Chum Salmon (*Oncorhynchus keta*)

Columbia River chum

Overall vulnerability—Moderate (3% Low, 97% Moderate)
Biological sensitivity—Moderate (2% Low, 97% Moderate, 1% High)
Climate exposure—Moderate (85% Moderate, 15% High)
Adaptive capacity—Moderate (1.9)
Data quality—84% of scores ≥ 2

	Columbia River Chum	Expert Scores	Data Quality	Expert Scores Plots (Portion by Category)
Sensitivity attributes	Early life history	1.6	2.8	
	Juvenile freshwater stage	1.4	2.8	
	Estuary stage	2.4	2.8	
	Marine stage	2.1	1.8	
	Adult freshwater stage	1.6	3	
	Cumulative life-cycle effects	2.7	2.3	
	Hatchery influence	1.5	2.8	
	Other stressors	2.5	2.3	
	Population viability	3	3	
	Ocean acidification sensitivity	1.9	1	
	Sensitivity Score	Moderate		
Exposure variables	Stream temperature	2.2	2.8	
	Summer water deficit	1.5	2	
	Flooding	1.5	2	
	Hydrologic regime	2.1	2.8	
	Sea level rise	2.7	2	
	Sea surface temperature	2.8	2.5	
	Ocean acidification exposure	3.9	3	
	Upwelling	1.8	2	
	Ocean currents	1.9	1	
	Exposure Score	Moderate		
	Overall Vulnerability Rank	Moderate		

Life History Synopsis

Adult Columbia River chum salmon enter fresh water at an advanced state of maturation and begin spawning in November in tributaries closest to the Columbia River mouth, such as Grays River and Big Creek. Later in the season, spawners progress to tributaries farther upstream, such as Hamilton and Hardy Creek, although spawning is restricted to areas below Bonneville Dam (Johnson et al. 1997). Columbia River chum usually spawns in the alluvial fans and lower reaches of medium and large streams (Salo 1991, Myers et al. 2006). Chum has been observed spawning just above the level of saltwater intrusion and tidal influence. A remnant summer-run chum salmon population still exists in the Cowlitz River. Although information is

limited, these fish enter the river earlier, migrate relatively farther upstream to pass Mayfield Dam (rkm 80), and spawn earlier than other Columbia River chum populations. Chum will also seek out areas of groundwater seeps (Bakkala 1970, Salo 1991). For example, there are a number of spawning areas in the mainstem Columbia River where groundwater percolates through the gravel (Rawding and Hillson 2003). Finally, chum tend to spawn in large aggregations, possibly to improve juvenile survival through predator swamping.

Juveniles migrate to the ocean soon after emergence, and may spend weeks in the estuary and Columbia River plume (Salo 1991, Johnson et al. 1997). Thus, growth and survival during the first year is less dependent on freshwater than on estuarine conditions relative to other salmonids. In the estuary, juvenile chum feed on copepods and gammarid amphipods (Salo 1991). Once in the ocean, these juveniles grow quickly and begin moving along the coast in a northerly direction (Weitkamp et al. 2012). Chum salmon typically has a high seas distribution, and fish from Washington rear from the Gulf of Alaska west to the International Date Line and north into the Bering Sea (Urawa et al. 2018). Although there have been relatively few studies, tagged Columbia River chum have been recovered in fisheries off of British Columbia and Southeast Alaska, with the majority of fish returning as 4- and 5-year-olds. In contrast to other salmon, chum salmon spend most of their lives in the ocean and little time in fresh water, either as juveniles or adults.

Climate Effects on Abundance and Distribution

Given the late-autumn return and spawn timing of Columbia River chum, temperatures under climate change scenarios may not be limiting for adult prespawn survival or early life history. Furthermore, the preference for some of these chum to spawn in areas with groundwater seeps provides relatively constant incubation conditions and would moderate somewhat the effect from changes in temperature and precipitation. For chum that spawn in the lowermost reaches of Columbia River tributaries, sea level changes could result in an expansion of areas influenced by saltwater intrusion or tidal (slack water) influence.

Estuary and ocean temperature conditions may change more rapidly than incubation conditions, especially at groundwater seeps, and such changes could leave juvenile migrants "out-of-sync" with nursery conditions. Accordingly, sensitivity to *cumulative life-cycle effects* was ranked ***moderate.*** The small size of juvenile emergent chum migrating to the estuary makes them especially vulnerable to changing conditions in the lower river and estuary as well. For example, the quantity, type, and timing of zooplantkton that juvenile chum feed upon while rearing in the Columbia River estuary and nearshore environs may be dramatically altered under climate change, especially due to *ocean acidification*. It is during this early ocean entry period that chum salmon are most vulnerable to alterations in their environment.

Extrinsic Factors

Columbia River chum salmon are listed as threatened under the U.S. Endangered Species Act, and sensitivity for *population viability* was ranked ***moderate***. Other external sensitivity attributes, such as *other stressors* and *hatchery influence*, were ranked ***low***.

Adaptive Capacity

Adaptive capacity for this DPS was ranked ***moderate***.

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