Species and Habitat Studies: Riverscape Surveys

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Overview of Project Purpose

• Juvenile salmonid summer rearing habitat is limited in rain dominated rivers
• Little was known about summer rearing distributions of juvenile salmonids in the Chehalis
Overview of Project Purpose

• Identify fish, habitat, and temperature associations during summer low flow period
  o Identify spatial distribution of juvenile salmonids

• Understand fish and habitat diversity within and among sub basins
Riverscape Approach

• Spatially continuous snorkel and habitat surveys
• Temperature logging sites 1 – 5 km apart
• Relative abundance by species and life stage
Spatial Distribution of Juvenile Salmonids and Other Fish
Fish Assemblages in Chehalis Mainstem 2013 & 2014

![Graphs showing fish assemblages in Chehalis Mainstem in 2013 and 2014. The graphs display Age 0 Trout, Age 0 Salmon, Shiner, and Dace along the river kilometer.]
Fish Assemblages in Chehalis Mainstem 2013 & 2014

Age 0 Trout
Age 0 Salmon

DAM

RESERVOIR

Shiner Dace

Principal Component 1 (53%)

River kilometer

2013

2014

DAM

RESERVOIR

Age 0 Trout

Shiner Dace

Principal Component 1 (70%)

River kilometer
Relatively consistent species distribution across sub basins
Spatial Organization of Habitat and Temperature in Chehalis Mainstem

Less pools, less complexity, finer substrate

More pools, more complexity, coarser substrate

Principal Component 1 (39%)

Principal Component 1 (56%)

Cooler

Warmer
Longitudinal “river gradient” — species, habitat, and temperature change together

Temperature (mean daily)

<table>
<thead>
<tr>
<th>METRIC</th>
<th>VALUE</th>
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</thead>
<tbody>
<tr>
<td>Min</td>
<td>18.7°C</td>
</tr>
<tr>
<td>Max</td>
<td>22.8°C</td>
</tr>
<tr>
<td>Range</td>
<td>4.1°C</td>
</tr>
<tr>
<td>Dur. &gt; 18°C</td>
<td>0.90</td>
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<table>
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<tr>
<th>METRIC</th>
<th>VALUE</th>
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<tbody>
<tr>
<td>Min</td>
<td>16.2°C</td>
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<tr>
<td>Max</td>
<td>20.3°C</td>
</tr>
<tr>
<td>Range</td>
<td>4.1°C</td>
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<tr>
<td>Dur. &gt; 18°C</td>
<td>0.44</td>
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</table>
Do habitat and temperature metrics predict fish composition when controlling for river km?

- Partial Redundancy Analysis – can habitat and temperature metrics explain species composition when controlling for river kilometer (i.e. “river gradient” accounted for)

- Variance partitioning - How much variation is explained by each variable individually and together? (Borcard et al 1992; Peres-Neto et al. 2006)
Majority of variation explained by combination of habitat, temperature, river km

- Longitudinal “River gradient” explains majority of overall variation (52.4%) in species composition but a smaller portion is explained by habitat (12.3%) and temperature (7.3%) characteristics alone.

<table>
<thead>
<tr>
<th></th>
<th>AGE-0 TROUT</th>
<th>SHINER</th>
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<tbody>
<tr>
<td>Habitat</td>
<td>Coarse substrate</td>
<td>Fine substrate</td>
</tr>
<tr>
<td></td>
<td>High long. complexity</td>
<td>Low long. complexity</td>
</tr>
<tr>
<td>Temperature</td>
<td>Low minimum</td>
<td>High minimum</td>
</tr>
<tr>
<td></td>
<td>Low maximum</td>
<td>High maximum</td>
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<table>
<thead>
<tr>
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<th>AGE-0 SALMON</th>
<th>DACE</th>
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<tbody>
<tr>
<td>Habitat</td>
<td>High pool freq</td>
<td>Low pool freq</td>
</tr>
<tr>
<td>Temperature</td>
<td>Low maximum</td>
<td>High maximum</td>
</tr>
<tr>
<td></td>
<td>Low temp range</td>
<td>High temp range</td>
</tr>
</tbody>
</table>
Overview of Project Purpose

• Identify fish, habitat, and temperature associations during summer low flow period
  o Identify spatial distribution of juvenile salmonids

• Understand fish and habitat diversity within and among sub basins
Mean maximum temperature (July 15 – Aug 31) variable among sub basins

![Graph showing mean maximum temperature over elevation for different sub basins in 2014 and 2015. The graph includes data points for East Fork Satsop, North Fork Newaukum, Upper Chehalis, and West Fork Satsop.]
Wood densities variable among sub basins
Pool-riffle dominant channel type among sub basins

Montgomery and Buffington 1997
East Fork Satsop headwaters unique to our surveys
Results to Date

• Higher elevation locations are important summer rearing areas for juvenile salmonids
• Majority of summer rearing for juvenile salmonids in Chehalis mainstem is upstream of proposed dam location
  o Highlights magnitude of importance of this area
• Fish composition can be explained by an interaction of habitat, temperature, and river km
  o Cautious to say one factor makes reach suitable for juvenile salmonids
• Upper Chehalis is warmer with less wood than other surveyed sub-basins (Newaukum, Satsop)
• Temperature and habitat of East Fork Satsop is unique among our surveys
Acknowledgements

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• Funding: Washington State Legislature
• Paul Pickett, Ecology (temperature monitoring)
• Land access: Weyerhaeuser Co., Green Diamond Resource Company, Panesko Tree Farm
Questions

Upper West Fork Humptulips
Results to Date

- Similar longitudinal pattern of fish and habitat among sub basins
  - Higher elevation locations important summer rearing for juvenile salmonids
- Fish composition can be explained by an interaction of habitat, temperature, and river km
  - Cautious to say one factor makes reach suitable for juvenile salmonids
- Upper East Fork Satsop is unique
- Upper Chehalis (in dam/reservoir footprint) is important for juvenile salmonid summer rearing
- Upper Chehalis has lower LWD relative to other sub basins
Planned Analyses

• Meta analysis of fish, habitat, and temperature riverscape data from multiple sub-basins
• PIT-tagging summer movement study in SF Newaukum
Species Explained by Habitat and Temperature
Once river km was accounted for, the combination of habitat and temperature metrics explained additional variation in fish species composition.
Species Explained by Habitat and Temperature – Variance Partitioning

Numbers are adj $R^2$ values
Residual Adj $R^2= 0.229$
Spatial Organization of Habitat and Temperature in Chehalis Mainstem

Less pools, less complexity, finer substrate

↓ pool freq.
↓ horiz. complex
↑ wet width/BFW fine substrate

↑ pool freq.
↑ horiz. complex
↓ wet width/BFW coarse substrate

↓ min temp
↓ dur. >18C

↑ min temp
↑ dur. >18C

Cooler

Warmer

Principal Component 1 (39%)

Principal Component 1 (56%)

River kilometer