WRIA 7 CLIMATE CHANGE IMPACTS TO SALMON ISSUE PAPER

Prepared for the Snohomish Basin Salmon Recovery Technical Committee

Prepared by:

Beth IeDoux – Snoqualmie Watershed Forum

Jessica Engle – King County Climate Adaptation

Morgan Ruff – Tulalip Tribes Natural Resources Department

Colin Wahl – Tulalip Tribes Natural Resources Department

Climate Change: Combining Forces

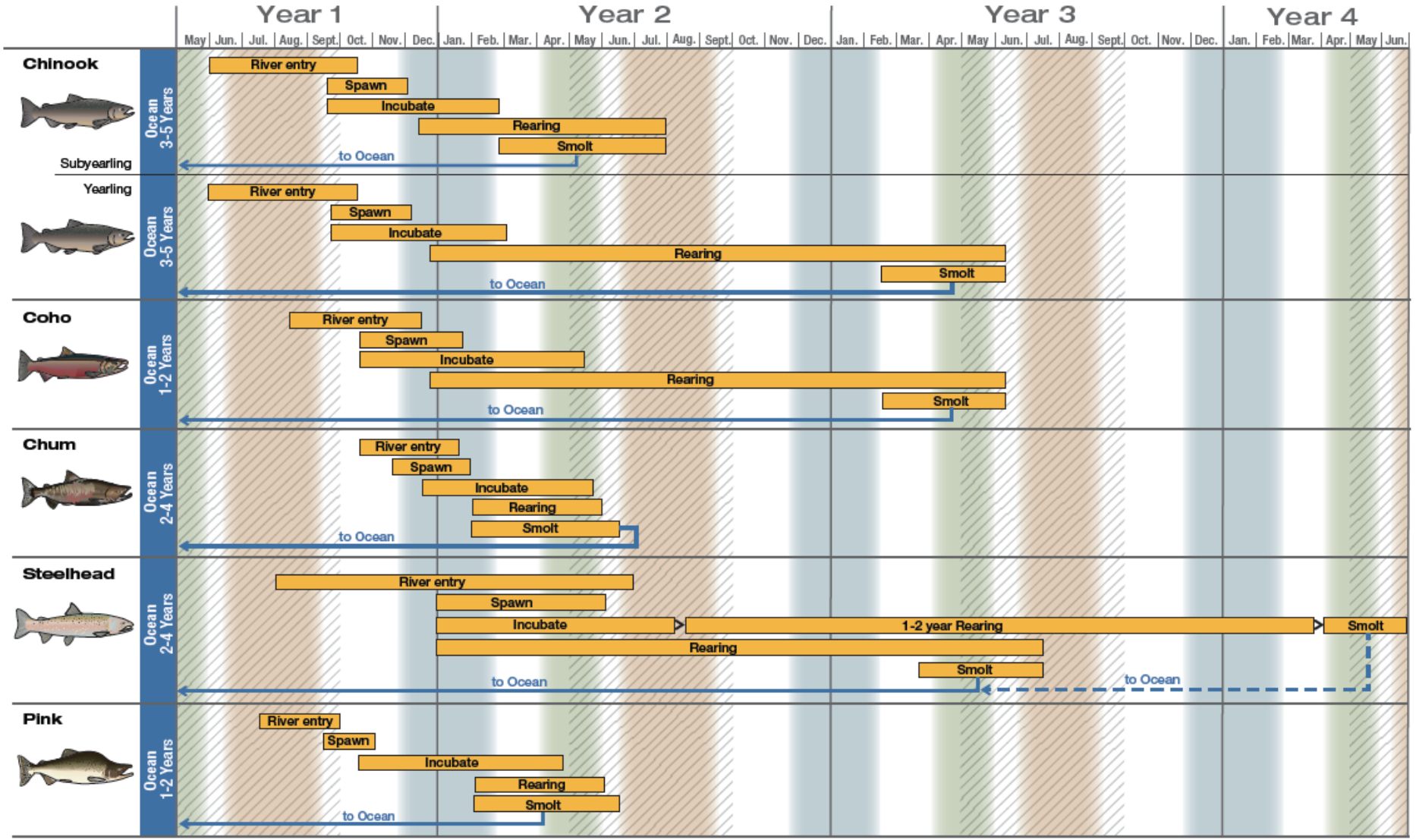
Climate impact	Salmon impact	Primary geographic area
Hydrology	Shifting timing of life cycle transitions; scouring/smothering redds; stranding; increased disease; loss of thermal refugia; loss of flood refugia; migration barriers due to extreme low and/or high flows	Mainstem spawning reaches – Lower Tolt, Lower Raging, Snoqualmie at Fall City reach, Snoqualmie at Carnation reach, middle Pilchuck, mainstem Skykomish
Temperature	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	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
Stormwater	Increased water pollution causing decreased oxygen, food web alteration, pre-spawn mortality	Older developed areas in Patterson and Tuck Creeks and the cities of Everett and Monroe
Sedimentation	Lethal conditions, smothering of interstitial spaces in redds and choking of gills; interference with migration cues; decreased resistance to disease; altered /decreased habitat	Headwaters of Skykomish, Snoqualmie, Raging and Tolt Rivers. Nearshore
Sea level rise	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	The Puget Sound nearshore including the Snohomish basin nearshore (Everett to Mukilteo) and estuary
Ocean acidification and increased temperature	Altered food webs; decreased food availability; decreased ocean survival; diminished dissolved oxygen affecting metabolism; altered migration pattern	Puget Sound, Salish Sea, and Pacific Ocean

Source: Skagit Climate Science Consortium, www.skagitclimatescience.org

Climate Change Impacts on Snohomish Basin Salmonids

Adapted from Beechie et al (2012) fish timing represents typical fish behavior

King County
Department of Natural Resources and Parks
Water and Land Resources Division
Rural and Regional Services Section



Increased summer temperature may decrease growth or kill juvenile salmon where temperatures are already high and block/delay migration. May also decrease spawning fecundity (e.g. Chinook).

Decreased summer low flow may contribute to increased temperature, decrease rearing habitat capacity for juvenile salmonids, and decrease access to or availability of spawning areas.

Increased winter floods may increase scour of eggs, or increase mortality of rearing juveniles where flood refugia are not available, displace juveniles to less desirable habitats.

Loss of spring snowmelt may decrease or eliminate spawning opportunities for steelhead, may alter survival of eggs or emergent fry for other salmonid species, cause early dewatering of off channel and side channel habitats, and reduce connectivity to the floodplain.

1701_8214L_W7_fish_ClimateImpacts.ai

Climate impact	Strategies and Actions
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