# Appendix A:

# Snake River Steelhead DPS: Updated Viability Curves and Population Abundance/Productivity Status.

## Introduction

The Interior Columbia River Technical Recovery Team (ICTRT) developed viability criteria for application to each of the salmon ESUs and steelhead DPSs listed under the ESA (ICTRT, 2007). Following the general guidance in McElhany et al. 2000, those criteria were expressed in terms of four viable salmonid population parameters (abundance, productivity, spatial structure and diversity). Abundance and productivity are considered as a combination and are evaluated against viability curves developed to express relative risks of quasi-extinction in light of the level and year to year patterns in environmentally induced survival variations. The data to generate viability curves for Snake River Steelhead populations and to express current status of individual populations against those curves were very limited at the time the ICTRT developed its recommendations. Annual escapement estimates for two populations (both in the Grande Ronde basin) as well as aggregate abundance estimates of A and B run component returns were used in the original ICTRT analysis. The average patterns in those returns along with an average age composition to generate a single set of viability curves for the DPS. It was only possible to directly assess the status of two of the four populations in the Grande Ronde major population group against the viability curve. Surrogate estimates of average abundance and productivity for A and B run stocks were developed as an indication of general status of the remaining 18 populations in the DPS. Gaining additional information on annual abundance and productivity for representative populations was highlighted as a high research, monitoring and evaluation priority.

Shortly thereafter, two major initiatives were implemented to generate more specific estimates of steelhead spawning and natural production at the population or subregional level within the basin. One approach has been using a multistock genetic baseline combined with systematic sampling of annual runs at Lower Granite Dam to estimate how many natural origin steelhead are returning from specific stock production areas (e.g. Ackerman et al. 2015). The second approach involves systematically marking a proportion of the run over Lower Granite Dam with PIT tags and then generating estimates of escapement past upstream antenna arrays in particular watersheds. Regional managers under the coordination of the Idaho Department of Fish and Game have used information from both studies to produce five year data series representative of several stock groups, each of which represents one or more populations. In addition, IDFG has extrapolated from those recent five year estimates to construct longer term data series.

## Methods

The ICTRT evaluated the sensitivity of viability curves to basic parameter inputs in their 2007 viability report. Average brood year age structure and the level of autocorrelation in annual environmental patterns were both relatively influential in determining curves corresponding to 5% and 1% risks of going below a quasi-extinction threshold. The age structure estimates for individual populations, stock groups and subwatershed data series representative of a range of Snake River steelhead natural production areas are depicted in figure 1. The distributions, displayed as cumulative functions, fall into two distinct groupings based on differences in the relative proportions of the youngest (age 3) and oldest (age 5-7) ages. All sampled groups have a similar proportion of age 4 returns on a brood year basis. One group, corresponding to lower elevation production areas had relatively low proportions of age 5 and older and higher relative proportions of age 3 returns. The second grouping had consistently higher proportions age 6 or older and relatively low proportions of age 3. The two groupings had similar levels of environmental variance and autocorrelation of annual return rates, influenced largely by the fact that many years in the respective series of the stock groups were proportionally derived from the aggregate Lower Granite Dam run series.

Sets of viability curves (25%, 5% and 1% risk of quasi-extinction over a 100 year period) were derived for each grouping using the grid search routines described in ICTRT (2007). Both of the updated curves require higher combinations of abundance and productivity to meet particular risk objectives. The ICTRT(2007) recommended updating viability curves if an updated 5% risk curve exceeded levels that would be associated with a 3% risk curve based on the prior data sets. Both of the new Snake River Steelhead curves exceed that level.

