Lostine River Supplementation Program (1997 – 2009)

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Abstract:
Efforts to rebuild Lostine River Chinook salmon (*Oncorhynchus tshawytscha*) in Oregon's Grande Ronde Basin were undertaken with two supplementation programs. A captive broodstock program began collecting Lostine River juvenile parr for broodstock in 1995 and a conventional program began collecting Lostine River adult broodstock in 1997. Smolts from the supplementation programs were acclimated and volitionally released during the spring. Hatchery Chinook salmon were monitored as smolts and returning adults using coded-wire tags, PIT tags, redd counts, and mark-recapture escapement estimates. Survival estimates for natural Chinook salmon smolts from 1999 to 2009 were higher than for hatchery Chinook salmon smolts in all years except 2002. Spawner abundance from 1997 to 2000 never exceeded 250 spawners. Spawner abundance increased to 270 to 1,055 spawners from 2001 to 2009 with returning hatchery origin females beginning in 2001. Hatchery origin spawners comprised 29% to 80% of all adult spawners. Hatchery Chinook salmon had significantly more age 3, and fewer age 5 adult returns than natural Chinook salmon for brood years 1997 to 2004. Natural progeny-to-parent ratios declined from brood year 1999 to brood year 2003. Supplementation has increased the overall abundance of Lostine River Chinook salmon and provided harvest opportunities but adult recruitment needs to increase if supplementation is to be a successful strategy for rebuilding the natural population.

Introduction:
This program is funded by the Bonneville Power Administration who chose to fund M&E and O&M as a package back in 1997. The funding provided by BPA allows NPT to work cooperatively with state and federal agencies for field activities such as pre-release sampling, and spawning ground surveys. It also allows NPT to participate in annual production planning for the Lower Snake River Compensation Plan (LSRCP). The Lostine River is considered to be part of the larger Wallowa/Lostine River Spring Chinook salmon population area as defined by NOAA (Figure 1). This definition is used when evaluating population status (ICTRT 2006). However, when supplementation began in the Lostine River the population area was not defined and the Lostine River was managed as its own population. Therefore, the results presented for the purpose of this review are limited to the Lostine River.

The Lostine River watershed drains an area of 236 km^2 in the Grande Ronde Subbasin and originates from an elevation of 2,225 m. The majority of the stream above the acclimation facility is within US Forest Service lands and majority of the stream below the acclimation facility is contained within agricultural farm lands. The majority of the Chinook salmon spawning habitat in the Lostine River is located upstream of the town of Lostine.

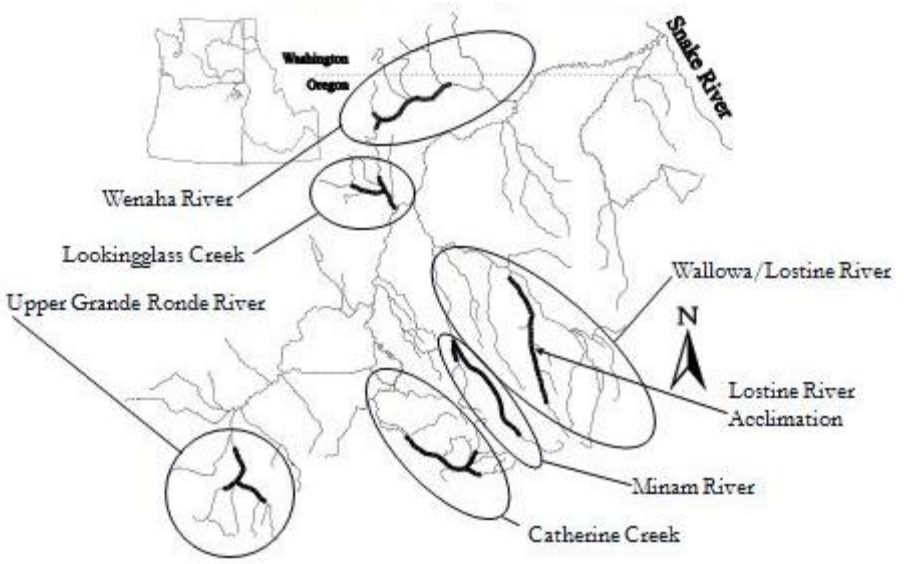

Figure 1. A map showing the Grande Ronde Basin spring Chinook salmon populations in northeast Oregon.

