Pink Salmon (*Oncorhynchus keta*)

Puget Sound pink (Odd- and even-year pink combined)

Overall vulnerability—Moderate (30% Low, 70% Moderate)
Biological sensitivity—Moderate (30% Low, 70% Moderate)
Climate exposure –Moderate (68% Moderate, 31% High)
Adaptive capacity—Moderate (2.0)
Data quality—89% of scores ≥ 2

	Puget Sound Pink	Expert Scores	Data Quality	Expert Scores Plots (Portion by Category)
Sensitivity attributes	Early life history	2.8	2.8	
	Juvenile freshwater stage	1.4	2.8	
	Estuary stage	2.4	2.8	
	Marine stage	2.3	2.3	
	Adult freshwater stage	2	3	
	Cumulative life-cycle effects	2.3	2.3	
	Hatchery influence	1.4	2.8	
	Other stressors	2.4	2.8	
	Population viability	1.3	3	
	Ocean acidification sensitivity	2.4	1	
	Sensitivity Score	Low		
Exposure variables	Stream temperature	2.1	2.8	
	Summer water deficit	1.9	2	
	Flooding	1.7	2	
	Hydrologic regime	2.5	2.8	
	Sea level rise	2.8	2	
	Sea surface temperature	2.9	2.5	
	Ocean acidification exposure	3.9	3	
	Upwelling	1.5	2	
	Ocean currents	2.1	1	
	Exposure Score	Moderate		
	Overall Vulnerability Rank	Low		

Low
Moderate
High
Very High

Life History Synopsis

Puget Sound pink salmon adults migrate a relatively short distance to spawning grounds (30-150 km). Adult migration occurs mostly during summer or early fall. Pink salmon enter Puget Sound as age-0 fry and rear in Puget Sound briefly, rarely residing through the summer (Heard 1991). Most spend limited time in estuaries that are not constrained by temperature or flow (Heard 1991). Migration out of Puget Sound begins in summer, and along with pink salmon from other Salish Sea populations, this DPS migrates slowly northward along the continental shelf, reaching northern British Columbia by fall before heading offshore into the Gulf of Alaska (Radchenko et al. 2018). Pink salmon returns as a mature adult after one winter

at sea (Heard 1991, Ruggerone and Goetz 2004). Some regions of Puget Sound are experiencing losses in primary production and increases in eutrophication, possibly due to nutrient inputs. These can be exacerbated by higher temperatures and increased stratification, and could impact fish in this DPS via losses in secondary production and hypoxia (Moore et al. 2008, Mauger et al. 2015).

Climate Effects on Abundance and Distribution

Few studies have examined the effect of climate factors on productivity of Puget Sound pink salmon. Early marine climate signals such as temperature, upwelling, and PDO explain a large proportion of variation in total return rates (Mantua et al. 1997, Beamish and Mahnken 2001, Ruggerone and Goetz 2004). Some other climate signals imply that warmer winters would result in shorter incubation periods and higher freshwater flows. However, greater sedimentation would result in higher egg-to-fry mortality (Myers et al. 1998, Zimmerman et al. 2015). Sensitivity in the *early life history* (egg incubation stage) was the only attribute ranked ***moderate***.

Exposure overall was ranked ***moderate***, with three factors contributing to that score: *hydrological regime*, mean *sea surface temperature* and *sea level rise*.

Summer temperature barriers exist in some lowland river systems, and these conditions are likely to worsen (Heard 1991). In Puget Sound, summer and fall temperatures in a minority of watersheds may be near the maximum threshold now and in the future. Nonetheless, stream temperatures in this region are expected to change somewhat less than in other regions.

Juveniles consume marine arthropods including copepods, which may be impacted by ocean acidification. A major component of pink salmon diets is pteropods (Armstrong et al. 2005), for which there is strong evidence of OA impacts (Lischka and Riebesell 2012). However, it remains unclear how readily pink salmon might switch prey (Kaczynski et al. 1973, Godin 1981, Armstrong et al. 2008). Exposure to *ocean acidification* was ranked ***very high*** for Puget Sound pink salmon, as pink is the only Pacific salmon species with demonstrated developmental sensitivity to low pH (Ou et al. 2015).

Extrinsic Factors

Some regions of Puget Sound are experiencing losses in primary production and increases in eutrophication, possibly due to nutrient inputs. These can be exacerbated by higher temperatures and increased stratification, and could impact fish via losses in secondary production and hypoxia. In addition, when high flow events are preceded by extended dry months, non-point source pollutants have caused pre-spawn, egg, and juvenile mortality (Scholz et al. 2011).

Adaptive Capacity

Adaptive capacity for Puget Sound pink salmon was ranked ***moderate***.

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