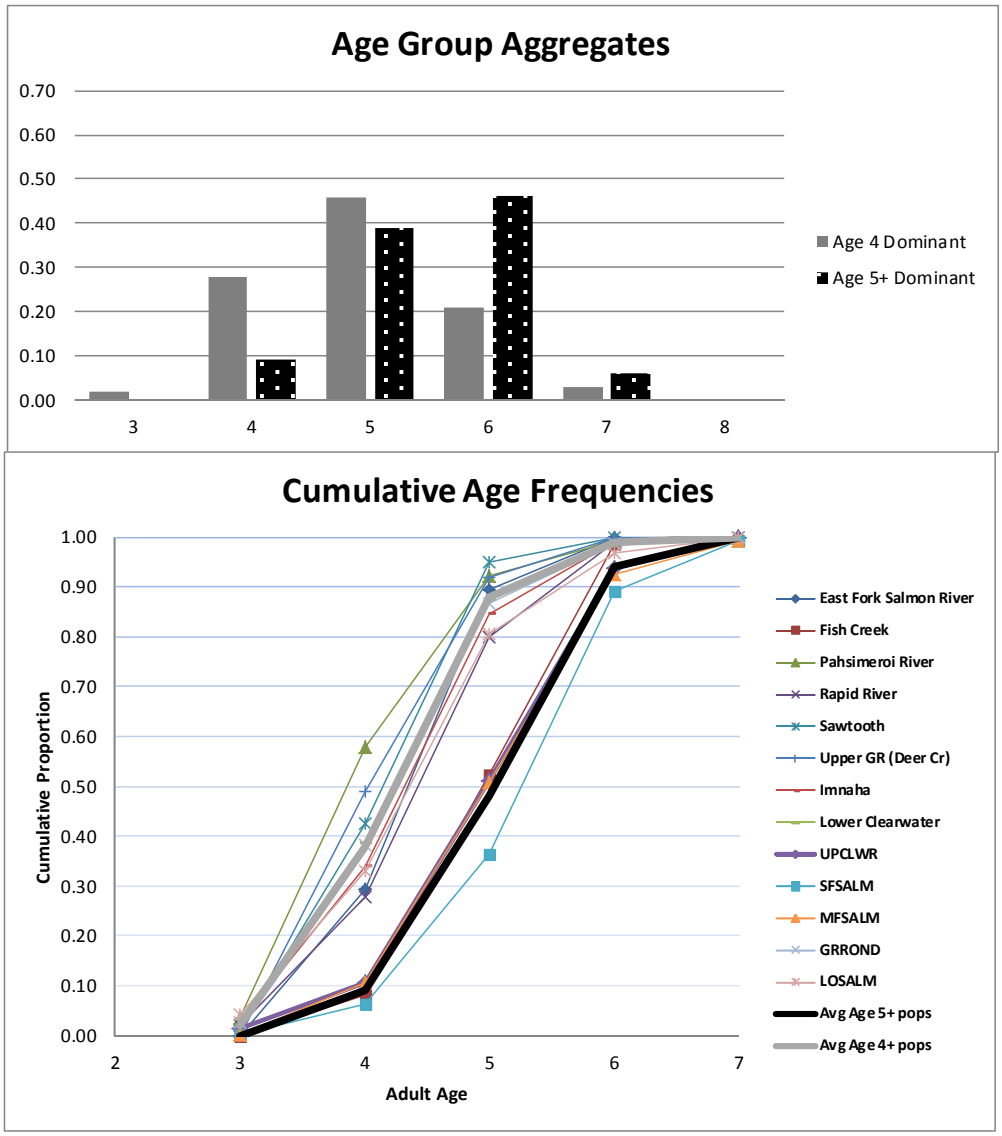



**Figure 1.** Distribution of age at return for natural production from stock groups and weir sampling sites for naturally produced Snake River Steelhead. Top panel is average distribution across ages for two groupings (age 4 dominant and age 5+ dominant. Age 4 dominant runs fall include returns from within Lower Granite arrivals classified as A run. Age 5+ dominant groups include a range of combinations of returns over Lower Granite Dam classified as A or B.

## Results

The following graphs depict the updated viability curves for application to the two age based categories of natural Snake River Steelhead populations/stock groups. Examples of each curve set with minimum abundance thresholds for Intermediate size populations are provided in figure 2.

