

TITLE: The Use of Ultrasound for Early Determination of Maturation and Sex in Captive Broodstock Chinook Salmon

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The Grande Ronde Basin Chinook Salmon Captive Broodstock Program collects will parr and rears them to adulthood in either freshwater or saltwater, following smoltification. Upon maturation, we spawn them and the offspring are incorporated into the Lower Snake River Compensation Plan (LSRCP) hatchery production. We rear the offspring to smolt then release them into the natal streams of their parents to complete their life cycle in nature.

Producing healthy adults for spawning is paramount to the program. Therefore, determining when to transfer maturing fish from saltwater to freshwater is critical for maintaining fish health. In the early stage of the Grande Ronde Basin Captive Broodstock Program, we conducted up to four maturity sorts, which involved handling each fish and visually identifying those that were maturing, stressing both the fish and fish culturists. Some fish reared in saltwater were not identified as maturing until as late as August, well after the time their wild counterparts had entered freshwater, possibly leading to osmotic stress and reduction in health and fecundity. Early determination of maturation and sex will allow us to transfer fish from saltwater to freshwater at the appropriate time, which will improve fish health and egg quality. It will also allow us to better plan for expected production which will improve our ability to manage the Captive Broodstock and LSRCP programs.

We have examined ovaries from fish held at Manchester Marine Station and have found some evidence of maladies that we suspect is caused by osmotic stress due to fish being held in saltwater when their physiology has switched to freshwater functioning. Healthy ovaries are full of eggs and are fairly symmetrical in size. The eggs are turgid and large. Unhealthy ovaries have been asymmetrical with the left ovary usually being much smaller and less developed than the right. Egg quality is poor with some or many undeveloped and/or atresic eggs.

When the program began, we relied on visual identification of maturing fish, based on changes in color and body shape. We conducted four maturity sorts each season, beginning in May and ending in August and each sort required handling of each fish. Using ultrasound, we have reduced the number of maturity sorts to two per year and we are now able to begin sorting in early April and the final sort is in May. This greatly reduces stress on the fish which undoubtedly helps maintain fish health.

We began using ultrasound in May 2001 under the supervision of Allen Evans (Columbia River Inter-Tribal Fisheries Commission), who has been using this method with steelhead. With his help, we were 100% correct in assigning maturity and 99.6% correct in assigning sex. In 2002 and 2003, we began sorting in later March / early April, the approximate time that Grande Ronde River stocks enter the Columbia River. As expected, in each year our accuracy improved between the early and late sort (due to more developed gonads) and our accuracy improved from 2002 to 2003.

We were correct in assigning maturity 83.9% of the time in 2002, 78.7% in March/April

and 94.2% in May. In 2003, we were correct 91.1% of the time, 89.8% in April and 97.5% in May/June.

We were correct in assigning sex 96.1% of the time in 2002, 95.5% in March/April and 97.3% in May. We were correct 97.2% of the time for females and 95.0% for males. In 2003, we were correct 99.6% of the time, 96.4% in April and 100% in May/June. We were correct 99.5% and 99.6% for females and males, respectively.

There was no pattern to our incorrect identifications of maturation. In March/April 2002, we incorrectly assigned maturity for 21.2% of the fish because we were being cautious - not wanting to incorrectly call a fish mature and have it transferred from saltwater to freshwater, resulting in death. Of those incorrect assignments, 91.8% were mature fish that we called immature and only 8.2% were immature fish that were thought to be maturing. In May 2002, we were incorrect on only 3.7% of the fish and 56.9% were immature fish that were incorrectly called mature while 43.1% were mature fish that were incorrectly called immature. In April 2003, we were more accurate, being incorrect only 4.0% of the time: 53.2% immature called mature and 46.8% mature called immature. Of the immature fish that were incorrectly identified as maturing, nearly all of those were fish for which immature ovaries looked different than we had previously seen and we incorrectly identified them as maturing testes. In May/June 2003, we were only 0.2% incorrect in assigning maturity and all of those fish were immature fish that were thought to be mature.

There were also no patterns in our incorrect identification of sex. In March/April 2002, we incorrectly assigned sex for 4.5% of the fish determined to be maturing. Of those incorrect assignments, 38.5% were females that were called males and 61.5% were males that were called females. In May 2002, we were incorrect on only 2.8% of the fish and 25% were incorrectly called females while 75% were incorrectly called males. We were more accurate in April 2003, being incorrect only 0.4% of the time: 50% females called males and 50% males called females. In May/June 2003, we were 100% correct in assigning sex to the examined fish.

We have concluded that ultrasound is a viable method for early determination of maturation and sex in captive broodstock chinook salmon. Overall, we correctly assigned maturation for 91% of the fish examined and correctly assigned sex for 98% of the fish examined. Experience is required to accurately make these determinations and we have shown increasing accuracy between the two years of use. The most common mistake is incorrectly identifying immature females as maturing males, which is problematic for saltwater-reared females. We believe that it will help us maintain the health of the fish and egg quality of the maturing females by reducing handling stress. It will also allow us to better plan ahead for spawning and rearing of the offspring.