## The Fate of Emerging PFOS Pollution in Shellfish and Fish of Galveston Bay



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## a) **PFOS body-burdens in biota**

 Our previous work after the Deer Park fire and AFFFs spill (March 2019) established PFOS as a prominent PFAS in biota.



Dr. Rayna Nolen

- Here, we monitored background levels of PFOS in biota (2021-2022) and identified biomarkers of exposure.
- Fish from Galveston Bay:
  - Gafftopsail catfish (n=44)
  - Red drum (n=41)
  - Spotted seatrout (n=37)
- Fish and dolphins from the Gulf of Mexico:
  - Red snapper (n=10), Yellowfin tuna (n=26), Bottlenose dolphins (n=10)





- PFOS Levels were highest in dolphins (liver and blubber).
- Galveston Bay fish had higher levels than pelagic fish.



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A seafood safety risk assessment showed all fish to be in the unrestricted meal consumption category (i.e., no concern for harm).



- For Galveston Bay, our recent estimates were lower than those measured following the Deer Park fire (March 2019).
- Which included an advisory of 1–2 meals/week for gafftopsail catfish and red drum, and 2 meals /week for spotted seatrout, to be protective for minimizing human exposure to PFOS.



## b) **PFOS exposure biomarker discovery**

• A survey of 67 toxicological studies with fish, mammals, cell lines, etc., showed wide-ranging biological effects.



- We used a novel systems toxicological approach to identify the diagnostic biomarkers of PFOS exposure and effects in fish.
- A genome-scale stoichiometric metabolic model of zebrafish was used to integrate metabolomics and transcriptomics datasets.

(Wang et al., 2021) 8,344 metabolites 12,909 reactions 2,714 genes



 Simulations of impacted reactions and associated metabolic subsystems indicated effects on the carnitine shuttle and fatty acid oxidation.



#### The carnitine shuttle and fatty acid oxidation are related metabolic processes and likely targets for PFOS' dyslipidemia effects.



## c) **Biomarker verification**

The levels of carnitine and fatty acids in liver tissue was measured by demarcating samples into Low (<25<sup>th</sup> percentile) vs. High (>75<sup>th</sup> percentile) PFOS body-burdens.



 We identified overall significant and positive correlations between PFOS and carnitine levels.

# Spearman's Rank Correlation of PFOS vs. Carnitine (*p* ≤ 0.05)

	Total Carnitine		Free Carnitine	
	rho	p-value	rho	p-value
Galveston Bay	0.16	7.45E-02*	0.08	0.37
Gulf of Mexico	0.71	2.19E-05**	0.69	3.77E-05**
Gulf of Mexico (fish only)	0.47	0.02**	0.40	0.05*

- The strongest correspondence between PFOS and carnitine levels was for dolphins.
- Despite also measuring fatty acids as potential biomarkers, a co-factor (i.e., carnitine) appeared to be a more representative biomarker of environmental PFOS exposure.

A) Galveston Bay



#### B) Gulf of Mexico

## **Conclusions:**

- Elevated PFOS exposure of aquatic biota is likely following AFFFs spills into the bay.
- A human risk assessment and sea food consumption advisory can be performed based upon edible body-burden analysis in biota.
- A metabolic co-factor (carnitine) appears to be a more modal biomarker of exposure.
- Consequences of sub-lethal and chronic PFOS exposure on organismal fitness remain to be determined.

## **Acknowledgements/Funding**

Co-P.I.'s (TAMUG): Dr. Antonietta Quigg Dr. Karl Kaiser Dr. Lene Petersen

Collaborators (DISL) Dr. Ruth Carmichael Dr. Jennifer Bloodgood Ms. Mackenzie Russell

PhD Candidate (TAMUG): Dr. Rayna Nolen (8/2023)









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