

**Title:**

Comparing The Reproductive Success Of Yakima River Hatchery- And Wild-Origin Spring Chinook

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A growing body of literature suggests that adult salmon produced by artificial culture are not as reproductively successful as wild fish when they spawn under natural conditions. Many of the studies that have compared the reproductive success (RS) of hatchery and wild fish, however, have used non-local hatchery fish that have experienced multiple generations of culture. Few efforts have been made where both the hatchery and wild fish have originated from the same population. When such studies have been performed differences in the competency of hatchery fish to produce offspring have not been detected or are not as great as those expressed when non-local hatchery fish have been used.

The hatchery spring Chinook produced by the Yakima Fisheries Project originated from wild fish returning to the upper Yakima River. When they return as adults, almost all of them will spawn naturally in the Yakima River. The offspring they produce are expected to augment the Yakima spring Chinook population. Whether such an increase will occur or how great it may be depends on two factors, the ability of hatchery fish to reproduce under natural conditions and the capacity of their offspring to survive to maturity. One of the objectives of the Yakima Fisheries Project is to determine whether the adults produced by the project have experienced any reduction in their ability to reproduce under natural conditions. To accomplish that objective an observation stream was built in 2000 on the grounds of the Cle Elum Supplementation and Research Facility. Beginning in 2001 hatchery and wild spring Chinook from the upper Yakima River stock have been introduced into the stream and allowed to reproduce.

Microsatellite DNA is used to establish the genetic relationships between the adults placed into the stream and the fry they produced. Six populations consisting of mixtures of wild and hatchery fish have been placed into the stream. Pedigree assessments have been completed on five of them. These assessments have shown that reproductive success in males is often twice as variable as that experienced by females. In the five populations so far examined, wild males (age 4 and 5) produced the most offspring. The success of comparable hatchery males relative to wild males ranged from 37% to 113%. Hatchery and wild males maturing as 3-yr-olds (jacks) and as 1- and 0-yr-olds (precocious males) were also used in the study populations. They were not as successful at producing offspring as the larger hatchery and wild males.

During 2001 and 2002 two populations of hatchery and wild fish were placed into the observation stream each year. Each one occupied about half of the structure. In these populations wild females exhibited a superior capacity to deposit eggs. In addition, their eggs survived to the fry stage at higher rates. This survival advantage ranged from 1.9 to 11.7%. In 2003 the entire observation stream was made available to a single population of fish in an effort to reduce intrasexual competition among females for redd locations. In this year, hatchery females were better at depositing eggs (12.5%) and their buried eggs also achieved a higher egg-to-fry survival rate (3.4%). This suggests that at low population levels hatchery females were as competent as wild fish in burying eggs and in producing fry.

Although variation in the reproductive success of females was lower than that seen in males it could be quite variable. For example, coefficient of variation values calculated on female RS ranged from 34 to 77% in the populations we examined. Numerous factors may affect RS in females. We examined the potential impact of body size, longevity, redd defense, agonistic interactions, instantaneous density, water velocities in the redd area, how long it took to establish a redd, and proximity to neighboring fish on the ability of females to produce offspring. Two of these factors, redd defense and longevity proved to be the most important. The other factors had little or no impact on female RS.