TEMPORAL TRENDS OF HALOGENATED COMPOUNDS AND MERCURY IN SEABIRD EGGS FROM THE CANADIAN ARCTIC

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Abstract

Temporal trends of most legacy organochlorines have decreased from 1975 to 2014 in eggs of thick-billed murres, northern fulmars and black-legged kittiwakes collected from Prince Leopold Island in the Canadian high Arctic. In contrast, total mercury has been increasing, and polybrominated diphenyl ethers increased from 1975 to 2003 in both murre and fulmar eggs followed by a rapid decline. Arctic seabirds continue to be good indicators of changes in contaminant exposure in arctic marine ecosystems.

Introduction

- Legacy organochlorines (OCs), polybrominated diphenyl ethers (PBDEs), and mercury (Hg) reach the Arctic via long-range atmospheric transport.
- Bans and regulations were implemented during the 1970s and 1980s to reduce emissions of legacy organochlorines.
- Penta- and octa-BDE technical products were banned in Europe in 2004 and voluntarily discontinued in the United States in 2005.
- Anthropogenic emissions of Hg have increased over the past century and increases have continued into recent decades.
- Implementation of the Minamata Convention on Mercury will help to reduce global mercury pollution over the coming decades.
- Here, we examine temporal trends of ΣPCB (35 PCB congeners), ΣDDT (DDT metabolites), ΣPBDE (11 BDE congeners), and total Hg in eggs of three species of seabirds breeding on Prince Leopold Island in the Canadian high Arctic.

Methods

- From 1975 to 2014, eggs of black-legged kittiwakes (*Rissa tridactyla*), northern fulmars (*Fulmarus glacialis*) and thick-billed murres (*Uria lomvia*) were collected from Prince Leopold Island (74°02'N, 90°05'W) in Lancaster Sound, Nunavut, Canada.
- Egg homogenates were individually analyzed for total Hg, and for the legacy OCs and PBDEs, as pooled (composite) samples, each consisting of three eggs.
- The legacy OCs were analyzed by gas chromatography using a mass selective detector (GC/MSD) as described elsewhere[1].
- The 1975-98 samples were analyzed for PBDEs by high resolution gas chromatography (HRGC) coupled to a high resolution mass spectrometer (HRMS) operated in electron ionization (EI) mode, and the 2003-14 samples were analyzed using GC-low resolution MS run in electron capture negative ionization (ENCI) mode[2]. Results from the two methods were comparable within ± 20%.
- The 1975-98 samples were analyzed for total Hg using cold vapor atomic absorption spectrophotometry (CVAAS), and the 2003-14 samples were analyzed by an AMA-254 or a DMA-80 direct mercury analyzer. Results for sample duplicates (n=24) using the two methodologies were not significantly different ($p > 0.05$).
- Samples were analyzed for stable isotopes of nitrogen ($^{15}N/^{14}N$, expressed as $\delta^{15}N$) according to methods described elsewhere[2].