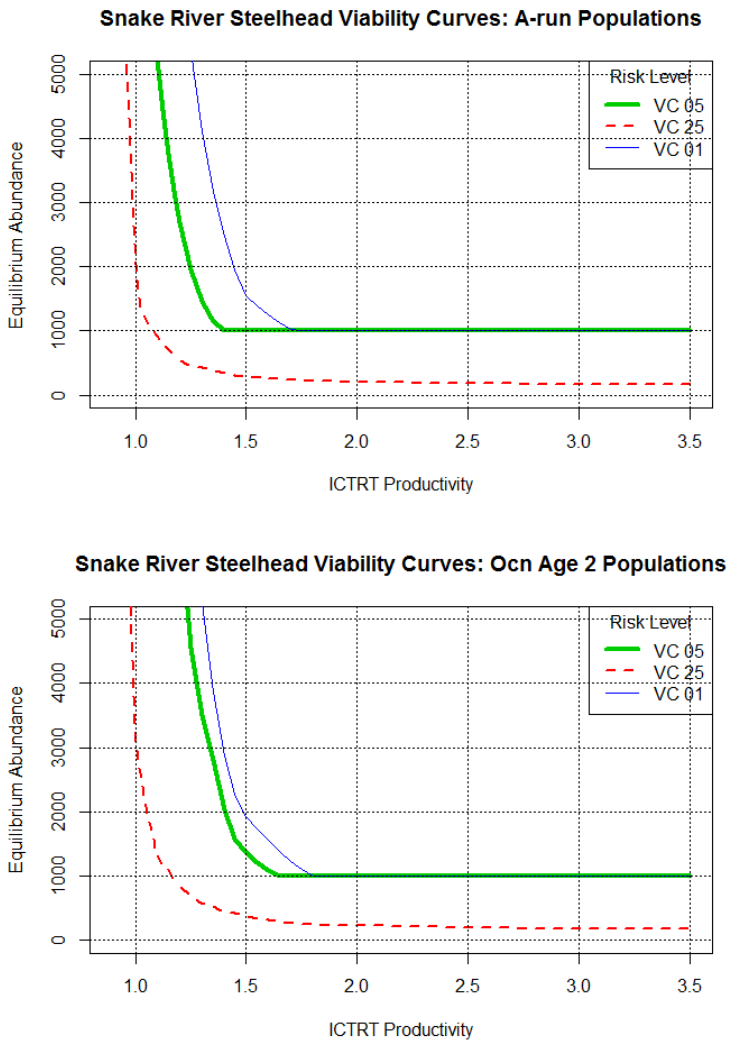



**Figure 2.** Updated viability curves (25%, 5% and 1% risk) derived for populations within two age groupings representative of Snake River natural steelhead production. Examples include a minimum abundance threshold of 1,000 corresponding to the Intermediate population size category. Risk of going below a quasi-extinction level of 50 spawners per year for four consecutive years. ICTRT productivity equivalent to slope of ascending limb of hockey stick curve or steepness parameter for Beverton Holt relationship. Variance and autocorrelation estimates: age 5+ populations (var=0.46,lag 1 autocorr.=.61; age 4 populations (var=.38, autocorr=0.64)

## Status Assessment Applications

The 2016 NWFSC Five Year Status Review (Ford et al. 2015) included a table of paired estimates of abundance and productivity for those populations and stock groups within the Snake River Steelhead DPS (see below). Those estimates are plotted against their corresponding viability curves in the following figures. Three of the estimates correspond directly to single populations. The remaining estimates are at the stock group level and are composites of 2 or more individual populations. At this point it is not possible to break out those groupings into estimates for individual populations. Regional co-manager efforts to develop approaches to break out individual populations are continuing and may result in finer scale estimates in the future.