Program Overview:

Supplementation in the Lostine River began in response to a decline in redd counts. Lostine River supplementation is part of the Grande Ronde Basin Endemic Spring Chinook Supplementation Program (GRESP 1998). This program began in 1995 as a cooperative project between co-managers. In 2006 a formal monitoring and evaluation plan for supplementation (Hesse et al. 2006) was completed and reviewed by the ISRP. Two approaches were taken for supplementation in the Lostine River. A captive broodstock program was chosen for one approach because it did not require the use of returning adults for broodstock. The second approach was a conventional broodstock program. The two approaches had two major differences. The captive broodstock program used all wild origin broodstock whereas the conventional program incorporated hatchery origin fish as part of the broodstock. The second major difference was that the captive broodstock program collected juvenile parr as broodstock to obtain eggs for smolt production. This meant that it took longer to start up the program because the parr had to be raised to the adult life stage to obtain eggs. The conventional program collected returning adults as broodstock for smolt production so it took less time to obtain eggs.

The program objectives for Lostine River supplementation were first stated in the NEOH Master plan in 2000 (Ashe et al. 2000) and were divided into short, mid, and long term objectives. These objectives are as follows:

- Short term goal - Preservation of population by maintaining an annual escapement of 250 adults.
- Midterm – Restoration of population by achieve an annual escapement of 500 natural adults.

- Long term – Reestablish historical escapement and harvest by maintaining natural self-sustaining population of 1,716 adults and achieve the LSRCP hatchery-origin goal of 1,625 adults.

The short term objective was established with the mindset that loss of Lostine Chinook salmon was a real possibility. The midterm objective for natural escapement was established to work towards a self sustaining population of Lostine River Chinook salmon. The long term objective was the original goal for the LSRCP in the Lostine River and included a component for harvest.

Program objectives required that the captive and conventional supplementation programs release 250,000 smolts. It was planned that the number of captive broodstock smolts produced would be reduced as the population of Chinook salmon in the Lostine River increased and that the captive broodstock smolt production would eventually be replaced by smolts produced by the conventional broodstock program. The goal of 250,000 smolts was chosen because at a 0.1% smolt-to-adult return rate it was expected to return 250 adults. Two hundred and fifty adults was a minimum number of adults returns that co-managers thought would prevent the loss of Chinook salmon in the Lostine River as stated in the short term goal.

As with any supplementation program, there are risks as well as benefits. The risks that co-managers were most concerned with were that natural and hatchery life history traits could diverge over time and that productivity of the stock could decrease due to a decreased fitness in hatchery origin fish. The benefits that were expected with supplementation were higher egg-to-smolt survival and harvest opportunities.

Results:
Prior to the first adult returns from the supplementation, the catch at the weir from 1997 to 2000 did no exceeded 100 fish. The catch of hatchery Chinook salmon pushed the catch over the desired minimum adult return of 250 Chinook salmon beginning in 2005. But not all returning fish are captured at the weir. Escapement at the Lostine River weir is estimated using a mark-recapture technique (Cleary and Edwards 2009). The bar graph shows the catch from 1997 to 2009 with escapement shown by the dotted line. Only in 2007 has there been a census count at the weir. But the point to be made is that escapement since 2001 has been greater than 500 Chinook salmon (Figure 2). However, the mid-term goal was to return 500 natural origin Chinook salmon. This goal was reached only recently in 2008 and 2009 (Figure 3).

The majority of the escapement since 2001 has been comprised of hatchery origin adult returns. The abundance returns of hatchery origin Chinook salmon have contributed to both sport and tribal fisheries below Lower Granite Dam, and in the Wallowa River and Lostine River. The terminal tribal fishery and distribution of fish at the weir for food banks occurred on and off from 2001 to 2009. The sports fishery was re-established in the Wallowa River in 2008 and continued in 2009. The majority of the harvest (Figure 4)

