Assessment of PCB accumulation in reef fish collected on the Oriskany Reef

Keith Mille[1], Jeff Renchen[1], and Robert Turpin[2]
[1]*Florida Fish and Wildlife Conservation Commission, Division of Marine Fisheries Management, Tallahassee, FL*
[2]*Escambia County Marine Resources Division, Pensacola, FL*

Abstract

The Oriskany Reef, a decommissioned US Navy aircraft carrier, was deployed 23.5 nm southeast of Pensacola at a depth of 212 ft in May 2006. The Navy was permitted by the US Environmental Protection Agency (EPA) to allow an estimated 722 pounds of non-liquid PCBs (distributed in wiring, insulation, paint and gaskets) to remain onboard the vessel when sunk as an artificial reef. Annual reef fish monitoring by FWC and Escambia County is required as a condition of the EPA permit to measure the local accumulation of PCBs in reef fish. Tissue analysis from this monitoring indicated that reef fish species have different accumulation rates of PCBs, most likely influenced by their life history, diet, and location on the vessel. As tissue samples continue to exhibit PCB values greater than the 20-ppb threshold set by the EPA, monitoring of those specific fish species with high PCBs levels will carry on.

Methods

Sampling

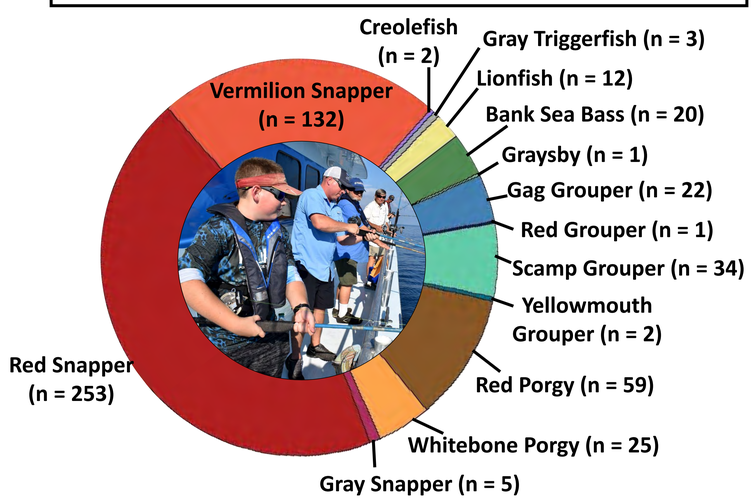
- Targeted legal-sized reef fish on the Oriskany
  - Gear: Fish traps, hook and line, spearing
- Sampled fish at nearby reefs for a baseline
- (2006 to 2010) Collected twice a year
- (2010 to 2019) Collected annually
- Captured fish were frozen and shipped to Texas A&M University for PCB analysis

PCB Analysis

- Skin-on lateral muscle fillets analyzed
- Total PCB measured (209 PCB congeners)
- Percent lipid in tissues measured

Reef Fish PCB Level Assessment

- EPA threshold for an advisory
  - 15 fish samples per year
  - Mean ΣPCB > 20 ppb
- FL DOH threshold for an advisory
  - 8 samples per year
  - Mean ΣPCB > 50 ppb



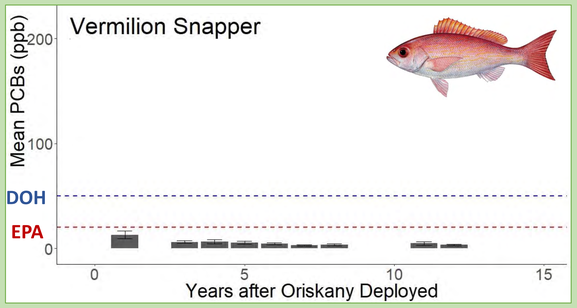
Results

From April 2010 to May 2019, a total of 663 samples have been collected (579 from the Oriskany Reef and 84 from nearby reference reefs). All the fish samples from the nearby reference reefs had PCB levels that were less than the EPA threshold, with an average ΣPCB of 1.59 ppb. There are eight species that had at least 10 total samples, but only four of those had the minimum number of samples in a year to meet the FL DOH sampling requirements. However, there is enough information to evaluate which species may be more susceptible to PCB accumulation.

