May 2nd, 10:30 AM - 12:00 PM

**Variation in juvenile Chinook salmon diet composition and foraging success between two estuaries with contrasting land-use histories**

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Wetland loss and juvenile Chinook salmon foraging performance in Salish Sea (and other) estuaries

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²Nisqually Indian Tribe, Department of Natural Resources
³Earth Design Consultants
⁴King County, Water and Land Resource Division
A critical size and period hypothesis to explain natural regulation of salmon abundance and the linkage to climate and climate change

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b National Marine Fisheries Service, 7305 Beach Drive East, Port Orchard, WA 98366, USA

Size Selective Predation Among Juvenile Salmonid Fishes in a British Columbia Inlet

ROBERT R. PARKER
Fisheries Research Board of Canada
Biological Station, Nanaimo, B.C.

Over-winter lipid depletion and mortality of age-0 rainbow trout (Oncorhynchus mykiss)

Peter A. Biro, Ashley E. Morton, John R. Post, and Eric A. Parkinson

From Duffy and Beauchamp (2011)
Estuaries provide productive foraging opportunities

But human impacts to estuaries may affect juvenile salmon foraging performance
Wetland loss/modification

Shifts in invertebrate assemblages

Reduced invertebrate populations

Reduced juvenile salmon growth

Density of conspecifics

Reduced salmon foraging performance

Reduced estuarine and marine survival

From Magnusson and Hilborn (2003)
Hypotheses

Minimal wetland loss

Extensive wetland loss

Foraging rate

Diet composition

Minimal wetland loss

Extensive wetland loss
<table>
<thead>
<tr>
<th>Estuary</th>
<th>Relevant references</th>
<th>Number of salmon</th>
<th>Years sampled</th>
<th>Percent wetlands lost</th>
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<tbody>
<tr>
<td>Alsea</td>
<td>(Bieber 2005)</td>
<td>74</td>
<td>2004</td>
<td>59.1</td>
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<td>Coquille</td>
<td>(Bieber 2005)</td>
<td>43</td>
<td>2003</td>
<td>94.3</td>
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<td>Duwamish</td>
<td>(Cordell et al. 2011, Ruggerone et al. 2006)</td>
<td>1000</td>
<td>2003; 2005</td>
<td>98.9</td>
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<td>50</td>
<td>2003</td>
<td>91.3</td>
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<tr>
<td>Nisqually</td>
<td>unpublished</td>
<td>505</td>
<td>2010-2012</td>
<td>41.3</td>
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<td>Yaquina</td>
<td>(Bieber 2005)</td>
<td>32</td>
<td>2003</td>
<td>70.6</td>
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Methods
Ration size = \(100 \times \frac{\text{stomach contents mass}}{\text{fish mass}}\)
The diagram shows a scatter plot with the logarithm of Ration + 0.1 on the y-axis and the proportion of wetlands lost on the x-axis. The correlation coefficient is given as $P = 0.42$ and the coefficient of determination as $R^2 = 0.10$. The data points are labeled for different regions, including Salmon, Nisqually, Siuslaw, Yaquina, Nestucca, Duwamish, Coquille, Alsea, and Columbia.
Energy ration = \[ \sum \text{prey taxa mass}_i \ast \text{energy density}_i \] / \text{fish mass}
Multivariate diet analysis

- Canonical correspondence analysis (CCA)
- Used sampling events (location x date) as the unit of observation.
- Explanatory variables:
  - Proportional wetland loss
  - Salinity
  - Day of year
  - Mean fork length
### Multivariate results

#### Inertia Proportion

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#### Term df F N. perm P

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<td>Salinity</td>
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#### Model df F N. perm P

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Conclusions

• Little evidence of a direct effect of estuarine wetland loss on salmon foraging performance.

• But, wetland loss appeared to mediate the effect of density on salmon foraging performance.

• Salmon recovery efforts need to recognize that density-dependent processes may still be important at abundances that are low relative to historic levels (Achord et al. 2003; Green and Beechie 2004).
Acknowledgements

Lia Stamatiou
Mary Austill Lott
Walker Duval
Claire Levy
Alisa Bieber
Beth Armbrust
Erin Morgan
Emiliano Perez
Trevan Cornwell
Angela Lind-Null
Karl Stenberg
Dave Beauchamp
Thomas Quinn
ODFW
And many others

Funding: US EPA, NSF Graduate Research Fellowship Program, Nisqually Indian Tribe, US Fish and Wildlife Service, Salmon Recovery Funding Board, King County Conservation Fund, Oregon Sea Grant, Washington Sea Grant

Photos: Michael Grilliot, Jeff Cordell, Jason Toft, Christopher Ellings, Stuart Munsch, the Wetland Ecosystem Team.