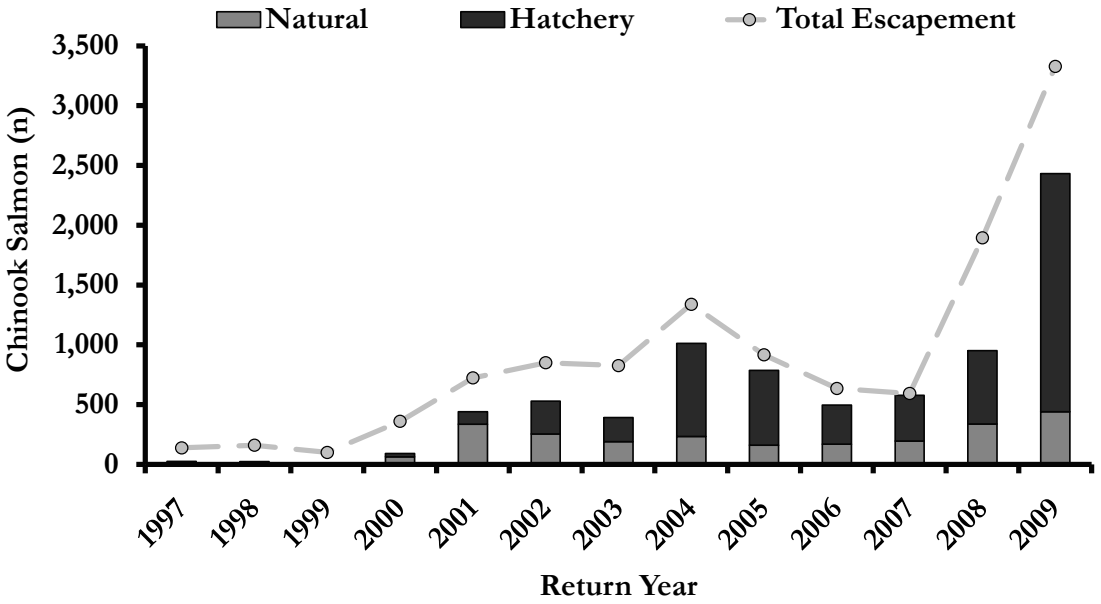

Figure 2. The catch of natural and hatchery Chinook salmon at the Lostine River weir from 1997 to 2009 and the total escapement as shown by the dotted line.

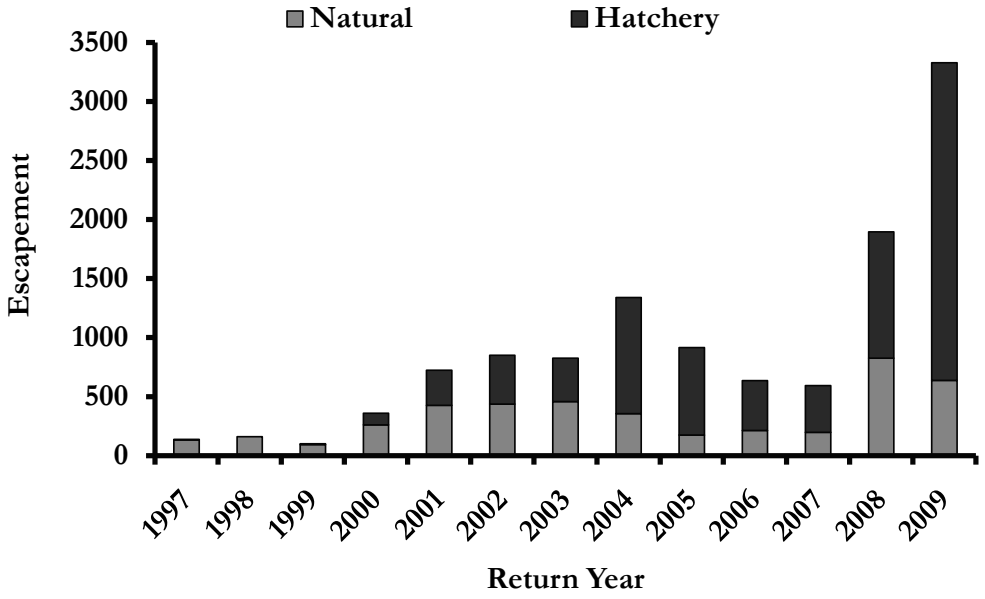

Figure 3. The estimated escapement of Lostine River Chinook salmon that occurred from 1997 to 2009.

