



Emerging and Legacy Pesticide Contamination in Waishkey Bay, Brimley, Michigan



Jessica Elrod¹, Claryn Sangster¹, Diana McKenzie¹, Brian Wesolek², Aubrey Maccoux-LeDuc²
¹Bay Mills Community College, ²Bay Mills Biological Services

Introduction

The Waishkey Bay is located on the Upper Saint Mary's River at the outflow of Lake Superior, 20 miles west of Sault Saint Marie, MI. The Bay Mills Indian Community, an Anishinaabe tribe, is located at the point where the lake, river, and bay meet.

The Waishkey Bay watershed is comprised of regions that include a golf course, gravel pits, agricultural lands, and four sewage lagoons. In all, these land uses pose threat for pesticide contamination in runoff. Many emerging and legacy pesticides have proven to be persistent in the environment, and may biomagnify in the food chain.

There have been few studies to document the chemical contamination in the Great Lakes and the lower Saint Marys River surface waters, but almost no research has been done about the contamination in the Waishkey Bay.

The characterization of co-existing chemicals in the Great Lakes is lacking. The prevalence, exposures, and toxicities of chemical mixtures in the food chain is not well understood in this, and other, aquatic systems.

Anishinaabe tribal members rely heavily on the bay for food, recreation, and economic use, so the potential for pesticide contaminants could have an enormous impact on the whole community.

Objectives

- Gather a baseline data of legacy and emerging pesticide contamination within the Waishkey Bay watershed.
 - Conduct a broad chemical analysis of seventy-six pesticide in surface water and sediment collected from ten separate sample sites.
 - Identify pesticides of interest for future foodweb analysis.

Methods

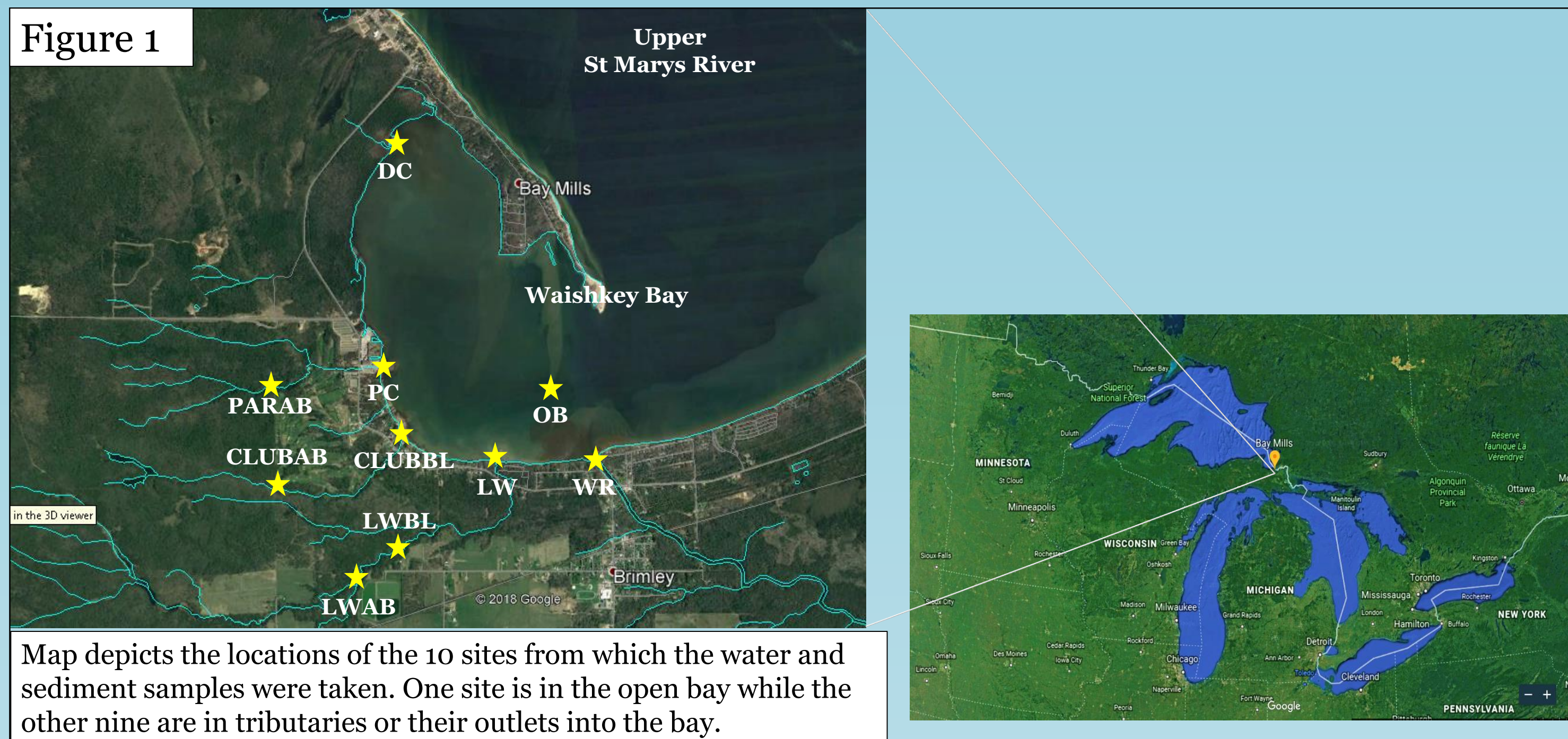
- Sediment sample collection in summer 2018
 - Ponar sampler or gloved grab
 - 19" Boston Whaler
 - 175 mL Traceclean Amber Glass Bottles
- Water sample collection in summer 2018
 - Collected surface water
 - 1 Liter Traceclean Amber Glass bottles
- Qualitative analysis of 76 chemicals, including volatile and semi volatile pesticides.
 - Lake Superior State University
 - Hexane Extraction
 - Gas Chromatography Mass Spectrometry

