Zooplankton variability in the Northern Salish Sea over the past 3 decades, and relationships with Coho salmon

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Zooplankton variability in the Northern Salish Sea over the past 3 decades, and relationships with Coho salmon

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Young et al., Salish Sea Ecosystem Conference, Seattle, 5 April 2018
Salish Sea Marine Survival of Salmon Program
Pacific Salmon Foundation (PSF-SSMSP)

Plankton project main objectives:

1. What are the seasonal patterns of zoo/ichthyoplankton species composition, abundance, and biomass in the northern Salish Sea areas?

2. How do these properties vary with changes in physical conditions?

3. How do variations in these properties influence the marine growth and survival of juvenile salmon in these areas?

Young et al., Salish Sea Ecosystem Conference, Seattle, 5 April 2018
**Objectives**

Work is In Progress
Analyses and sampling are continuing

Objectives for this presentation:

1) Describe recent (2015 - 2017) patterns of zooplankton for Central Strait of Georgia;

2) Describe patterns of zooplankton for Central Strait of Georgia among years (1995-2017);

3) Compare long-term (1990-2017) zooplankton patterns in Central and Northern Strait of Georgia with Coho marine survival patterns in this region.

Young et al., Salish Sea Ecosystem Conference, Seattle, 5 April 2018
Total plankton biomass (g DryWt/m²) – biomass peaks in June-July

2015 by month

2016 by month

2017 by month

Blue dots are means

GEO1 (central SoG) 2017

Young et al., Salish Sea Ecosystem Conference, Seattle, 5 April 2018
Mostly copepods by abundance (blue colours)

More euphausiids (yellow), amphipods (red) and jelly (green) by biomass
Central Strait of Georgia – total zooplankton biomass ($\log_{10} \text{g/m}^2$)

**Abundance**

- **Biomass Seasonal Cycle**
  - Winter
  - Spring
  - Summer
  - Fall

**Biomass**

- **Biomass Annual Anomalies**

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Central Strait of Georgia – Calanoid copepod biomass anomalies

Cumulative Annual Anomalies

Year

1995 2017

Calanoid copepods Large
Calanoid copepods Medium
Calanoid copepods Small

Young et al., Salish Sea Ecosystem Conference, Seattle, 5 April 2018
Central Strait of Georgia – Gelatinous plankton biomass anomalies

Cumulative Annual Anomalies

Year


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Comparisons of zooplankton with Coho marine survival

Strait of Georgia Coho
PC1 (90% of variance)

Big Qualicum
Inch Creek
Quinsam
Black Creek (wild)

Marine survival vs Ocean Entry year

Dashed line represents linear trend

Data courtesy Jim Irvine
Residuals after removing the decreasing linear trend from the PC1 Coho marine survivals

Biomass anomalies of key juvenile Coho prey (Crabs, Amphipods, Shrimp: represented by Class Malacostraca)

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Residuals from Coho marine survival PC1 are not correlated with Class Malacostraca biomass anomalies: p=0.09

Coho salmon marine survival vs ‘Fish food’ plankton

Class Malacostraca (Crabs, Amphipods, Shrimp) Biomass Anomaly

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Using all data, a multiple linear regression with
Residuals from Coho marine survival PC1 = f{ Class Malacostraca Biomass anomaly, North Pacific Gyre Oscillation (NPGO) Index } produces a significant relationship:

\[ R^2_{\text{adj}} = 0.38 \]
\[ P\text{-value} = 0.02 \]
Summary

1. **Zooplankton biomass peaks in the summer** months (June-July) (most plankton sampling programs have focussed on Spring);

2. **Total zooplankton biomass** in Central Strait of Georgia has been increasing since 2014; 2017 is similar to that during the late 1990’s;

3. Annual biomass anomalies of **Calanoid copepods display a U-shaped pattern**, with minima during 2003-2010; Annual biomass patterns of gelatinous plankton have been increasing since 1995;

4. The **residuals of Coho salmon marine survival** (i.e. with the declining trend from 1990 to 2010 removed) are **significantly related** to a combination of **the annual biomass anomalies of their preferred crustacean zooplankton prey** (a local influence), and the **North Pacific Gyre Oscillation Index** (a large-scale influence). Zooplankton prey is the more important independent variable in this relationship.

5. A consistent zooplankton monitoring program in the Salish Sea can assist with projections of future abundances of juvenile salmon.

Young et al., Salish Sea Ecosystem Conference, Seattle, 5 April 2018
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