

Attachment A

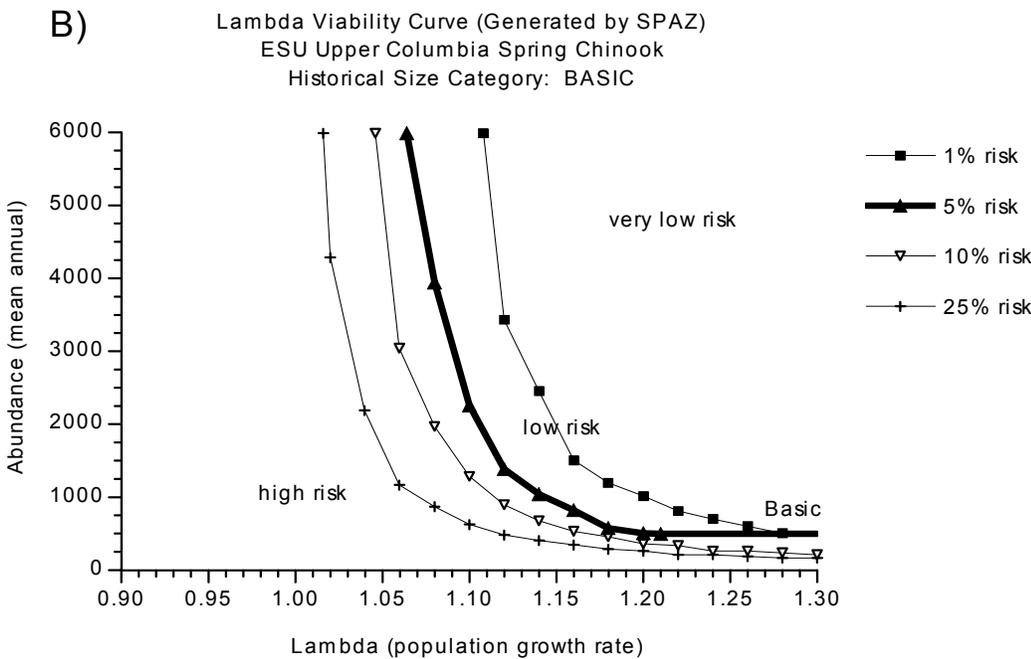
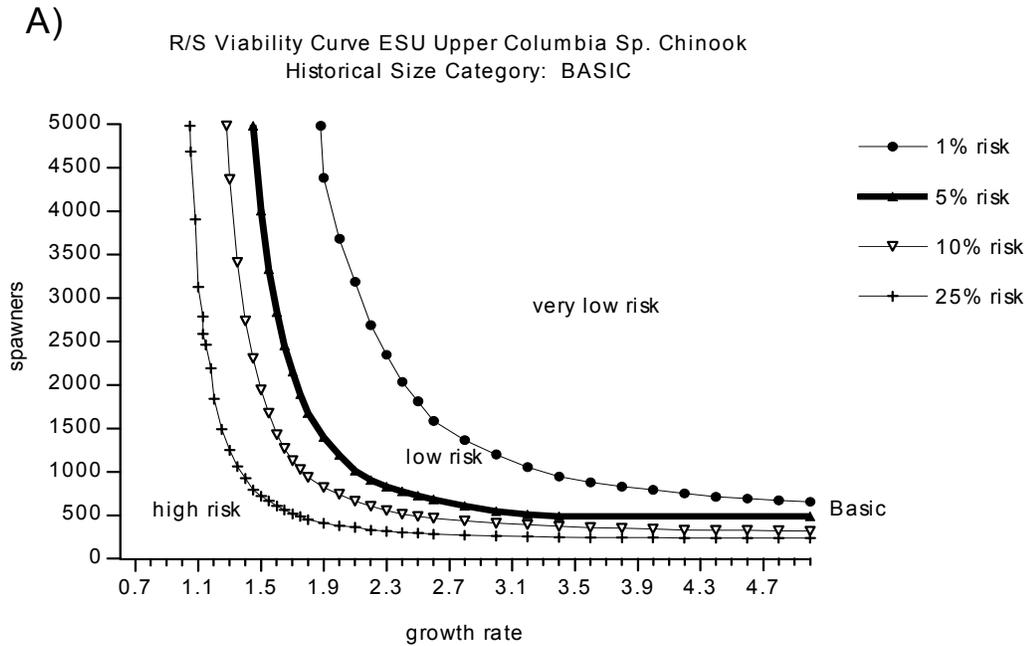
Abundance/Productivity Viability Curves for Interior Columbia Chinook and Steelhead ESUs.

The ICTRT has adopted the Viability Curve concept (e.g., LCWTRT, 2003) as a framework for defining population specific abundance and productivity criteria. A viability curve describes those combinations of abundance and productivity that yield a particular risk threshold. The two parameters are linked relative to extinction risks associated with short-term environmental variability. Relatively large populations are more resilient in the face of year to year variability in overall survival rates than smaller populations. Populations of listed chinook and steelhead within Interior Columbia ESUs vary considerably in terms of the total area available to support spawning and rearing. The ICTRT has identified four population size groups based on estimates of historically accessible spawning and rearing habitat and incorporated minimum abundance thresholds into viability curves specific to each category. Viability curves for application to populations within each ESU were generated for each population size category using average variance and autocorrelation statistics derived from representative trend data sets. In addition to depicting the 5% risk of extinction threshold for evaluating population viability, the figures also include risk thresholds corresponding to a relatively high risk of extinction (10% and 25% in 100 years) and a lower risk level (1% in 100 years).

Two alternative approaches to using spawner data series have been used to generate viability curves. Return/Spawner based viability assessments require more detailed run reconstruction information. Annual population growth rates based on running sums can be generated from simple annual abundance data. It is possible to express the productivity term in a Viability Curve in terms of stock-recruitment functions - e.g. Beverton Holt or Ricker curves. In most cases data used to evaluate current status will be based on a relatively limited number of years. Uncertainty levels and bias in parameter estimates can be very large. Status assessments that use fitted stock recruit curve parameters as an index of current productivity should directly incorporate considerations for sampling induced errors and bias in their assessments.

Under historical conditions, it is likely that most populations would have demonstrated combinations of intrinsic production potential and abundance well above the 5% Viability Curve. At the population level, recovery strategies should be targeted on achieving combinations of abundance and productivity above the threshold represented by the 5% viability curve.

Figure 1. Viability Curves for UPPER COLUMBIA SPRING CHINOOK populations – BASIC size group.. 1% and 5% risk curves modified to incorporate minimum abundance threshold for BASIC sized steelhead populations (based on historical intrinsic potential analysis). A) Spawner/Spawner metric, Hockey Stick production function. Variance: 0.53 ; autocorr coefficient (lag 1): 0.68; brood year age structure(4,5): 60%, 40%. B) Population Growth rate metric. Variance (running sum method):



0.15.

Figure 2. Viability Curves for UPPER COLUMBIA SPRING CHINOOK populations. 1% and 5% risk curves modified to incorporate minimum abundance threshold for INTERMEDIATE sized steelhead populations (based on historical intrinsic potential analysis). A) Spawner/Spawner metric, Hockey Stick production function. Variance: 0.53 ; autocorrelation coefficient (lag 1): 0.68; brood year age structure(4,5): 60%, 40%. B) Population Growth rate metric. Variance (running sum method): 0.15.

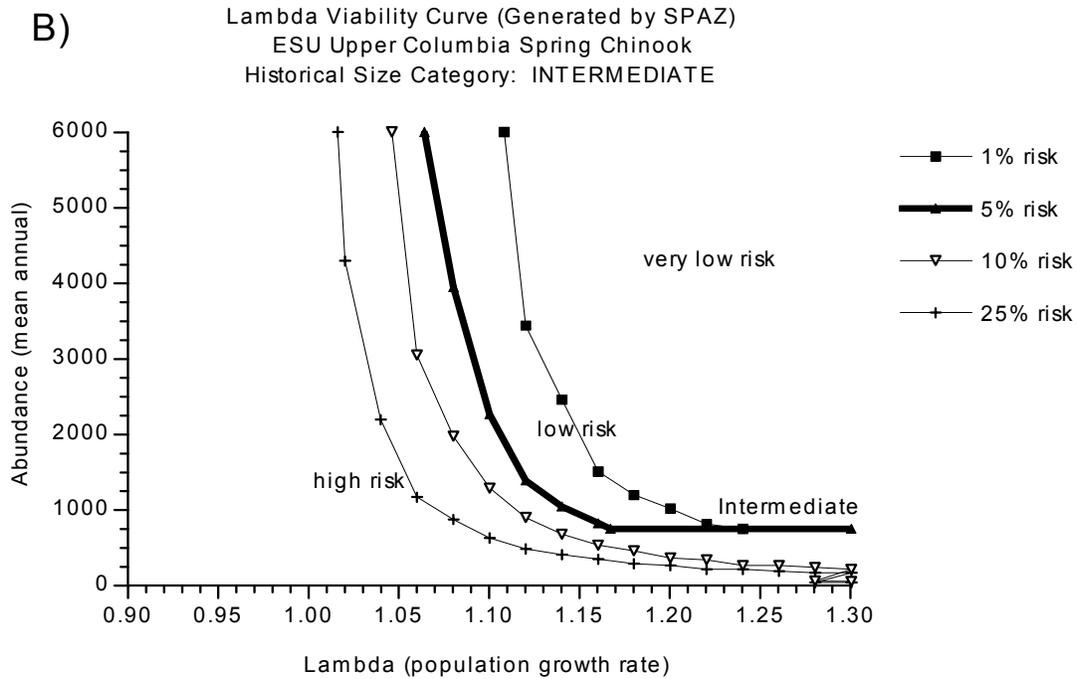
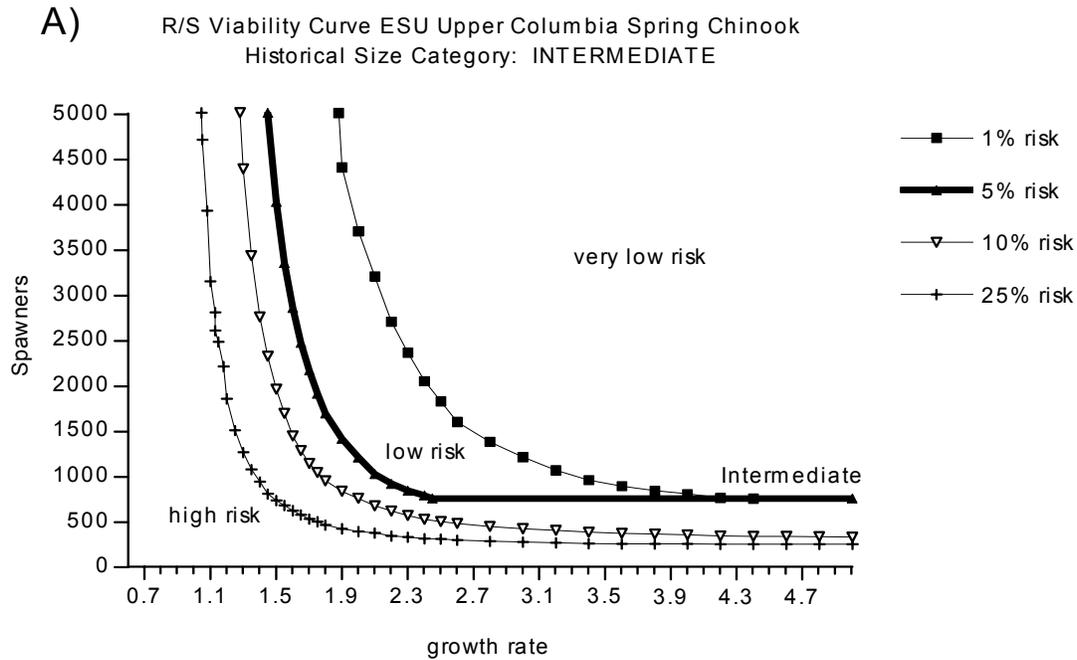


Figure 3. Viability Curves for UPPER COLUMBIA SPRING CHINOOK populations. 1% and 5% risk curves modified to incorporate minimum abundance threshold for LARGE sized steelhead populations (based on historical intrinsic potential analysis). A) Spawner/Spawner metric, Hockey Stick production function. Variance: 0.53 ; autocorrelation coefficient (lag 1): 0.68; brood year age structure(4,5): 60%, 40%. B) Population Growth rate metric. Variance (running sum method): 0.15.

