UNIVERSITY OF MIAMI ROSENSTIEL SCHOOL of MARINE & ATMOSPHERIC SCIENCE



Introduction

- *Deepwater Horizon* (*DWH*) oil spill released over 800 million liters of oil into the Gulf of Mexico in 2010.¹
- Polycyclic aromatic hydrocarbons (PAHs) from oil impair the glucocorticoid stress response in teleost fishes.²
- Short-term exposure to PAHs = increase in cortisol levels.
- Long-term exposure to PAHs = decrease in cortisol levels and pituitary atrophy.
- Atrophied pituitary corticotrophs display a reduced cell area and greater intercellular.³

Objective and Hypothesis

- To quantify pituitary surface area and perimeters of Gulf toadfish exposed to DWH oil for 28-days under control (not detectable) or high $(3.53 \pm 0.26 \mu g)$ PAH_{50}/L) concentrations.
- It is hypothesized that pituitaries exposed to DWH oil would have a reduced surface area and/or perimeter than control pituitaries.



Extracted pituitaries embedded in paraffin blocks.⁴

Methods







Light microscope to analyze pituitary surface area and perimeter.



Potential Impacts of a 28-Day Exposure to Deepwater Horizon Oil on the Gulf Toadfish, Opsanus beta, Pituitary Gland

Shannon Dickey, Anastasiya Plotnikova, M. Danielle McDonald

Rosenstiel School of Marine and Atmospheric Science, University of Miami, FL ShannonLongvalley@gmail.com; Anastasiya.plotnikova@rsmas.miami.edu; Dmcdonald@rsmas.Miami.edu

Results





Fig. 1: (A) A cross-section of a Gulf toadfish pituitary exposed to control conditions and a (B) cross-section of a Gulf toadfish pituitary exposed to high PAH concentrations. Scale bar, 0.1 millimeters, and magnification of 10X.



Fig. 2. Gulf toadfish pituitary surface area after control or high PAH exposure, N= 7. Values are means; error bars denote standard error of the mean, **P* < 0.05 compared to control.

Fig. 3. There is no relationship between sex and pituitary surface area (females N= 9 and males N = 5). Values are means; error bars denote standard error of the mean.





Fig. 4. Gulf toadfish pituitary perimeter after control or high exposure, N = 7. Values are means; error bars denote standard error of the mean.

Fig. 5. There is no relationship between sex and pituitary perimeter (females, N= 9 and males, N = 5). Values are means; error bars denote standard error of the mean.









- PAH exposure may disrupt thyroid hormone
- Pituitaries can become hyperactive to compensate for thyrotropin deficiency.
- Hyperthyroidism is linked to reduced cortisol levels in common carp (*Cyprinus carpio*).⁸
- Hyperplasia and hypertrophy may also play a role in pituitary enlargement.⁹
- Pituitary growth may be biologically important for the relief, adaptation, and acclimation to stressful environments.¹⁰

1] Barron, M. G. (2012). Ecological impacts of the Deepwater Horizon oil spill: implications for immunotoxicity. Toxicologic pathology, 40(2), 315-320 2] Reddam, A., Mager, E. M., Grosell, M., & McDonald, M. D. (2017). The impact of acute PAH exposure on the toadfish glucocorticoid stress response. Aquatic toxicology, 192, 89-96. 3] Hontela, A. L. I. C. E., Daniel, C. L. A. U. D. E., & Rasmussen, J. B. (1997). Structural and functional impairment of the hypothalamo-pituitary-interrenal axis in fish exposed to bleached kraf mill effluent in the St Maurice River, Quebec. Ecotoxicology, 6(1), 1-12. 4] Hontela, A., Rasmussen, J. B., Audet, C., & Chevalier, G. (1992). Impaired cortisol stress response in fish from environments polluted by PAHs, PCBs, and mercury. Archives of Environmental Contamination and toxicology, 22(3), 278-283 5] Abcam. (2019). Sectioning of paraffin-embedded tissue. [6] Abcam. (2019). IHC deparaffinization protocol 7] Brown, S. B., Adams, B. A., Cyr, D. G., & Eales, J. G. (2004). Contaminant effects on the teleost fish thyroid. Environmental Toxicology and Chemistry: An International Journal, 23(7), 16

[8] Geven, E. J., Verkaar, F., Flik, G., & Klaren, P. H. (2006). Experimental hyperthyroidism and central mediators of stress axis and thyroid axis activity in common carp (Cyprinus carpio L. Journal of molecular endocrinology, 37(3), 443-452 [9] Stolk, A. (1955). Changes in the pituitary gland of the viviparous cyprinodonts Xiphophorus helleri Heckel and Lebistes reticulatus (Peters) after nitrofurazone treatment. Proceedings Koninklijke nederlandse akademie van wetenschappen, 58, 61-72. [10] Peter, V. S., Joshua, E. K., Bonga, S. E. W., & Peter, M. S. (2007). Metabolic and thyroidal response in air-breathing perch (Anabas testudineus) to water-borne kerosene. General and Comparative Endocrinology, 152(2-3), 198-205.



Discussion

• Hypothesis was not supported.

synthesis and promote pituitary enlargement.⁷

Thyrotrophs **Thyroid-Stimulating Hormones** Activation of Thyroid Pituitary Growth

Future Directions

 Compare cortisol secretion between PAH-related pituitary atrophy and enlargement under combinations of environmental stressors. • Ecological consequences of *DWH* oil spill on population dynamics with emphasis on recruitment rates of fish species.

Acknowledgments

My sincere thanks to Dr. McDonald for her expertise and guidance throughout this project. As well, to the members of the RSMAS Toadfish Lab for their support and willingness to lend a hand always.

References