Assessing risk of exposure to polycyclic aromatic hydrocarbons and other dioxin-like compounds of migratory shorebirds

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Evidence suggests that widespread marine oil pollution is leading to the exposure of shorebird populations to petroleum derivatives and other industrial contaminants, across their migratory range.

Polycyclic aromatic hydrocarbons (PAHs), found in petroleum based products, and other dioxin-like compounds have been largely overlooked as a cause of the decline shorebirds population despite their global distribution, toxicity, cumulative effects, and the large annual quantities introduced into the marine environment.

Objective

1) Identify to what extent shorebirds are exposed to polycyclic aromatic hydrocarbons (PAHs), polychlorinated biphenyls (PCBs) and dioxins, across their range in North and South America.
2) Assess in vitro sensitivity to a range of PAHs and other dioxin like compounds, as well as he mixture compounds found in the winter and stop over areas.

Introduction

Methods

Sediments from shorebird migratory stopover sites in Canada, United States (pre and post oil spill), Colombia, Ecuador, Uruguay and Brazil were collected during 2013 and 2014.

Results

Figure 1. Sediment sampling represented by yellow stars.

Figure 2. (a) Multiple approaches were tested to detect CYP1A in adult birds. Ethoxyresorufin-O-deethylase (EROD) activity could not be validated for either monolayer and liver slices. (b) Methodology used to detect CYP1A induction potency using mRNA: Sanderlings were euthanized to obtain liver slices, which have been dosed with pure compounds and sediment extracts to assess their relative toxicity. Pure compounds used were TCDD (0.0003, 0.001, 0.003, 0.01, 0.03, 0.1, 0.3, 1, 10 nM), Benzo-k-fluoranthene, Benzo-a-pyrene, Aroclor 1254 (0.3, 1, 3, 10, 30, 100, 300, 1000, 3000, 10000 nM).

Figure 3. Sanderling CYP 1A4 gene expression. Liver slices from three control Sanderlings were dosed with different concentrations of TCDD (a) and Benzo-k-fluoranthene (b), a PAH for 24 hours. Bar graphs represent mean CYP 1A4 expression.

Ongoing Activities

1- Sediments were collected in Brazil (north and south), Colombia, Ecuador, Uruguay, United States (Texas before and after oil spill, and Delaware) and Canada (James Bay and Chaplin Lake).
2- Samples from Colombia, Ecuador, Uruguay, Texas (after oil spill), Delaware, and James bay have been collected and are being shipped to the University of Saskatchewan for future analysis.
3- Luciferase reporter gene bioassay is being adapted to identify toxic potency of sediment extracts.

In vitro Assay

1- Pure compounds are being used on Sanderling liver slices to identify toxic potency.
2- Liver slices are being dosed with 10 doses of each pure compound.
3- Sediment extracts will be used to dose liver slices during summer 2014.

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