Intra- and Inter-specific Competition Affects to Growth and Survival of Spring Chinook Salmon

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The number of adult spring Chinook salmon that returned to the Yakima Basin prior to 1800 has been estimated to be 120,000. The capacity of the environment to produce such abundant returns has decreased dramatically because of factors contributing to competition-induced mortality and poor smolt-to-adult survival. Without density dependent interactions the number of late parr that the upper Yakima Basin could produce would be substantially higher particularly during years following large adult returns. Based on food and space competition indices, intraspecific competition was much stronger than interspecific competition. We therefore developed more specific intraspecific competition indices for food and space. The estimated amount of food that the entire spring chinook salmon population consumed during the summer was negatively correlated with parr size during September and October which suggests that food limited growth. In addition, the correlation was higher than that between parr size and redd abundance the previous year. Contrary to our expectations, the proportion of spring Chinook salmon in "sub optimal habitats" did not increase with increasing abundance of spring Chinook salmon, and the number of fish occupying "optimal habitats" increased with increasing abundance. Standard microhabitat variables that we used to measure "optimal microhabitats" may not measure the variables that are most important for microhabitat selection. New microhabitat variables were measured in 2005 to investigate these possible shortcomings. Chinook salmon occupied focal positions that had slower velocities than those within two body-lengths, suggesting that focal point positions alone are insufficient to explain habitat selection. Preliminary estimates of the proportion of the river channel that has water velocities within the upper limit observed for

juvenile Chinook salmon, suggests that unnaturally high stream discharges in the summer dramatically decreases the area available to these fish. Increasing the area of the river channel that provides suitable water velocities, cover, and food has the potential to increase the capacity of the upper Yakima basin. Hatchery supplementation has the potential to increase the productivity and capacity of the environment (i.e., fish food) by restoring marine derived nutrients through increased biomass of salmon carcasses and eggs. To date, we found little evidence to indicate that current ranges of abundances of salmon carcasses provided significant nutrient benefits to salmon or trout in the upper Yakima Basin. This may be the result of insufficient capacity to retain nutrients or insufficient biomass of salmon carcasses during our study. Because hatcheries can produce more adult returns than natural environments, hatchery supplementation has the potential to increase natural production during years that have insufficient natural returns to fully seed the environment.