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)

STATE OF THE STRAIT

MONITORING FOR SOUND MANAGEMENT

2004 Conference Proceedings

Edited by:

Rachael Eedy, University of Windsor
John Hartig, U.S. Fish and Wildlife Service
Charlie Bristol, Bristol Technical Services, Inc.
Melanie Coulter, Detroit River Canadian Cleanup
Tracy Mabee, University of Windsor
Jan Ciborowski, University of Windsor

Based on a binational conference convened by
The Great Lakes Institute for Environmental Research, University of Windsor, Greater Detroit American Heritage River Initiative of Metropolitan Affairs Coalition Detroit River Canadian Cleanup, Detroit River International Wildlife Refuge, Detroit Water and Sewerage Department, and other organizations.

Suggested citation: Eedy, R., J. Hartig, C. Bristol, M. Coulter, T. Mabee and J. Ciborowski eds. (2005). *State of the Strait: Monitoring for Sound Management*. Great Lakes Institute for Environmental Research, Occasional Publication No. 4, University of Windsor, Windsor, Ontario.

6.14. PBDEs, PCBs, and DDE in Snapping Turtle Eggs from Canadian Areas of Concern on the Lower Great Lakes

Kim J. Fernie and Shane R. de Solla, Canadian Wildlife Service, Environment Canada, Burlington, Ontario
Shaogang Chu, Ken G. Drouillard and Robert J. Letcher, Great Lakes Institute for Environmental Research, University of Windsor, Windsor, Ontario

Introduction

The International Joint Commission designated 43 Areas of Concern (AOCs) within the Great Lakes basin based upon the impairment of beneficial uses. For many AOCs, including the Detroit River AOC, one impairment was restrictions on fish and wildlife consumption due to polychlorinated biphenyl (PCB) contamination. Delisting AOCs is dependent upon remediation of the causes of the problems. Although polybrominated diphenyl ether (PBDE) flame retardants have not yet been implicated in impairing ecosystems within the AOC framework, they are increasing at almost exponential rates in biota in the Great Lakes basin.

Environment Canada initiated the Wildlife and Fish Health Effects program in 2001 to assess and monitor contaminant levels in sediment and water. The program also monitors as contaminant burdens and selected health parameters in fish, herring gulls, mink, and snapping turtles within Canadian AOCs in the Great Lakes basin. The initial assessments are being conducted in Canadian AOCs on the lower Great Lakes.

This study reports the pattern of PBDE and PCB contamination in the eggs of snapping turtles. The contaminant burden was compared to sport fish consumption guidelines (OME 2001) and environmental quality guidelines (CCME 1998). Snapping turtles are non-migratory and have small home ranges, and thus their contaminant burdens reflect their local environment (de Solla and Fernie 2004). Consequently, contaminant burdens in turtle eggs were used to assess differences in contaminant sources among the sites surveyed. We present the contaminant loads in turtle eggs from two sites within the Detroit River AOC, Turkey Creek and Canard River, as well as sites from various AOCs throughout Lake Ontario and Lake Erie, and from two inland reference sites.

Methods

Snapping turtle eggs were collected annually from each site in southern Ontario for contaminant analysis in 2001-2003. The Detroit River AOC was sampled in 2001 (at Turkey Creek and Canard River) and 2002 (Turkey Creek). A total of 112 clutches were analyzed from all sites (4–17 per site) for PCBs, while 52 clutches were analyzed for PBDEs. Five eggs were selected from each clutch, and the egg contents for each clutch were pooled. PCBs and PBDEs were analyzed using capillary gas chromatography coupled with a mass selective (GC/MSD), or electron capture detector (GC/ECD). Sum PCBs and PBDEs were reported as the total of 36 and 9 congeners (different chemical configurations of each compound), respectively.

Contaminants were expressed on a wet-weight basis for comparisons. Patterns of PCBs

were examined using ANOVA and factor analysis on untransformed contaminant concentrations. Thirty-three congeners were included and expressed as a proportion of the sum PCBs.

