### Climate Change: Combining Forces

<table>
<thead>
<tr>
<th>Climate impact</th>
<th>Salmon impact</th>
<th>Primary geographic area</th>
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<tbody>
<tr>
<td><strong>Hydrology</strong></td>
<td>Shifting timing of life cycle transitions; scouring/smothering redds; standing; increased disease; loss of thermal refugia; loss of flood refugia; migration barriers due to extreme low and/or high flows</td>
<td>Mainstem spawning reaches — Lower Tolt, Lower Raging, Snoqualmie at Fall City reach, Snoqualmie at Carnation reach, middle Pilchuck, mainstem Skykomish</td>
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<tr>
<td><strong>Temperature</strong></td>
<td>Can be lethal above certain temperatures; sub-lethal effects above 17 °C include developmental abnormalities, altered growth rates, non-fertilization of eggs; altered food web; migration timing; altered predator/prey relationship; increased disease</td>
<td>Temperature will be a concern for the whole watershed. Areas likely to feel the greatest impacts include: the Mainstem Skykomish, Snoqualmie, Snohomish. Cherry Creek, Raging River, Woods Creek</td>
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<td><strong>Stormwater</strong></td>
<td>Increased water pollution causing decreased oxygen, food web alteration, pre-spawn mortality</td>
<td>Older developed areas in Patterson and Tuck Creeks and the cities of Everett and Monroe</td>
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<td><strong>Sedimentation</strong></td>
<td>Lethal conditions, smothering of interstitial spaces in redds and choking of gills; interference with migration cues; decreased resistance to disease; altered /decreased habitat</td>
<td>Headwaters of Skykomish, Snoqualmie, Raging and Tolt Rivers. Nearshore</td>
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<td><strong>Sea level rise</strong></td>
<td>Shifting habitat range; loss of estuarine habitat; altered food web; could create passive gains in habitat depending on nearby infrastructure constraints, elevation, and vegetation gradients</td>
<td>The Puget Sound nearshore including the Snohomish basin nearshore (Everett to Mukilteo) and estuary</td>
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<tr>
<td><strong>Ocean acidification and increased temperature</strong></td>
<td>Altered food webs; decreased food availability; decreased ocean survival; diminished dissolved oxygen affecting metabolism; altered migration pattern</td>
<td>Puget Sound, Salish Sea, and Pacific Ocean</td>
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Source: Skagit Climate Science Consortium, www.skagitchlimatecience.org
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<tr>
<th>Climate impact</th>
<th>Strategies and Actions</th>
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| Hydrology      | • Encourage natural processes that may moderate expected shifts.  
                 • Research and implement innovative restoration practices where appropriate to dampen the effects of shifting hydrology.  
                 • Protect habitat outside current habitat boundaries so habitats can shift and adapt.  
                 • Monitor land use in headwater areas to minimize impacts to hydrology.  
                 • Reconnect disconnected floodplains in mainstems and headwaters.  
                 • Remove and fix barriers like culverts and floodgates to ensure access to tributaries and oxbows, and protect pools.  
                 • Work with dam operators to use reservoirs to ameliorate hydrologic impacts.  
                 • Plant and protect forests in the basin. Work with forestry managers and researchers to investigate longer stand rotations and selective logging to improve basin hydrology. |
| Temperature     | • Identify, protect and enhance processes and habitats that provide cool water.  
                 • Protect and restore tributaries, which are cooler than the mainstem rivers.  
                 • Remove and fix barriers like culverts and floodgates to ensure access to tributaries and oxbows, and protect pools.  
                 • Monitor land use changes, particularly tree removal and new development, to quantify and mitigate impacts.  
                 • Restore riparian buffers to help stabilize stream temperatures and reduce sediment and toxins.  
                 • Work with dam operators to use reservoirs to ameliorate temperature impacts.  
                 • Plant and protect forests in the basin. Work with forestry managers and researchers to investigate longer stand rotations and selective logging to improve basin hydrology. |
| Stormwater      | • Study and prioritize areas that need stormwater retrofits and accelerate those actions.  
                 • Implement Green Stormwater Infrastructure in urban and residential areas. |
| Sedimentation   | • Restore riparian buffers more quickly to help reduce sediment load.  
                 • Protect intact buffers to reduce sediment load and minimize erosion.  
                 • Study and understand sedimentation changes in mainstem areas (Grossman work). |
| Sea level rise  | • Identify how habitat boundaries, such as nearshore and estuaries, are changing.  
                 • Protect marine and freshwater shorelines at risk of being armored as climate change continues.  
                 • Protect habitat outside current habitat boundaries.  
                 • Improve regulatory protection in all unarmored marine areas. |
Next Steps - Climate Change 2.0

• Vulnerability analysis
• Understands actions that are sensitive to climate change – culverts
• Multi-benefits analysis
• What projects need specific climate change data (streamflow, temp)
• Salmon Conservation Plan update
• Project prioritization