



# Laurentian SETAC

Laurentian Chapter of the Society of  
Environmental Toxicology and Chemistry

## L-SETAC Virtual Student Event

Featuring:

**Claire Bottini, University of Western Ontario**

Knowledge of molt sequence is key to linking feather mercury with environmental exposure in songbirds

**Noa Gang, Carleton University**

The relationship between dioxin exposure and adult-onset diabetes

**Sarah Wallace, Institut national de la recherche scientifique**

Identifying molecular biomarkers of exposure and effects in embryonic birds exposed *in ovo* to diluted bitumen

**Jasmine Yu, University of Toronto**

A review of microplastics categorization schemes to facilitate source apportionment: Implications for North American freshwaters

**Jonathan Blumenthal, University of Toronto**

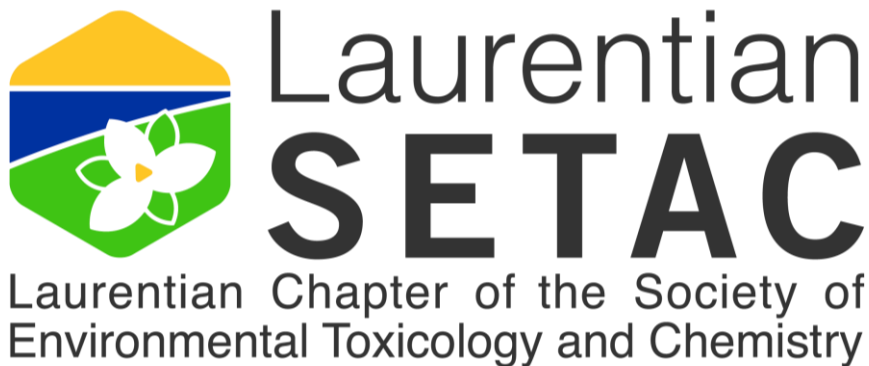
Stockholm Convention National Implementation Plans suggest global PCB elimination unlikely by 2028

**When:** Wednesday, September 9<sup>th</sup>, 2020, 6:30-8:15 pm EST

**Where:** ONLINE via Zoom!

**Cost:** Free! But please consider donating to the [Laurentian SETAC student fund](#).

**RSVP:** Please RSVP to [gillianmanning@gmail.com](mailto:gillianmanning@gmail.com) to receive the meeting link and password.



# L-SETAC Virtual Student Event

## Schedule:

6:30 to 6:35 PM – Welcome

6:35 to 7:50 PM – Student presentations

7:50 to 8:10 PM – Reverse Q&A

8:10 to 8:15 PM – Announcement of the winner  
and closing remarks



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# Knowledge of molt sequence is key to linking feather mercury with environmental exposure in songbirds

Claire Bottini, University of Western Ontario

Methylmercury (MeHg) is a globally distributed pollutant that negatively affects wildlife. Feathers are regularly used as a monitoring tool of contamination, but variability in total mercury (THg) content in flight feathers has raised questions about this practice. Our objective was to quantify blood and feather THg depuration through the progression of feather molt in order to clarify the relationship between blood and feather mercury load, and test the reliability of feather THg measurements as a monitoring tool in songbirds. We experimentally exposed song sparrows (*Melospiza melodia*) to dietary MeHg and measured their blood and feather THg concentration during exposure and post-exposure periods of three months each. We found a rapid decrease in feather and blood THg concentration through molt progression. Feather THg content was higher in feathers grown during the MeHg exposure period compared to those grown during the post-exposure period. However, regardless of timing of molt and exposure, blood THg decreased linearly over time at the same rate in both periods. Feather THg concentration was highly correlated with blood THg at the time of feather growth ( $R = 0.98$ ), indicating that, although THg concentration is variable among flight feathers, this reflects sequential molting patterns and declining blood concentration during depuration. Feathers thus provide an accurate and useful tool for estimating mercury load of birds at the time a chosen feather was grown.



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# The relationship between dioxin exposure and adult-onset diabetes

Noa Gang, Carleton University

**Topic:** Impact of dioxin exposure on molecular pathways in pancreatic  $\beta$ -cells and crosstalk with pro-inflammatory cytokines.