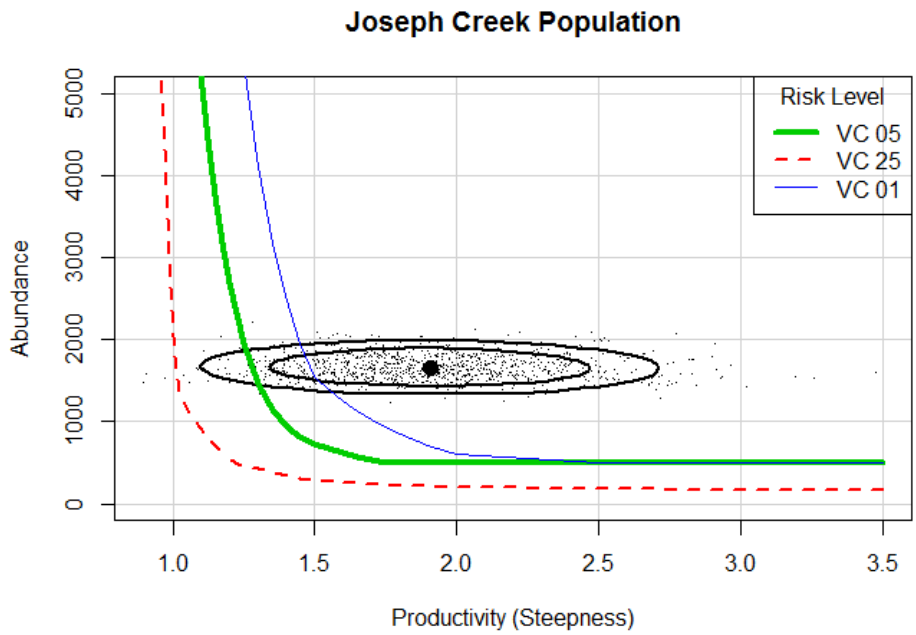
To illustrate the potential average status within each grouping, surrogate estimates are depicted in the set of graphs below. A surrogate estimate is generated by assuming that the returns to populations within a particular stock group are distributed among the component populations in proportion to their respective total intrinsic potential (ICTRT 2007). Care should be taken in interpreting these surrogate estimates when evaluating a particular population. Differences in current conditions within specific populations not accounted for with simple intrinsic potential could result in substantial alterations in the actual returns.

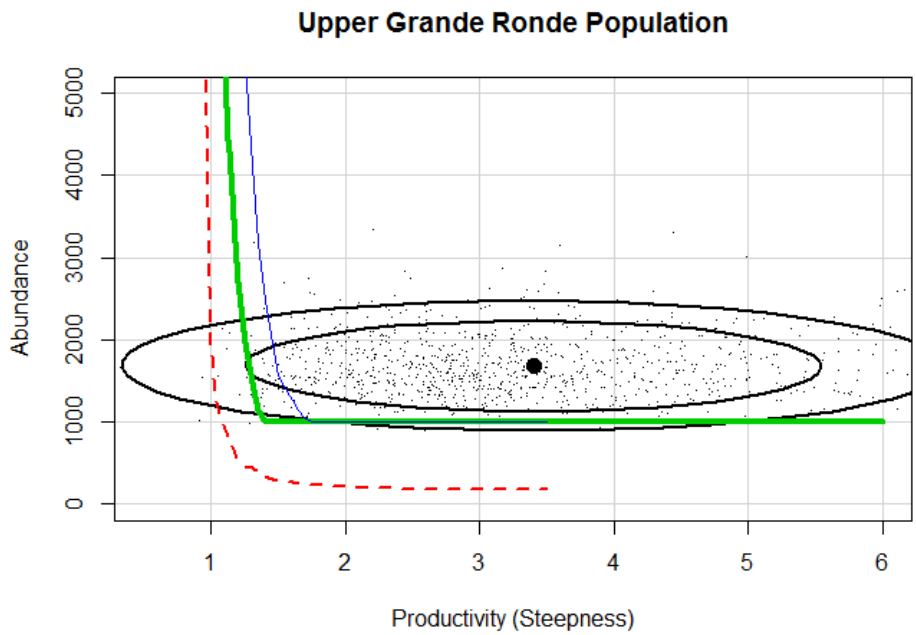
**Table** 1. from NWFSC Five Year Status Review (2015) - Summary of available natural origin abundance and productivity estimates for Snake River Steelhead DPS populations. Limited to populations with direct estimates (Joseph Creek and Upper Grande Ronde) or GSI stock groups with low misclassification rates and low estimated or inferred hatchery proportions. ICTRT minimum abundance thresholds summed for stock group aggregates. Methods: Redd Exp – expansion from index area and supplemental redd counts using fish per redd estimates; MRC –mark recapture study ; GSI: run reconstruction based on genetic stock identification estimates from the natural origin run at Lower Granite Dam accounting for estimated harvest and weir removals above Lower Granite Dam (e.g. Copeland et al. 2015).

