



Pharmaceuticals and Personal Care Products of Emerging Concern in Whaishkey Bay, Michigan



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Introduction

Bay Mills Indian Community is located along the Whaishkey Bay near the Saint Mary's River's outflow into Lake Superior in Michigan's Eastern Upper Peninsula. This Anishnaabe tribe relies heavily on these adjacent waters for commercial fishing, tourism, and recreation. Unfortunately, within the Whaishkey Bay watershed resides three municipal lagoons and one active landfill, which could be linked to elevated levels of pharmaceuticals and personal care products. The knowledge of prevalence of chemical mixtures within the Great Lakes is limited. The exposures and toxicological effects of these chemicals to these aquatic ecosystems, human health, and to the Anishnaabe way of life are even more understudied.

Objectives

- Gather baseline monitoring data for a variety of emerging chemicals of concern within the Whaishkey Bay
- Investigate potential emerging chemicals of concern within the local food web.

Methods

- Sample collection, Nov 2017
 - Surface water grab
 - 2L total collected from each site
 - TraceClean amber glass bottles
 - 1L collected for general pharmaceuticals and personal care products
 - 1L collected for endocrine disrupting pharmaceuticals
 - 2-mercaptopyriden-1- 65 mg/L Microbial inhibitor
- Qualitative laboratory analysis
 - General pharmaceuticals and personal care products
 - EPA method 1694
 - Solid-Phase Extraction
 - Liquid Chromatography Tandem Mass Spectrometry
 - Endocrine disrupting pharmaceuticals
 - EPA method 539
 - Solid-Phase Extraction
 - Liquid Chromatography Electrospray Ionization Tandem Mass Spectrometry

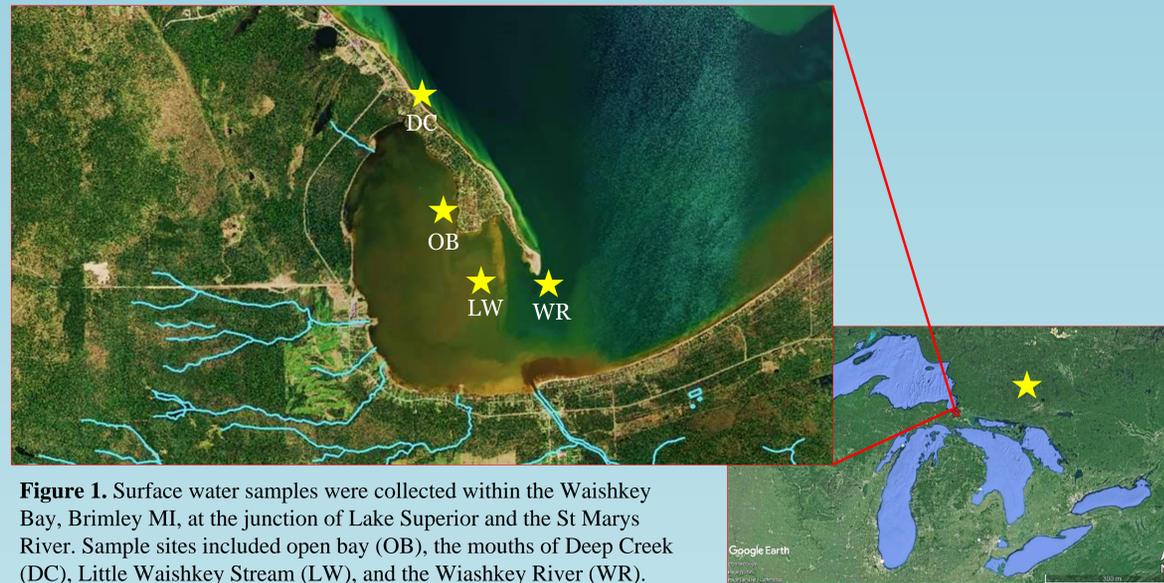


Figure 1. Surface water samples were collected within the Whaishkey Bay, Brimley MI, at the junction of Lake Superior and the St Marys River. Sample sites included open bay (OB), the mouths of Deep Creek (DC), Little Whaishkey Stream (LW), and the Whaishkey River (WR).