**Introduction:** Exposure to 2,3,7,8-tetrachlorodibenzo-p-dioxin (TCDD; dioxin) results in upregulation of cytochrome P450 (CYP)1A enzymes, which are required to excrete foreign compounds. CYP1A overexpression can also lead to oxidative stress and DNA/protein damage. Our lab has shown that TCDD activates CYP1A1 enzymes in islets, the pancreatic endocrine cells required for maintaining systemic glucose homeostasis. Interestingly, pro-inflammatory cytokines inhibited TCDD-induced CYP1A1 expression in islets. My research investigates 1) the effect of CYP1A1 enzymes on  $\beta$ -cell function and survival and 2) molecular crosstalk in  $\beta$ -cells during TCDD exposure and obesity-related inflammation.

**Methods:** To assess the impact of CYP1A1 on  $\beta$ -cells, I will overexpress CYP1A1 in human islets using a plasmid construct. To study molecular crosstalk, I will treat human islets with TCDD and cytokines simultaneously or in temporal windows of TCDD  $\pm$  cytokines. Molecular pathway activation will be determined by measuring downstream gene targets, and changes in  $\beta$ -cell function, gene expression, and survival.

**Results to Date:** Plasmid-induced upregulation of functional CYP1A1 enzymes has been validated in cell-lines. Human islet transfections are forthcoming. Simultaneous co-treatment of TCDD and/or cytokines in mouse islets showed that downregulation of genes required for glucose-sensing, insulin production, and insulin secretion were driven by either TCDD- or cytokine-activated pathways. However, some changes in gene expression were driven by combined exposure to TCDD and cytokines, such as downregulation of *G6pc2*, which protects  $\beta$ -cells from glucose toxicity.

**Value of Findings:** This research will contribute valuable information about the negative effects of environmental pollutants on  $\beta$ -cell function and survival, which can increase the susceptibility of dioxin-exposed populations to develop adult-onset diabetes. This project will inform policymakers on risks associated with pollutant exposure and promote the use of science in environmental policy.



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## Identifying molecular biomarkers of exposure and effects in embryonic birds exposed *in ovo* to diluted bitumen

Sarah Wallace, Institut national de la recherche scientifique

The transport of polycyclic aromatic compounds (PAC) mixtures such as diluted bitumen (dilbit) across Canada could pose a risk to wildlife if a spill occurs. However, the mechanisms of action of PAC mixtures are not fully elucidated in birds. The research objectives of this study were to investigate the mechanism of toxicity in embryonic avian species exposed to dilbit through egg injection. Double-crested cormorant (*Phalacrocorax auritus*; DCCO) eggs were collected from reference sites in Ontario and injected with a dilution (1:10 to 1:10,000) of one of Canada's dilbit products (Clearwater or Cold Lake Blend). In addition, Northern gannet (*Morus bassanus*; NOGA) eggs were collected from Bonaventure Island, Quebec and injected with 1:10 dilution of Cold Lake Blend. Non-injected and vehicle only (corn oil) controls were included. The eggs were artificially incubated until the liver matured (day 12 for DCCO, day 14 for NOGA) to assess effects during early development. Physical malformations were assessed and tissues were preserved for targeted transcriptomic analyses of genes involved in phase I, II, and III xenobiotic metabolism pathways. Expression of cytochrome P450 1a (*cyp1a*) genes, known biomarkers of PAC exposure, increased in both the liver and chorioallantoic membrane with dilbit exposure compared to controls, suggesting their relevance to embryotoxicity in birds exposed to PAC mixtures. In addition, preliminary results suggest that dilbit exposure through egg injection decreases the heart rate in developing bird embryos. Currently, experiments are underway in the more sensitive species domestic chicken (*Gallus gallus domesticus*) exposed to dilbit to assess these molecular biomarkers. Overall, these results of identifying molecular mechanisms of action can help develop appropriate biomarkers to assess PAC exposure and effects of more environmentally realistic exposure scenarios for avian species.