Oriskany Reef
579 Reef Fish Collected (2006 – 2019)

Low PCB Levels

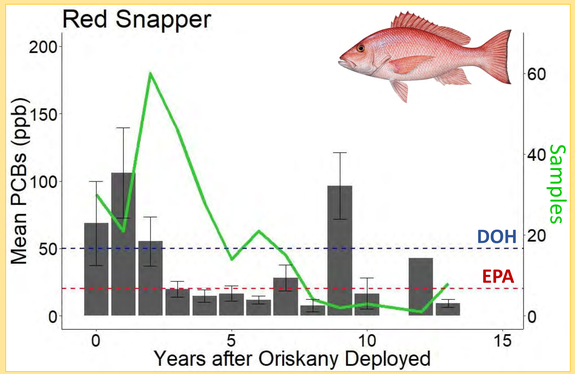
Species	Mean ΣPCB (ppb)	Samples
Vermillion Snapper	**5.0** ± 0.5	132
Gag Grouper	**12.6** ± 3.0	22



Vermillion Snapper and Gag Grouper
- Exhibited consistently low PCB levels
- No advisory needed

Intermediate PCB Levels

Species	Mean ΣPCB (ppb)	Samples
Red Snapper	**40.4** ± 6.6	253
Whitebone Porgy	**49.8** ± 10.7	25
Lionfish	**72.1** ± 46.1	12

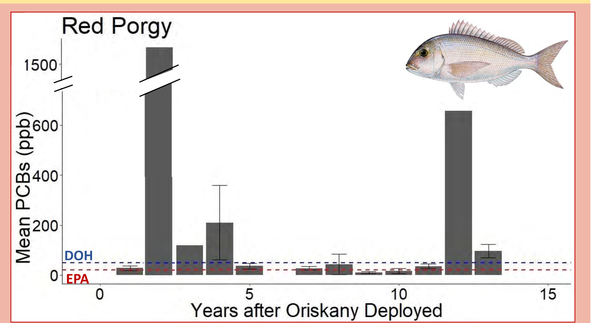


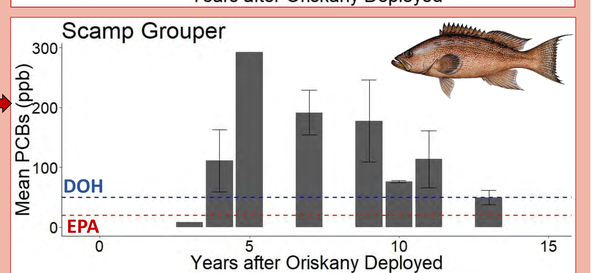
Red Snapper
- High PCB for first 2-3 years
- Declining PCB levels over time
- Declining catch rates over time

Whitebone Porgy and Lionfish
- Low sample size and high variability
- Some samples with high PCB levels

High PCB Levels

Species	Mean ΣPCB (ppb)	Samples
Red Porgy	**179.2** ± 50.0	59
Bank Sea Bass	**92.3** ± 59.1	20
Scamp Grouper	**112.7** ± 18.1	34





Red Porgy
- High variability due to low sample size
- Recent samples (2018-19) exhibit higher PCB levels than previous seven years
- Largest max PCB value among all species

Bank Sea Bass and Scamp Grouper
- Exhibited high PCB levels
- Scamp samples supplemented by spearing
  - 15 of 34 samples (44%)
- FL DOH issued guidelines for consumption
  - Bank Sea Bass: 2 meals/week
  - Scamp Grouper: 1 meal/week

Note: No samples collected in 2020 due to COVID-19 concerns

Mean PCBs for Vermilion Snapper (top), Red Snapper (middle), Red Porgy (bottom), and Scamp (bottom) caught at the Oriskany Reef. The DOH and EPA PCB thresholds are denoted in blue and red respectively.

Discussion

Reef fish PCB Concentrations

Vermillion and Red Snapper were the only species with enough samples in a year to meet the EPA criteria. Red Snapper PCB levels exhibited some variability, but decreased over time to below threshold levels. Modeling this relationship for red snapper estimates that it took around 5.5 years post-sinking for PCB levels to decrease below the 20 ppb threshold. Due to the declining PCB levels in Red Snapper and the consistently low PCB levels in Vermillion Snapper, a fish consumption advisory action was not recommended for either.

The majority of analyzed species had a low number of samples with high PCB variability, so no fish consumption 'advisory' actions could be taken. However, in June 2017 DOH issued 'guidelines' for Bank Seabass (2 meals per week) and Scamp Grouper (1 meal per week). Red Porgy has recently shown higher PCB levels in recent samples and may warrant a similar type of guideline in the near future.

Oriskany Reef as a Fishing Destination

Assessing PCB concentrations is only one component for determining if an consumption advisory should be enacted. CPUE and fishermen visitation rates should also be taken into account to determine if the catch rates of fish species with higher PCB concentrations warrant further action.

The Oriskany Reef is greater than 20 nm from shore, so it not a regularly targeted site by fishermen. In addition, the fish assemblage has changed over time and there are fewer Red Snapper being landed from this site over the last 6 years. The combination of these factors may be enough to deter regular fishing trips to this location, which reduces the overall public health risk of consuming fish from this site.

EPA Implications

- Transition to Tier II monitoring
  - Focus species with high PCB concentrations
- Assess PCB concentration trends over time
  - Increasing in site-attached fish species?
- Incorporate CPUE into triggering health advisory
  - Species with high PCBs but low catch rates may not represent a public health risk
- Oriskany Reef fish assemblage change
  - Reduction in Red Snapper has made this reef less targeted during fishing trips