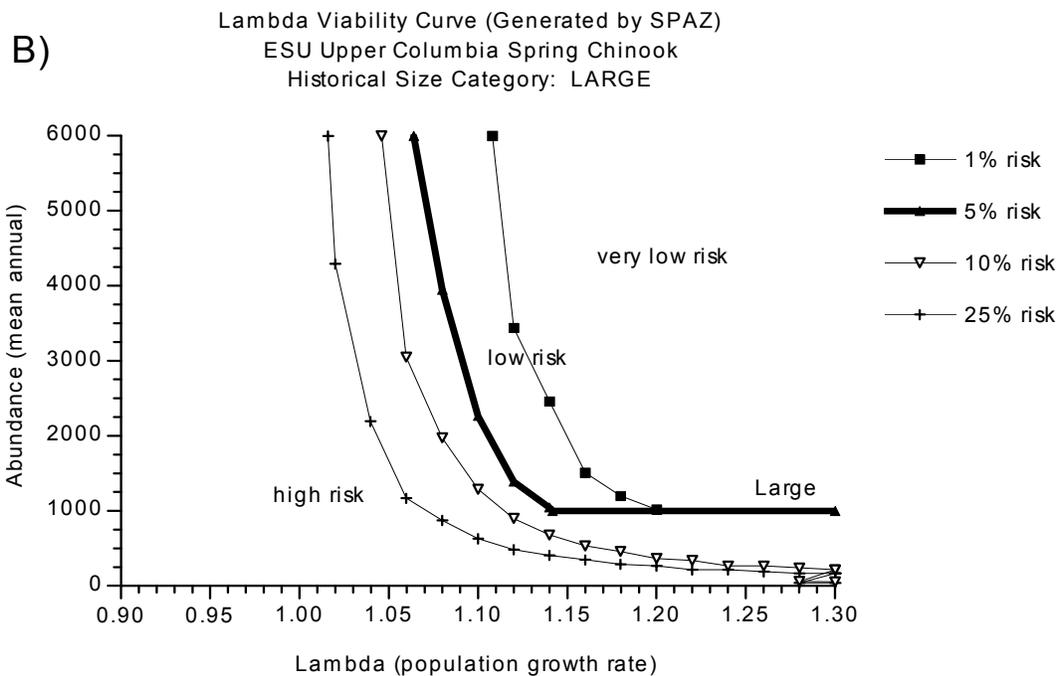
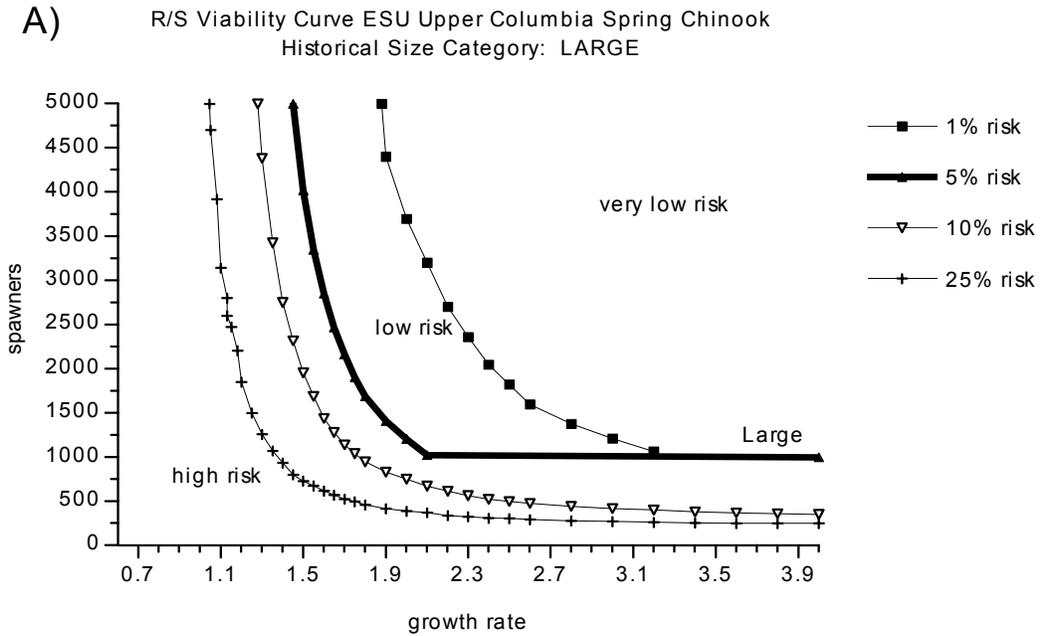


Figure 4. Viability Curves for UPPER COLUMBIA SPRING CHINOOK populations. 1% and 5% risk curves modified to incorporate minimum abundance threshold for VERY LARGE sized steelhead populations (based on historical intrinsic potential analysis). A) Spawner/Spawner metric, Hockey Stick production function. Variance: 0.53 ; autocorrelation coefficient (lag 1): 0.68; brood year age structure(4,5): 60%, 40%. B) Population Growth rate metric. Variance (running sum method): 0.15.

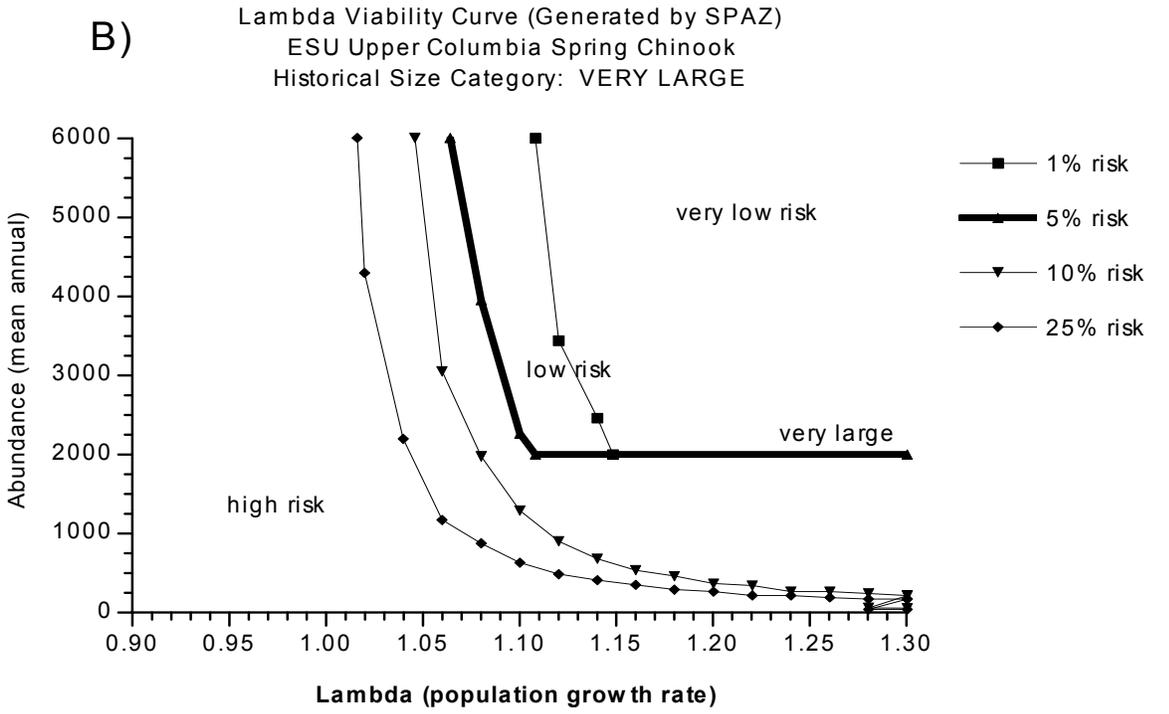
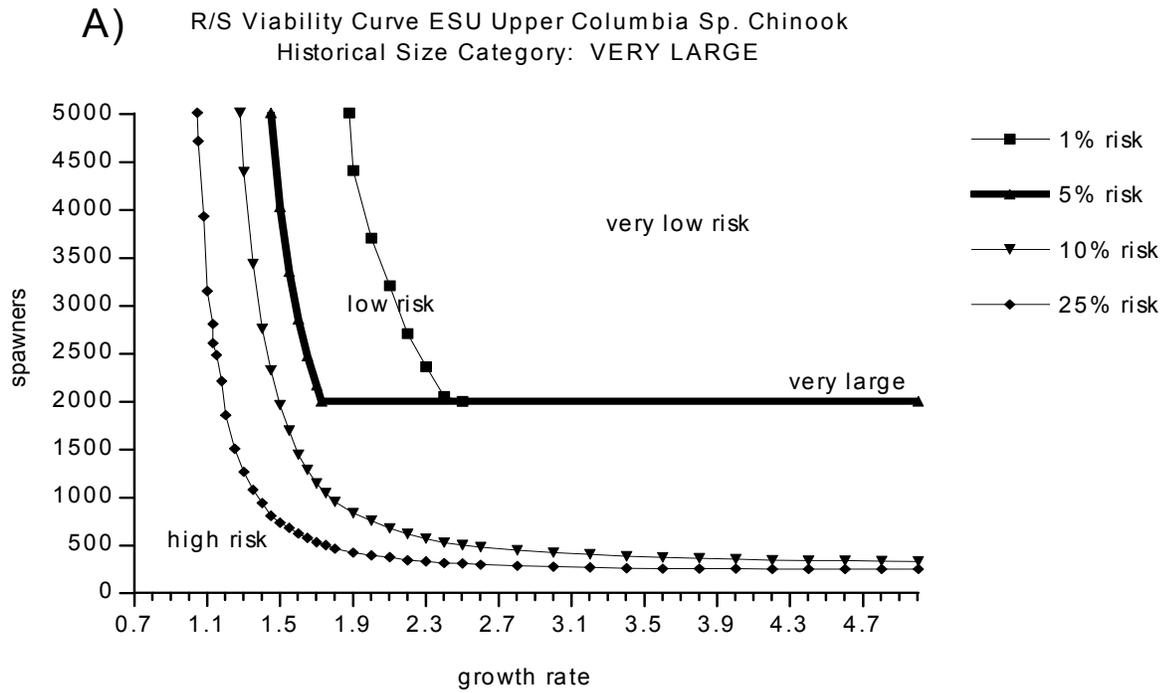


Figure 5. Viability Curves for SNAKE R. SPRING/SUMMER CHINOOK populations. 1% and 5% risk curves modified to incorporate minimum abundance threshold for BASIC sized steelhead populations (based on historical intrinsic potential analysis). A) Spawner/Spawner metric, Hockey Stick production function. Variance: 0.95 ; autocorrelation coefficient (lag 1): 0.44; brood year age structure (4,5): 57%, 43%. B) Population Growth rate metric. Variance (running sum method): 0.13.

