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Fine-scale taxonomic and spatiotemporal variability in the energy density of prey for juvenile Chinook salmon (Oncorhynchus tshawytscha)

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Fine-scale taxonomic and spatiotemporal variability in the energy density of prey for juvenile Chinook Salmon (Oncorhynchus tshawytscha)

Jacob Weil – MSc Student – Juanes Lab
University of Victoria
Critical Size/Period Hypothesis

- There are 2 periods of high mortality for juvenile salmon:
  - Ocean Entry (Spring): Predation-based mortality
  - First Marine Winter: Growth-based mortality
Assessing Growth

• Growth ~ prey quantity + prey quality
• Currently we assess quality by:

<table>
<thead>
<tr>
<th>Prey Proportion in Diet</th>
<th>Energy Density (J/g)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Insect</td>
<td>Hyperiid</td>
</tr>
<tr>
<td>Hyperiid</td>
<td>Gammarid</td>
</tr>
<tr>
<td>Gammarid</td>
<td>Fish</td>
</tr>
<tr>
<td>Fish</td>
<td>Euphausiid</td>
</tr>
<tr>
<td>Euphausiid</td>
<td>Decapod Larvae</td>
</tr>
<tr>
<td>Decapod Larvae</td>
<td>Cephalopod</td>
</tr>
</tbody>
</table>

Duguid and Juanes 2017
Assessing Growth

• Growth \sim \text{prey quantity} + \text{prey quality}
• Currently we assess quality by:
• BUT... when we do this we assume:

\begin{align*}
\text{Hyperia medusarum} &= \text{Hyperoche medusarum} \\
\text{Themisto pacifica} &= \end{align*}
Research Questions

i) Does energy density vary between similar species of invertebrate prey?

Hyperia medusarum  =  Hyperoche medusarum  =  Themisto pacifica
Research Questions

i) Does energy density vary between similar species of invertebrate prey?

ii) Does energy density of prey vary throughout a season?
Research Questions

i) Does energy density vary between similar species of invertebrate prey?

ii) Does energy density of prey vary throughout a season?

iii) Does energy density of prey vary spatially?
Methods
Methods

- Species Identification
Methods

i) Does energy density vary between similar species of invertebrate prey?
   • What is the best way to assess energy density?
Building A Model

- % Ash-free dry weight is highly correlated to energy density

Wet Weight | Dry Weight | Ash Weight
--- | --- | ---
[peaches] | [dried peaches] | [ash]

Trudel and Weil. *In Prep*
Building A Model

% Ash-free dry weight is highly correlated to energy density.

Trudel and Weil. *In Prep*
Results

![Graph showing energy density for different crab families](image)

- **Crab Zoea**
- **Crab Megalope**

**Family**
- Cancridae
- Grapsidae
- Xanthidae
- Majidae
- Paguridae
- Porcellanidae

**Energy Density (J/g)**
- 5000
- 4000
- 3000
- 2000
- 1000
Results

Amphipods

Energy Density (J/g)

Species

C. challengeri

Hyperocoe medusarum

T. pacifica

Hyperia medusarum
$H. \text{medusarum}$ Sex Differences

Energy Density (J/g Wet Weight)

- Female
- Male

Sex

2100 2200 2300 2400 2500 2600 2700
Research Questions

i) Does energy density vary between similar species of invertebrate prey?
Preliminary Conclusion

i) **YES!** Energy density appears to vary between similar species of invertebrate prey

Hyperia medusarum

≠

Hyperoche medusarum

≠

Themisto pacifica
Research Questions

i) Does energy density vary between similar species of invertebrate prey?

ii) Does energy density of prey vary throughout a season?
Results

Temporal Changes - T. pacifica

Energy Density (J/g)

April  May  June  July  August

Month

3400  3600  3800  4000
Preliminary Conclusion

ii) Does energy density of prey vary throughout a season?

**YES!** Energy density appears to vary temporally.
Research Questions

i) Does energy density vary between similar species of invertebrate prey?

ii) Does energy density of prey vary throughout a season?

iii) Does energy density of prey vary spatially?
Results

Spatial Differences - T. pacifica

Energy Density (J/g)

Sampling Location

Maple Bay  Cowichan Bay  Saanich Inlet
Research Questions

i) Does energy density vary between similar species of invertebrate prey?
   • Preliminary results suggest yes
   • Tied to life history

ii) Does energy density of prey vary throughout a season?
   • Preliminary results suggest yes

iii) Does energy density of prey vary spatially?
   • Not on a fine spatial scale
How Much Does It Matter?

• Goal: To determine to what degree variability will affect growth?

\[ G = \frac{dW}{W \cdot dt} = p \left[ C_{\text{max}} \cdot \left( \frac{CAL_z}{CAL_f} \right) \right] \] (Trudel et al. In press)
Thank You

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Field Assistants: Jessica Qualley, Katie Innes, Hailey Davies
Committee Members: Dr. Rana El-Sabaawi, Dr. John Dower
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