

Climate Change Impacts on Salmon

CHANGES DUE TO GLOBAL WARMING	IMPACT ON SALMON
<p>Higher river water temperatures in summer</p>	<p>Salmon physiology: Salmon are cold-water species that prefer temperatures between 12-15 °C (PFRCC 1999). The lethal water temperature limit for adult chinook and coho is 25 °C (Carter 2005), while is it 22-24 °C for sockeye (BC MoE 2016). Less extreme temperatures can also impact salmon migration, growth, and spawning.</p> <p>Salinity tolerance: Higher temperatures result in a loss of salinity tolerance, which affects smolt survival (and adult returns).</p> <p>Spawning streams: higher temperatures and reduced rainfall could reduce fish productivity, egg survival and smolt growth.</p> <p>Migration patterns: Higher water temperatures could also alter migration patterns, resulting in fish moving northwards.</p>
<p>Low water flows in summer</p>	<p>Migration: Impacts on spawning habitat and fish's ability to make it to the spawning area.</p> <p>Ecosystem shifts: Changes in stream flow are associated with shifts in salmon habitat, water temperature, nutrient availability, and sediment levels.</p>
<p>Glaciers and snowpack:</p> <p>Warmer temperatures may reduce snowpacks and stored water.</p> <p>Warmer springs may mean faster, more sudden melts of winter snowpacks, which can cause freshet flooding and introduce suspended sediments in the short term.</p> <p>In the long term, lower snow packs will result in reduced water flow in the river.</p>	<p>In the short term, more severe freshet flooding and suspended sediment could destroy fish habitat such as rearing areas, spawning areas etc.</p> <p>Suspended sediment from glacier melt, landslides or erosion due to deforestation can impact salmon by:</p> <ol style="list-style-type: none"> 1. blocking light, which reduces algae production. 2. damaging gill membranes of fish. <p>When sediment settles on gravel beds:</p> <ol style="list-style-type: none"> 1. it fills the gravel interstices, reducing the supply of dissolved oxygen to the fish eggs. 2. forms a barrier to fry emergence. 3. survival after fry emergence is impaired because of loss of escape cover and reduction of aquatic organisms that are food for the fry. <p>Excess sediment can also damage rearing habitat, areas where young fish feed and grow, by creating unfavorable conditions for growth of aquatic insects.</p> <p>In the long term, lower water flow could increase water temperature which adversely affects migration salmon who cannot tolerate higher water temperature. Lower water flows could also result in the drying up of spawning areas.</p>
<p>Intense winter storms and higher precipitation leading to landslides:</p> <p>Increased risk of landslides particularly where logging fire and mountain pine beetle outbreaks have reduced trees.</p>	<p>Barriers to movement: Landslides could create barriers to fish movement, destroy fish habitat and affect fish mortality. (see Impacts of Suspended Sediment above)</p> <p>Vegetation loss: Landslides could strip forests and streamside vegetation needed to shade and cool watercourses.</p> <p>Suspended sediment: Increased suspended sediment and woody debris affecting water quality.</p> <p>Invasive species: may become more established in disturbed areas.</p>
<p>Floods due to sea level rise and higher freshet</p> <p>Increased sediment load.</p> <p>Contaminated sites</p> <p>Flood infrastructure</p>	<p>Floods can damage riparian vegetation that fish rely on for shading, stir up of sediments, alter flows and substrates.</p> <p>Intense flooding may also affect fish habitat by stripping away riparian vegetation and causing plant mortality, which reduces stream shading and other benefits provided by riparian buffers.</p> <p>Floods can increase the possibility of soil from landslides entering waterways.</p> <p>Sediment released during floods could smother incubating eggs, which are located in the spawning streams, and incubate over the winter (McNeil 1966, Thorne and Ames 1987).</p> <p>A major winter or summer flood can reset the invertebrate community to a much earlier successional composition and reduce the total macroinvertebrate density was significantly, particularly during winter (Milner <i>et al.</i> 2018). These changes could have important consequences for juvenile salmon that feed on stream benthic invertebrates during rearing.</p> <p>Floods can resuspend harmful chemicals from on-land contaminated sites.</p> <p>Structures (like dikes and flood gates) built to control flood risks need to consider fish use and habitat values, as they can impact habitat complexity for fish, or block fish access to various areas.</p>

<p>Wildfires</p>	<p>Increased sediment and woody debris, damaging fish health and fish habitat.</p> <p>When plants which shade cold-water streams are destroyed, the overall water temperature rises, which impact metabolic and reproductive rates of fish.</p> <p>Higher surface runoff and increased erosion due to less vegetation that traps precipitation. This increases water quantity and decreases water quality.</p> <p>In severe, slow-moving fires the combustion of vegetative materials creates a gas that penetrates the soil profile. As the soil cools, this gas condenses and forms a waxy coating. This causes the soil to repel water – a phenomena called hydrophobicity – which can exacerbate runoff impacts.</p> <p>Toxins released by burnt organic and inorganic materials are in ash, which is redistributed throughout the ecosystem. Also, rainfall could transfer these toxins into waterways.</p> <p>Fire retardants containing water-soluble ammonium salts, industrial strength fertiliser, are used to stop fires. Ammonium phosphate can be harmful to fish.</p> <p>Invasive species may become more established in disturbed areas.</p>
<p>Ocean conditions</p> <p>Ocean Acidification</p> <p>Pacific warm blob – covers 2000 kms</p>	<p>Acidic ocean conditions - may require fish to spend more energy and disrupt a fish's ability to smell danger in the water. It also adversely impacts ventilation of the gills, and can reduce fish growth (Ishimatsu <i>et al.</i> 2008). Ocean acidification has an impact on plankton that affect the whole food chain.</p> <p>Pacific blob - can decrease salmon survival and reduce growth.</p>

(Extracted from : Lower Fraser Climate Adapt Project Phase 2 Report, 2020)

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