| Major Population Group | Stock Group/ Population | ICTRT Minimum Abundance Thresholds | 10 Year (2005-2014) Natural Origin Abundance (se) | 20 Year (1999-2008) Brood year Intrinsic Productivity (se) | Estimation Method |
|---|---|---|---|---|---|
| ***Grande Ronde*** | Joseph Creek (pop) | 500 | 1,839 (.09) | 1.87 (.20) | Redd Exp/MRC |
| | Upper Grande Ronde (pop) | 1,500 | 1,649 (.21) | 3.15 (.40) | Redd Exp |
| ***Clearwater*** | Lower Clearwater (pop) | 1,500 | 2,099 (0.15 ) | 2.36(.16) | GSI |
| | Upper Clearwater (stkgrp) | 2,000 | 1,650 (0.17) | 2.33 (0.18) | GSI |
| | *Lochsa R.* | *1,000* | | | |
| | *Selway R.* | *1,000* | | | |
| ***Salmon*** | South Fork (stkgrp) | 1,500 | 1,028 (0.17) | 1.80 (.148) | GSI |
| | *Secesh R.* | *500* | | | |
| | *South Fork Mainstem R.* | *1,000* | | | |
| | Middle Fork (stkgrp) | 2,500 | 2,213 (0.16) | 2.38 (.104) | GSI |
| | *Upper Middle Fork River* | *1,000* | | | |
| | *Lower Middle Fork River* | *1,000* | | | |
| | *Chamberlain Creek* | *500* | | | |
| ***Lower Salmon*** | Upper Asotin Cr. (subpop) | | 617 (0.16) | NA | weir est. |
| | *Asotin Creek* | *500* | | | |

## Grande Ronde Major Population Group

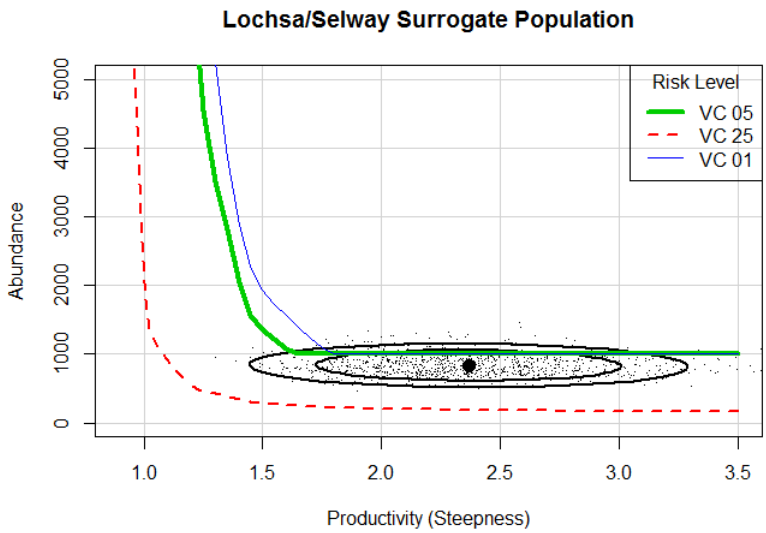
Two population level series, both age 4+ stocks.