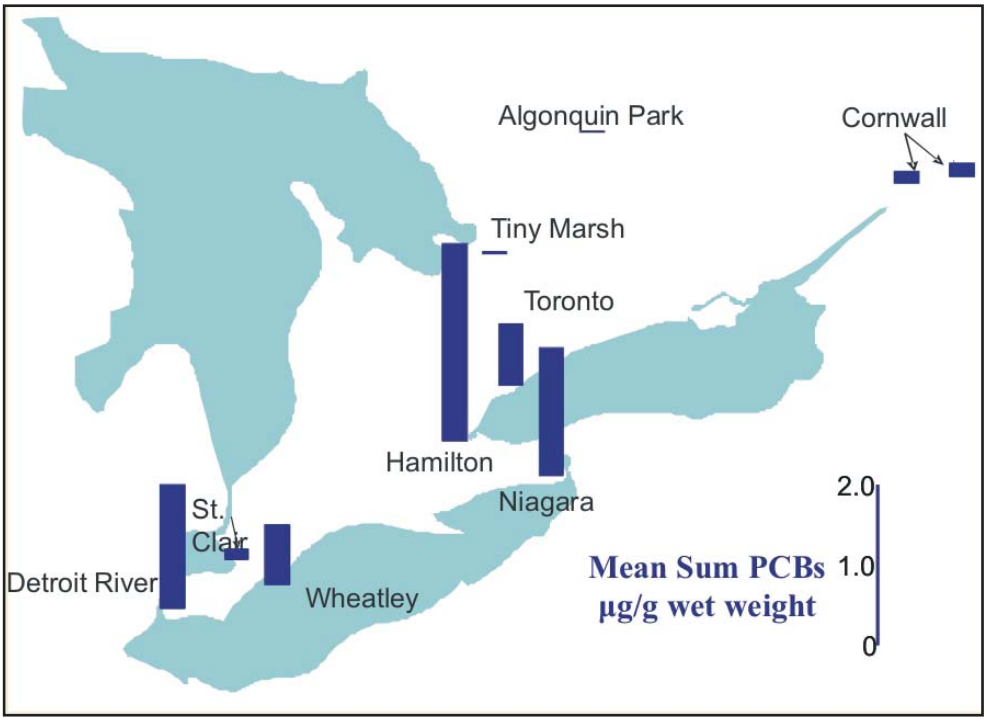

Figure 1. Mean sum PCBs (ug/g ww) at selected Canadian AOCs and reference sites in southern Ontario, 2001–2003. Concentrations were highest near known industrial sources: Hamilton Harbour, Niagara River, and Detroit River.

Results and Discussion

PCB concentrations in turtle eggs varied considerably among AOCs and inland reference sites (Figure 1). Although the concentrations at all AOCs (0.103–1.763 µg/g ww) were significantly higher than those at the reference sites (0.004–0.04 µg/g ww), sum PCBs were particularly high at Niagara River (Lyons Creek), Detroit River (Turkey Creek), and Hamilton Harbour (Grindstone Creek; see Figure 1). Turkey Creek had significantly higher mean concentrations of PCBs than Canard River (1.11 µg/g ww versus 0.28 µg/g ww, respectively). Although the contaminant burdens in snapping turtle eggs at all sites contained PCB congeners characteristic of both Aroclors 1254 and 1260 (commercial PCB mixtures), the Hamilton Harbour and Detroit River AOCs were particularly associated with Aroclor 1260, and both the Niagara River AOC (Lyons Creek) and St. Lawrence River AOC (Snye Marsh, Akwesasne) were associated with Aroclor 1254 (Figure 2).

Mean sum PBDEs differed among sites, and varied from a mean of 6.1 (Algonquin Park) to 107.0 ng/g ww (Toronto AOC; Figure 3). Generally, levels were lowest at Algonquin Park, where airborne deposition is assumed to be the main contaminant source. Consistent with reports that urban areas contain the highest PBDE concentrations, turtle eggs from the Hamilton Harbour and Toronto AOCs were the most contaminated among all sites (Figure 3). Mean concentrations of PBDEs at Turkey Creek (Detroit River AOC) were relatively low (13.7 ng/g ww) compared to most other AOCs.

Sum PCBs in the turtle eggs exceeded the partial Ontario Ministry of Natural Resources (OMNR) restriction guidelines for the consumption of fish (0.5 µg/g ww) at five AOCs: Hamilton Harbour, Toronto, Niagara River, Detroit River, and Wheatley Harbour. Additionally, turtle eggs from most AOCs, including both Canard River and Turkey Creek, exceeded the Canadian Environmental Quality Guidelines of PCB Toxic Equivalents (TEQs; 0.79 ng/kg for mammals).