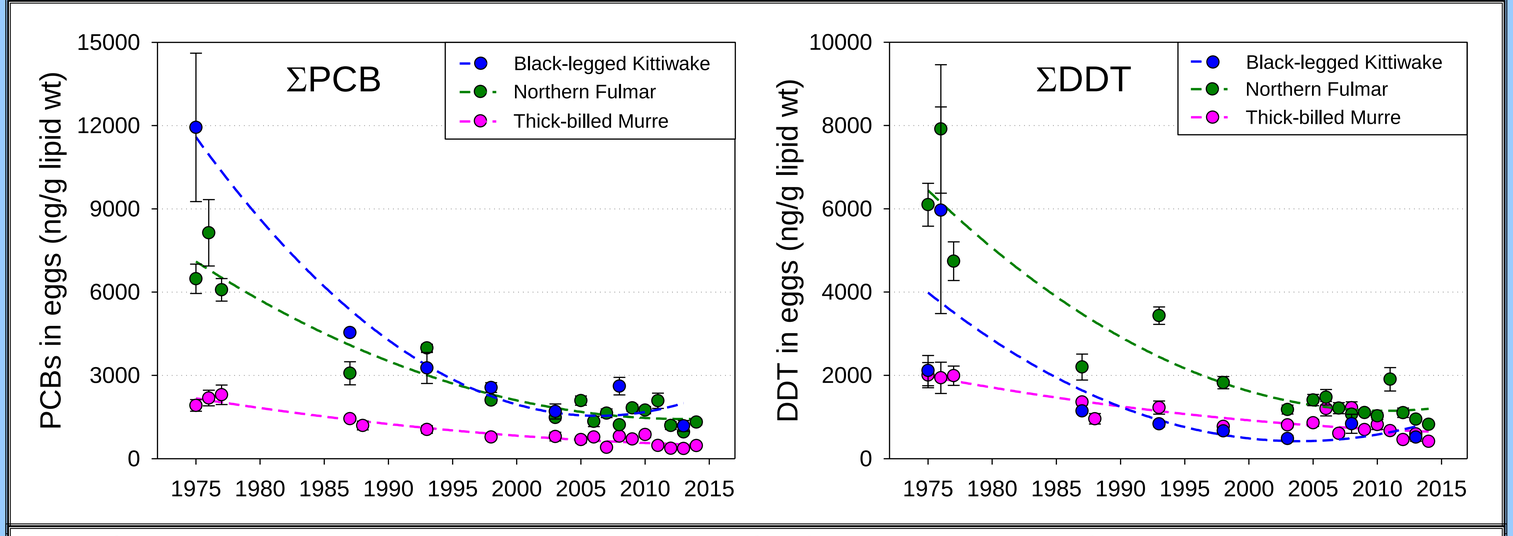

Figure 1. Mean annual concentrations (± standard error) of ΣPCB and ΣDDT in eggs of black-legged kittiwakes, northern fulmars and thick-billed murres from Prince Leopold Island, Nunavut, Canada, 1975-2014.

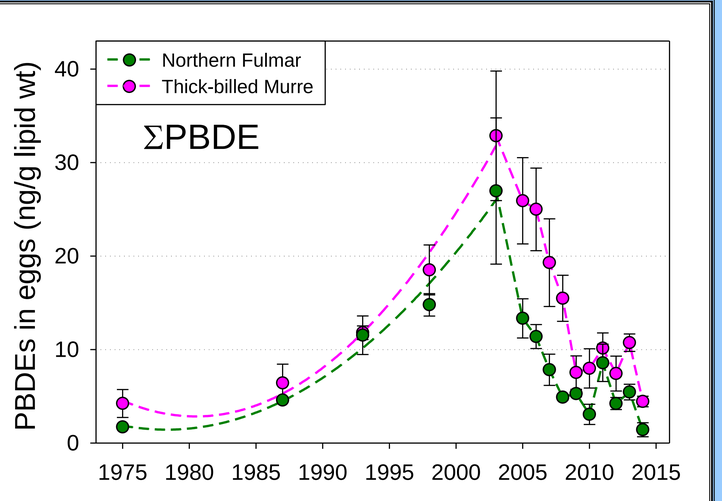

Figure 2. Mean annual concentrations (± standard error) of ΣPBDE in eggs of northern fulmars and thick-billed murres from Prince Leopold Island, Nunavut, Canada, 1975-2014. Modified from Braune et al. (2015)[2].

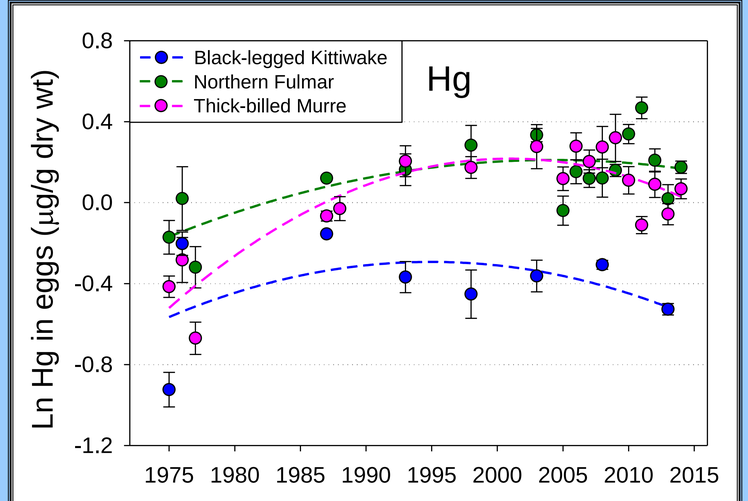

Figure 3. Mean annual concentrations (± standard error) of total mercury (Hg) in eggs of black-legged kittiwakes, northern fulmars and thick-billed murres from Prince Leopold Island, Nunavut, Canada, 1975-2014.

Results

- Legacy OCs, such as ΣPCB and ΣDDT, have decreased in the seabird eggs from 1975 to 2014 (Figure 1) in response to reduced emissions resulting from bans/regulations implemented in the 1970s and 1980s.
- PBDEs increased exponentially in the murre and fulmar eggs from 1975 to 2003 followed by a dramatic decline in response to reduced use of the penta- and octa-BDE products (Figure 2).
- Total Hg has increased in seabird eggs since 1975 with the period of greatest increase from 1975 to 1993 (Figure 3).

Conclusions

- The environment does respond to reductions in contaminant emissions (e.g. PCBs, DDT, PBDE flame retardants).
- Seabirds are good monitors of changing emission patterns of environmental pollutants.

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Literature Cited

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