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

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

Follow this and additional works at: [https://cedar.wwu.edu/ssec](https://cedar.wwu.edu/ssec)

Part of the [Fresh Water Studies Commons](https://cedar.wwu.edu/ssec), [Marine Biology Commons](https://cedar.wwu.edu/ssec), [Natural Resources and Conservation Commons](https://cedar.wwu.edu/ssec), and the [Terrestrial and Aquatic Ecology Commons](https://cedar.wwu.edu/ssec)

Majewski, Sheena; Nordstrom, Chad; Thomas, Austen C.; and Trites, Andrew W., "Harbour seals consume more juvenile and adult salmon in estuaries than elsewhere in the Strait of Georgia" (2018). *Salish Sea Ecosystem Conference*. 453.  

This Event is brought to you for free and open access by the Conferences and Events at Western CEDAR. It has been accepted for inclusion in Salish Sea Ecosystem Conference by an authorized administrator of Western CEDAR. For more information, please contact westerncedar@wwu.edu.
Harbour seals consume more salmon in estuaries than elsewhere in the Strait of Georgia.
Project Rationale

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

Update non-estuary diet information for seals in the Strait of Georgia \textit{(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
~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*

238 species

<table>
<thead>
<tr>
<th>Category</th>
<th>Percentage</th>
</tr>
</thead>
<tbody>
<tr>
<td>Salmon</td>
<td>55-85%</td>
</tr>
<tr>
<td>Rockfish</td>
<td></td>
</tr>
<tr>
<td>Other</td>
<td></td>
</tr>
<tr>
<td>Hexagramids</td>
<td></td>
</tr>
<tr>
<td>Gadids</td>
<td></td>
</tr>
<tr>
<td>Forage fish</td>
<td></td>
</tr>
<tr>
<td>Flat fish</td>
<td></td>
</tr>
<tr>
<td>Cephalopods</td>
<td></td>
</tr>
</tbody>
</table>
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

Seal diet %

2.4%

Estuary

1.4%

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

**SPRING (Apr – May) Juveniles**

- **Estuary**
  - 2.4% Atlantic
  - 1.2% Chinook
  - 0.6% Chum

- **Non-Estuary**
  - 0.4% Atlantic
Salmon in diet – Estuary vs. non-estuary

**SPRING (Apr – May) Juveniles**

- **Seal diet %**
  - **Chinook**
    - Estuary: 1.4%
    - Non-Estuary: 0.5%
  - **Coho**
    - Estuary: 0.3%
    - Non-Estuary: 0.3%
Salmon in diet – Estuary vs. non-estuary

**FALL (Aug – Nov) Adults**

<table>
<thead>
<tr>
<th>Seal diet %</th>
<th>Estuary</th>
<th>Non-Estuary</th>
</tr>
</thead>
<tbody>
<tr>
<td>0</td>
<td>35%</td>
<td>9%</td>
</tr>
</tbody>
</table>

**Graph:** 35% of the diet in the FALL (Aug – Nov) for Adults consists of salmon, with significantly higher percentages in the Estuary compared to the non-Estuary area.
Influence of prey abundance

FALL (Aug – Nov) Adults

Seal diet %

<table>
<thead>
<tr>
<th>Fish Type</th>
<th>Estuary (%)</th>
<th>Non-Estuary (%)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Adults</td>
<td>30%</td>
<td>5%</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Fall</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

- Fish diet composition in estuary and non-estuary during Fall (Aug – Nov) for adults
- 30% of fish diet in estuary, 5% in non-estuary.
- 8% of fish diet in non-estuary for Fall season.
Salmon consumption at Belle Chain Islets

All Salmon

Harbour seal diet %

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

< 1%

Non-Estuary

Belle Chain Islets – non-estuary

Estuary
Influence of Site Selection

Harbour seal diet %

<table>
<thead>
<tr>
<th>Month</th>
<th>Harbour seal diet %</th>
</tr>
</thead>
<tbody>
<tr>
<td>Apr-May</td>
<td>0.7, 0.4, 2.5</td>
</tr>
<tr>
<td>Jun-Jul</td>
<td>4%</td>
</tr>
<tr>
<td>Aug-Sep</td>
<td>4%</td>
</tr>
<tr>
<td>Oct-Nov</td>
<td>15%</td>
</tr>
</tbody>
</table>

65% of salmon diet is from Apr-May to Jul-Aug, 41% from Oct-Nov.
Interannual variability - SPRING

Salmon in diet at Cowichan (Apr-Jul)

- **2012**: 12.7%
- **2013**: 12%
- **2014**: 13%

Year:
- Apr-May (0) 2012
- Jun-Jul (56) 2012
- Apr-May (36) 2013
- Jun-Jul (40) 2013
- Apr-May (32) 2014
- Jun-Jul (35) 2014
- Apr-May (22) 2016
- Jun-Jul (86) 2016
- Apr-May (65) 2017
- Jun-Jul (0) 2017
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
Acknowledgements

• Pacific Salmon Foundation (Citizen Science and Research Partners)
• UBC Marine Mammal Unit
• Coastal Ocean Research Institute
• Fisheries and Oceans Canada - Genetics Lab and Cetacean Research Program
• Pacific Identifications Inc.