Results & Discussion

Five of the 76 pesticides analyzed were present above level of detection in sediment or surface waters collected from at least one study site.

- Pyridine was detected in both sediment and surface water samples from multiple locations.
 - Pyridine is a pesticide found in cigarettes and used in the synthesis of some antihistamines, herbicides, and water repellents.
 - Levels present above Dutch target standard for in sediment for pyridine (100ppb)
- 2,4-Dichlorophenol was detected in sediment at 60% of study sites.
 - Present in sediment in Club Creek, downstream of a golf course but absent upstream
 - Dichlorophenol is a chemical used in the preparation of herbicides and can also appear in the environment as a product of the photo degradation of triclosan.
 - It can cause renal failure and liver damage with elevated exposure.
 - The Dutch target standard for 2,4-dichlorophenol in sediment is <10 ppb
- 90% of sediments collected contained measureable levels of 1,2-Dichlorobenzene
 - Dichlorobenzene is used as an insecticide and in the softening and removing of carbon based contamination on metal surfaces.
 - Sediment contained levels well above the Dutch target standard for 1,2-dichlorobenzene (< 30 ppb).
- 2,4,6-Trichlorophenol was detected in sediment at the mouth of Parish Creek, only (0.59ppm).
 - 2,4,6-Trichlorophenol is a component of insecticide, fungicide, herbicide and antiseptic applications.
 - Production of 2,4,6-trichlorophenol was discontinued in the United States in the 1980's and the levels detected in the environment are generally less than 0.001 ppb.
 - Concentration at this site was nearly 6-fold higher than the Dutch target standard in sediment (10 ppb).
- 50% of study sites tested positive for 2,3,4,6-tetrachlorophenol
 - 2,3,4,6-Tetrachlorophenol was used as a preservative and a pesticide but is no longer produced in the United States.
 - Little research has been done on the effects of 2,3,4,6-tetrachlorophenol on humans, but studies have shown that it causes cancer in mice and rats.
 - Dutch target standard for 2,3,4,6-tetrachlorophenol in sediment is <10ppb, which is well below the average concentration in sediment collected in this study
- This study provides incite into prevalence of chemical cocktails in the Great Lakes, an area that is lacking in the literature.