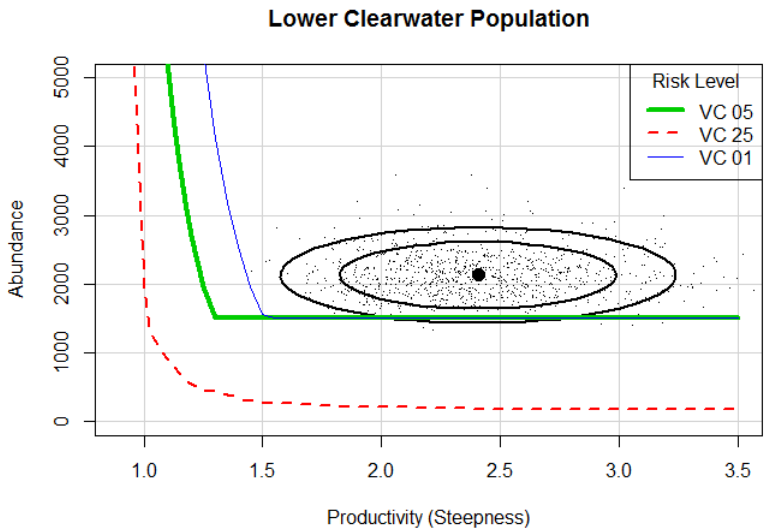


## Clearwater River Major Population Group

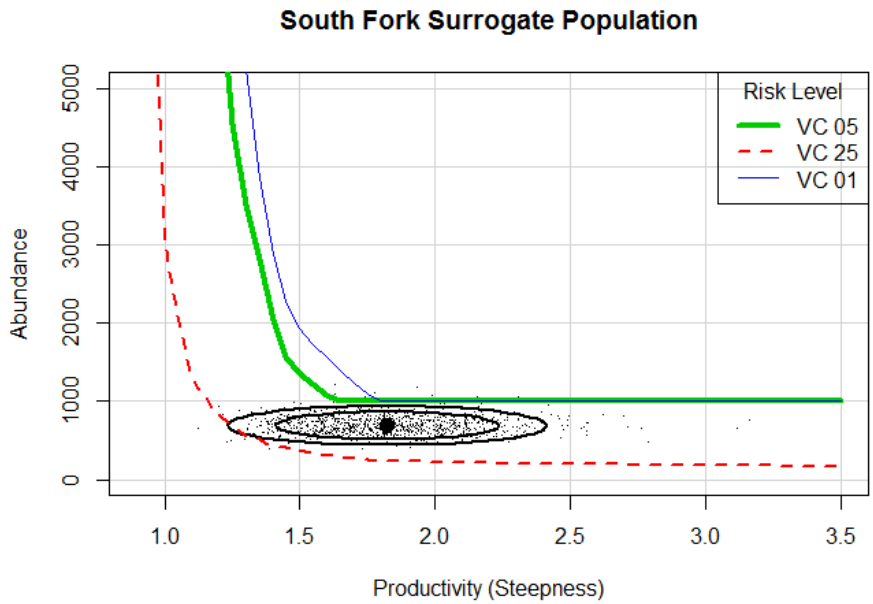
One surrogate age 5+ plot, one single population stock group age 4 plot.