Summary and Conclusions

Generally, concentrations of PCBs (0.004–1.763 ug/g ww) were ten times higher than PBDEs (0.006–0.107 ug/g ww) in snapping turtle eggs in the selected Canadian AOCs. Additional work is being completed to determine if these chemical concentrations are associated with observed health effects. Concentrations of these chemicals in the plasma of adult male snapping turtles are reported in the accompanying poster abstract by Chu et al.

The results of this study indicate that snapping turtle eggs are sensitive enough to differentiate not only relative exposure, but also the different sources of Aroclor mixtures in the Canadian AOCs on the lower Great Lakes. In addition, snapping turtle eggs reflect local sources of contamination since these turtles are non-migratory. The chemical concentrations found in their eggs also reflect the contaminant burdens of adult turtles. Although Russell et al. (1999) found that the ratio of contaminants between eggs and muscle in snapping turtles deviated from the equilibrium partitioning model, there was good agreement in relative concentrations between maternal and egg burdens (Pagano et al. 1999). Understanding the dynamics of contaminant accumulation in turtles would be enhanced by comparing turtle contaminant burdens with those of prey and sediment.

References

Canadian Council of Ministers of the Environment. (1998). *Protocol for the Derivation of Canadian Tissue Residue Guidelines for the Protection of Wildlife that Consume Aquatic Biota.* Canadian Council of Ministers of the Environment, Winnepeg.

de Solla, S.R. and K.J. Fernie. (2004). "Characterization of Contaminants in Snapping Turtles (*Chelydra serpentina*) from Canadian Lake Erie Areas of Concern: St. Clair, Detroit River, and Wheatley Harbour." *Environ. Pollut.,* 132:101-112.

Ontario Ministry of the Environment. (2001). *Guide to Eating Ontario Sport Fish, 2001-2002.* 21st Ed., Queen's Printer for Ontario.

Pagano, J.J., P.A. Rosenbaum, R.N. Roberts, G.M. Sumner and L.V. Williamson. (1999). "Assessment of Maternal Contaminant Burden by Analysis of Snapping Turtle Eggs." *J. Great Lakes Res.,* 25:950-961.

Russell, R.W., F.A.P.C Gobas and G.D., Haffner. (1999). "Maternal Transfer and *In Ovo* Exposure of Organochlorines in Oviparous Organisms: A Model and Field Verification." *Environ. Sci. Technol.,* 33:416-420.

