1.1.1.1.1.1 Assessment of Population Decline Criteria

Lindley et al. (2007) identified the population decline criteria as a way of assessing demographic risks, where severe and prolonged declines to small run sizes are considered strong evidence that a population is at risk of extinction. The criteria developed have two components– a downward trend in abundance and a critical run size (< 500 spawners). A downward trend in abundance is estimated as a 10 percent or greater decline in run size (abundance) per year. And while Lindley et al. (2007) noted that salmonid populations near a carrying capacity of 500 spawners with only modest intrinsic growth rates are typically at a low probability of extinction, it is incorrect to equate outputs of the WRLCM as equating to actual numbers of fish in the Sacramento River. Without actual numbers of fish the WRLCM is only able to provide guidance on the relative probability of a population decline and not whether abundance exceeds the critical run size.

To assess the relative probability of events in which next year's spawner abundance will drop by at least 10 percent, the WRLCM was run for 1000 iterations to represent multiple "states of nature." In each of the model iterations, four different time lags (X = 1, 4, 12, or 20 years) were incorporated to calculate whether the abundance X years in the future had declined by 10 percent or more. For a given iteration, the number of events with population declines of 10 percent or more are assigned into three possible categories: 1) the number of events where abundance decreased by 10 percent or greater was higher in the COS than the PA, 2) the number of events were equal, or 3) the number of events were higher under the PA than the COS. The probability of each outcome was then calculated as the number of outcomes in each of the three categories divided by the total number of iterations, i.e. 1000. This analysis does not indicate that there is a specific probability of a decline occurring under each scenario, but instead it indicates that over the 75-year timeframe (year 5 to 79), that there is a higher probability of events in which next year's spawner abundance will decline relative to the number of events under the other scenario.

Table 2.5.9-1 shows the relative probability of events in which the spawning abundance declines by more than 10 percent over several time periods. The general pattern shows a higher number of events in the PA relative to the number of events in the COS over the 75-year timeframe, and is consistent for spawner abundances at lags of 4 and 12 years with a shift toward more events under the PA relative to the COS at a lag of 20 years.

Table 2.5.9-1. Relative probability of events in which there is a decline in spawner abundance of ≥ 10 percent in time lags of 1, 4, 12, or 20 years under the COS and PA.

	1 Year	4 Years	12 Years	20 Years
Pr COS has more events	0.265	0.235	0.296	0.171
Pr of equal number of events	0.279	0.234	0.26	0.24
Pr PA has more events	0.456	0.531	0.444	0.589

This assessment also reflects the lower mean spawner abundance and higher variability in the spawning abundance in the PA relative to the COS (variance in spawner abundance under PA is 6.23% higher, 95% CI: -0.263%, 12.3% relative to variance in COS spawner abundance and probability that variance is higher under PA relative to COS is 0.971). This pattern is shown in the relative percent difference plot of spawner abundance over time (Figure 2.5.9-5). The lower mean spawner abundance is indicated by the percent differences being below the horizontal 0 line, whereas the variance is indicated by the year to year variability in the differences among years.