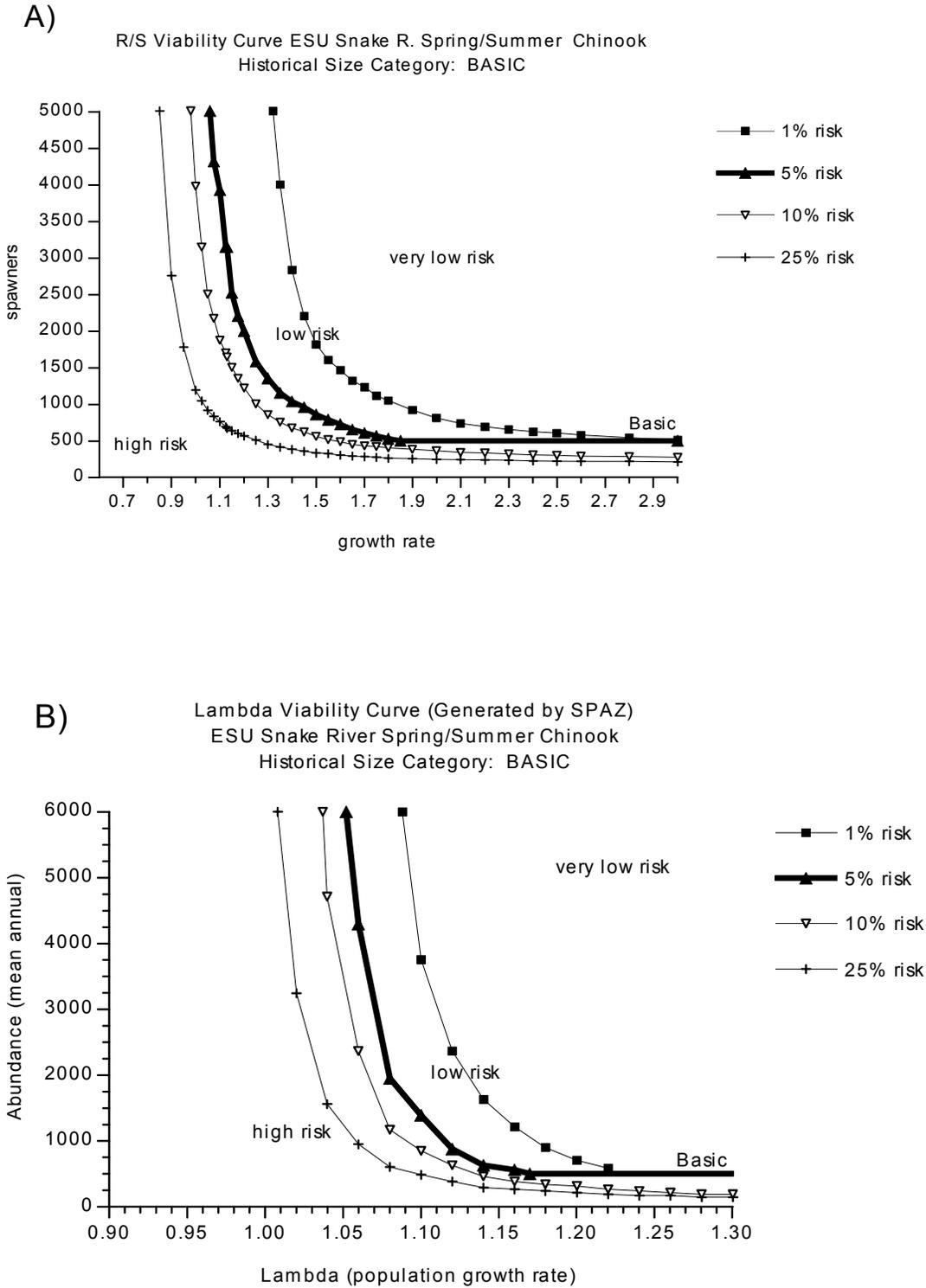


Figure 6. Viability Curves for SNAKE R. SPRING/SUMMER CHINOOK populations. 1% and 5% risk curves modified to incorporate minimum abundance threshold for INTERMEDIATE sized steelhead populations (based on historical intrinsic potential analysis). A) Spawner/Spawner metric, Hockey Stick production function. Variance: 0.95 ; autocorrelation coefficient (lag 1): 0.44; brood year age structure (4,5): 57%, 43%. B) Population Growth rate metric. Variance (running sum method): 0.13.

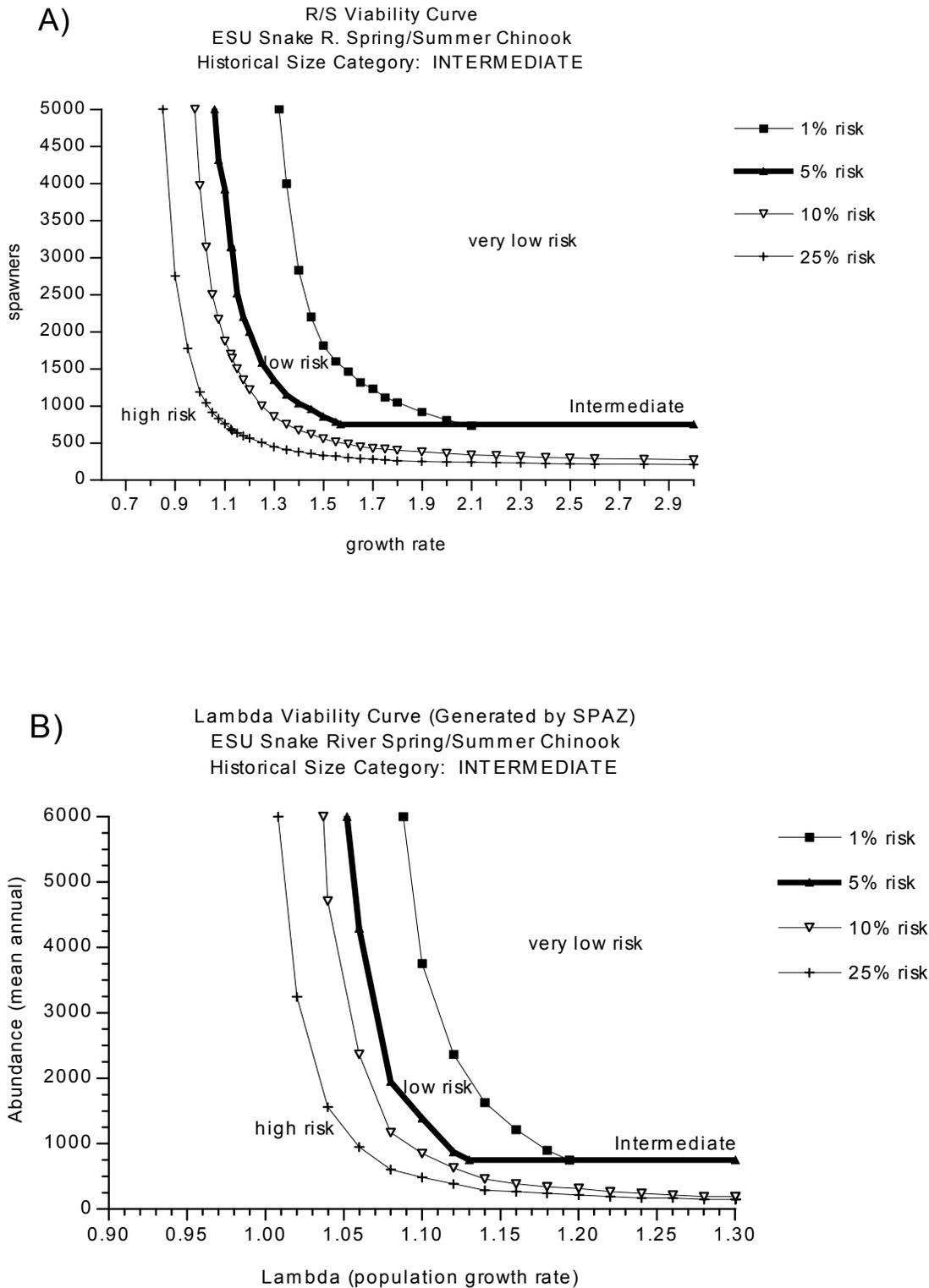


Figure 7. Viability Curves for SNAKE R. SPRING/SUMMER CHINOOK populations. 1% and 5% risk curves modified to incorporate minimum abundance threshold for LARGE sized steelhead populations (based on historical intrinsic potential analysis). A) Spawner/Spawner metric, Hockey Stick production function. Variance: 0.95 ; autocorrelation coefficient (lag 1): 0.44; brood year age structure (4,5): 57%, 43%. B) Population Growth rate metric. Variance (running sum method): 0.13.

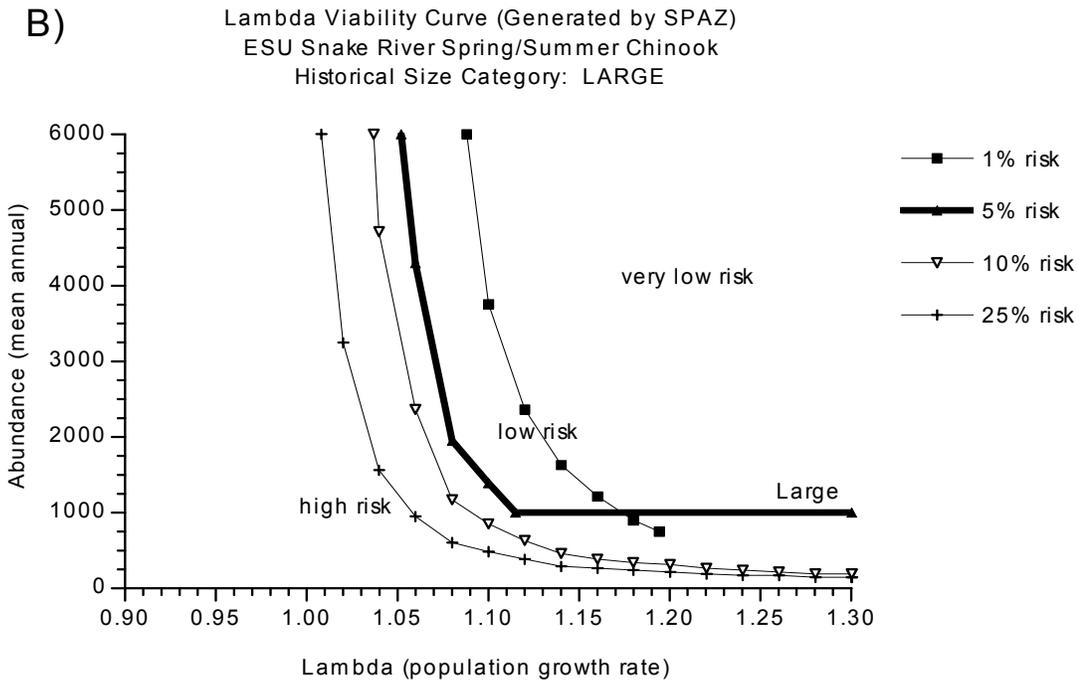
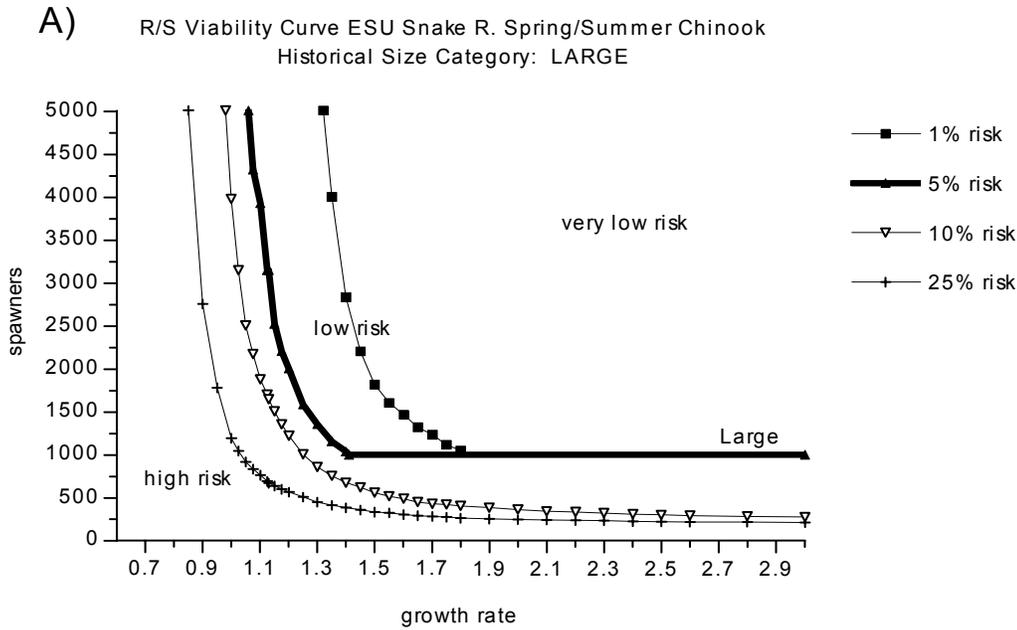
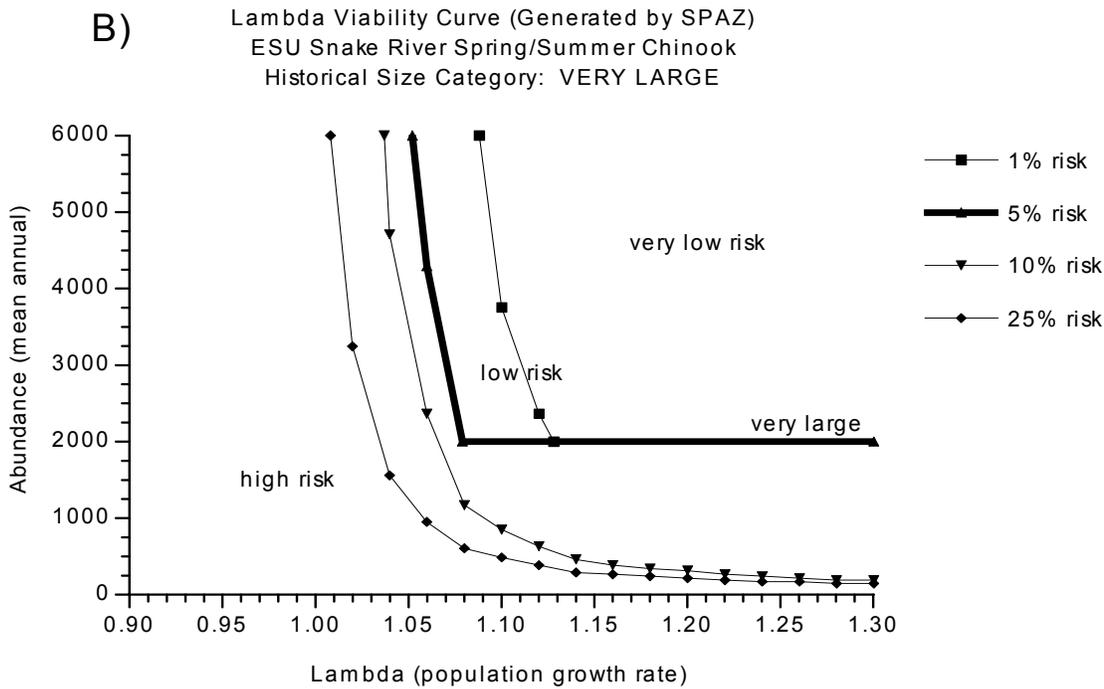
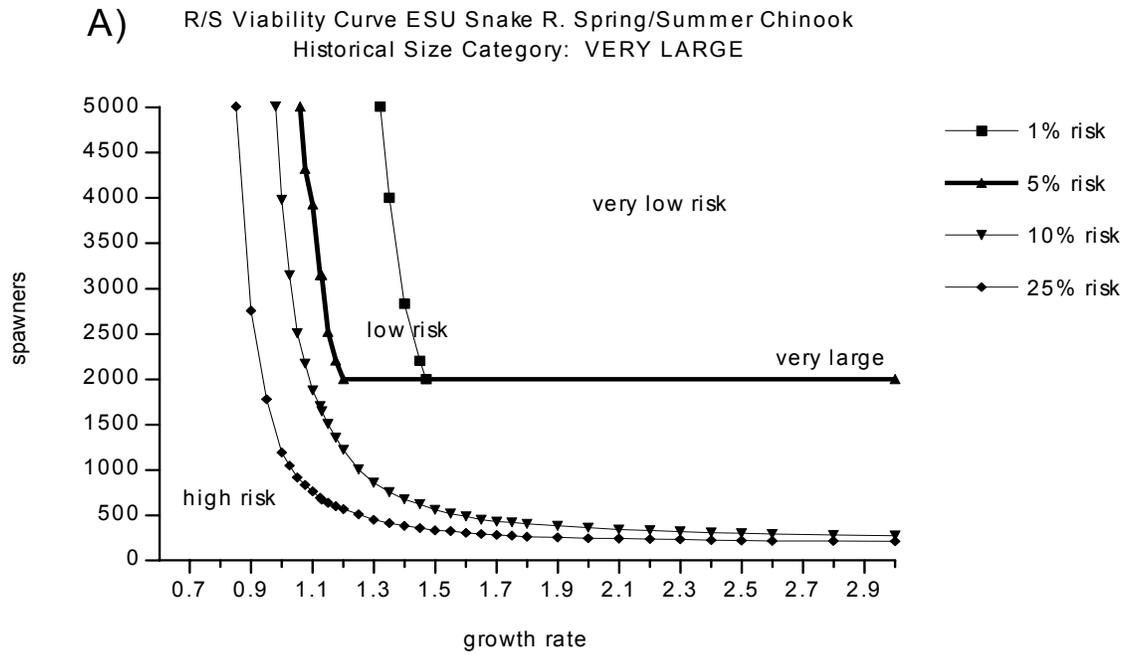


