The Influence of Canal Water Releases on the Methylmercury Production in Everglades National Park: Implications for Ecosystem Restoration

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WARNING

The Florida Department of Health and Rehabilitative Services has issued a health advisory urging limited consumption of largemouth bass and warmouth caught in certain portions of the Everglades due to excessive accumulation of the element mercury.

- Fish caught in Arthur R. Marshall Loxahatchee National Wildlife Refuge (Water Conservation Area 1) should not be eaten more than once per week by adults and not more than once per month by children under 15 and pregnant women.
- Fish caught in Water Conservation Areas 2a and 3 should not be eaten at all.

For additional information, contact the Florida Department of Health and Rehabilitative Services at (405) 355-3018.
The Mercury Cycle in South Florida Everglades

Sulfate from EAA runoff

Hg deposition

Sulfate

Hg deposition

Sulfate Reducing Bacteria

Microbial Methylation

Org. Carbon

CO₂

MeHg

Bioaccumulation
Sampling network:
• 76 sites covering marsh and canals
• Sampled in Fall of 2008 & 2009
• Surface water and small fish
• Analyzed for QW, Hg and MeHg
Four Year Mean Filtered Total Mercury Concentration in Surface Water
Sulfate and DOC – 4 Year Means

Sulfate

DOC
Four Year Mean Filtered Methylmercury Concentration in Surface Water
The Original – Goldilocks MeHg Hypothesis?
MeHg vs Total Hg Distribution Among Canal Water Affected Types

**Background**

- High Sulfate-Canal
- Mod Sulfate - Shark R.
- C111 sites
MeHg Distribution in Sulfate-DOC Space

ENP vs WCA “Goldilocks Zone”

SO₄ (mg/L)

DOC (mg/L)

MeHg (ng/L)
- 0.04 - 0.10 (ng/L)
- 0.11 - 0.25 (ng/L)
- 0.26 - 0.50 (ng/L)
- 0.51 - 0.70 (ng/L)
Redefining the Goldilocks Distribution

From Gilmour, 2011 SFER report

- Sulfide accumulation
- Sulfide removal: • Fe • $O_2$ flux (grain size, plants) • Organic matter
- DOM
- Hg solubility/bioavailability

Graph showing the relationship between log SO4, uM and % MeHg.
Four Year Mean Gambusia Methylmercury Concentration
What Drives Gambusia MeHg Levels?

Gambusia MeHg vs Wet Deposition 2007-2011

Sandheinrich et al., 2012, Reproductive effects level
Summary:

• The delivery of sulfate and DOC from canal water to regions of Everglades National Park has a profound affect on MeHg production

• Most of the Shark River Slough shows elevated levels of MeHg compared to “background” (canal water unaffected areas)

• Some ENP areas appear to exhibit possible sulfate and/or carbon limitation for MeHg production

• Sampling locations nearest the S12’s and L67’s discharge locations appear to show the “high sulfate inhibition effect” first revealed in WCA 2A

• Fish MeHg levels track the SRS/SO4/DOC distribution closely, with less obvious ties to deposition