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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
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

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

- Ubiquitous in environment
- Persistent, bioaccumulate, lipophilic
- Regulations and restrictions, penta, octa

Monitor: BFRs seabird eggs
Coastal

Double-crested Cormorant
*(Phalacrocorax auritus)*

Widely distributed across North America

Sub-surface pursuit diver

Crescent Gunnel
Longsnout Prickleback
Seaperch
Pacific Sand lance

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

Coastal near shore habitat
Great-blue Heron (Ardea herodias)

Widely distributed across North America

Stealth wading in shallow water

Mostly fish, but also amphibians, invertebrates, mammals

Estuarine habitat
Rhinoceros Auklet
(*Cerorhinca monocerata*)

**Offshore**

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

Lanternfish
Squid
Copepod
Amphipod
Monitoring Sites

Pacific Ocean

Lucy Is.
Hippa Is.

Heron
Cormorant
Auklet
Petrel

Collection Sites

UBC
Stanley Park
Mandarte Is.

Vancouver
USA

Study Area

YUKON
ALBERTA
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 – ΣPBDE, HBCD

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

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

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

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

**Cormorant**
- PBDEs: $R^2 = 0.4009$

**Heron**
- PBDEs: $R^2 = 0.5465$
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 δ^{15}N on ΣPBDE or dominant congeners

PBDEs local sources
HBCD offshore/Asian sources

Regulations worked – HBCD?
THANK YOU

• Co-authors
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• Today’s audience