Figure 8. Viability Curves for SNAKE R. SPRING/SUMMER CHINOOK populations. 1% and 5% risk curves modified to incorporate minimum abundance threshold for VERY LARGE sized steelhead populations (based on historical intrinsic potential analysis). A) Spawner/Spawner metric, Hockey Stick production function. Variance: 0.95 ; autocorrelation coefficient (lag 1): 0.44; brood year age structure (4,5): 57%, 43%. B) Population Growth rate metric. Variance (running sum method): 0.13.



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Figure 9. Viability Curves for UPPER COLUMBIA STEELHEAD populations. 1% and 5% risk curves modified to incorporate minimum abundance threshold for BASIC sized steelhead populations (based on historical intrinsic potential analysis). A) Spawner/Spawner metric, Hockey Stick production function. Variance: 0.27 ; autocorrelation coefficient (lag 1): 0.64; brood year age structure(3,4,5,6): 36%, 46%, 16%, 1%. B) Population Growth rate metric. Variance (running sum method): 0.16.

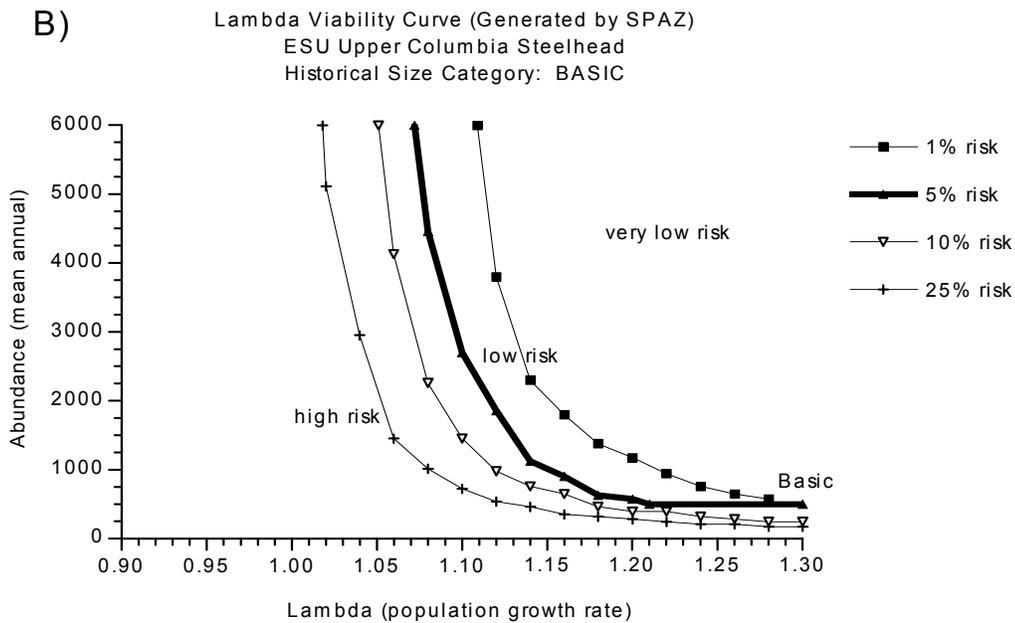
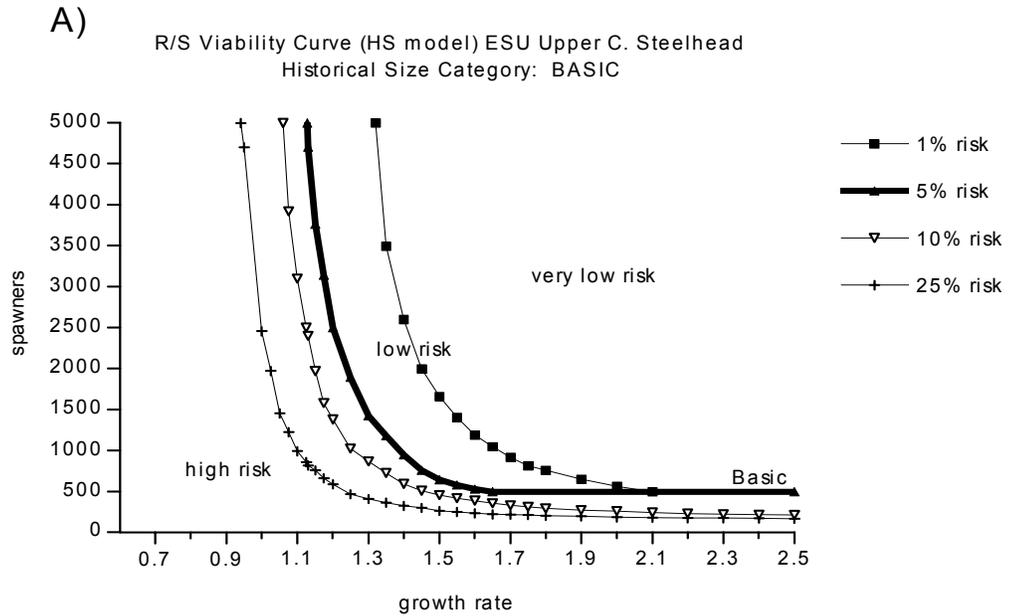


Figure 10. Viability Curves for UPPER COLUMBIA STEELHEAD populations. 1% and 5% risk curves modified to incorporate minimum abundance threshold for INTERMEDIATE sized steelhead populations (based on historical intrinsic potential analysis). A) Spawner/Spawner metric, Hockey Stick production function. Variance: 0.27 ; autocorrelation coefficient (lag 1): 0.64; brood year age structure(3,4,5,6): 36%, 46%, 16%, 1%. B) Population Growth rate metric. Variance (running sum method): 0.16.

