

Factors affecting the reproductive success (RS) of naturally spawning male spring chinook salmon

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Abstract

The Yakima spring chinook (*Oncorhynchus tshawytscha*) supplementation program is representative of salmon recovery efforts taking place in the Pacific Northwest that rely on native brood stocks. This concept is not without controversy. Behavioral, morphological, and physiological divergences have been observed between wild- and hatchery-adult salmonids. It has been suggested that these differences are created by divergent environmental conditions and relaxed or dissimilar selection pressures extant in hatcheries. Such differences may negatively impact hatchery fish when they reside in natural environments.

One of the research objectives of the Yakima Fish Production study has been to compare the reproductive success of fish produced from the Cle Elum hatchery with wild-born conspecifics. These comparisons are being made by placing wild and hatchery-origin spring chinook into an observation stream located at the CESRF where they are allowed to reproduce under natural conditions. Just prior to being liberated into the observation stream a small sample of fin material is removed from each fish for microsatellite DNA extraction. Microsatellite DNA is also obtained from the fry produced by these fish. This makes it possible to estimate the number of offspring produced by each adult fish placed into the observation stream.

While the fish are spawning, observers make behavioral records by using audiotapes. During the past year, audiotape records made on adults spawning in the observation stream in 2001 were transcribed and placed into 'ethograms'. Courting, agonistic, and location data were extracted from these chronological records and analyzed to characterize the reproductive behavior of both hatchery and wild fish. In addition, a "gold standard" microsatellite DNA-based pedigree analysis was completed on the fry produced by the adults placed into the observation stream in 2001. Behavioral and morphological data collected on hatchery and wild males were linked to the results of the pedigree analysis to ascertain what factors affected their reproductive success (RS) or capacity to produce fry. Individual RS values were calculated for each male placed into the observation stream and the coefficient of variation calculated from these values was greater than 100%. To determine what might be responsible for this degree of variation we examined the relative importance of a variety of physical and behavioral traits. Relative body size, for example, was found not to be an important predictor of reproductive success. Instead, the capacity to court females and dominate sexual rivals was directly associated with male RS. However, males that had low dominance scores were also successful at producing offspring. These individuals utilized alternative behavioral strategies to gain close proximity to females and were successful in their attempts to fertilize eggs. Observations made on the color patterns of males showed dominance was closely linked with the possession of an overall black or dark brown color pattern. In addition, we discovered that males that had multiple mates achieved higher RS values than those who spawned with fewer females. The approach we are taking to compare the reproductive competency of hatchery and wild fish is to first determine the factors that are strongly linked to reproductive behavior and then assess whether significant differences occur in the expression of these traits based on fish origin.

Transcriptions of audiotapes are continuing and a second gold standard pedigree analysis on the fry produced from adults placed into the observation stream in 2002 is nearing completion. Future work will be directed at discovering the factors that affect female RS values.