Viability Status of Oregon Salmon and Steelhead Populations in the Willamette and Lower Columbia Basins

Appendix D: Viability Curve Analysis

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Paul McElhany
National Marine Fisheries Service Northwest Fisheries Science Center

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National Marine Fisheries Service

This appendix describes modifications in the viability curve analysis methods of the TRT viability report that were made in conducting the Oregon WLC population status evaluations. These modifications were made based on the inclusion of new data from Washington populations and from the refinement of thinking on some topics. For complete description of the viability curve analysis methodology see the TRT viability report (McElhany et al. 2006).

Variance

Accurate estimates of recruitment variability (variance) are difficult to obtain, especially at the population level. As one solution to this problem we have calculated species level variance estimates by the averaging all of individual population variance estimates for each species. In addition the variance estimate, we have also estimated temporal autocorrelation in the same manner (i.e., an average of values obtained for all populations of each species). Autocorrelation is the tendency for annual differences between observed and model predicted recruitment to be somewhat correlated from one year to the next. (This tendency for streaks of "good years" and "bad years" might be caused, for example, by shifts in marine productivity.)

In the draft viability report, we relied on averaging information from only Oregon WLC populations. We have now included Washington LCR populations in the average and the viability curves used in this report are based on the new variance estimates in Table 1. We have also changed the variance and autocorrelations estimation methods so that they are based on residuals from fitting the MeanRS model rather than directly curve fitting a hockey-stick function (see viability report). Including data from Washington populations had much greater affect on average variance than the change to using MeanRS residuals. As a final modification, we have also calculated a "generic WLC salmon" variance and autocorrelation based on the average of the species averages. The steelhead variance estimates are substantially below those of the other species and there was concern that this may be an artifact of the relatively short time series. Therefore, we conducted the steelhead viability assessment using both the steelhead specific and the generic salmon variance estimates.

Table 1: Variance and autocorrelation based on MeanRS method. Chinook, coho and steelhead estimates are based on average of Oregon and Washington WLC populations.

Species	Variance	Correlation (Lag1)	Correlation (Lag 2)
Chinook	0.863	0.346	0.172
Chum	0.809	0.000	0.000
Coho	1.005	0.292	0.027
Steelhead	0.435	0.518	0.280
Generic WLC Salmon	0.778	0.292	0.114

QET and CRT

The forward projection model used to develop the viability curve tests for the probability that a population will drop to a Critical Risk Threshold (CRT). The CRT describes an abundance level below which the population will be at highly elevated extinction risk because of processes not considered in the extinct risk model (e.g. demographic stochasticty). In the viability report and previous analyses, we referred to similar thresholds as 'quasi-extinction thresholds' (QET). However, the term quasi-extinction threshold suggested to some that we were modeling a level below which a population would experience certain extinction. This is not the case – the lower threshold (the CRT or QET) is simply a region with greatly increased probability of extinction, but until the population is actually down to having only members of a single gender, recovery is possible. Because of the limitations of extinction risk models, using these sorts of lower thresholds, rather than zero fish, is a common practice in conservation biology, but setting the actual value is always challenging. In this analysis, the CRT is a function of the watershed size and we have partitioned Oregon WLC populations into small, medium and large size categories. In **Error! Reference source not found.** we reproduce the summary CRT table from the viability report.

Table 2: Thresholds for Oregon WLC populations copied from TRT viability report (McElhany et al. 2006). The number of fish per spawning km associated with the threshold is shown in parentheses rounded to nearest km. The stream km is a combination of the "Spawning and rearing" plus "Previous/Historical" categories from the ODFW fish distribution data summarized in the WLC habitat atlas (Maher et al. 2005). This may represent an overestimate of the historical spawning habitat because it is likely that not all stream km categorized as "Previous/Historical" was spawning habitat (i.e., some may be "Migratory and rearing" habitat). Stream km for some chum populations is not available (N/A). (McElhany et al. 2006a) *Note: CRT column labeled QET in TRT viability report.

ESU	Life History	Population	Stream (Km)	Size Category	CRT*
Lower Columbia Chinook	Fall	Big Creek	16	Small	50 (3)
		Clackamas River	61	Medium	150 (2)
		Clatskanie River	16	Small	50 (3)
		Lower Gorge Tributaries	10	Small	50 (5)
		Upper Gorge Tributaries	2	Small	50 (25)
		Hood River	39	Small	50 (1)
		Sandy River	75	Medium	150 (2)
		Scappoose Creek	7	Small	50 (7)
		Youngs Bay Tributaries	35	Small	50 (1)
	Spring	Hood River	75	Medium	150 (2)
		Sandy River	125	Medium	150 (1)
Lower Columbia Chum		Big Creek	71	Medium	200 (3)
		Clackamas River	N/A	N/A	N/A
		Clatskanie River	4	Small	100 (25)
		Lower Gorge Tributaries	N/A	N/A	N/A
		Upper Gorge Tributaries	N/A	N/A	N/A
		Hood River	N/A	N/A	N/A
		Sandy River	N/A	N/A	N/A