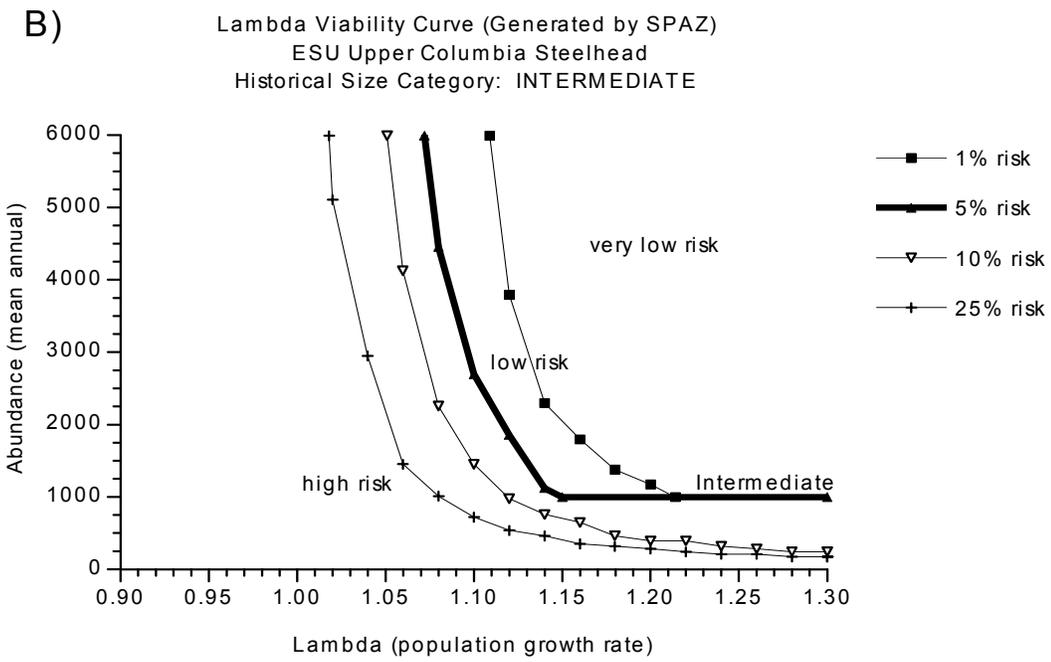
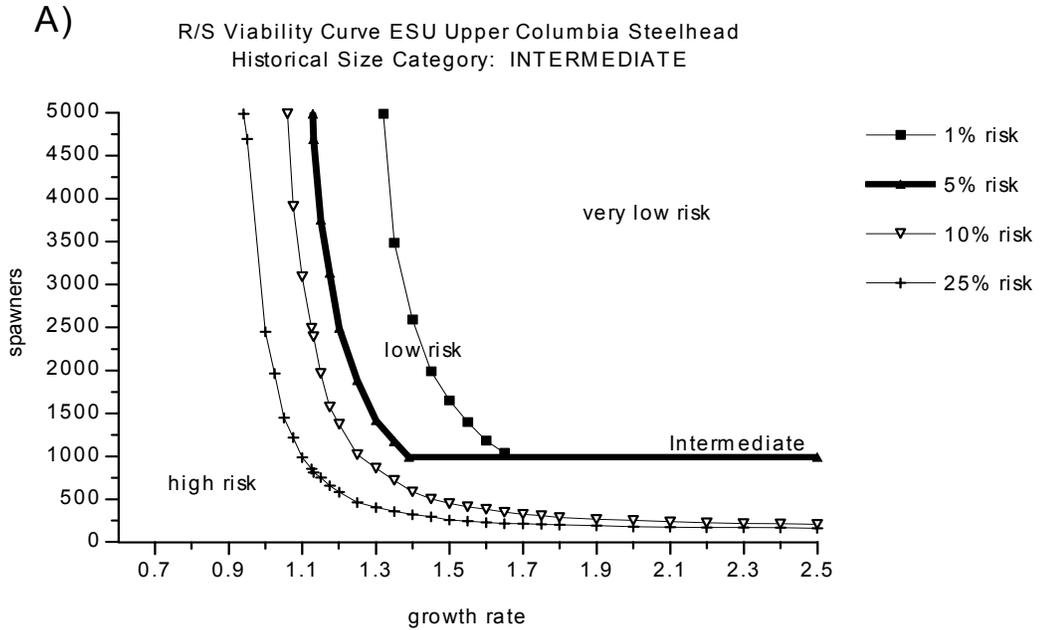
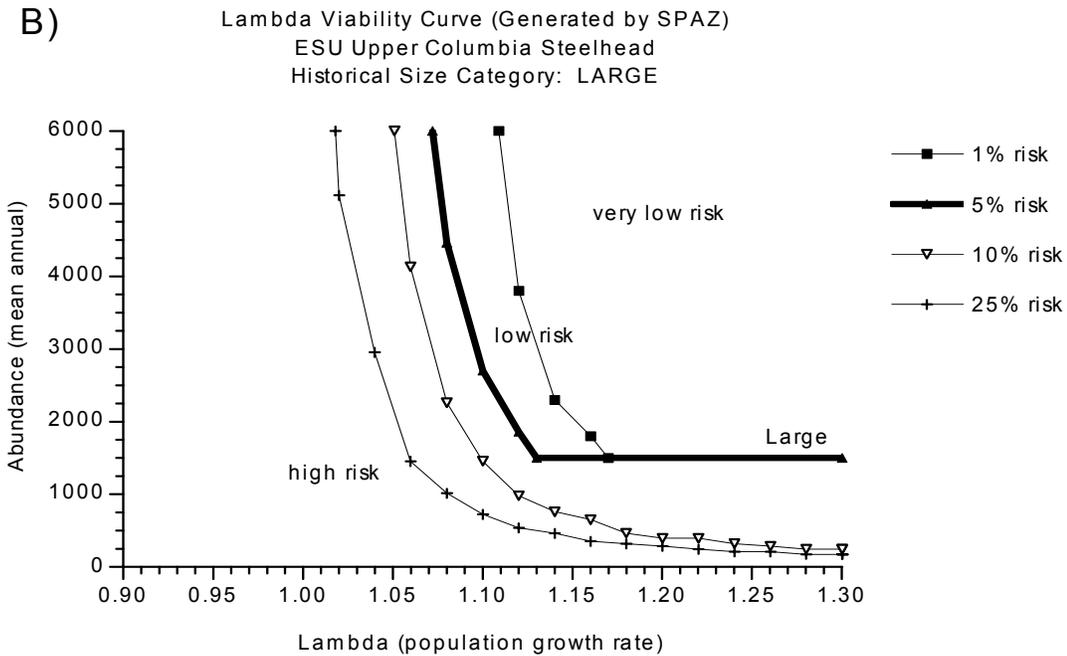
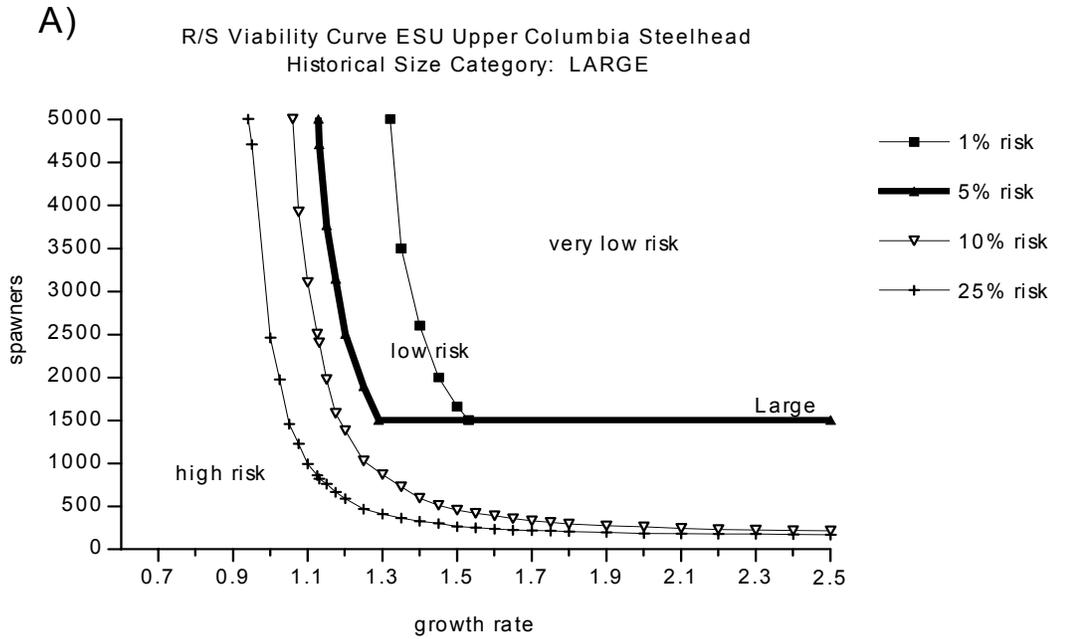
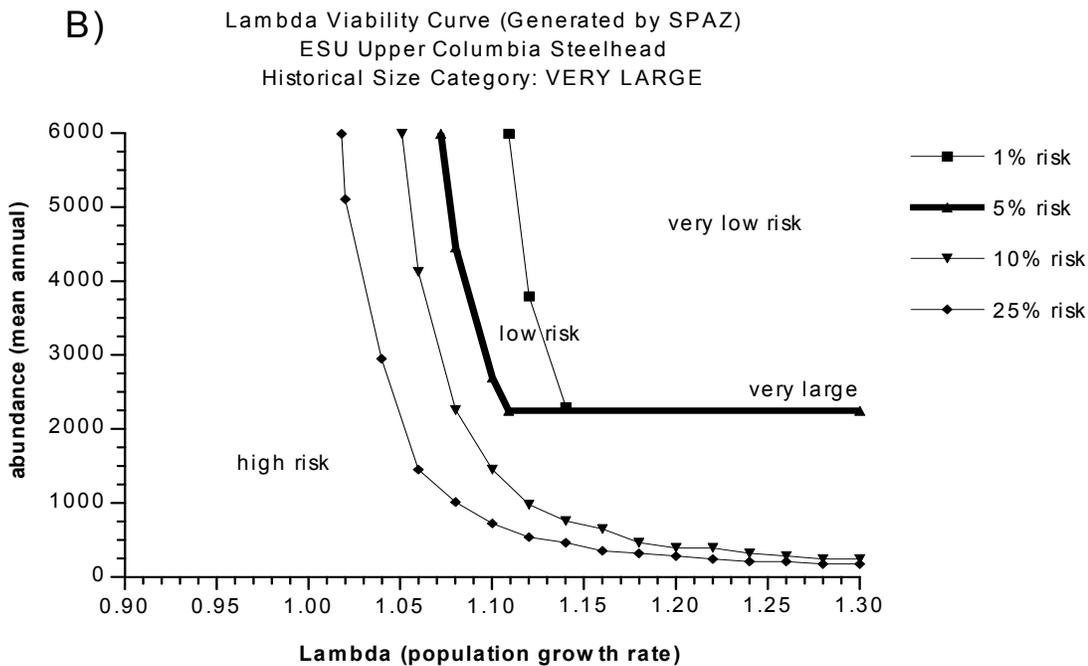
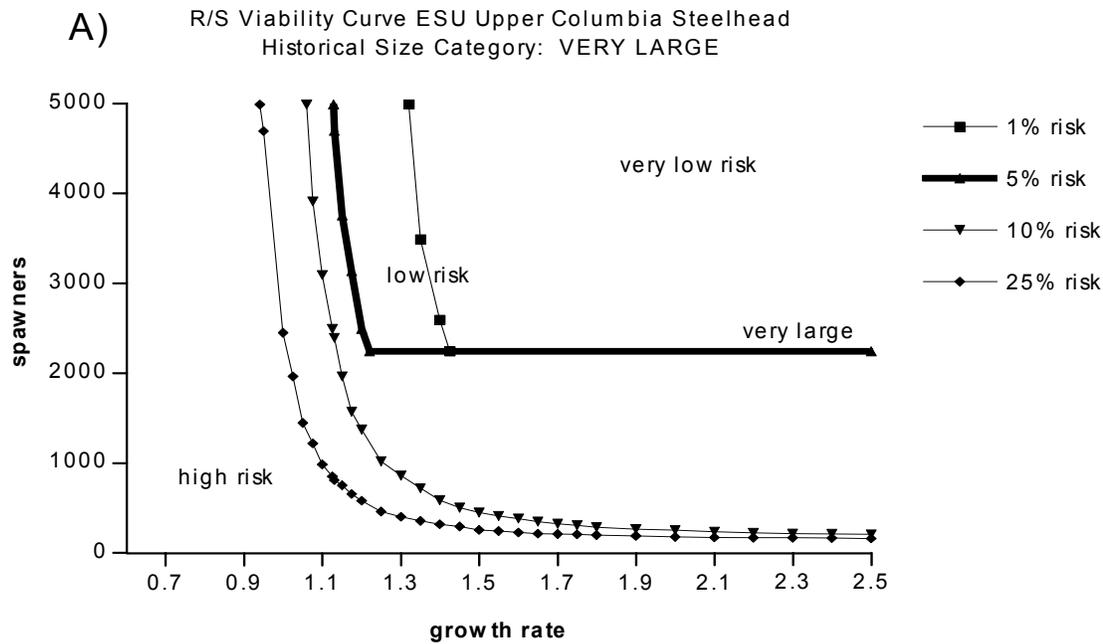


Figure 11. Viability Curves for UPPER COLUMBIA STEELHEAD populations. 1% and 5% risk curves modified to incorporate minimum abundance threshold for LARGE sized steelhead populations (based on historical intrinsic potential analysis). A) Spawner/Spawner metric, Hockey Stick production function. Variance: 0.27 ; autocorrelation coefficient (lag 1): 0.64; brood year age structure(3,4,5,6): 36%, 46%, 16%, 1%. B) Population Growth rate metric. Variance (running sum method): 0.16.



