

Title: Physiology and precocialism of hatchery and wild Yakima Spring Chinook.

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Precocious male maturation is a natural life-history strategy for many salmonid species including spring chinook. However, numerous studies have indicated that the hatchery rearing environment may potentiate this developmental pathway beyond natural levels resulting in loss of anadromous adults, skewing of sex ratios in favor of females among returning adults, and negative genetic and ecological impacts on wild populations. For several years we have conducted research to characterize the physiology and development of wild and hatchery-reared spring chinook salmon in the Yakima River Basin. Gonadosomatic index (GSI) and plasma levels of the reproductive steroid 11-ketotestosterone (11-KT) were used to estimate that 35-53% (depending on year) of males from the Yakima hatchery program undergo precocious maturation at 1+ years of age ("minijacks") compared with our estimate of 2.9-22% for wild fish. In 2003 we completed a growth modulation experiment at the Yakima Hatchery with brood year 2001 fish aimed at reducing the minijack rate in the hatchery fish. This experiment produced fish with four growth trajectories based on summer/autumn growth patterns with the following size and minijack rates as of release time in March, 2003: High/High (25 g, 69%), High/Low (18 g, 58%), Low/High (18 g, 51%), Low/Low (16 g, 42%) for comparison to production fish (22 g, 53%). These data suggest that minijack rates can be modulated through growth manipulation and the current production fish are being grown near a maximum rate for their water temperature (> 2X wild fish). These results were then used to develop a production scale experiment for brood year 2002 Yakima Hatchery fish. Ration was manipulated to produce Low Growth (10 grams or 45 fish/lb) and High Growth (15 grams or 30 fish/lb.) treatments by the start of tagging in mid-October. Fish were differentially tagged to monitor smolt survival and smolt-to-adult return. At the start of volitional release from the acclimation sites in March 2004 the minijack rate of the Low Growth males was 27% while that of the High Growth males was 43%. During smolt out migration Low and High Growth treatments and wild fish were captured at Prosser Dam in the lower Yakima River. For the Low and High growth treatments 27% and 28%, respectively of all male fish captured over four consecutive weeks were minijacks while only 11% of wild males were. In an effort to refine hatchery protocols to further reduce minijack rates we initiated an experiment in spring 2004 that combines alterations in emergence time, growth rate, and dietary lipid content. Results from this experiment will be used to modify the production hatchery protocols in subsequent years. (In cooperation with YN, WDFW, BPA contract #'s 1992-022 and 2002-032).