

**ORGANIC POLLUTANTS IN THE ATMOSPHERIC AND AQUATIC  
ENVIRONMENTS OF LAKE VICTORIA**

**BY**

**ARINAITWE KENNETH**

**BSc. Ed. (MUST), MSc. (MaK)**

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## EXECUTIVE SUMMARY

The large surface area of Lake Victoria and the multitude of chemical-emitting activities in the lake's watershed provide for elevated potential for atmospheric loading of organic pollutants yet there remain limited monitoring studies within its watershed. This thesis represents the largest study to-date on organic pollutants in air and precipitation samples from the lake's atmospheric environment. It provides the largest temporal datasets in Africa, to-date, on atmospheric measurements of polycyclic aromatic hydrocarbons (PAHs), brominated and alternative flame retardants, polychlorinated biphenyls (PCBs) and pesticide residues, all from high volume samples from the Ugandan part of the Lake Victoria watershed. This report also gives historical deposition profiles of persistent organic pollutants (POPs) into sediment of Lakes Victoria, Bujuku and Mahoma.

High volume (24 hr) air samples were collected from two sampling stations, at Kakira (KAK) and Entebbe (EBB) within the northern Lake Victoria watershed in Uganda. Sampling was conducted over two periods; 1999-2004 (at KAK and EBB) and 2008-2010 (at EBB only). *(The 1999-2004 air samples were collected by Michael Wejuli (R.I.P.) intermittently between August 1999 and August 2004, but he passed away before he could complete the data analysis, having generated the raw data files following sample analysis by Gas Chromatography with Electron Capture and Mass Spectrometry detection (GC ECD and GC MS). This data was never written up. The raw data was kept by Prof. Derek Muir at the Canada Centre for Inland Waters (CCIW), Burlington, Ontario. I processed the data and included it as a baseline component for the 2008 – 2010 sample set which I collected.)*

Precipitation samples were collected on a month-long basis during the 2008-2010 period at EBB using an automated wet-only collector with XAD-resin columns. Sediment cores from Lakes

Victoria, Bujuku and Mahoma were also analysed for POPs. The latter two lakes are equatorial mountain lakes situated high up in the Rwenzori mountain range along the border of Uganda and Democratic Republic of Congo. SC1 was taken from a central depositional part of the lake. The deposition profiles in Buju2 and Maho2 were a reference for historical atmospheric deposition in remote environments.

All samples were shipped to Prof. Derek Muir's research laboratories at the Canada Centre for Inland Waters (CCIW), Burlington, Ontario for analysis. Extraction of air samples and analysis for PAHs was done at the laboratories of AirZOne Ltd in Mississauga, Ontario while the rest of the analyses were done at CCIW.

The results indicate high influence of petroleum and biomass combustion on the observed PAH profiles. Combustion was also associated with the emissions of flame retardants likely from open burning of plastics and other old flame retarded consumer products. Combustion was also a factor in the elevated PCB atmospheric concentration in EBB 2009 and 2010 samples. Increasing atmospheric prevalence of POPs was observed, characterized by fresh emissions of DDTs, lindane and endosulfan. Chlorpyrifos was most abundant pesticide in the atmospheric samples. Analysis of air mass movements showed high potential of transboundary and local emission source influence on the observed atmospheric profiles of the analytes.

Sediment analysis showed that profiles in Lake Bujuku were less altered by the lake's catchment than Lake Mahoma. DDTs and PCBs were the most historically deposited in Lake Victoria. The deposition profiles of p,p'-DDE, chlordanes and hexachlorobenzene in a core from the north central basin of Lake Victoria (SC1) were consistent with atmospheric deposition while the profiles of PCBs and hexachlorocyclohexanes were indicative of particle-bound loadings from

other sources, in addition to atmospheric deposition. Profiles of endosulfans, DDTs, and chlordanes, among others, in SC1, were consistent with influence of other factors such as anoxia, and dilution.

The results of this study underscore the need for increased regional vigilance with a concerted effort to reduce environmental chemical emissions.