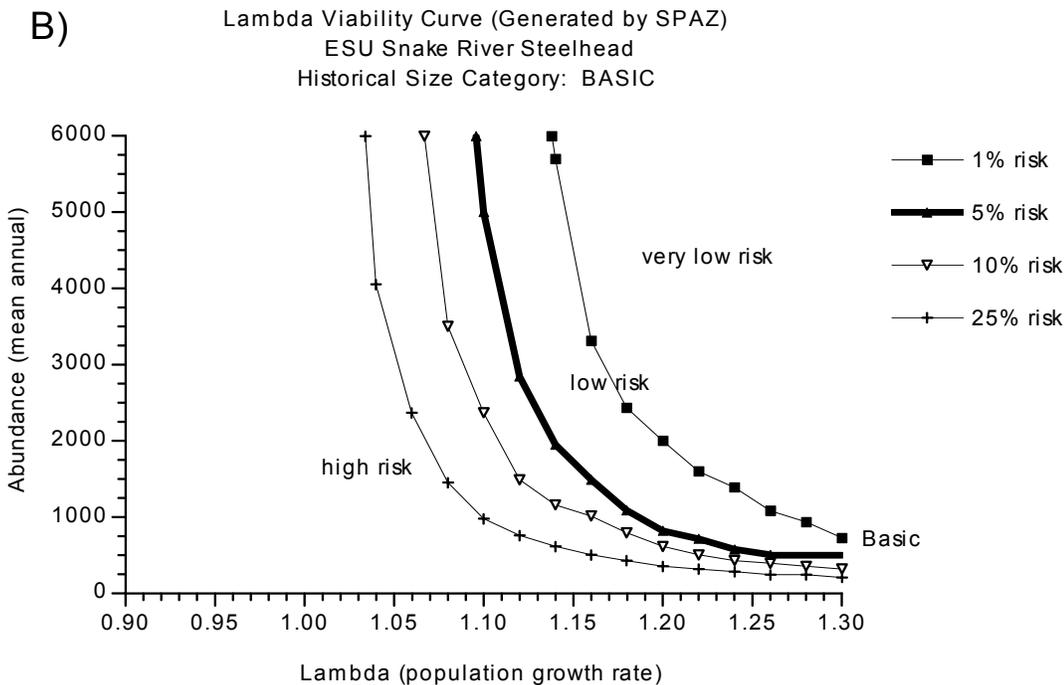
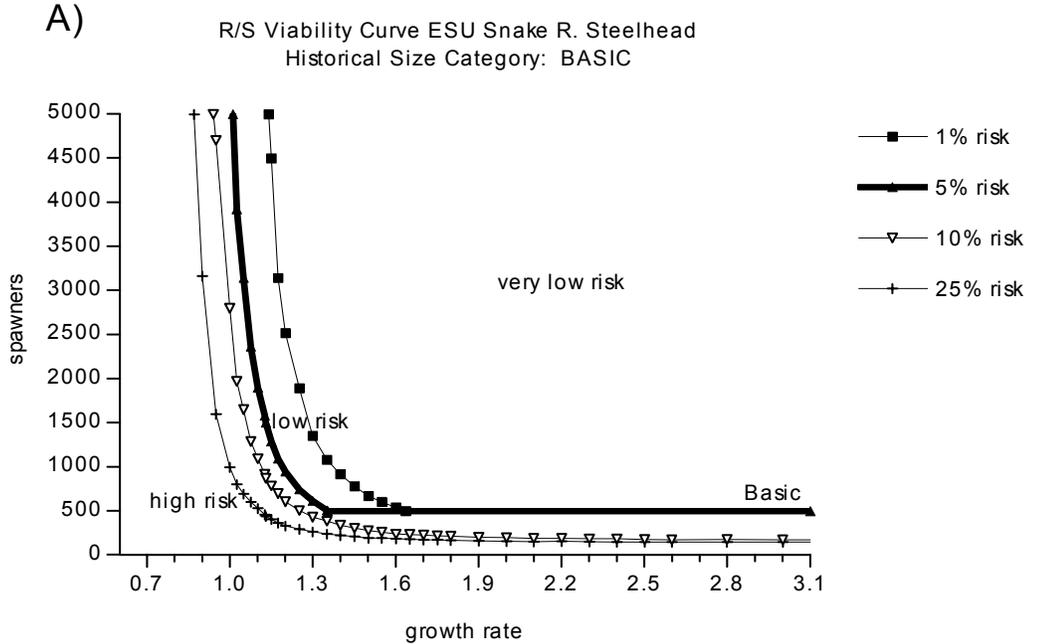
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Figure 12. Viability Curves for UPPER COLUMBIA STEELHEAD populations. 1% and 5% risk curves modified to incorporate minimum abundance threshold for VERY LARGE sized steelhead populations (based on historical intrinsic potential analysis). A) Spawner/Spawner metric, Hockey Stick production function. Variance: 0.27 ; autocorrelation coefficient (lag 1): 0.64; brood year age structure(3,4,5,6): 36%, 46%, 16%, 1%. B) Population Growth rate metric. Variance (running sum method): 0.16.



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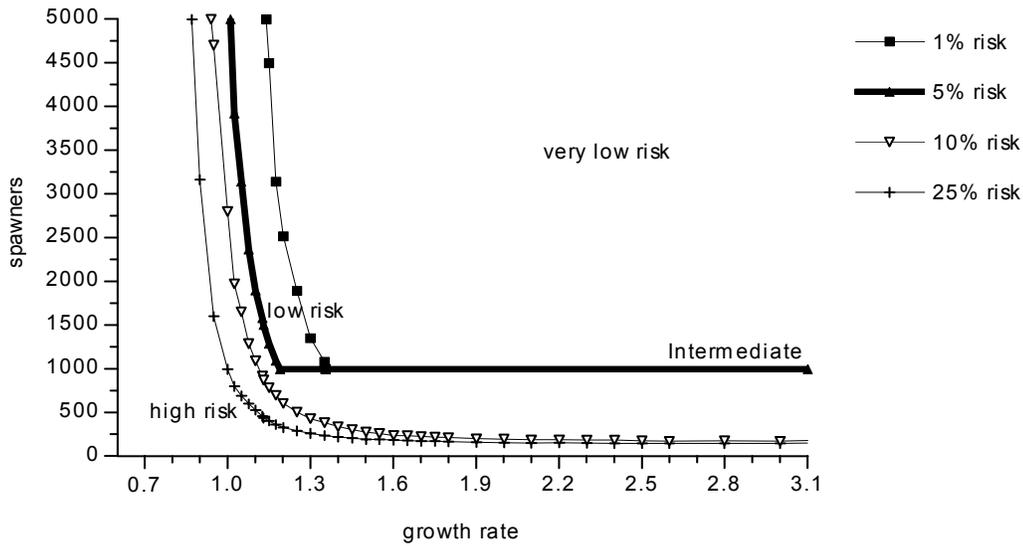
Figure 13. Curves for SNAKE RIVER STEELHEAD populations. 1% and 5% risk curves modified to incorporate minimum abundance threshold for BASIC sized steelhead populations (based on historical intrinsic potential analysis). A) Spawner/Spawner metric, Hockey Stick production function. Variance: 0.35 ; autocorrelation coefficient (lag 1): 0.54; brood year age structure(3,4,5,6): 3%, 61%, 35%, 2%. B) Population Growth rate metric. Variance (running sum method): 0.19.



Updated 6/28/05

Figure 14. Curves for SNAKE RIVER STEELHEAD populations. 1% and 5% risk curves modified to incorporate minimum abundance threshold for INTERMEDIATE sized steelhead populations (based on historical intrinsic potential analysis). A) Spawner/Spawner metric, Hockey Stick production function. Variance: 0.35 ; autocorrelation coefficient (lag 1): 0.54; brood year age structure(3,4,5,6): 3%, 61%, 35%, 2%. B)Population Growth rate metric. Variance (running sum method): 0.19.

A) R/S Viability Curve ESU Snake R. Steelhead
Historical Size Category: INTERMEDIATE



B) Lambda Viability Curve (Generated by SPAZ)
ESU Snake River Steelhead
Historical Size Category: INTERMEDIATE

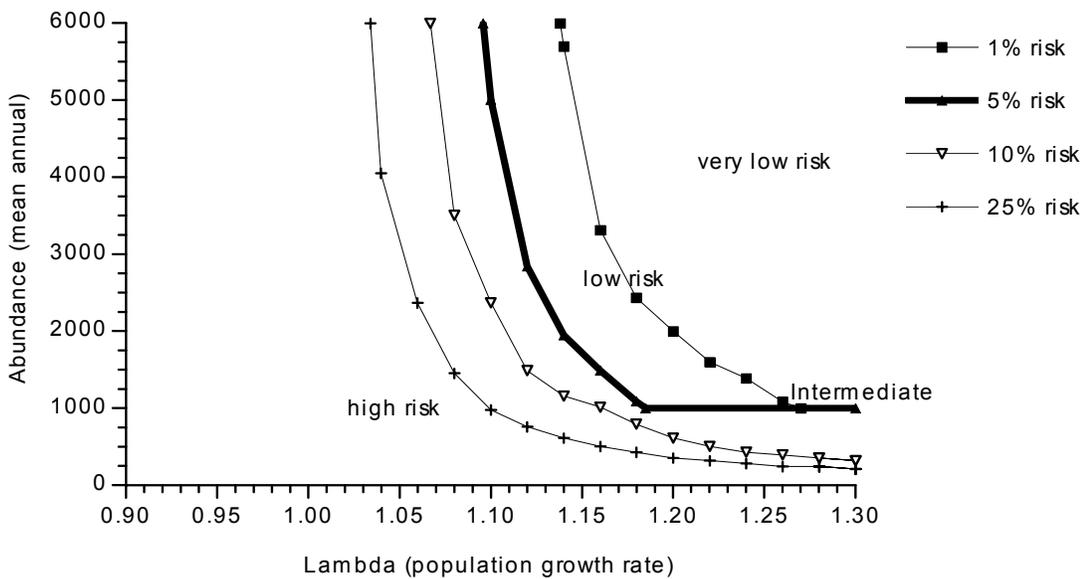


Figure 15. Curves for SNAKE RIVER STEELHEAD populations. 1% and 5% risk curves modified to incorporate minimum abundance threshold for LARGE sized steelhead populations (based on historical intrinsic potential analysis). A) Spawner/Spawner metric, Hockey Stick production function. Variance: 0.35 ; autocorrelation coefficient (lag 1): 0.54; brood year age structure(3,4,5,6): 3%, 61%, 35%, 2%. B) Population Growth rate metric. Variance (running sum method): 0.19.

