Floodplains, Fish Habitat, and Climate Change Resilience

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What is resilience?

- Ability of an ecosystem to maintain its structure and functions despite environmental change
- For salmon, resilience more commonly means persistence of the species despite climate change
- Floodplains confer climate change resilience through:
  - Habitat diversity
  - Thermal diversity
  - Species diversity
Change in flow regime

Data source: http://www.hydro.washington.edu/2860/report/
Increased water temperature

Beechie et al. 2013
Higher habitat diversity

Young scroll bar channel

Riffle dominated
Higher habitat diversity

Young abandoned main stem

Mixed riffle and pool
Higher habitat diversity

Old abandoned main stem

Pool / pond dominated
Surface water temperature patterns in the Sauk River floodplain
Longer hyporheic flow paths regulate stream temperature

Poole et al. 2008
Longer hyporheic flow paths regulate stream temperature

Poole et al. 2008
Higher invertebrate diversity

- Young channels dominated by gatherers
- Older channels dominated by scrapers
Higher growth rate

Jeffres et al. 2008
Enclosed experiment, same age Chinook

Main channel
Floodplain
More salmonids in side channels

Bellmore et al. 2013, Pess et al. 2008
### What can floodplains do for climate change resilience?

<table>
<thead>
<tr>
<th>Restoration action</th>
<th>Temperature increase</th>
<th>Low flow decrease</th>
<th>Peak flow increase</th>
<th>Increase resilience</th>
</tr>
</thead>
<tbody>
<tr>
<td>Longitudinal connectivity</td>
<td>Y</td>
<td>Y</td>
<td>N</td>
<td>Y</td>
</tr>
<tr>
<td>Floodplain connectivity</td>
<td>Y</td>
<td>N</td>
<td>Y</td>
<td>Y</td>
</tr>
<tr>
<td>Restore incised channel</td>
<td>Y</td>
<td>Y</td>
<td>Y</td>
<td>Y</td>
</tr>
<tr>
<td>Restore in-stream flow</td>
<td>Y</td>
<td>Y</td>
<td>N</td>
<td>N/Y</td>
</tr>
<tr>
<td>Riparian rehabilitation</td>
<td>Y</td>
<td>N/Y</td>
<td>N</td>
<td>N</td>
</tr>
<tr>
<td>Sediment reduction</td>
<td>N</td>
<td>N</td>
<td>N</td>
<td>N</td>
</tr>
<tr>
<td>In-stream habitat</td>
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<td>N</td>
<td>N</td>
<td>N</td>
</tr>
<tr>
<td>Nutrient enrichment</td>
<td>N</td>
<td>N</td>
<td>N</td>
<td>N</td>
</tr>
</tbody>
</table>
Reducing climate change effects through restoration

Waples et al. 2008
Reducing climate change effects through restoration

Waples et al. 2008
And restoring incised channels

Reduce temperature
Increase low flow
Decrease peak flow (or its effect)
Summary

• Connected or restored floodplains confer resilience through
  • Habitat diversity
  • Thermal diversity
  • Species diversity

• They also can ameliorate peak flow and high temperature effects through
  • Flood attenuation and refugia
  • Thermal refugia