EVALUATING SPRING CHINOOK SALMON RELEASES ABOVE DETROIT DAM AND BELOW BIG CLIFF DAM, ON THE NORTH SANTIAM RIVER, USING GENETIC PARENTAGE ANALYSIS

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For almost two decades, primarily hatchery-origin (HOR; adipose fin removed) spring Chinook salmon (*Oncorhynchus tshawytscha*) have been released above the Detroit-Big Cliff Dam complex on the North Santiam River with the goal of reestablishing natural spawning activity in historical habitats. In addition, natural-origin (NOR; adipose fin intact) spring Chinook salmon that enter the Minto Fish Collection Facility have been released into the reach between Minto and Big Cliff Dam. Genetic parentage analysis has been used to evaluate the contribution of spring Chinook salmon released above Detroit Dam to subsequent NOR adult salmon recruitment to the river. Here, we extend the analysis by assigning NOR adult salmon returns in 2016 – 2020 to salmon released above Detroit Dam or to salmon released into the reach between Minto and Big Cliff Dam in 2011 – 2017. Note, a large number of NOR salmon (N = 498) were released above Detroit Dam in 2015 as a special measure to distribute the risk of potentially high prespawn mortality that was expected to occur in that extremely low, warm water year.

We found that assignment rates of returning NOR adult spring Chinook salmon increased from 35% in 2016 to 91% in 2020, with most individuals assigning to salmon previously released above Detroit Dam. The increase in assignment rate is likely, at least partially, attributed to operation of the new Minto Fish Collection Facility beginning in 2013. The inferred age structure of NOR returns based on our genetic parentage analysis results indicates that most adult offspring are age-4 with interannual fluctuations in the proportions of age-3 and age-5 salmon.

On average, about 30% of salmon released above Detroit Dam in 2011 – 2015 produced at least one adult offspring that was identified through genetic parentage analysis. Mean total lifetime fitness (TLF), which considers all age-3, age-4, and age-5 adult offspring, was higher for females than males released above Detroit Dam, except in 2012 when the sex ratio was female biased. We found that sex and overall sex ratio of salmon released above Detroit Dam in a year was highly predictive of TLF. We also found that the effect of sex depended on the sex ratio. The predicted effect of sex ratio was strong and suggests that TLF could be substantially improved if sex ratios were balanced.

Cohort replacement rate (CRR), or the number of future spawners produced by a spawner, was estimated using all individuals (CRR_{total}), only females (CRR_F), or only males (CRR_M). Estimates for the 2011 – 2015 cohorts never approached one, indicating that replacement had not been met.

On average, about 20% of NOR salmon released into the reach between Minto and Big Cliff Dam in 2013 – 2015 produced at least one adult offspring that was identified through genetic parentage analysis. Mean female TLF was greater than mean male TLF in all three years and mean female TLF (0.93 ± 1.70 SD) and CRR_{total} (0.56) were highest in 2015, the extremely low, warm water year. Interestingly, only 148 salmon were sampled and released below Big Cliff Dam that year and the sex ratio was close to one.

Based on our findings, the decision to release ~500 NOR spring Chinook salmon above Detroit Dam in 2015 increased productivity in the system for that year. Mean TLF of NOR salmon released above Detroit Dam was 1.87-fold greater than the mean TLF of HOR salmon released above Detroit (Wald test p-value: 2.0 x 10-7), and 1.51-fold greater than the mean TLF of NOR salmon released below Big Cliff Dam (Wald test p-value: 0.039).

Reference

O'Malley, K.G., Dayan, D.I., Fitzpatrick, C.K., Bohn, S., Grenbemer, G.A. (2023) Evaluating spring Chinook salmon releases above Detroit Dam and Below Big Cliff Dam, on the North Santiam River, using genetic parentage analysis. U.S. Army Corps of Engineers. PDF