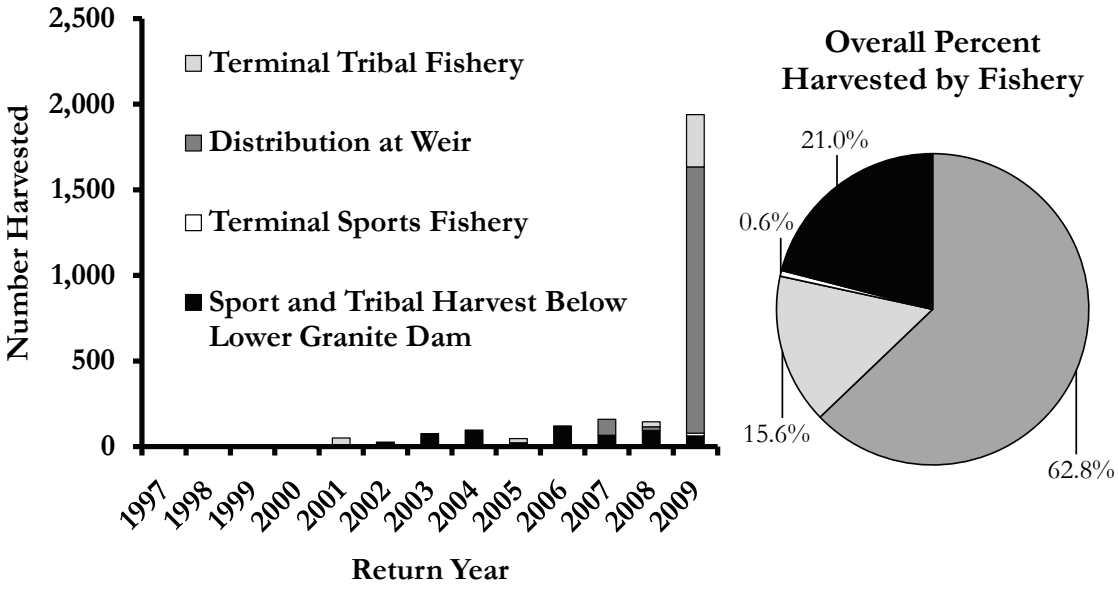

Figure 4. The number of Lostine River Chinook salmon harvested by fishery and the percent of harvest accomplished by each fishery.

occurred in 2009 from the tribal distribution at the weir. The Nez Perce Tribe was required to remove these hatchery fish at the weir under an existing agreement with co-managers to limit the influence of hatchery origin spawners (Ashe et al. 2000)

During the first four years of the program it was not possible to meet the goal of 250,000 smolts. Adult returns were so poor in brood years 1998 and 1999 that no broodstock was taken for the conventional supplementation program and we relied entirely on smolts produced from the captive broodstock program for juvenile releases in 2000 and 2001. However, with the exceptions of 2005 and 2008, the smolt production goal of 250,000 smolts was reached and by 2005, 75% of the smolt production was accomplished by the conventional broodstock program (Figure 5). Pre-release sampling at Lookingglass Fish Hatchery showed that smolts ranged in size from 109 to 128 mm. The smolts were acclimated and volitionally released from two temporary structures. The facility had a combined capacity for 125,000 smolts. This meant that when smolt production reached 250,000 smolts in 2003 the single acclimated volitional release had to be split into two acclimated volitional release that occurred in the early and late spring. As a single release group, these hatchery smolts were significantly larger than their natural smolt counterparts when compared side by side at the Lostine River screw trap and all differences were significant (Figure 6). Hatchery smolts did not survival as well as natural smolts from the Lostine River screw trap to Lower Granite Dam (Figure 7). And natural smolts tended to have a more prolonged migration time to Lower Granite Dam and arrive a bit later than their hatchery counterparts (Figure 8). However, arrival timing may have been influenced in some years by the early acclimated volitional release group of hatchery Chinook salmon smolts.