Figure 1



Map depicts the locations of the 10 sites from which the water and sediment samples were taken. One site is in the open bay while the other nine are in tributaries or their outlets into the bay.

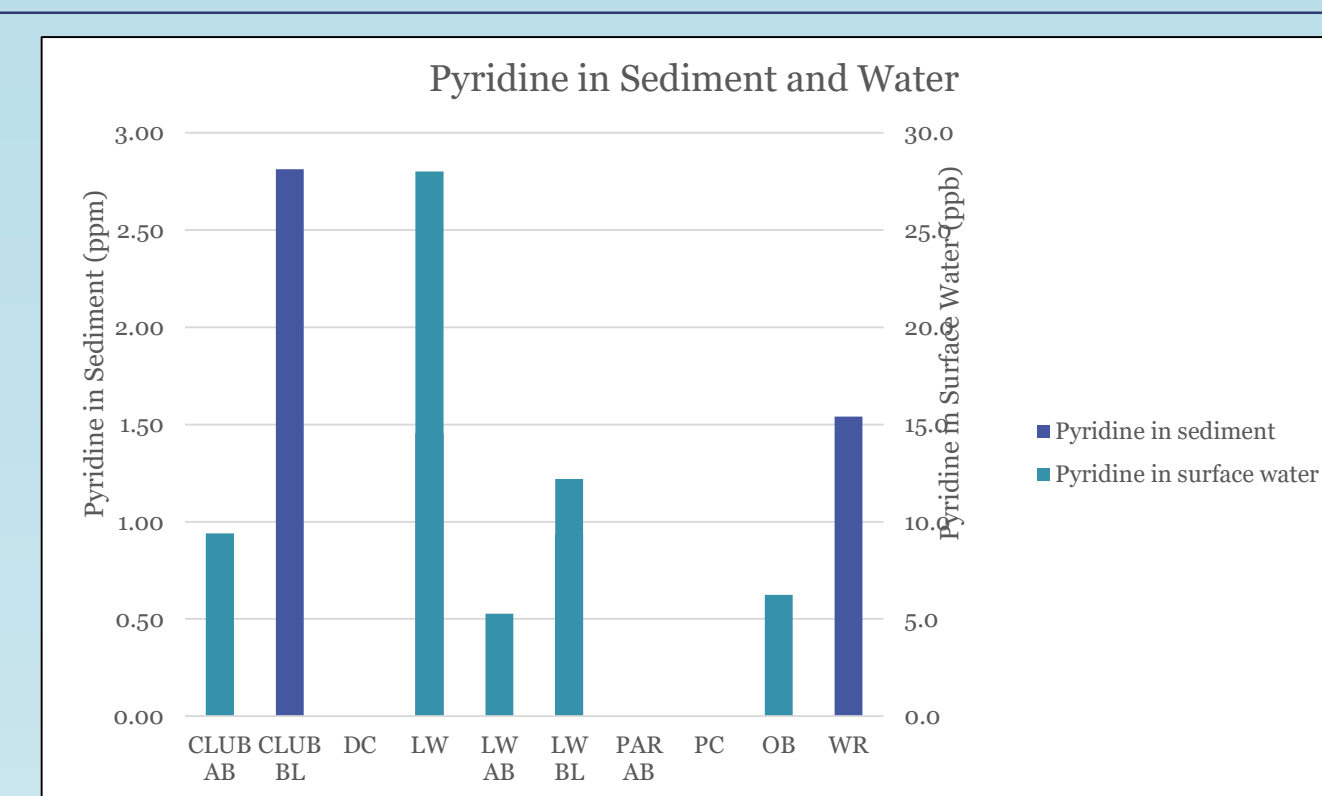


Figure 2: Pyridine was found in both sediment and water from multiple sites. Concentrations in surface water ranged from below detection to 28.00ppm (average: 12.21ppb). The range of pyridine concentration in sediment was below detection limit to 2.81ppm (average: 1.69ppm).

