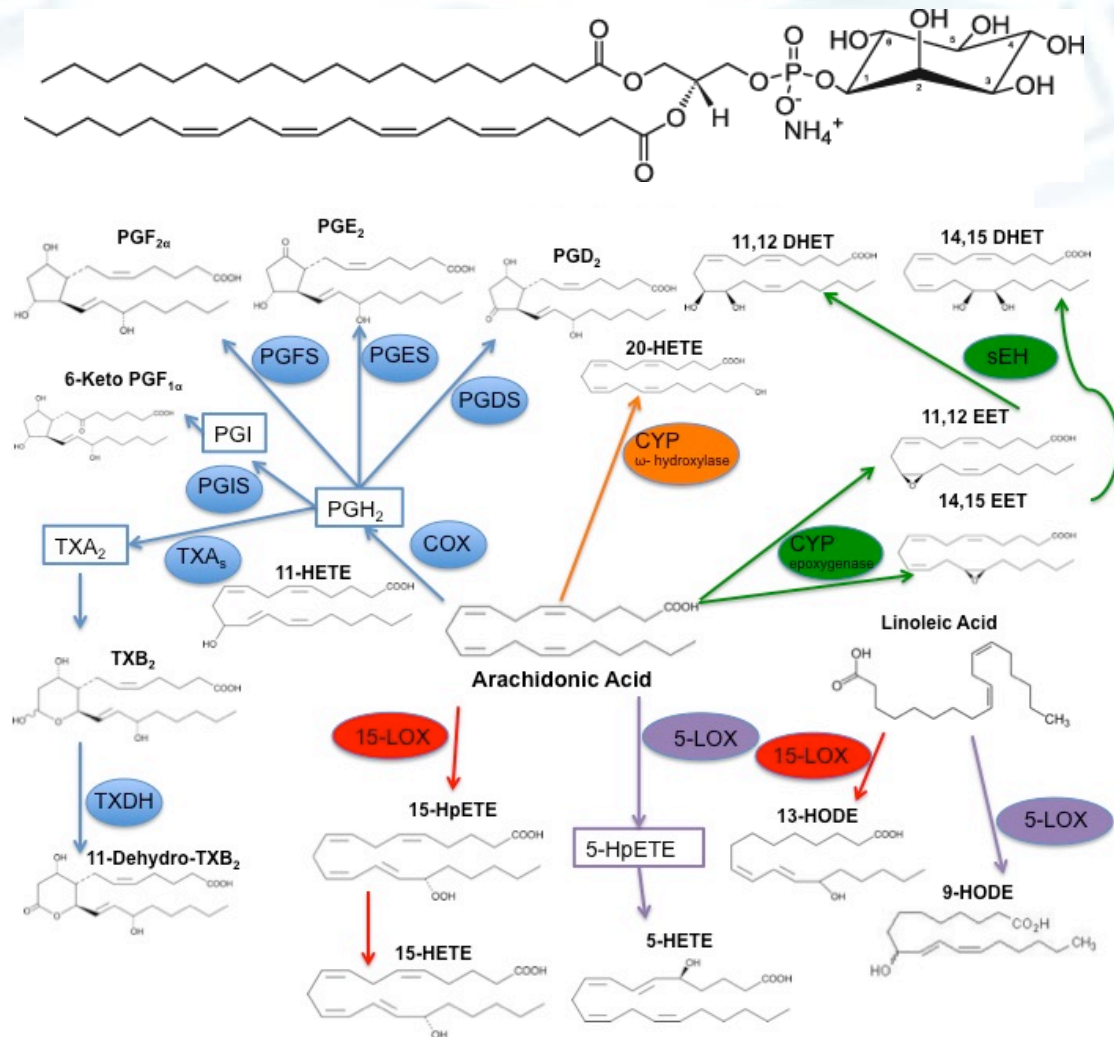
Number of Lipid Species

'Pilot' Lipidomic Results

- *Brevard County Control (n=12)
 - *Brevard County UME (n=22)
 - *Brevard County CSS (n=21)
 - Crystal River Control (n=39)
 - Everglades Control (n=8)
 - *Margaret Hunter, USGS
- UME

CSS

Diet & PFAA



Summary

- Determine lipid signatures/pathways expressed with cohorts
- Lipids are only one snapshot -> metabolomics and proteomics
- Translation to other wildlife species, humans

Acknowledgements

- Kady Palmer, REU, Eckerd College
- Jackie Bangma, MUSC
- USGS (Robert Bonde, Margaret Hunter)
- NIST Lipidomics/Metabolomics Team
- NASA Research Team



NIST

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