Temperature, cyprinid density, and juvenile steelhead summer occurrence patterns

John Winkowski, Mara Zimmerman, Eric Walther, WDFW

Steelhead Managers Meeting – Walla Walla, WA

March 20-22, 2018
Fish assemblages in rivers

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Profiles and Biology of Western European Streams as Related to Fish Management

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Landscape Influences on Longitudinal Patterns of River Fishes: Spatially Continuous Analysis of Fish–Habitat Relationships

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Spatial Distribution of Native and Nonnative Salmonids in Streams of the Eastern Slopes of the Canadian Rocky Mountains

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John R. Post

Temperature-dependent performance as a driver of warm-water fish species replacement along the river continuum

Matthew J. Troia, Michael A. Denk, and Keith B. Gido

Temperature mediation of competitive interactions among three fish species that replace each other along longitudinal stream gradients

Yoshinori Taniguchi, Frank J. Rahel, Douglas C. Novinger, and Kenneth G. Gerow
Chehalis River

- Flood damage
  - Proposed dam
- Habitat degradation
  - Aquatic Species Restoration Plan
Chehalis River

- Hydrology – rain dominant
  - Low summer flows
  - High summer temperatures
Replacement of salmonids by cyprinids in downstream direction in August

Interactions Between the Redside Shiner (Richardsonius balteatus) and the Steelhead Trout (Salmo gairdneri) in Western Oregon: The Influence of Water Temperature

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Temperature-Dependent Interactions between Juvenile Steelhead and Sacramento Pikeminnow in Laboratory Streams

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Objectives

• Describe landscape, habitat, temperature, and steelhead distribution in our study area

• Explore associations between temperature and cyprinids on steelhead occurrence in our study area
Field methods

- 37.5 km study area
- Landscape characteristics via National Land Cover Database, Terrainworks
- Habitat metrics by 200m segments
- Temperature measured in study area via HOBO pendant loggers
- Fish count by snorkeling, 200m segments
  - 4 surveys
Landscape characteristics

13-16% Forest cover, 42-44% Cultivated land
0.4 – 0.6 % Gradient
27-36.1 Valley confinement index

46-48% Forest cover
0.7 – 1.4 % Gradient
2.7 – 10.6 Valley confinement index
Habitat – minimal longitudinal pattern

- Pool riffle dominant
- LWD 1.7-4.9 per 100m
- Wetted widths 9.1 – 13.2m
- Maximum depth 1.2 – 1.7m
- Pool counts 0.9 – 1.7 per 100m
- Substrate was slightly more coarse in upstream reaches
Temperature characteristics

- Mean maximum daily temperatures by month
Cooler in upstream sections, warmer in downstream sections
Cooler in upstream sections, warmer in downstream sections, warmer in July.
Cooler in upstream sections, warmer in downstream sections, warmest in August
Cooler in upstream sections, warmer in downstream sections, cooler in September
Juvenile steelhead distribution
Cumulative proportion of juvenile steelhead observations increased in an upstream direction.
50% of observations shifted upstream by 11 river km
Association of juvenile steelhead occurrence, temperature, cyprinids

Generalized linear mixed effects model:
Steelhead occurrence (0/1) ~

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<tr>
<th>Fixed effects</th>
<th>Maximum temperature</th>
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<td>log(Cyprinid density)</td>
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<td>Maximum temperature*log(Cyprinid density)</td>
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<td>Random effects</td>
<td>Segment (200m)</td>
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Discussion

• Strong association of juvenile steelhead and temperature
  • Coldest = high occurrence
  • Warmest = low occurrence
  • Restoration take-home: actions that cool temperatures should expand summer rearing locations for juvenile steelhead

• Association between juvenile steelhead and cyprinids depends on temperature
  • Coldest = no association
  • Warmest = negative association
    • Restoration take-home: When maximum temperatures are above 20C native taxa may further limit distribution of juvenile steelhead
  • Intermediate = positive association
    • Restoration take-home: When maximum temperatures are below 20C native taxa are unlikely to limit distribution of juvenile steelhead
Next steps

• Account for spatial autocorrelation in model
• Explore 200m scale habitat variables
• Determine associations with steelhead density
Thank you!
Acknowledgements

- Field crew
- Landowners of Newaukum basin
- Funding by the Washington State Legislature