STATE of the STRAIT

State Of The Strait
Monitoring For Sound Management






A Binational Conference on the Detroit River Ecosystem

Convened December 2004 by Great Lakes Institute for Environmental Research, University of Windsor, The Greater Detroit American Heritage River Initiative of Metropolitan Affairs Coalition, The Detroit River Canadian Cleanup, The Detroit River International Wildlife Refuge, The Detroit Water and Sewerage Department, and other organizations.

Cover photos: photos left and center (upper and lower): Recreational fishing in the Huron-Erie Corridor (lower center photo by Kurt Byers, Michigan Sea Grant Extension, courtesy of United States Environmental Protection Agency, Great Lakes National Program Office; other photos courtesy of OMNR); upper right: Scientist sampling water, benthic invertebrates and sediment in Lake Erie (photo courtesy of Environment Canada and University of Windsor); lower right: Longear sunfish (*Lepomis megalotis*) (photo courtesy of Nicolas Lapointe)

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MONITORING FOR SOUND MANAGEMENT

2004 Conference Proceedings

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6.18. Whole-water Sampling Techniques for the Determination of Trace Mercury and Trace Metal Concentrations that Do Not Require In-field Clean-room Facilities

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Introduction

Several water-sampling systems, known as ISOMET (isolation sampler for trace metals), have been designed by Environment Canada for the collection of reliable whole-water trace metal samples. The strategy was to develop simple and effective isolation and containment methodologies for the complete monitoring cycle: from the preparation stage, through field sampling, to analyses in the laboratory. The ISOMET samplers were developed specifically for mercury and trace metal monitoring such that they would be suitable for ultra-low level and contaminated-site sampling. These samplers are simple to use and do not require clean facilities in the field, even for sampling Great Lakes surface waters with the lowest environmental concentrations.

Applications and Methods

The ISOMET samplers weigh less than five kg. They can be operated manually in small boats, by wading, and under ice with the ISOMET-ML (manual operation), or remotely suspended from an all-plastic winch system for sampling off vessels and bridges with the ISOMET-EL (electronic operation). Rigid PFA (perfluoroalkoxy) 180 mL containers that can withstand eight atmospheres of pressure are used for both trace metal and mercury sampling. For trace metal sampling, the containers are first prepared in a clean-air workstation and then stored double-nested in clean, rigid isolation containers. In the field, the Teflon containers are then mounted onto the ISOMET sampler, opened and closed underwater, and then immediately returned to their isolation container. Exposure in the field is therefore limited to the water being sampled. In the lab, samples are acidified in a clean workstation, and later digested within their original "closed" sample containers while stored within isolation containers.

Performance Assessment and Results

In a comparison study conducted in Lake Ontario (2002), ISOMET-EL derived samples were compared with results obtained from samples collected with a GO-FLO sampler (General Oceanics Inc.) that was used in conjunction with a clean room on board the CSS Limnos Research Vessel. Essentially, identical mean whole-water mercury concentrations were obtained from samples collected with the GO-FLO and ISOMET-EL samplers; Flett Research and Frontier GeoScience Laboratories performed the analyses. The mean concentration for each of these sample sets, taken at a Lake Ontario master station, was 0.37 ng/L. Whole-water mercury concentrations from ten open-water sites sampled throughout Lake Ontario in 2002 showed little variability (0.38 ± 0.03 ng/L). A similar comparison for a wide range of trace metals also indicated good agreement between the GO-FLO and ISOMET samplers. Combined, these results indicate that

representative ultra-trace samples can be collected effectively without clean facilities in the field.

A performance assessment of the ISOMET-EL and ISOMET-ML was conducted from the CSS Shark, in the western basin of Lake Ontario with a set of seven replicates collected with each sampler. In terms of cadmium, the same mean concentration (0.016 ug/L) was found with both samplers, and the standard deviation of these means was also identical (0.001 ug/L) and equivalent to the analytical detection limit. The percent coefficient of variance, for both the ISOMET-EL and ISOMET-ML samplers, was small for other trace metal concentrations (Cr 3% and 4%; Cu 1% and 4%; Ni 4% and 5%). Of all the metals investigated, zinc is one of the most common due to its wide use in personal care products, such as shampoos and hand creams, as well as in metal structures and components. Although it is not a toxic metal at ambient environmental concentrations, this parameter can serve as a sentinel for the effectiveness for water quality sampling protocols. Results of the replicate sampling revealed virtually the same mean zinc concentration (EL: 0.34 and ML 0.35 ug/L), and the variance was less than the detection limit (0.05 ug/L). These results show that trace metals can be measured with good precision by both the ISOMET-EL and ISOMET-ML samplers and confirm that samples can be collected without contamination using these methods.

In 2003, whole-water samples were collected in the open waters of Lake Superior (n=7), Lake Huron (n=5), and Lake Ontario (n=7) with the ISOMET sampler. The mean cadmium concentrations were 0.009, 0.007, and 0.015 ug/L, respectively. In all cases, the standard deviation was 0.001 ug/L. Similarly, chromium exhibited little variation in the open-waters of the Great Lakes, with percent coefficients of variance of 9%, 4%, and 5%, respectively.

Conclusions

Little training is required to operate the ISOMET samplers, and they can be used to support a wide range of sampling activities. The ISOMET sampling system has a very modest start-up cost in comparison with traditional clean techniques that utilize clean-air workstations in the field. The ISOMET samplers routinely yield valid samples, and false-positive non-compliant data are effectively mitigated. As a result, the need for follow-up sampling is reduced. In addition, a more accurate representation of the "real" spatial distribution and temporal variance of mercury and trace metal concentrations is discernible. The ISOMET sampling system is being widely used by Environment Canada and the Ontario Ministry of the Environment for sampling in the Great Lakes and Detroit River as well as by government agencies in British Columbia and the Yukon. In addition, lay collectors can now conduct compliance monitoring for the most stringent of water quality guidelines for highly toxic metals virtually anywhere.