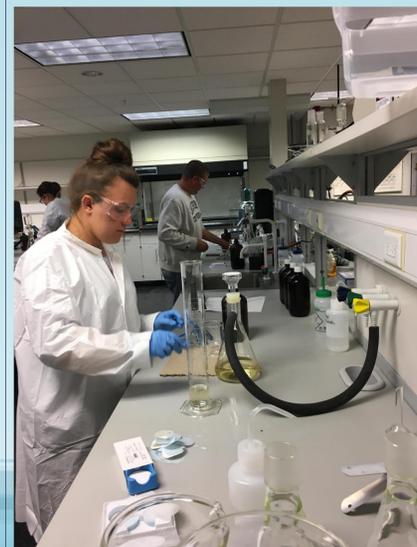


Figure 2. Student researcher, Claryn Sangster, processes water samples through Sigma Millipore filters at Lake Superior State University Environmental Analysis Lab.

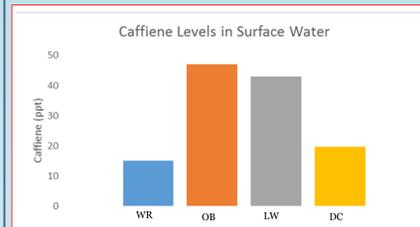


Figure 3. Caffeine was present above detection level in surface water at all four sample locations. Caffeine concentrations ranged from 15.1 ppt in the Whaishkey River, to 47.0 ppt in the open water of the Whaishkey Bay.

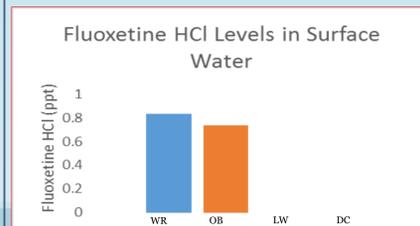


Figure 4. Samples collected in the Whaishkey River and the open bay contained detectable levels of fluoxetine (0.835 ppt and 0.74 ppt, respectively). Levels in the Little Whaishkey and Deep Creek were below detection.

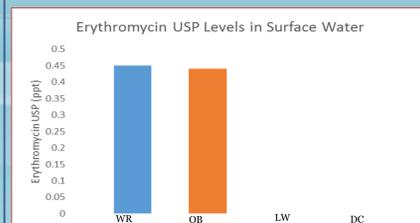


Figure 5. Erythromycin was detected in samples collected from the Whaishkey River and open bay (0.45 ppt and 0.44 ppt, respectively). Levels in the Little Whaishkey and Deep Creek were below detection.

Results

- During our analysis of 22 pharmaceuticals and personal care products, 5 chemicals were detected. These 3 chemicals include caffeine, Fluoxetine HCl, and Erythromycin. An average of 3 of these chemicals are shown in figure 2.
- In addition to these 3 chemicals, 2 more were detected at low levels at only 1 site each.
 - Carbamazepine was found at site 1 with an average of 0.265 ppt.
 - Sulfamethoxazole was found at site 2 with an average of 1.855 ppt.

Discussion

- Caffeine is one of the world's most widely used stimulants.
 - Has been shown to reduce the size and reproduction rates of mussels.
- Carbamazepine is an anticonvulsant drug that is commonly used to treat seizures, nerve pain, and bipolar disorder.
 - This drug bio accumulates in algae, and it can inhibit metabolic processes in animals and humans
 - Fluoxetine HCl is an antidepressant drug.
 - Studies have shown that this drug can affect the brains in some fish, triggering affecting behaviors such as mating and nesting
- Sulfamethoxazole is a sulfonamide antibiotic
 - Effects soil fertility by inhibiting denitrification
 - Slows plant growth
- Erythromycin is a macrolide antibiotic that inhibits the growth of bacteria
 - A study has shown that Erythromycin significantly affects the brain and liver in carp
- Little to no research has been conducted on how these chemicals affect the environment or what levels meet acceptable standards.
 - Chemical concentrations in surface water is often indicative of a snapshot of time. More current research is undergoing to investigate the prevalence of these chemicals concurrently in surface waters and sediment.
- A more robust sample scheme was conducted at the end of summer 2018 with 6 additional sites. In this follow-up analysis, sediment and water are both being investigated.