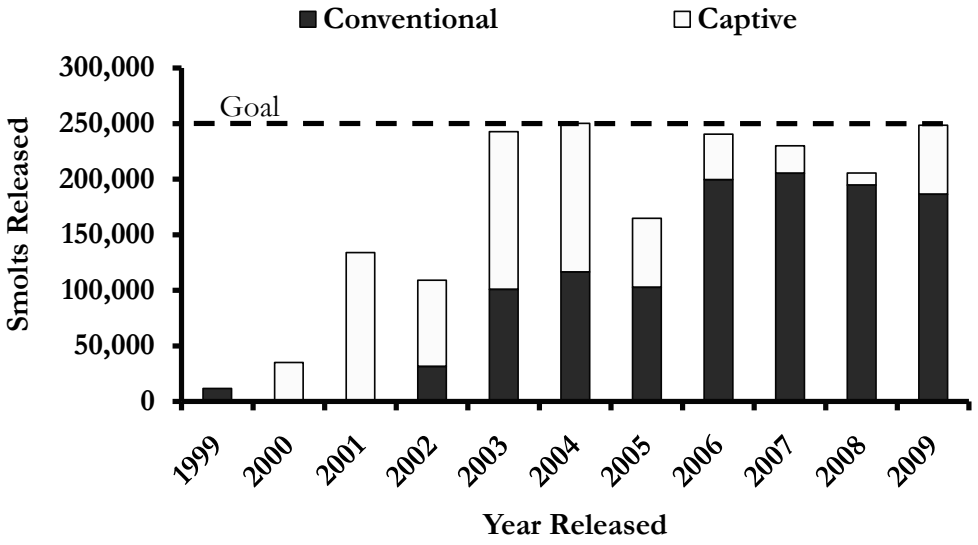

Figure 5. The number of Lostine River Chinook salmon smolts produced from 1999 to 2009 by the conventional and captive broodstock programs.

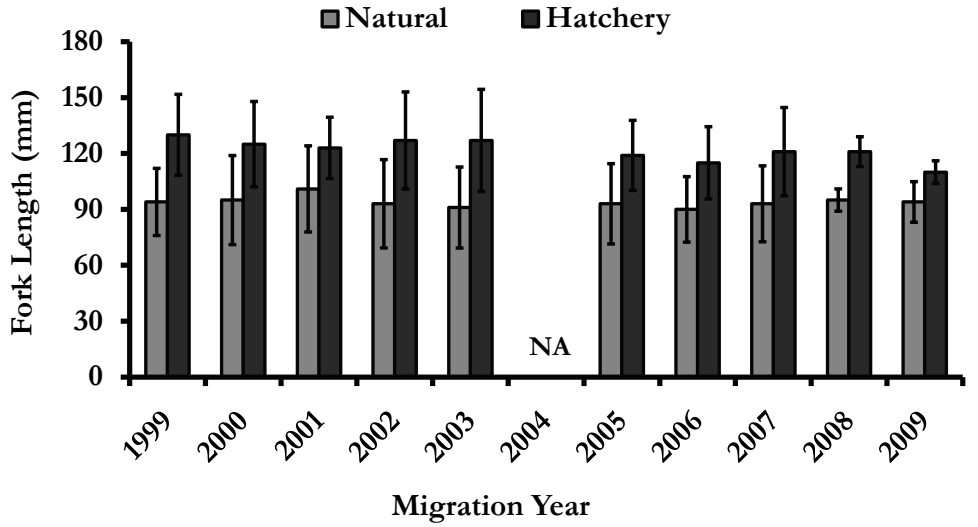

Figure 6. Length at emigration as compared at the Lostine River screw trap from 1999 to 2009. No data was available for 2004.

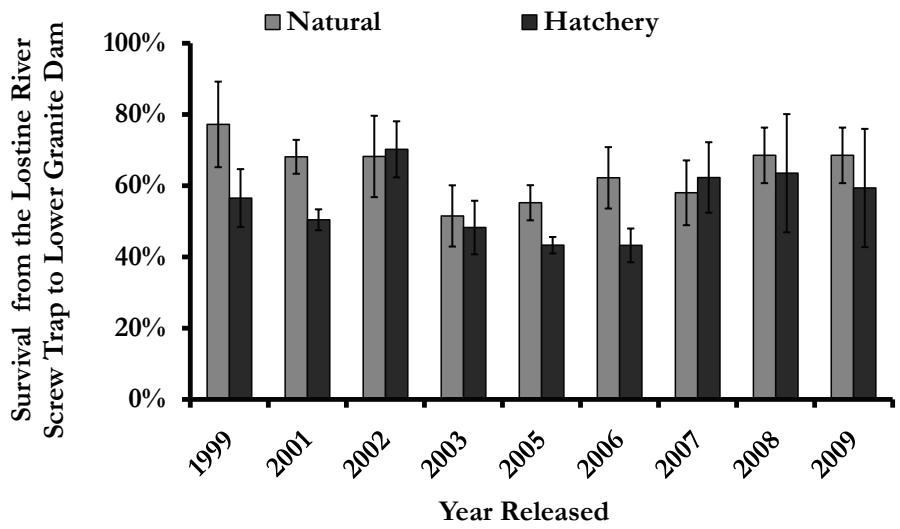

Figure 7. The survival of Lostine River natural and hatchery Chinook salmon from the Lostine River screw trap to Lower Granite Dam from 1999 to 2009.

