# Polycyclic Aromatic Hydrocarbon (PAH) Analysis of Red Snapper, *Lutjanus campechanus*, Muscle Tissue after the Deepwater Horizon Oil Spill

# Hidrocarburos Aromáticos Policíclicos (PAH) Análisis de Pargo Rojo, *Lutjanus campechanus*, Tejido Muscular de Después del Derrame de Petróleo de Deepwater Horizon

# Hydrocarbures Aromatiques Polycycliques (HAP) Analyse de Vivaneau, *Lutjanus campechanus*, Tissus Musculaire Après le Déversement Deepwater Horizon

CLAIRE ROBERTS* and STEPHEN SZEDLMAYER

*Auburn University, 8300 State Highway 104, Fairhope, Alabama 36532 USA. *cer0017@auburn.edu.*

**EXTENDED ABSTRACT**

## Introduction

The Deepwater Horizon oil spill occurred on 20 April 2010, which led to approximately 4.9 million barrels of oil entering the northern Gulf of Mexico. Polycyclic Aromatic Hydrocarbons (PAHs) are a component of petroleum and are typically the component of concern due to their toxic, mutagenic, and potentially carcinogenic properties to aquatic organisms (Rose et al. 2012). There are a number of ways aquatic organisms can be exposed to PAHs, including through contaminated water, sediments, and food resources. Red snapper, *Lutjanus campechanus,* are an economically important commercial and recreational species in the Gulf of Mexico, and were potentially exposed to PAHs from this oil spill.

Fish, unlike most invertebrates, have the ability to metabolize PAHs within two to three days following exposure (Pointet and Milliet 2000). This characteristic makes them less vulnerable to the toxic effects of oil, unless the exposure is chronic. While the Deepwater Horizon oil spill would be considered an episodic oil exposure, the Gulf of Mexico also has chronic oil influx from several sources, including natural seeps, periodic tanker spills and Mississippi River runoff. The Gulf of Mexico also receives exposure to pyrogenic hydrocarbon sources from burning coal. Because of this characteristic, it's important to address whether the PAHs in our samples stem from petrogenic or pyrogenic sources. It can be difficult to separate out these differences, however several PAH ratios have been proposed which attempt to identify emission sources. For example, high ratio values (> 10 ) of phenanthrene (PHEN): anthracene (ANTH), and low ratio values (< 1) of fluoranthene (FLA): pyrene (PYR), indicate a petrogenic emission source (Ke et al. 2002). Another study used different ratio calculations, ANTH: (ANTH+PHEN) and FLA: (FLA+PYR). For these ratios, values of < 0.1 and < 0.5, indicate a petrogenic source (Tobiszewski and Namiesnik 2012). Thus far all samples are considered post-spill from 02 June 2010 through 2012 and future work will analyze pre-spill samples from May 2010. Additionally, we quantified the frequency of external skin lesions seen in collected fish. Also, if PAHs were identified in red snapper tissues, did they result from petrogenic or pyrogenic emission sources.

## Methods

Sampling sites were randomly selected from artificial reefs in the northern Gulf of Mexico off the coast of Alabama. Red snapper were caught using both hook-and-line and baited trap fishing. These fish were put on ice until reaching the lab for dissection. In the lab, muscle, liver, and gall bladder tissues were taken, weighed, and stored at -10 °C until extraction and analysis. All red snapper were visually inspected for external skin lesions or structural abnormalities. These abnormalities were photographed and recorded. Samples were extracted and analyzed following Sloan et al. (2004). This method is extremely accurate and gives the concentration of each PAH in parts-per-billion (ppb).

## Results and Discussion

The highest total PAH in an individual red snapper muscle tissue was 52 ppb among all samples analyzed from 2010 (n = 123), 2011 (n = 32), and 2012 (n = 448). Significant differences were observed in total (± SE) PAH by year, with 2010 = 4.6 ± 0.5 ppb, 2011 = 7.1 ± 0.6 ppb, and 2012 = 2.5 ± 0.2 ppb (ANOVA: $F_{2,600} = 22.7$, $p < 0.0001$). We have analyzed post-spill tissue samples for eight PAH compounds. The highest PAH concentrations were shown for naphthalene (1.5 ± 0.1 ppb) and fluorene (0.7 ± 0.1 ppb).

Among all tissue samples analyzed, 75.8% had < 5 ppb total PAH (Figure 1). Of the 2,176 red snapper sampled 0.4 % (n = 9) showed lesions. Only a small proportion of our samples had each of the contaminants necessary to examine emission source ratios. For PHEN: ANTH (n = 66) the mean ± SD = 2.58 ± 2.23. For FLA: PYR (n = 134) the mean = 1.40 ± 3.07. Both of these ratios indicated a pyrogenic source rather than a petrogenic source. For the second set of ratios, ANTH: (ANTH+PHEN) the mean ± SD = 0.37 ± 0.18, and FLA: (FLA+PYR) the mean ± SD = 0.45 ± 0.18. Only the FLA: (FLA+PYR) ratio indicated a petrogenic source. While these ratios can give us some information regarding the emission source of hydrocarbons, these results are preliminary and there are confounding variables that still need examination.

We are beginning to analyze pre-spill muscle samples at this time. In addition to muscle tissue, we will be extracting and analyzing red snapper liver samples and sediment samples from reef sites that were potentially exposed to oil from the DWH oil spill.

KEY WORDS: British Petroleum, Macondo blowout, toxicology

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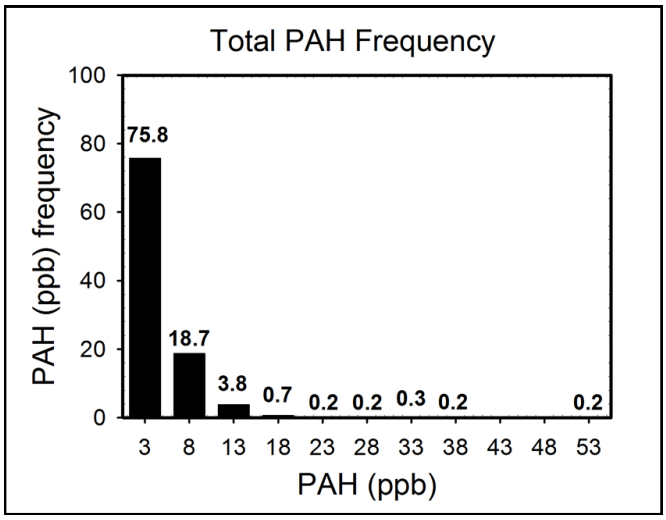


**Figure 1.** Total PAH frequency