A Non-lethal Approach to Assess and Monitor Mercury Concentrations in Black Basses from a Mercury Impacted Stream in the Shenandoah Valley, Virginia

Joshua A. Collins[1], G. Murphy[2], J.R . Flanders[1], and R. Stahl Jr[3]

(1) URS Corporation, Ft. Washington, PA, USA
(2) URS Corporation*, Ft. Washington, PA, USA
*Currently PA Fish and Boat Commission, Bucksville, PA, USA
(3) DuPont, Wilmington, DE, USA

Background

Mercury (Hg) was used between 1929 and 1950 at a textile manufacturing plant in Waynesboro, Virginia, and was released and transported into surface water, sediments, soils, and biota of the South River. In the 1970s when fish tissue Hg concentrations were found to be elevated relative to background, it was believed that the Hg in the aquatic system would naturally flush out, and that Hg levels in biota would begin to decline. However, Hg concentrations in some fish species in the South River have remained stable compared to tissue levels observed in 1978. This work was performed as part of the South River Science Team. The South River Science Team is an interdisciplinary team of individuals from industry, government, citizens groups, academic institutions, and private research established by DuPont and VDEQ in 2000 to revisit the issue of mercury contamination in the South River.

Objectives

A non-lethal sampling approach has been developed to assess and monitor total mercury (THg) concentrations in black basses along 26 miles of the South River.

- Track and evaluate seasonal and inter-annual changes in THg concentrations in the muscle tissue of smallmouth and largemouth bass from four stations along the South River (Figure 1)
- Utilize passive integrated transponder (PIT) tags for unique identification and tracking of sample population over time
- Collect data on spatial, temporal and ontogenetic variations of THg in muscle tissues of black bass
- Evaluate dermal biopsy methods for non-lethal tissue collection in order to potentially integrate study with agency monitoring program in future

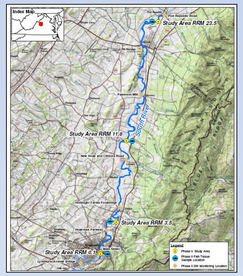

Figure 1: Primary Study Area

Methods

- Fish collected using electrofishing techniques and held in flow through live wells to minimize handling stress
- Mid-dorsal tissue biopsy collected using 3.5 mm diameter biopsy punch from three size classes of fish (Figure 2)
- Biopsy site treated with anti-bacterial salve to prevent infection (Figure 3)
- 12.5 mm, 134khz PIT tag inserted for tracking (Figure 3)
- Samples collected bi-annually 2009, 2010 and Spring 2011

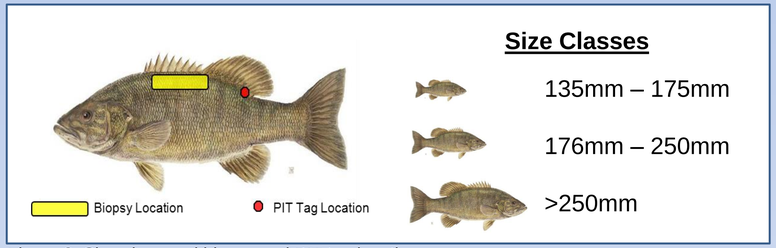

Figure 2: Size class and biopsy and PIT tag locations

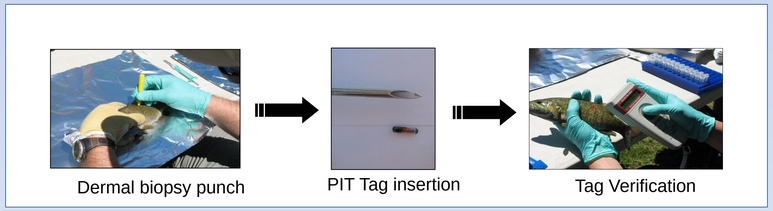

Figure 3: Biopsy and tagging procedure

Figure 4: Biopsy punch and biopsy site four months post-sampling

Results

- The relationship between plug and filet THg concentrations was established through triplicate samples in three archived smallmouth bass (Figure 5)
- The use of tissue plugs to collect a sample for THg analysis has a minor effect on THg concentration
- In the low concentration area (RRM 0.1), the filet method was approximately 0.4 µg/g higher than the plug method; While in other populations, the filet method was lower by ~0.6 µg/g (Figure 6)

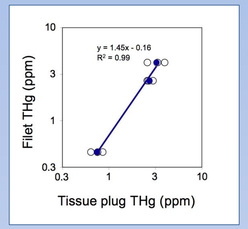

Figure 5: Relationship between plug and filet THg concentration

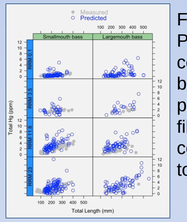

Figure 6: Predicted filet concentrations based on biopsy plug and historical filet THg concentrations vs total length

Discussion

The ability to monitor mercury concentrations in populations of smallmouth and largemouth bass over time, without impacting the community structure by traditional lethal sampling techniques is of key importance in maintaining a balanced fishery. The use of non-lethal tissue biopsy punches to monitor mercury concentrations has proven to be a sustainable and reliable predictor of THg concentrations in fish tissue. However, before adopting a monitoring program utilizing non-lethal biopsy techniques a more robust dataset is necessary to better establish the relationship between plug and filet.