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# **A review of microplastics categorization schemes to facilitate source apportionment: Implications for North American freshwaters**

Jasmine Yu, University of Toronto

Microplastics, a widespread pollutant in freshwater systems, have numerous sources which are not well understood. Part of source reductions efforts requires knowledge of sources which is based on confident categorization and characterization. A literature review was conducted to compare the categories used for reporting types of microplastics found in North American freshwater environments. Analysis showed that categorization schemes for grouping microplastic particles are highly variable, with up to 17 different categories used across 31 studies. In some studies, pellets and microbeads are used interchangeably and grouped in a single category or assigned separate categories. Similar observations were seen with the fiber and line categories. Fragments are commonly a 'catch-all' category to describe irregularly shaped particles. Although uncommon, some studies have included source-specific categories such as tire wear, commercial fragments, paint, and irregular microbeads. While there is no universally accepted categorization framework for characterizing microplastics, harmonization would help with source identification. The broad range of categories across studies to report microplastic types creates ambiguity in determining key sources and their contributing load in freshwater environments. Source apportionment efforts would benefit from using particle morphology to assign microplastics to source-specific categories. This will help facilitate cross-study comparisons of microplastic types and help target management and reduction strategies in North America.



# Stockholm Convention National Implementation Plans suggest global PCB elimination unlikely by 2028

Jonathan Blumenthal, University of Toronto

Under the Stockholm Convention, signatory parties are to phase out polychlorinated biphenyl (PCB) use by 2025 and ensure their environmentally sound destruction by 2028<sup>1</sup>. Signatories provide regular progress updates through National Implementation Plans (NIPs), which are made public<sup>1</sup>. There is no defined format for NIPs, nor penalties for failing to submit them<sup>1</sup>.

By August 2020, 183 signatories had submitted at least one NIP<sup>2</sup>. Of these, 14 (8%) had no plans to manage PCB stocks, 76 (42%) had plans but had not completed thorough inventories of their stocks, 24 (13%) had completed inventories but had no capacity (administrative, financial, or practical) to act, and 12 (7%) had not made significant progress despite having capacity and an inventory<sup>2</sup>. Thirty-four (19%) were in the process of eliminating PCB stocks, and 22 (12%) reported environmentally sound management of PCBs<sup>2</sup>. In Canada, where PCBs were only imported, stocks have been inventoried and destruction is nearing completion<sup>3</sup>. The United States, which was the world's largest producer and consumer of PCBs, has not ratified the Stockholm Convention and so does not submit NIPs<sup>4,5</sup>.

For many low-income countries, eliminating PCBs is not just a question of will, but of overcoming financial, institutional, and practical barriers. Several NIPs reported an inability to track down PCBs due to mismanagement, theft, and corruption<sup>2</sup>. A lack of public health awareness surrounding PCBs has also contributed to their misuse<sup>2</sup>. For example, factory workers in a European country were documented to have used PCB oils for handwashing and heating homes<sup>2</sup>. In one African country, meanwhile, PCB oils were applied as a dermal lotion<sup>2</sup>.

Globally, progress towards managing PCB stocks has been slow and uneven. The failures or inability of low-income and high-income countries to document and manage their stocks threatens the goal of PCB elimination by 2028 and perpetuates their release to the environment.

## References

1. Secretariat of the Stockholm Convention. Stockholm Convention on Persistent Organic Pollutants (POPs). <http://www.pops.int/TheConvention/Overview/TextoftheConvention/tabid/2232/Default.aspx> (2018).
2. Secretariat of the Stockholm Convention. National Implementation Plans. <http://chm.pops.int/Implementation/NationalImplementationPlans/NIPTransmission/tabid/253/Default.aspx> (2020).
3. Shu-Yin, A., Diamond, M. L., Melymuk, L. E. & Spak, S. PCB Inventory in the Great Lakes Region. (2018).
4. Breivik, K., Sweetman, A., Pacyna, J. M. & Jones, K. C. Towards a global historical emission inventory for selected PCB congeners - A mass balance approach: 1. Global production and consumption. *Sci. Total Environ.* 290, 181–198 (2002).
5. Secretariat of the Stockholm Convention. Status of Ratification. <http://chm.pops.int/Countries/StatusofRatifications/PartiesandSignatoires/tabid/4500/Default.aspx> (2020).