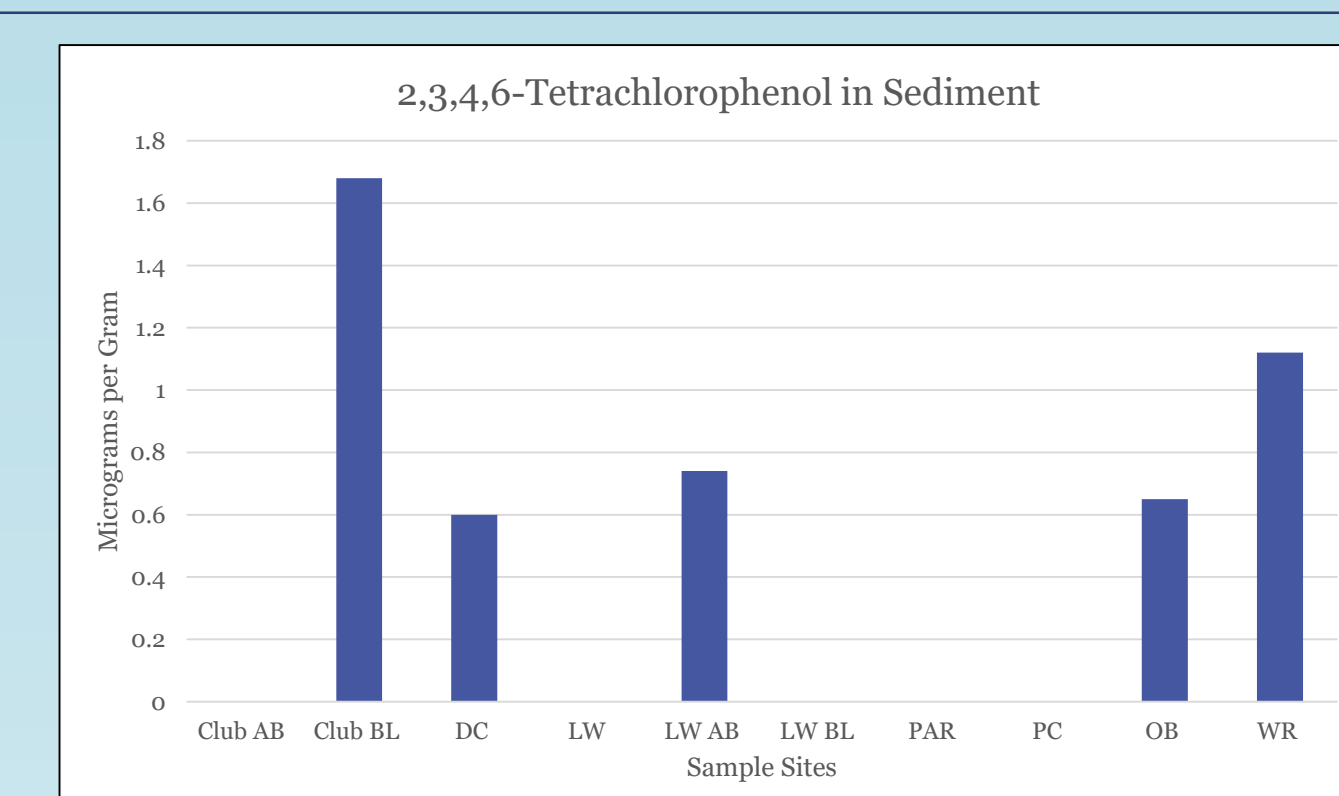


Figure 2: 2,3,4,6-Tetrachlorophenol was present above detectable limits in half of the sample sediments (range: below detection to 1.68ppm; average: 0.95ppm).

