Upper Columbia River spring-run Chinook

Overall vulnerability—High (73% High, 27% Very high)
Biological sensitivity—High (84% High, 16% Very high)
Climate exposure—High (86% High, 14% Very high)
Adaptive capacity—Moderate (1.8)
Data quality—79% of scores ≥ 2

Upper Columbia River spring-run Chinook		Expert Scores	Data Quality	Expert Scores Plots (Portion by Category)
Sensitivity attributes	Early life history	1.5	2.8	
	Juvenile freshwater stage	3.5	3	
	Estuary stage	1.5	2.8	
	Marine stage	2.9	2.3	
	Adult freshwater stage	3.5	3	
	Cumulative life-cycle effects	2.8	2.3	
	Hatchery influence	3.1	2.5	
	Other stressors	3.1	3	
	Population viability	3.5	2.8	
	Ocean acidification sensitivity	1.9	1.8	
	Sensitivity Score	High		
Exposure variables	Stream temperature	3.2	2.3	
	Summer water deficit	2.9	1.8	
	Flooding	2.4	2	
	Hydrologic regime	3.5	2.5	
	Sea level rise	1.8	2.3	
	Sea surface temperature	3.4	2	
	Ocean acidification exposure	3.8	2.5	
	Upwelling	2.3	1.8	
	Ocean currents	1.8	1.3	
	Exposure Score	High		
Overall Vulnerability Rank		High		

Life History Synopsis

Upper Columbia River spring-run adults enter the Columbia River as an early part of the aggregate run of spring/summer Chinook salmon, passing Bonneville Dam in April and May (Keefer et al. 2008, Crozier et al. 2016). These fish migrate to three major spawning areas and hold over summer in deep, cool pools before spawning in August or September. Eggs incubate over winter and hatch in spring. The majority of juveniles from these populations spend a full year in fresh water before the downstream migration in April and May. Like other yearling Chinook migrants, juveniles from these populations have a relatively brief estuary resident (Teel et al. 2014, Weitkamp et al. 2015). During their first summer in marine waters, they rapidly move northward along the continental shelf (Fisher et al. 2014, Teel et al. 2015). Like other stream-type Chinook, Upper Columbia spring Chinook salmon are thought to have oceanic

marine distributions and are rarely caught by coastal fisheries (Healey 1991, Myers et al. 1998, Riddell et al. 2018). Although some fish return after one year in the ocean (mostly males and more hatchery than wild fish), most adults return after 2-3 years at sea.

Climate Effects on Abundance and Distribution

For Upper Columbia River spring-run Chinook, high overall sensitivity scores stemmed largely from migration characteristics. Multiple studies have examined the effect of climate change on water temperature and potential viability of populations in this DPS (Cristea and Burges 2010, Honea et al. 2016). Adult holding occurs in some lower tributaries where it is associated with high pre-spawn mortality. However, it appears to be mainly hatchery production fish that utilize these lower-river holding areas. Thus, wild stocks do not appear directly threatened by high stream temperatures in holding tributaries.

Increasing fines in sediment due to increased winter flooding has been highlighted as a potential risk (Honea et al. 2016), although it was considered a lower risk for this DPS than for other Chinook DPSs considered in this assessment. Upper Columbia River spring-run Chinook was ranked ***very high*** in sensitivity for the *adult freshwater stage* and ***very high*** in exposure to *hydrologic regime* shift. Most of this DPS inhabits streams with temperatures that are currently below optimal for growth, so short-term warming does not pose an imminent threat to juvenile survival. Nonetheless, juveniles in this DPS characteristically spend a full year in fresh water, and smolt survival depends on high spring flows, so the DPS was ranked ***very high*** in sensitivity to climate change at the *juvenile freshwater stage*.

Long migrations contribute to climate risk for populations in this DPS; however, their spawning and rearing habitat is of relatively high quality compared to those of many other DPSs. Eggs incubate over winter, with relatively low risk of warming, and this was reflected in a ***low*** mean sensitivity attribute score. Flow regime in the Columbia Basin is strongly driven by snowmelt; therefore, loss of snowpack and subsequent reduction in the spring freshet will affect juvenile rearing and smolt migration. Although the spring smolt migration is slower in low snowpack years, earlier migration timing might benefit this DPS because at present, much of the population enters the ocean later than the optimal period for survival (Scheuerell et al. 2009). This was reflected in a ***moderate*** rank for the *marine stage*. The longer juvenile residence period translates to a higher risk of freshwater mortality but allows smolts to spend very little time in the estuary and lowers exposure to *sea level rise*. Thus, Upper Columbia River spring-run Chinook ranked ***low*** in sensitivity at the *estuary stage*.

The primary concern in terms of cumulative life-cycle effects is loss of the unique life histories of spring-run adults and yearling juvenile migrants. *Cumulative life-cycle effects* was ranked ***moderate***. However, Upper Columbia River spring-run Chinook is at less risk than Snake River spring/summer Chinook, largely because of cooler temperatures in rearing and in most natural-spawner holding habitat and earlier adult migration, which largely avoids high temperature stress during migration, prespawn holding, and juvenile rearing.

Extrinsic Factors

Upper Columbia River spring-run Chinook is listed as threatened under the U.S. Endangered Species Act, with most populations at high risk of extinction due to low abundance and productivity. Spatial structure is also greatly depleted in this DPS because much of the original spawning habitat is blocked by impassable dams. Sensitivity to population viability was therefore ranked ***very high***. This DPS also ranked ***high*** in sensitivity to *hatchery influence* because it is heavily supplemented by hatcheries, and natural reproduction is low. Its location in an agricultural region contributed to a ***high*** rank for *other stressors*, particularly water diversions and habitat loss.

Adaptive Capacity

Upper Columbia River spring-run Chinook may have sufficient adaptive capacity to shorten the juvenile freshwater residence period, but the consequences of such a shift for population viability are unknown. This DPS was deemed unlikely to shift upstream migration timing substantially. Overall this DPS was ranked ***moderate*** in adaptive capacity.

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