Apr 30th, 1:30 PM - 3:00 PM

Brominated Flame Retardants: Spatial and Temporal Patterns and Trends in Seabird eggs from the Nearshore Pacific Coast of Canada

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Speaker
Aroha Miller, John Elliott, Kyle Elliott, Sandi Lee, Melanie Guigueno, and Abde Idrissez

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Brominated Flame Retardants: Spatial and Temporal Patterns and Trends in Seabird eggs from the Nearshore Pacific Coast of Canada

Aroha Miller, John Elliott, Kyle Elliot, Mélanie Guigueno, Laurie Wilson, Sandi Lee, Abde Idrissi
Outline

- The culprit - brominated flame retardants (BFR)
  - The birds – 4 species, offshore & coastal
  - Study design
    - Results
    - Summary

AIMS

1. Compare and contrast BFR temporal trends between two offshore feeding/breeding seabirds and two coastal breeding birds from British Columbia, Canada.
2. Use stable isotopes to examine whether contaminant changes are due to diet or regulations
Brominated Flame Retardants

Polybrominated diphenyl ethers (PBDEs)
- Textiles, plastics, furnishings, carpets
- Penta, octa and deca
- Ubiquitous in environment
- Persistent, bioaccumulate, lipophilic
- Regulations and restrictions, penta, octa

Hexabromocyclododecane (HBCD)
- Primarily construction materials
- α, β and γ

Monitor: BFRs seabird eggs
Double-crested Cormorant  
(*Phalacrocorax auritus*)

Widely distributed across North America

Coastal near shore habitat

Sub-surface pursuit diver

- Crescent Gunnel
- Longsnout Prickleback
- Seaperch
- Pacific Sandlance

Piscivorous: variety of benthic & mid-water schooling fish diet

Coastal
Great-blue Heron
(*Ardea herodias*)

Widely distributed across North America

Stealth wading in shallow water

- Sculpin
- Seaperch
- Townsend’s Vole

Mostly fish, but also amphibians, invertebrates, mammals

Estuarine habitat
Offshore

Rhinoceros Auklet
(*Cerorhinca monocerata*)

Temperate waters of the N. Pacific

Continental shelf habitat

Subsurface feeder

Juvenile Rockfish

Pacific Herring

Anchovy

Pacific Sandlance

Piscivorous: Midwater schooling fish
Leach’s Storm Petrel
(Oceanodroma leucorhoa)

North Atlantic and Pacific distribution

Surface dabbling

Omnivorous: Pelagic plankton & myctophid fish

Offshore/Oceanic habitat
Monitoring Sites

Collection Sites
- Heron
- Cormorant
- Auklet
- Petrel

Study Area

Pacific Ocean

YUKON

ALBERTA

USA

Mandarte Is.

UBC

Vancouver

Stanley Park

Hippa Is.

Lucy Is.

Cleland Is.
Sampling Design

- Bird eggs collected – offshore sp every 4 years, coastal sp usually more frequent
- Offshore, approx 15 eggs p/yr =
- Coastal, ranged yr to yr
  - herons 1 pool 5 eggs since mid-90s, >#s earlier yrs
  - cormorants 5x3 most recent yrs, earlier varied

Retrospectively:
- 1.5 g ww homogenized egg sent for chemical analysis
- 1 mg samples, same eggs, sent for SIA
## Biology

Moisture and lipid content ± SEM for each species at each site over time.

<table>
<thead>
<tr>
<th>Species and Site</th>
<th>Moisture (%)</th>
<th>Lipid (%)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Rhinoceros auklet, Cleland Island</td>
<td>69.4 ± 0.4</td>
<td>10.3 ± 1.5</td>
</tr>
<tr>
<td>Rhinoceros auklet, Lucy Island</td>
<td>68.1 ± 1.3</td>
<td>11.2 ± 0.4</td>
</tr>
<tr>
<td>Leach’s storm-petrel, Cleland Island</td>
<td>71.7 ± 0.3</td>
<td>10.0 ± 1.4</td>
</tr>
<tr>
<td>Leach’s storm-petrel, Hippa Island</td>
<td>71.4 ± 0.6</td>
<td>11.0 ± 0.5</td>
</tr>
<tr>
<td>Double crested cormorant</td>
<td>83.8 ± 0.1</td>
<td>4.6 ± 0.3</td>
</tr>
<tr>
<td>Great blue heron</td>
<td>81.5 ± 0.2</td>
<td>6.1 ± 0.1</td>
</tr>
</tbody>
</table>

No significant changes over time except...

### Dominant Congeners

**Offshore**
- Pentas > BDE154/BB153
- HBCD

**Coastal**
- Pentas > BDE154/BB153
  - > 153
Temporal – $\Sigma$PBDE, HBCD

Auklet, Cleland Is.

Petrel, Cleland Is.

Auklet, Lucy Is.

Petrel, Hippa Is.

Cormorant

Heron

Auklet, Cleland Is.:
- $R^2 = 0.7091$
- $R^2 = 0.6764$

Petrel, Cleland Is.:
- $R^2 = 0.4352$
- $R^2 = 0.5983$

Auklet, Lucy Is.:
- $R^2 = 0.6077$
- $R^2 = 0.4646$

Petrel, Hippa Is.:
- $R^2 = 0.482$
- $R^2 = 0.672$

Cormorant:
- $R^2 = 0.4009$

Heron:
- $R^2 = 0.5465$
Multiple linear regression – no significant relationship between PBDEs and $\delta^{13}$C or $\delta^{15}$N on individual sp/site basis
Summary

• ΣPBDEs increase/decrease offshore & coastal in line with phase outs and regulations on PBDEs
  – HBCD increasing offshore sp., trace conc coastal sp.
• Offshore sp lower conc. cf. coastal sp
• No influence of δ¹⁵N on ΣPBDE or dominant congeners

PBDEs local sources
HBCD offshore/Asian sources

Regulations worked – HBCD?
THANK YOU

• Co-authors
• Environment Canada and some NSERC funding
• Today’s audience