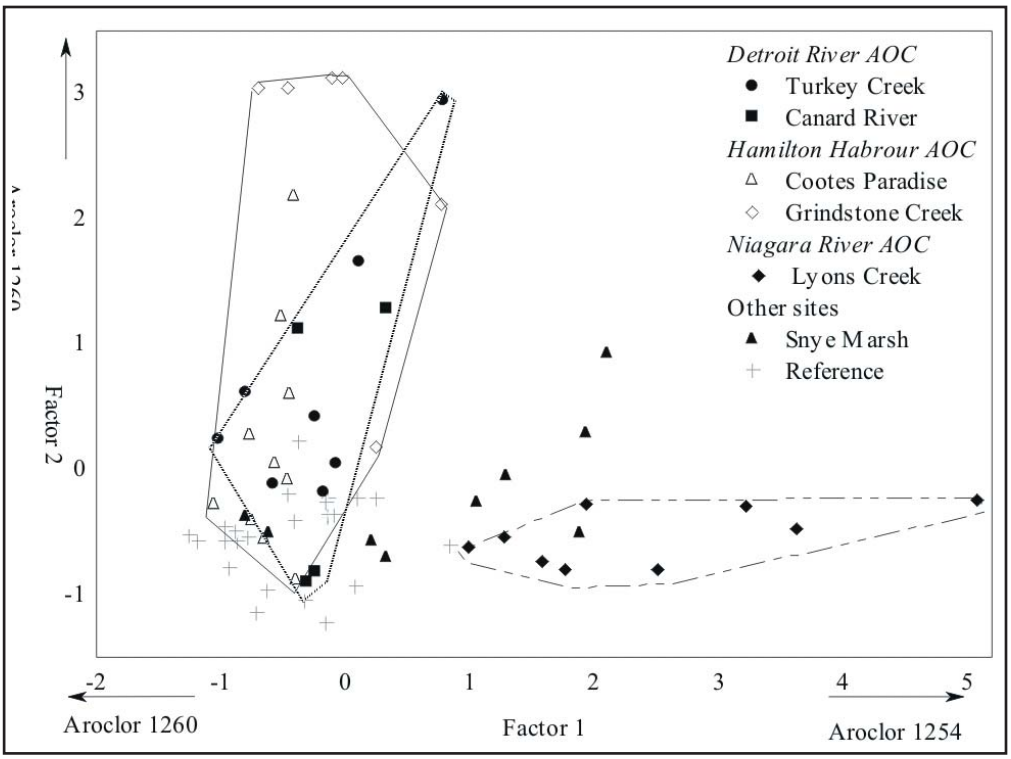

Figure 2. Factor scores from the first two factors of PCB congeners in snapping turtles eggs from selected sites, 2001-2003. Factor 1 is positively correlated with Aroclor 1254 and negatively correlated with Aroclor 1260. Factor 2 is positively correlated with Aroclor 1260. Hamilton Harbour and Detroit River AOCs are associated with Aroclor 1260, while St. Lawrence (Snye Marsh) and Niagara River (Lyons Creek) AOCs are associated with Aroclor 1254.

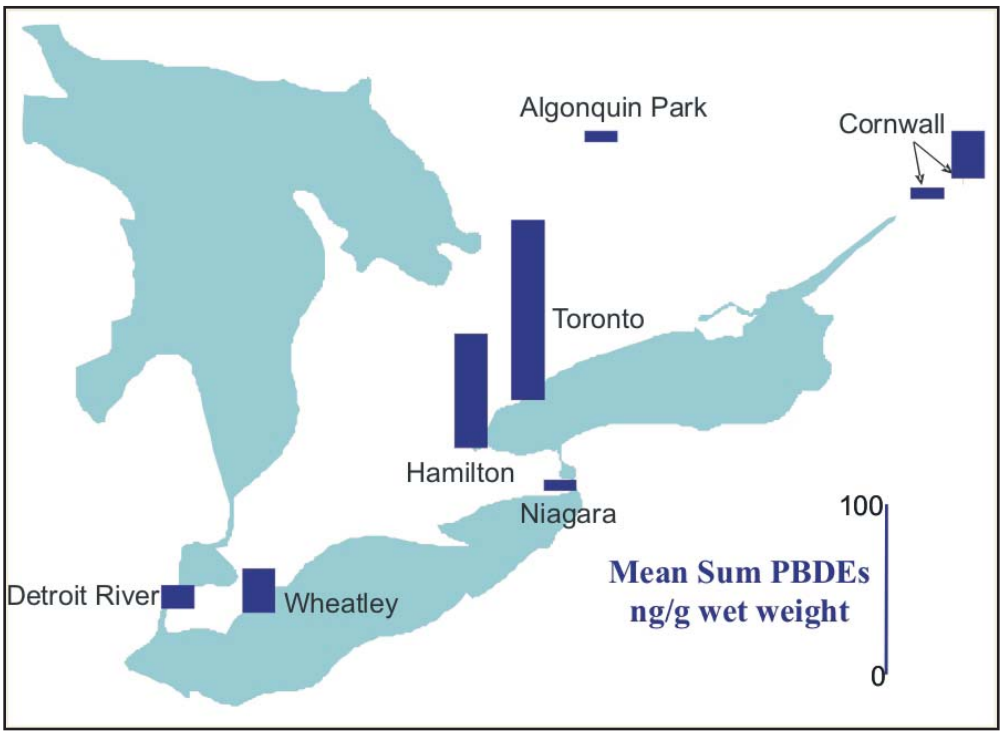

Figure 3. Mean sum PBDEs (ng/g ww) at AOCs and reference sites in southern Ontario, 2001-2003. Concentrations were highest at two large urban centres, Hamilton and Toronto. Levels were relatively low at Turkey Creek, Detroit River.