Assessing regional patterns of juvenile salmon growth in the Salish Sea

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Assessing patterns of early marine growth in juvenile salmon in the Salish Sea and surrounding waters

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Outline

Introduction
1. Importance of early marine growth
2. What is Insulin-like Growth Factor-1 (IGF-1)?
3. Use of IGF-1 as index of ocean growth
4. Areas of interest and sampling

Analysis and Results
1. Large scale regions
2. Small scale sub-regions
3. Inter-annual

What’s next?
Early marine growth is positively correlated to adult survival

• Positive correlation between early marine growth and survival to reproductive age

• Understanding growth patterns at sea introduces means to understand mortality at sea
Increases in IGF-1 are indicative of growth

What is IGF-1?
- Insulin-like Growth Factor-1
- Hormone released from the liver
- IGF-1 travels to the tissue and stimulates body growth

Can IGF-1 be used as an ecological tool?
IGF-1 is positively correlated with instantaneous growth in juvenile salmon.

- $r^2 = 0.62$
- $p < 0.0001$
- $n = 197$

Beckman et al. 2004 TAFS
IGF–1 can be used as an index of ocean growth in juvenile salmon.
Juvenile salmon sampling occurs along marine migration routes.
Juvenile salmon sampling in 2012 and 2013

2012: Juvenile Chinook, coho, chum, sockeye, and pink
2013: Juvenile Chinook, coho, and chum

1. Large scale region analysis: Coho and chum
2. Small scale sub-region analysis: Coho and chum
3. Inter-annual analysis: Chinook, coho, and chum
From north to south; large scale regions of interest

From north to south:

**Queen Charlotte Sound**
Queen Charlotte Strait
Johnstone Strait

**North Strait of Georgia**
Mid Strait of Georgia
South Strait of Georgia

**North Puget Sound**
Puget Sound
Coho salmon IGF-1 differs significantly across large scale regions

- **2012**: Low in JS, High in NSOG and SOG
- **2013**: Low in JS and Puget, High in QC Sound and NSOG
Chum salmon IGF-1 differs significantly across large scale regions

- 2012: Low in QCSt and JS
- 2013: Low in JS and N. Puget
  High in QC Sound
IGF-1 levels differ from north to south when compared to the Strait of Georgia

<table>
<thead>
<tr>
<th></th>
<th>Coho 2012</th>
<th>Coho 2013</th>
<th>Chum 2012</th>
<th>Chum 2013</th>
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<tbody>
<tr>
<td>Queen Charlotte Sound</td>
<td>X</td>
<td>HIGH</td>
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<tr>
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<tr>
<td>Puget Sound</td>
<td>LOW</td>
<td>LOW</td>
<td>HIGH</td>
<td>AVERAGE</td>
</tr>
</tbody>
</table>
IGF-1 levels also vary from north to south within the Strait of Georgia

• Species specific variation exists between north, mid, and south Strait of Georgia:
  – Coho 2012 and 2013 show **significant regional variation** in IGF-1 from north to south
  – Chum 2012 and 2013 show **no significant variation** in IGF-1 from north to south

• What are possible explanations for these species specific patterns?
Strait of Georgia: sub-regions of interest

NSOG: Discovery Islands
    Desolation Sound
    North SOG

SOG:    SOG
    Malaspina

SSOG:  South SOG
    Howe Sound
    Gulf Islands
    Plume
Coho IGF-1 variability increases with sub-regional analysis.
Coho IGF-1 variability increases with sub-regional analysis.
Chum IGF-1 variability increases with sub-regional analysis

![Graph showing Chum 2012 variability](image)

- Insufficient sample size
Do geographic sub-region differences in IGF-1 depict tow-by-tow relationships?
Are these tow-by-tow relationships species specific?
IGF-1 levels vary from north to south within the Strait of Georgia

• Some regions within SOG appear to have more extreme IGF-1 deviations
  – Discovery Islands
  – Desolation Sound
  – Malaspina
  – Gulf Islands

• Variation from north to south exists, but why?
  – Geographic or biotic divisions?
  – Species specific?
Juvenile salmon IGF-1 varies annually within the Strait of Georgia. 

Coho salmon: 2012 vs. 2013
Chinook salmon: 2012 vs. 2013
Chum salmon: 2012 vs. 2013

Average IGF-1 (ng/mL)

The implications of these patterns will become more apparent when adult return data are available.
IGF-1 offers a unique way to spatially and temporally assess growth

• The geographic scale used to asses growth is important
  • Large scale regions
  • Small scale sub-regions
  • Tow-by-tow

• Are there ecological processes at play within the Salish Sea driving these variations in growth?
  • Yes, but how do we identify these relationships?
Future sampling and analysis plans

• Sampling in 2014
  – Inter-annual comparisons over 3 years
  – Additional regional and sub-regional analysis

• Discriminate species specific patterns
  – Are regions consistent across a three year period?
  – Is there overlap between species?
  – Geographic delineations?
  – Biotic delineations?
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