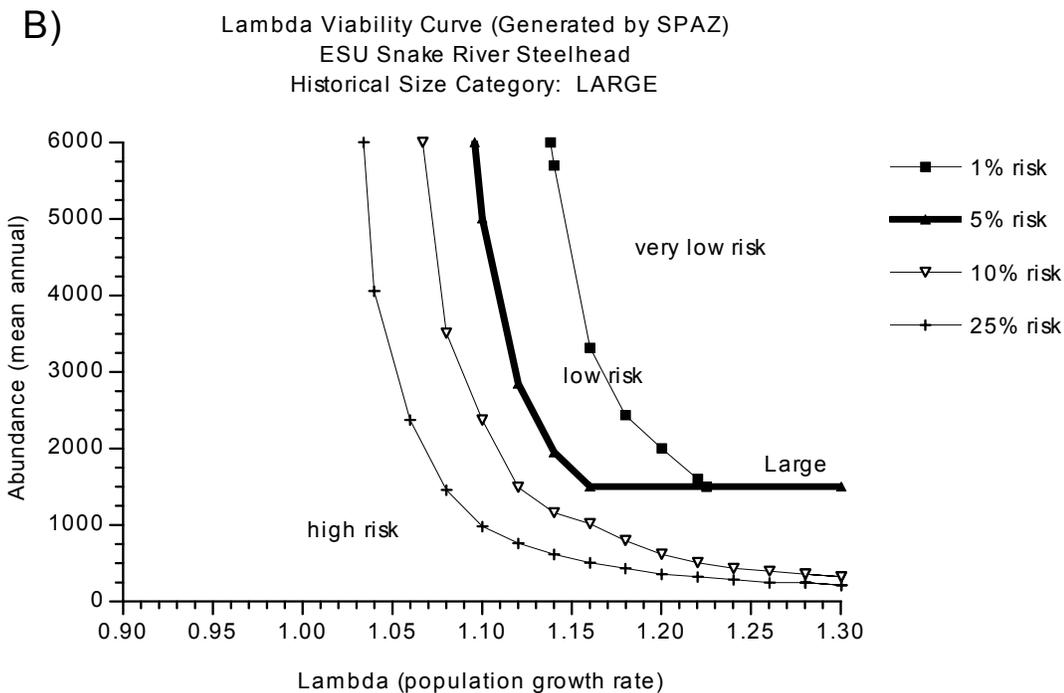
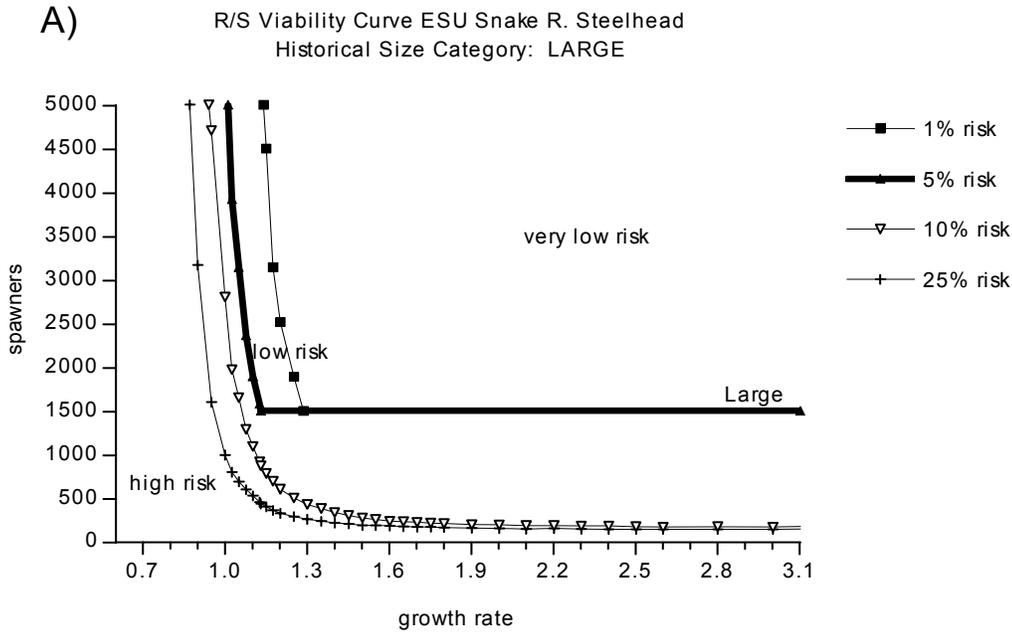
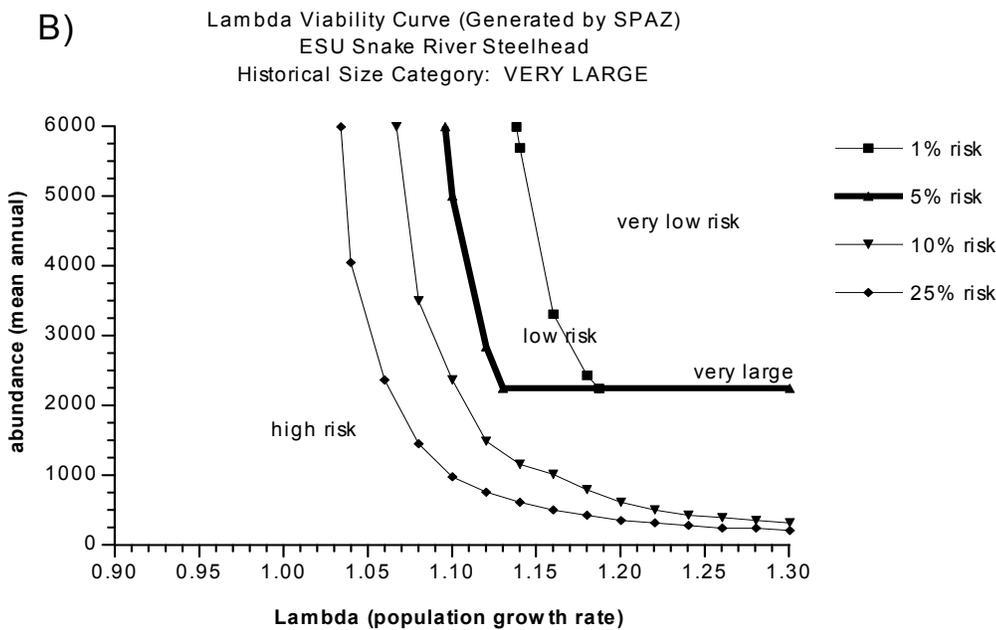
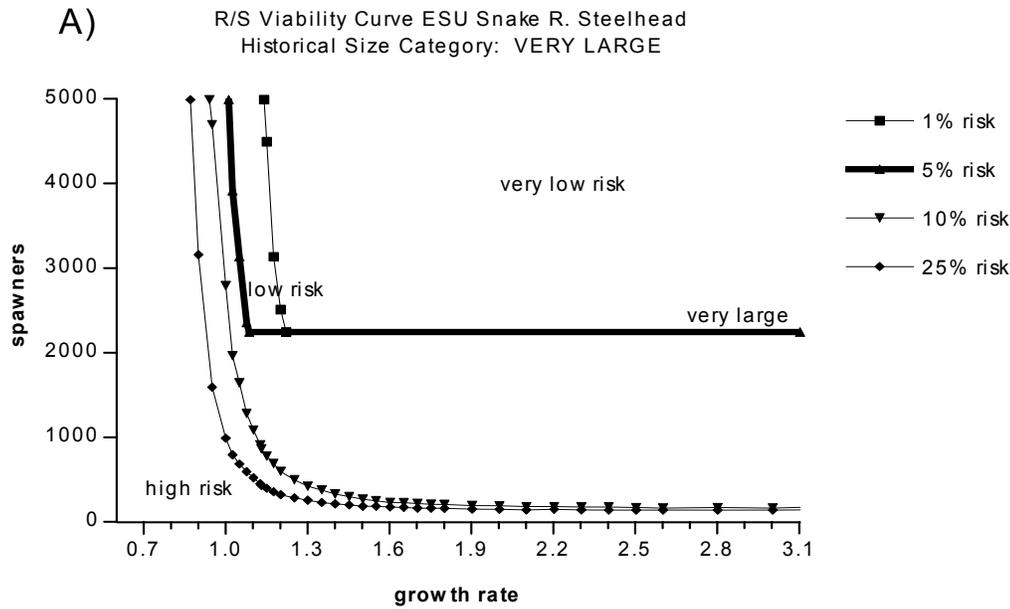


Figure 16. Curves for SNAKE RIVER STEELHEAD populations. 1% and 5% risk curves modified to incorporate minimum abundance threshold for VERY LARGE sized steelhead populations (based on historical intrinsic potential analysis). A) Spawner/Spawner metric, Hockey Stick production function. Variance: 0.35 ; autocorrelation coefficient (lag 1): 0.54; brood year age structure(3,4,5,6): 3%, 61%, 35%, 2%. B) Population Growth rate metric. Variance (running sum method): .19



Updated 6/28/05

Figure 17. Viability Curves for MID COLUMBIA STEELHEAD populations. 1% and 5% risk curves modified to incorporate minimum abundance threshold for BASIC sized steelhead populations (based on historical intrinsic potential analysis). A) Spawner/Spawner metric, Hockey Stick production function. Variance: 0.23 ; autocorrelation coefficient (lag 1): 0.69; brood year age structure(3,4,5,6): 22%, 46%, 28%, 4%. B) Population Growth rate metric. Variance (running sum method): 0.17.

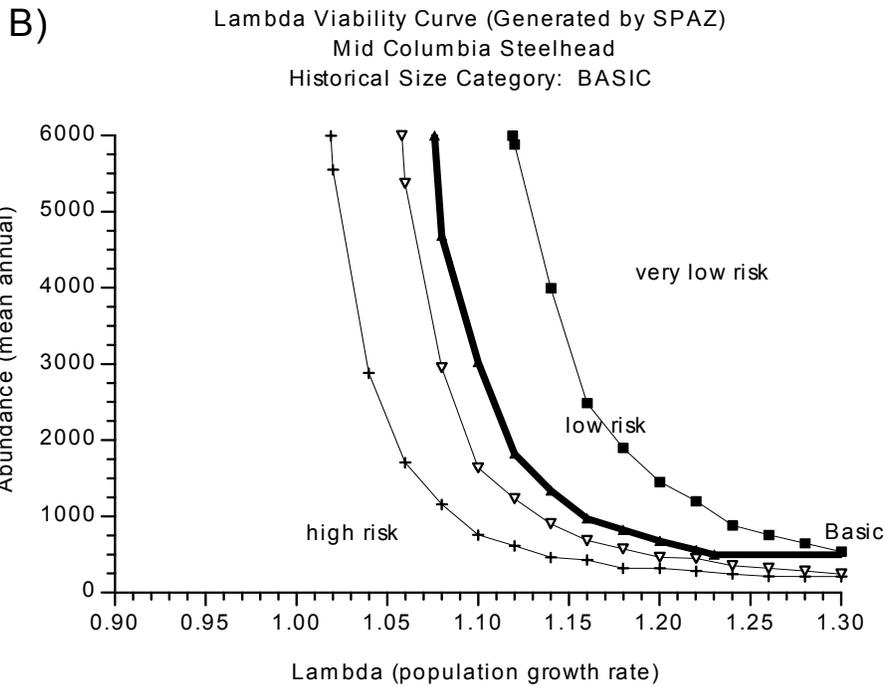
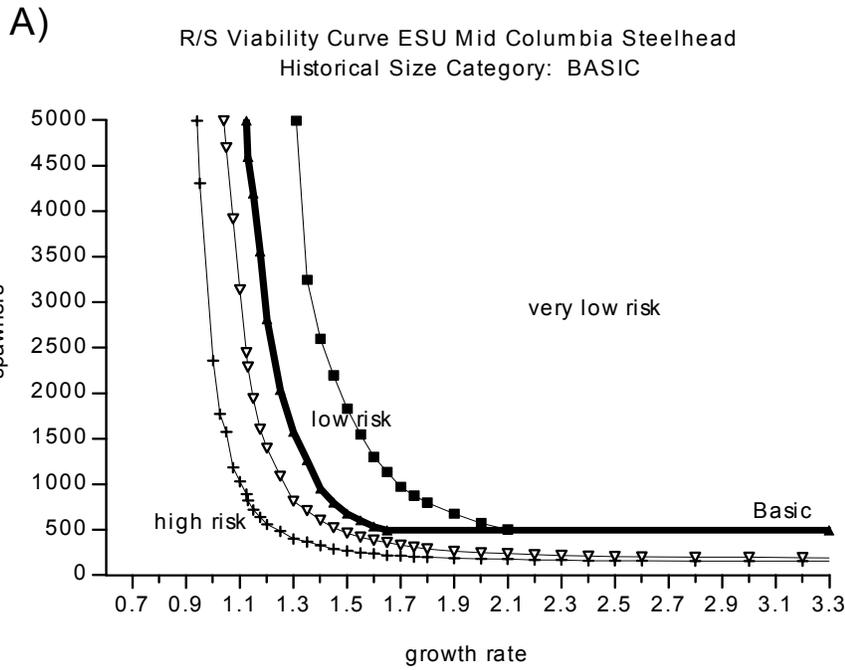


Figure 18. Viability Curves for MID COLUMBIA STEELHEAD populations. 1% and 5% risk curves modified to incorporate minimum abundance threshold for INTERMEDIATE sized steelhead populations (based on historical intrinsic potential analysis). A) Spawner/Spawner metric, Hockey Stick production function. Variance: 0.23 ; autocorrelation coefficient (lag 1): 0.69; brood year age structure(3,4,5,6): 22%, 46%, 28%, 4%. B) Population Growth rate metric. Variance (running sum method): 0.17.