		Scappoose Creek	N/A	N/A	N/A
		Youngs Bay Tributaries	91	Medium	200 (2)
Lower Columbia Coho		Big Creek	78	Small	100 (1)
		Clackamas River	465	Large	300 (1)
		Clatskanie River	105	Medium	200 (2)
		Lower Gorge Tributaries	14	Small	100 (7)
		Sandy River	247	Large	300 (1)
		Scappoose Creek	125	Medium	200 (2)
		Youngs Bay Tributaries	94	Small	100 (1)
		Hood River	119	Medium	200 (2)
Lower Columbia Steelhead	Summer	Hood River	131	Medium	100 (1)
	Winter	Clackamas River	492	Large	200 (0)
		Lower Gorge Tributaries	14	Small	50 (4)
		Upper Gorge Tributaries	12	Small	50 (4)
		Hood River	154	Medium	100 (1)
		Sandy River	348	Large	200 (1)
Upper Willamette Chinook	Spring	Calapooia River	59	Medium	150 (3)
		Clackamas River	182	Large	250 (1)
		McKenzie River	244	Large	250 (1)
		Molalla River	104	Medium	150 (1)
		North Santiam River	129	Medium	150 (1)
		South Santiam River	190	Large	250 (1)
		Middle Fork Willamette River	272	Large	250 (1)
Upper Willamette Steelhead	Winter	Calapooia River	91	Small	50 (1)
		Molalla River	240	Large	200 (1)
		North Santiam River	198	Medium	100 (1)
		South Santiam River	323	Large	200 (1)

Harvest Rate and Measurement Error Assumptions

For the pre-harvest viability curves, we must also make assumptions about future harvest. We assumed that future harvests would be similar to that observed in recent years. Harvest rate assumptions are copied from the viability report and shown in Table 3. The viability curve analysis also requires assumptions about the measurement error of input parameters, which are copied from the viability report and shown in Table 4. The values in these tables did not change from the TRT viability report, but sense these parameters are important for the viability curve analysis, they are repeated here.

Table 3: Future harvest rate assumptions for Oregon WLC populations based on approximations of current harvest rates (McElhany et al. 2006a).

ESU	Harvest Rate
LCR Fall Chinook	50%
LCR Spring Chinook	25%
CR Chum	5%
LCR Coho	25%
LCR Steelhead	10%
UW Chinook	25%
UW Steelhead	10%

Table 4: Measurement error assumptions for viability curve analysis input parameters for Oregon WLC populations. Modified from (McElhany et al. 2006a). Age composition is the shape parameter from finite multi-nominal sampling (See Appendix A).

ESU	Life History	Population	Data Collection Method	Spawner Abundance	Hatchery Proportion	Age Composition	Fishery Impact
Chinook	Fall (tule)	Clatskanie	Spawning Surveys	±40%	±70%	20	±40%
	Late Fall (bright)	Sandy	Spawning Surveys	±40%	±20%	20	±40%
	Spring	Sandy River	Spawning Surveys	±40%	±40%	20	±30%
Lower Columbia Coho		Big Creek*	Spawning Surveys	±50%	±40%	500	±50%
		Clackamas	Dam Passage Counts	±20%	±20%	500	±50%
		Clatskanie*	Spawning Surveys	±50%	±40%	500	±50%
		Sandy River	Dam Passage Counts	±20%	±20%	500	±50%
		Scappoose River*	Spawning Surveys	±50%	±40%	500	±50%
		Youngs Bay*	Spawning Surveys	±50%	±40%	500	±50%
Lower Columbia Steelhead	Summer	Hood River*	Dam Passage Counts	±20%	±20%	50	±40%
	Winter	Clackamas	Dam Passage Counts	±20%	±20%	20	±40%
		Hood River*	Dam Passage Counts	±20%	±20%	100	±40%
		Sandy River	Dam Passage Counts	±20%	±20%	20	±40%
Upper Willamette Chinook	Spring	Calapooia*	Spawning Surveys	±40%	±40%	100	±30%
		Clackamas	Dam Passage Counts	±20%	±20%	20	±30%
		McKenzie	Spawning Surveys (partial dam count)	±40%	±40%	20	±30%
		Molalla*	Spawning Surveys	±40%	±40%	20	±30%
Upper Willamette Steelhead	Winter	Calapooia	Spawning Surveys	±70%	±60%	20	±40%
		Molalla	Spawning Surveys	±70%	±60%	20	±40%
		N. Santiam	Spawning Surveys	±70%	±60%	20	±40%
		S. Santiam (Lower)	Spawning Surveys	±70%	±60%	20	±40%
		S. Santiam (Upper)	Trap and Handle	±5%	±5%	20	±40%