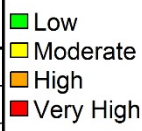
Lower Columbia River steelhead

Overall vulnerability—Moderate (2% Low, 92% Moderate, 6% High)
Biological sensitivity—Moderate (3% Low, 93% Moderate, 3% High)
Climate exposure—High (98% High, 2% Very high)
Adaptive capacity—High (2.3)
Data quality—84% of scores ≥ 2

	Lower Columbia River Steelhead	Expert Scores	Data Quality	Expert Scores Plots (Portion by Category)
Sensitivity attributes	Early life history	1.5	2.8	
	Juvenile freshwater stage	2.1	2.8	
	Estuary stage	1.7	2.3	
	Marine stage	2	2	
	Adult freshwater stage	1.6	2.8	
	Cumulative life-cycle effects	1.8	2	
	Hatchery influence	3.2	2.5	
	Other stressors	2.7	2.5	
	Population viability	2.5	2.8	
	Ocean acidification sensitivity	1.9	1.8	
	Sensitivity Score	Moderate		
Exposure variables	Stream temperature	3.4	2.5	
	Summer water deficit	2.6	2	
	Flooding	2	2	
	Hydrologic regime	1.7	2.8	
	Sea level rise	1.8	2	
	Sea surface temperature	3.2	2.3	
	Ocean acidification exposure	3.9	3	
	Upwelling	1.6	1.8	
	Ocean currents	1.8	1	
	Exposure Score	High		
	Overall Vulnerability Rank	Moderate		



Life History Synopsis

Lower Columbia River steelhead adults migrate year-round, but are generally classified as summer or winter run. Migration is generally December-April for the winter run and April-November for the summer run (Busby et al. 1996). Spawning in both runs occurs predominantly in winter and spring, when temperatures generally are not severe. Incubation and early rearing occurs in late spring, at temperatures generally below critical limits (Wade et al. 2013). Rearing conditions also do not appear to be limited by temperature at present (Busby et al. 1996, Wade et al. 2013).

Steelhead may spend multiple years in fresh water as juveniles, making the freshwater juvenile stage inherently more sensitive to environmental conditions than for other species.

Nonetheless the panel discussed overall evidence for tolerance of this DPS to a broad range of temperatures, leading to a sensitivity score of ***low*** for the *juvenile freshwater stage*, although sensitivity was scored slightly higher than for other stages. Fish from this DPS spend little time in the estuary as they migrate to marine waters (Weitkamp et al. 2015).

Lower Columbia River steelhead smolts generally exhibit early ocean migratory patterns that limit their exposure to potential climate change effects. Like most West Coast steelhead populations, juvenile migrants in this DPS exhibit rapid westward movement, indicative of an offshore distribution that limits exposure to nearshore conditions such as changes in upwelling or sea level rise (Daly et al. 2014). Marine distribution extends across the subarctic Pacific Ocean (Myers 2018). Freshwater migration distances are also relatively short, limiting exposure of adult fish to in-stream threats, and there are no effects of mainstem dams for this DPS except for the few populations above Bonneville Dam.

In the Lower Columbia River, altered stream and/or riparian habitats, including loss of side-channel rearing areas, are key impacts affecting each population, especially in downstream reaches. Several populations have significant habitat area blocked by tributary dams (NMFS 2013).

Climate Effects on Abundance and Distribution

Overall the ***moderate*** ranking for this DPS reflected substantial exposure to changes in the freshwater environment tempered by moderate sensitivity via tolerance for warm conditions and reproductive timing that avoids peak temperatures.

Exposure to *ocean acidification* was ***very high***, as it was for all species in this assessment, due to the strong magnitude of expected pH change, the broad spatial extent of ocean acidification, and the certainty in the direction of change. Exposure was also ranked ***high*** for sea *surface temperature*, reflecting the broad spatial extent of this attribute. Exposure to *stream temperature* was also ranked ***very high***, and exposure to *summer water deficit* was ***moderate***.

Exposure to nearshore attributes was low, since these steelhead tend to spend less time in the nearshore environment and migrate offshore more quickly than some other salmon species. These nearshore attributes to which steelhead had ***low*** exposure included *sea level rise*, *upwelling*, and *ocean currents*.

Wade et al. (2013) found that relative to other Pacific Northwest steelhead, Lower Columbia River steelhead had ***moderate*** exposure to expected changes in *stream temperature* and ***high*** exposure to changes in flow. Steelhead of this DPS were expected to have high sensitivity scores based on habitat condition and threatened population status.

Lower Columbia River steelhead juveniles migrate rapidly through the estuary in late spring and experience a short window of exposure to estuarine factors relative to other species (Fresh et al. 2005). Therefore, exposure to *sea level rise* effects on the estuary was ***low***.

Compared to other steelhead, however, fish in this DPS use the estuary more extensively than many other steelhead stocks, and therefore these fish had slightly higher exposure scores for sea level rise than other Oregon and Washington stocks.

Extrinsic Factors

Lower Columbia River steelhead ranked ***high*** for *hatchery influence*, and ***moderate*** for both *other stressors* and current *population viability*: most hatcheries are production hatcheries. More specifically, among populations for which data are available, five of nine winter-runs have more than 40% hatchery adults in the spawning population, and 3 of 5 summer-runs have more than 25% hatchery returns (Good et al. 2005).

The Lower Columbia River was discussed as an area with high human impacts of diverse types, which led to the score of ***moderate*** for *other stressors*. These other stressors may include loss of floodplain habitats and invasive species (NMFS 2013). Dams limit or block access to the higher elevation spawning habitat that would provide a cold water refuge from climate change (Myers et al. 2006, Ford et al. 2015). In the Lower Columbia River, except for the Wind River summer-run population, all populations of steelhead have moderate to very low probabilities of persistence (Good et al. 2005, NMFS 2013). Both abundance and productivity are low (Good et al. 2005).

Adaptive Capacity

Lower Columbia River steelhead can tolerate a broad range of temperatures and has a very flexible life history. However, this DPS may have to shift migration or spawn timing if hydrologic regime changes affect migration and spawning (Wade et al. 2013). Overall the adaptive capacity score was ***high***.

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