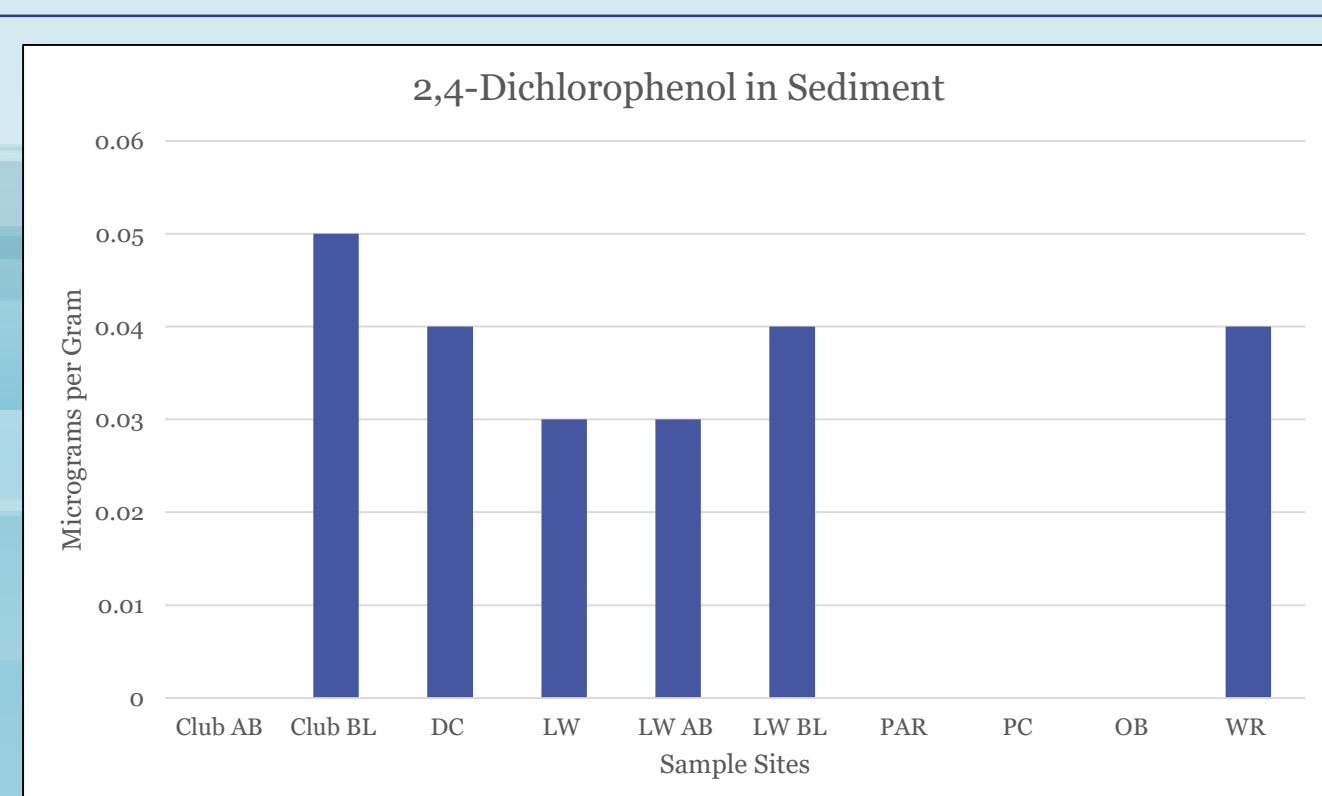


Figure 3: 2,4-Dichlorophenol concentrations ranged from 0.94 to 2.81ppm (average: 1.69ppm) from 6 of 10 study sites.

