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Harbour seals consume more juvenile and adult salmon in estuaries than elsewhere in the Strait of Georgia

Sheena Majewski
*Fisheries and Oceans Canada, Pacific Biological Station, Canada*, Sheena.Majewski@dfo-mpo.gc.ca

Chad Nordstrom
*Coastal Ocean Research Institute, Vancouver Aquarium, Canada*, chad.nordstrom@vanaqua.org

Austen Thomas
*Smith-Root, Inc., United States*, athomas@smith-root.com

Andrew Trites
*Institute for the Oceans and Fisheries, The Univ. of British Columbia, Canada*, a.trites@oceans.ubc.ca

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Harbour seals consume more salmon in estuaries than elsewhere in the Strait of Georgia

SHEENA MAJEWSKI, DFO
CHAD NORDSTROM, CORI
AUSTEN THOMAS, SMITH-ROOT
ANDREW TRITES, UBC MMRU
Project Rationale

Complement 2012-2014 estuary focused studies (estimates of predation on Chinook and Coho salmon smolts) (Thomas et. al., 2017)

Update non-estuary diet information for seals in the Strait of Georgia (Olesiuk et. al., 1990, 1993)

Are the diets determined from scats collected in estuaries representative of diets throughout the Strait of Georgia?
Harbour Seals - Strait of Georgia

2016-17
70 scats/month (April – November 2016 and April-May 2017)

1 estuary site (Cowichan Bay)
~ 400 samples

7 primary non-estuary sites
+ other non-estuary sites
~1300 harbour seal and ~300 sea lion samples
Objectives

- Representative sample (high seal densities)
- DNA metabarcoding (species)
- Analysis of hard parts (size)
- Compare diet findings - between estuary / non-estuary - within estuaries previous years
Harbour seal diet - *Strait of Georgia 2016-17*

<table>
<thead>
<tr>
<th>Category</th>
<th>Percentage</th>
<th>Species Count</th>
</tr>
</thead>
<tbody>
<tr>
<td>Salmon</td>
<td></td>
<td>238</td>
</tr>
<tr>
<td>Rockfish</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Other</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Hexagramids</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Gadids</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Forage fish</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Flat fish</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Cephalopods</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

238 species
Salmon in diet – Estuary vs. non-estuary

**SPRING (Apr – May) Juveniles**

<table>
<thead>
<tr>
<th>Seal diet %</th>
<th>Estuary</th>
<th>Non-Estuary</th>
</tr>
</thead>
<tbody>
<tr>
<td>0</td>
<td>9%</td>
<td>2.4%</td>
</tr>
<tr>
<td>1</td>
<td>1.4%</td>
<td></td>
</tr>
<tr>
<td>2</td>
<td></td>
<td></td>
</tr>
<tr>
<td>3</td>
<td></td>
<td></td>
</tr>
<tr>
<td>4</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
Salmon in diet – Estuary vs. non-estuary

**SPRING (Apr – May) Juveniles**

- **Estuary**: 2.4%
- **Non-Estuary**: 1.4%

*Images of estuary and non-estuary landscapes.*
Salmon in diet – Estuary vs. non-estuary

SPRING (Apr – May) Juveniles

- 2.4% Atlantic
- 1.2% Chinook
- 0.6% Chum
- 0.4% Atlantic

Estuary Non-Estuary
Salmon in diet – Estuary vs. non-estuary

SPRING (Apr – May) Juveniles

- **Salmon in diet**
  - Estuary
  - Non-Estuary

- **Seal diet %**
  - Estuary: 1.4%
  - Non-Estuary: 0.5%

- **Fish types**
  - Chinook: 0.3%
  - Coho: 0.3%

**Chart details**
- **SPRING (Apr – May) Juveniles**
- **Chinook** and **Coho** fish species.
Salmon in diet – Estuary vs. non-estuary

FALL (Aug – Nov) Adults

Seal diet %

Estuary 34.4\%  Non-Estuary 9\%

35\%
Influence of prey abundance

FALL (Aug – Nov) Adults

Seal diet %

Estuary

0%

30%

5%

8%

Non-Estuary
Salmon consumption at Belle Chain Islets

All Salmon

Harbour seal diet %

< 1%

0 0.7 0.4 2.5

Apr-May Jun-Jul Aug-Sep Oct-Nov

Non-Estuary Belle Chain Islets – non-estuary Estuary
Influence of Site Selection

![Graph showing the influence of site selection on different months.](image)

- **Apr-May**: < 1%
- **Jun-Jul**: 4%
- **Aug-Sep**: 7%
- **Oct-Nov**: 65%
Interannual variability - Cowichan Bay

Diet %

Year

2012 2013 2014 2016 2017

Thomas et al. 2017 Nelson Current study
Interannual variability - SPRING

Salmon in diet at Cowichan (Apr-Jul)

<table>
<thead>
<tr>
<th>Year</th>
<th>Apr-May</th>
<th>Jun-Jul</th>
</tr>
</thead>
<tbody>
<tr>
<td>2012</td>
<td>0</td>
<td>5</td>
</tr>
<tr>
<td>2013</td>
<td>12%</td>
<td>13%</td>
</tr>
<tr>
<td>2014</td>
<td>0.5%</td>
<td>5%</td>
</tr>
<tr>
<td>2016</td>
<td>2.3%</td>
<td>4%</td>
</tr>
<tr>
<td>2017</td>
<td>0</td>
<td>0%</td>
</tr>
</tbody>
</table>
Conclusions

Site selection influences consumption estimates

- Salmon consumption inside vs. outside estuaries:
  - significantly higher in estuaries in the fall
  - minor but important differences in diet percentages in spring
- Belle Chain is unique among non-estuary sites (not representative)

Annual and seasonal variability influence estimates

- Salmon diet in estuaries follows an annual pattern
  BUT
  highly variable year to year and between seasons

Long-term monitoring is critical for assessing impacts of predation
Ecosystem perspective

- Ongoing sampling at index sites
- Coordinated Salish Sea harbour seal population surveys
- Further analysis of combined datasets
- Patterns of prey availability (including hatchery releases)
- Indirect effects of predation on salmon
- Impacts on other major prey species
- Species co-occurrence
- Impact of other predators
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