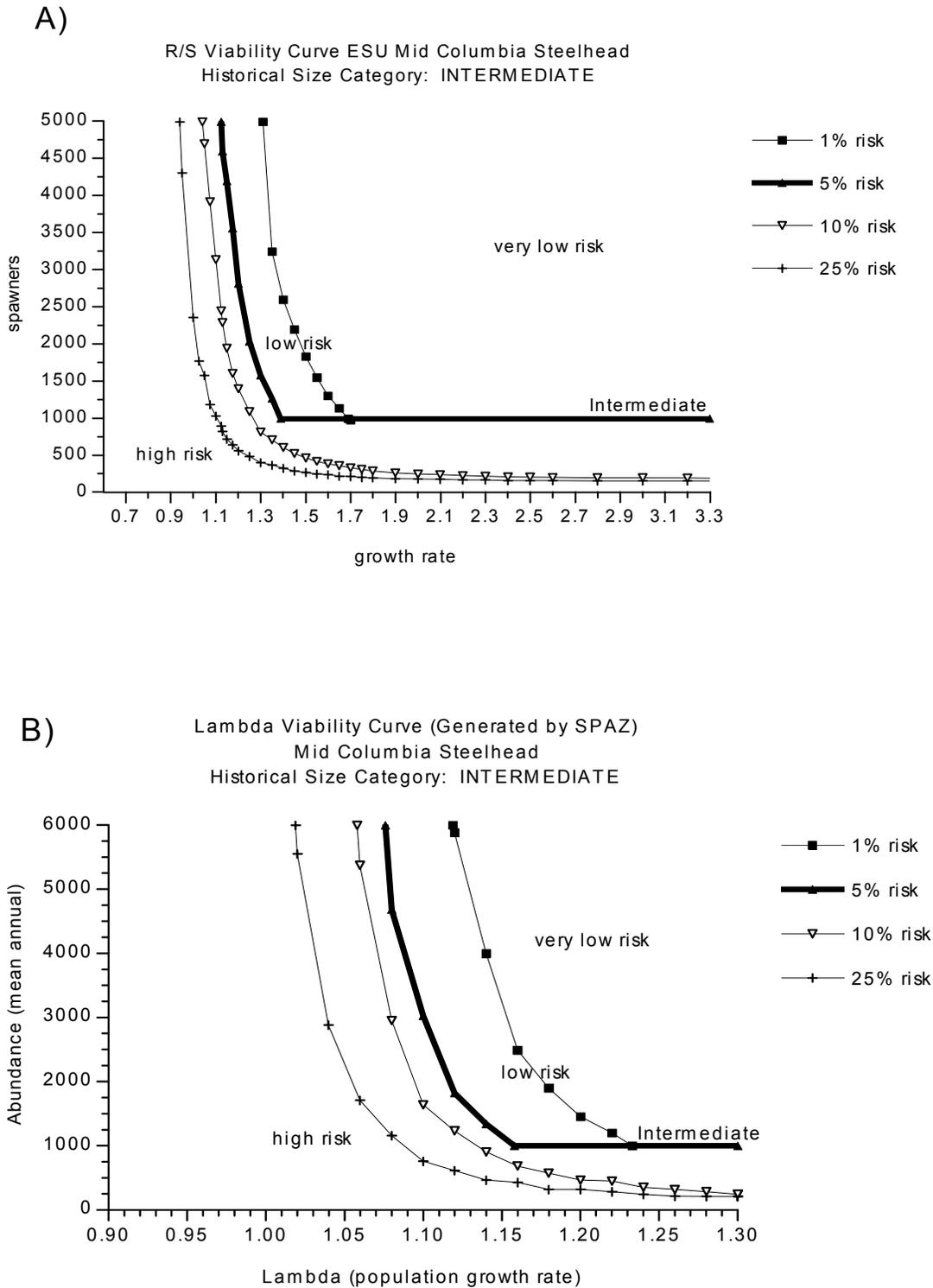
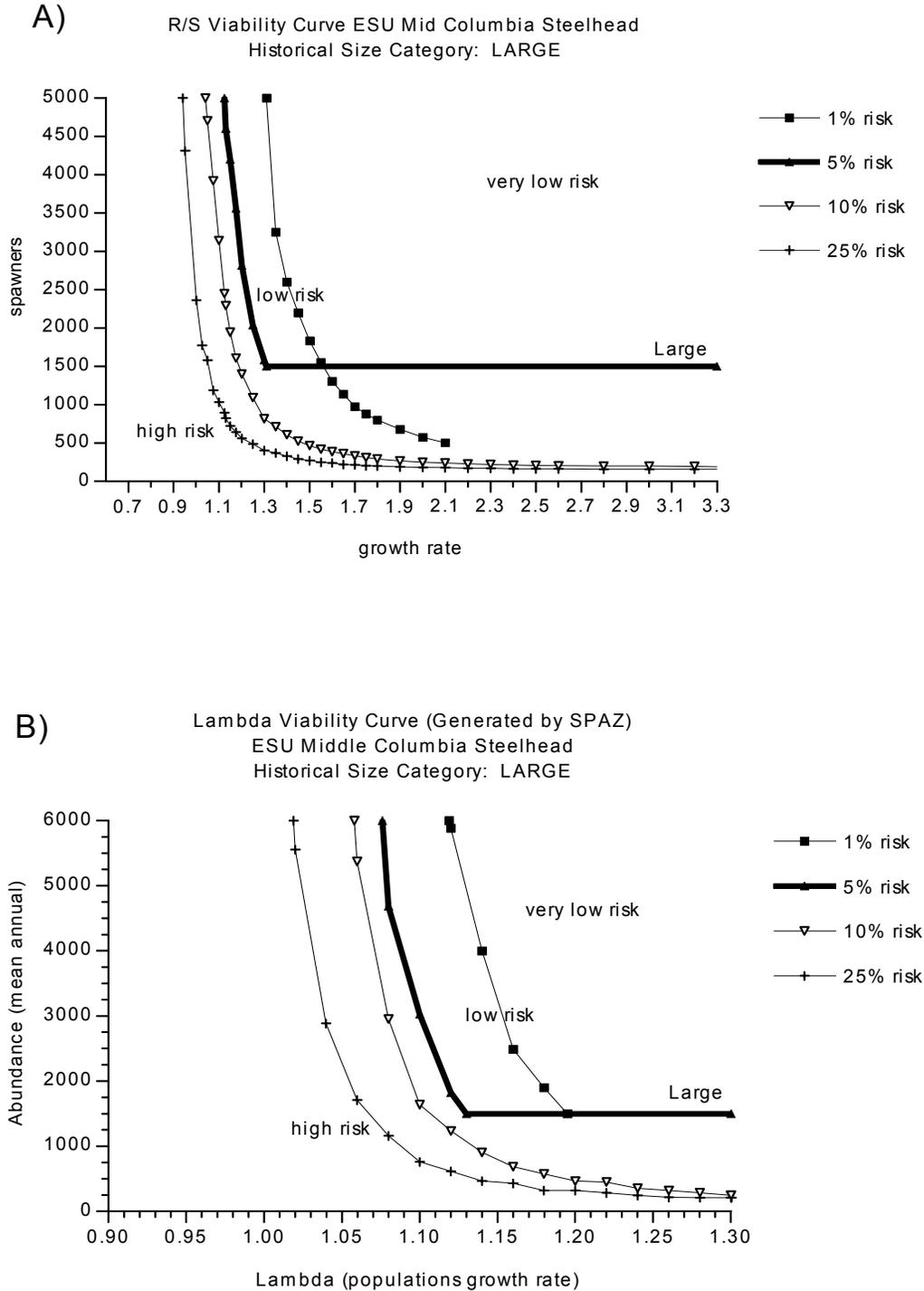
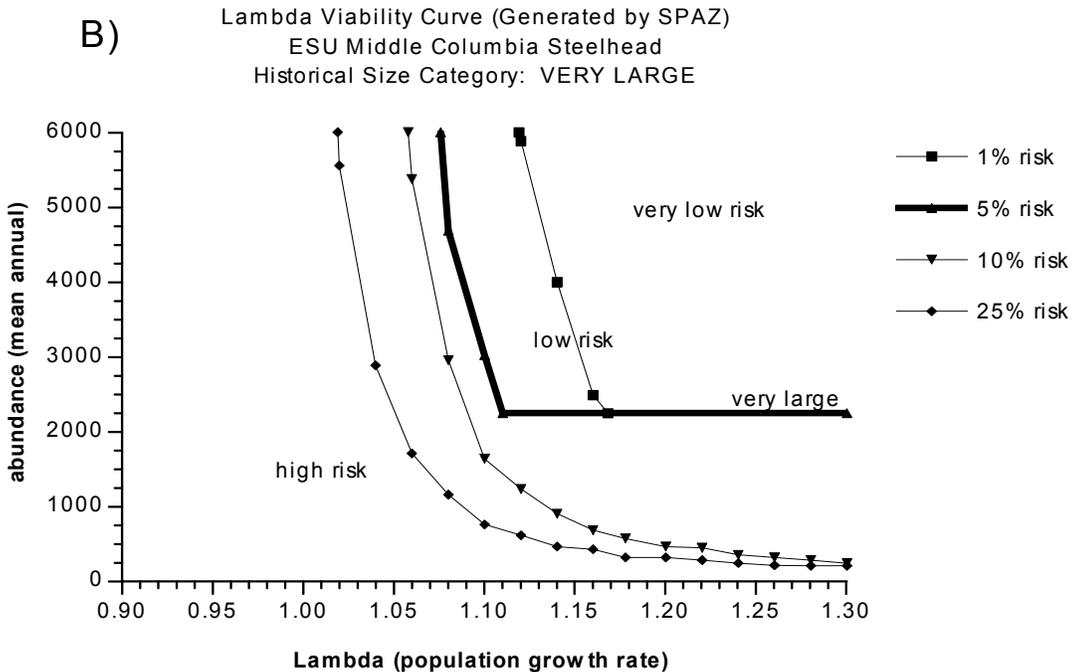
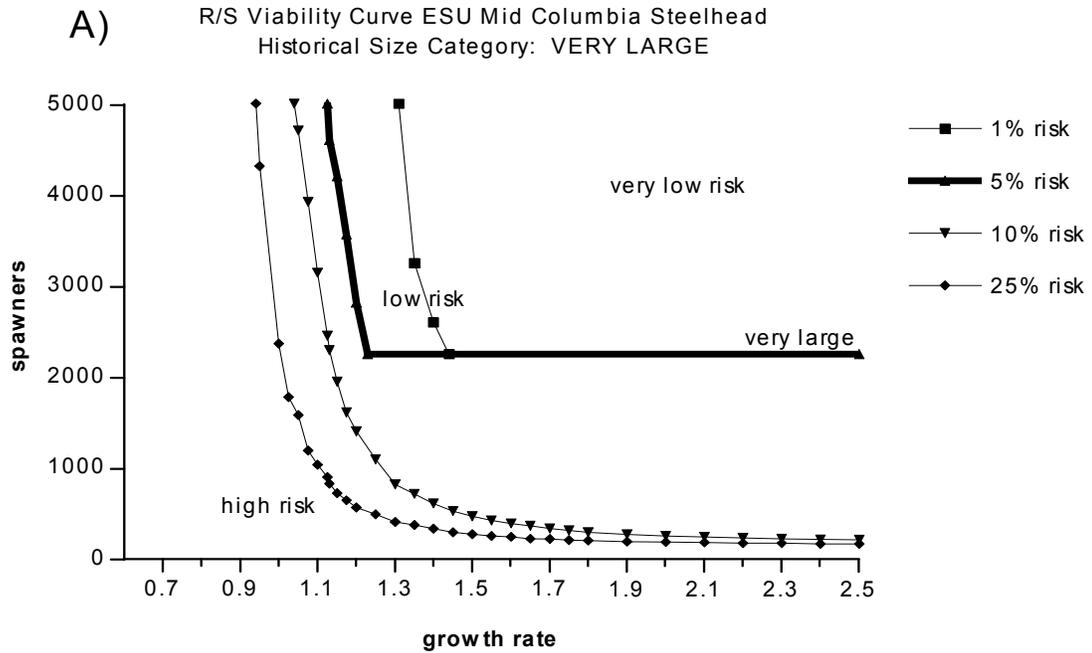


Figure 19. Viability Curves for MID COLUMBIA STEELHEAD populations. 1% and 5% risk curves modified to incorporate minimum abundance threshold for LARGE sized steelhead populations (based on historical intrinsic potential analysis). A) Spawner/Spawner metric, Hockey Stick production function. Variance: 0.23 ; autocorrelation coefficient (lag 1): 0.69; brood year age structure(3,4,5,6): 22%, 46%, 28%, 4%. B) Population Growth rate metric. Variance (running sum method): 0.17.



Updated 7/6/05

Figure 20. Viability Curves for MID COLUMBIA STEELHEAD populations. 1% and 5% risk curves modified to incorporate minimum abundance threshold for VERY LARGE sized steelhead populations (based on historical intrinsic potential analysis). A) Spawner/Spawner metric, Hockey Stick production function. Variance: 0.23 ; autocorrelation coefficient (lag 1): 0.69; brood year age structure(3,4,5,6): 22%, 46%, 28%, 4%. B) Population Growth rate metric. Variance (running sum method): 0.17.



Updated 7/6/05