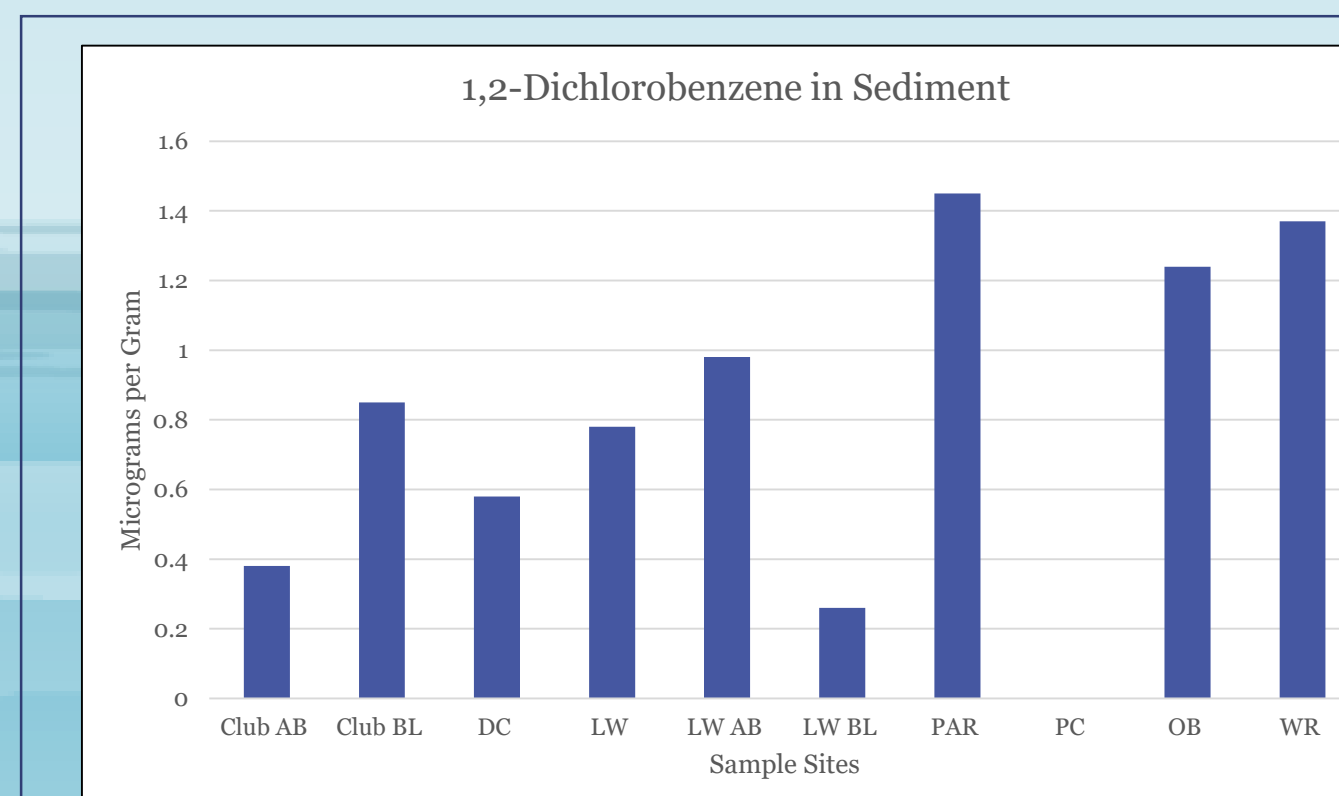


Figure 4: 1,2-Dichlorobenzene was present at above detection levels in sediment in all but one of the sample sites. Concentrations ranged from 0.26 to 1.45ppm (average: 0.92).

Acknowledgements

Partners in this project include Bay Mills Indian Community, Brimley, MI; Bay Mills Biological Services, Brimley, MI; Lake Superior State University Environmental Analysis Lab, Sault Ste Marie, MI; Wayne State University Lumigen Instrument Center, Detroit, MI; Michigan State University, Michigan Sea Grant, Sault Ste. Marie MI branch; USDA National Institute of Food and Agriculture (2017-38424-27083).