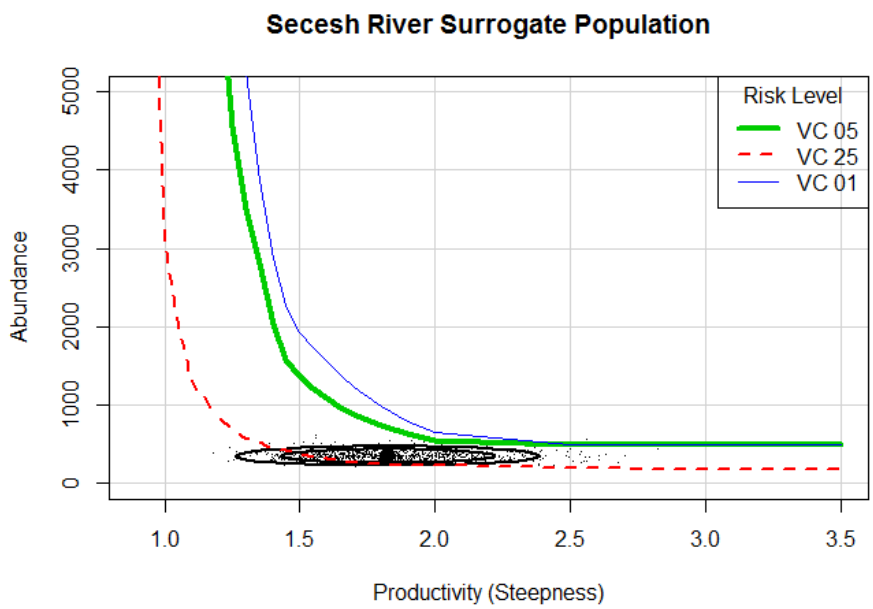


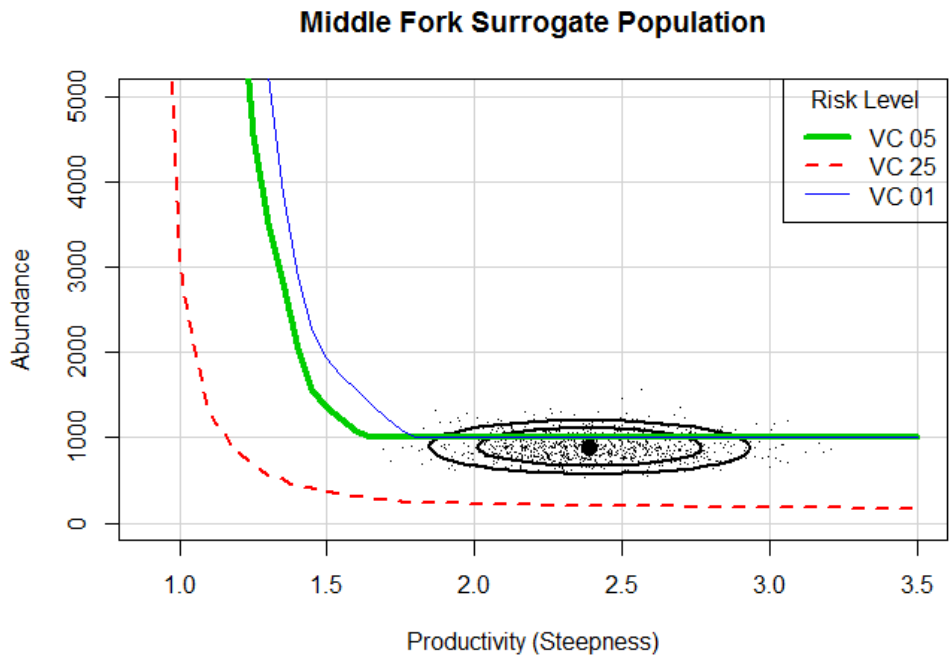



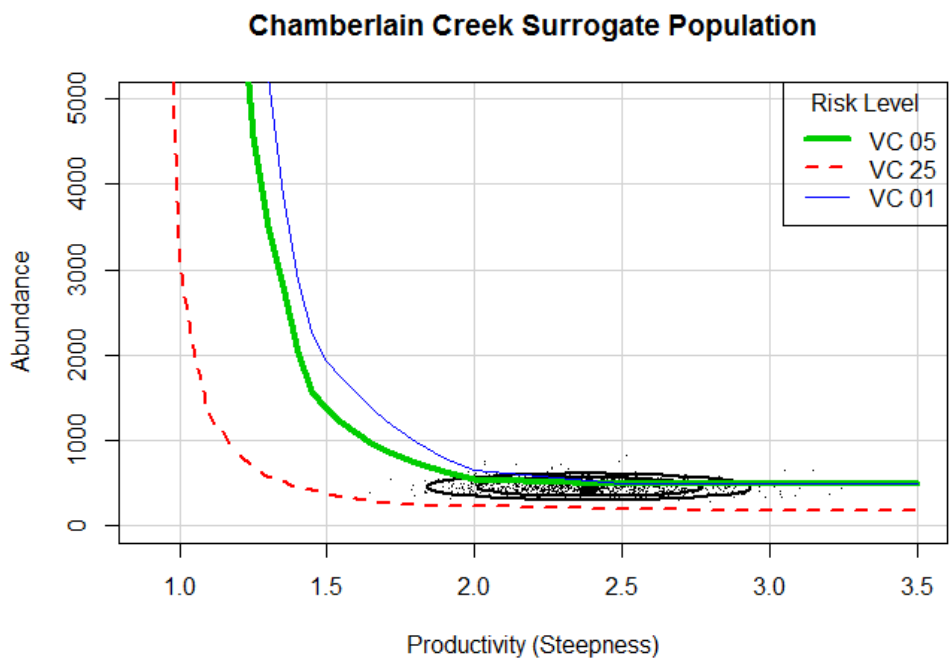
## Salmon River Major Population Group

Four surrogate stock group plots (age 5+)




Middle Fork Surrogate Population
Risk Level
VC 05
VC 25
VC 01
Abundance
0
1000
2000
3000
4000
5000
1.0
1.5
2.0
2.5
3.0
3.5
Productivity (Steepness)


Chamberlain Creek Surrogate Population
Risk Level
VC 05
VC 25
VC 01
Abundance
0
1000
2000
3000
4000
5000
1.0
1.5
2.0
2.5
3.0
3.5
Productivity (Steepness)

## Literature Cited

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