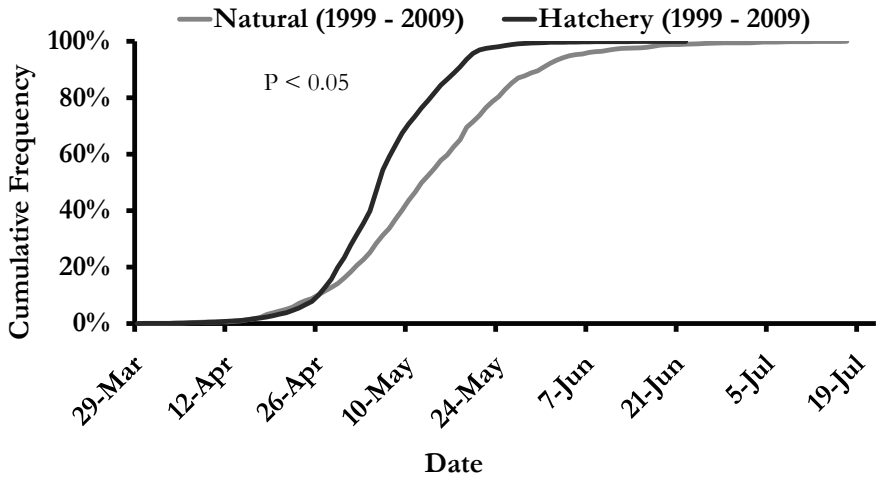

Figure 8. Average smolt migration timing to Lower Granite Dam from 1999 to 2009.

Returning natural origin adults out performed hatchery origin adults, both as surviving adults and to the tributary. But in all years the hatchery smolt to adult return rate exceeded the rate of 0.1% used originally in planning the releases of 250,000 smolts (Figure 9). So predictably spawner abundance increased with escapement but the majority of the spawners were hatchery origin Chinook salmon (Figure 10). The number of smolts per spawner ranged from 56 smolts per spawner to 312 smolts per spawner from brood years 1997 to 2007 but there was no decisive trend (Figure 11). However, natural recruits per adult spawner showed a decrease in productivity from 1997 to 2000 prior to the return of age 4 hatchery females. Once age 4 hatchery females began returning in 2001 the number of recruits per spawner decreases below 1.0 (Figure 12). But this may be just a coincidence caused by poor migratory or ocean conditions.

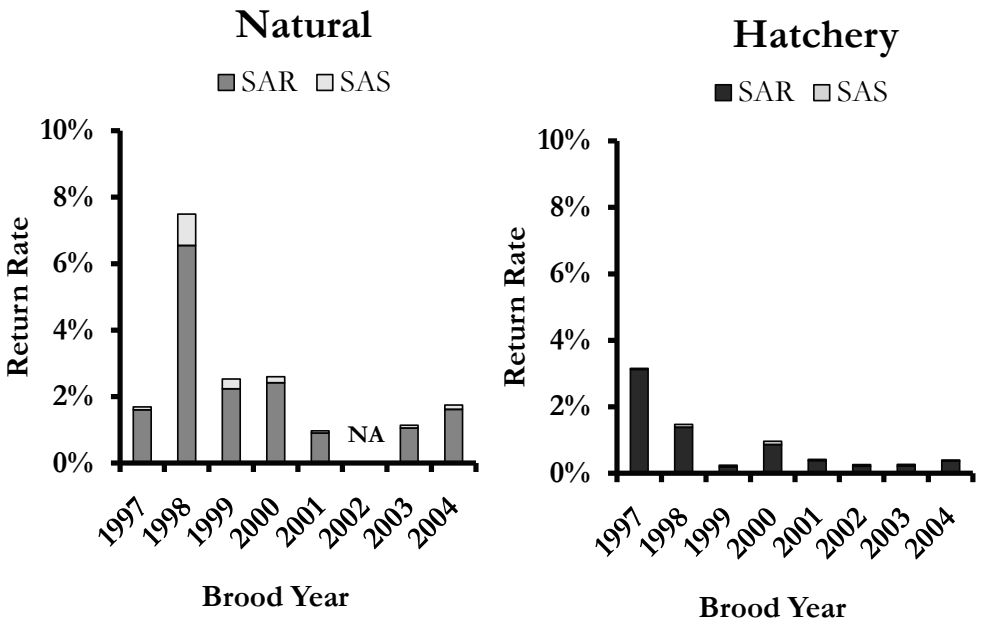

Figure 9. Lostine River natural and hatchery smolt-to-adult returns and smolt to adult survival from brood years 1997 to 2004.

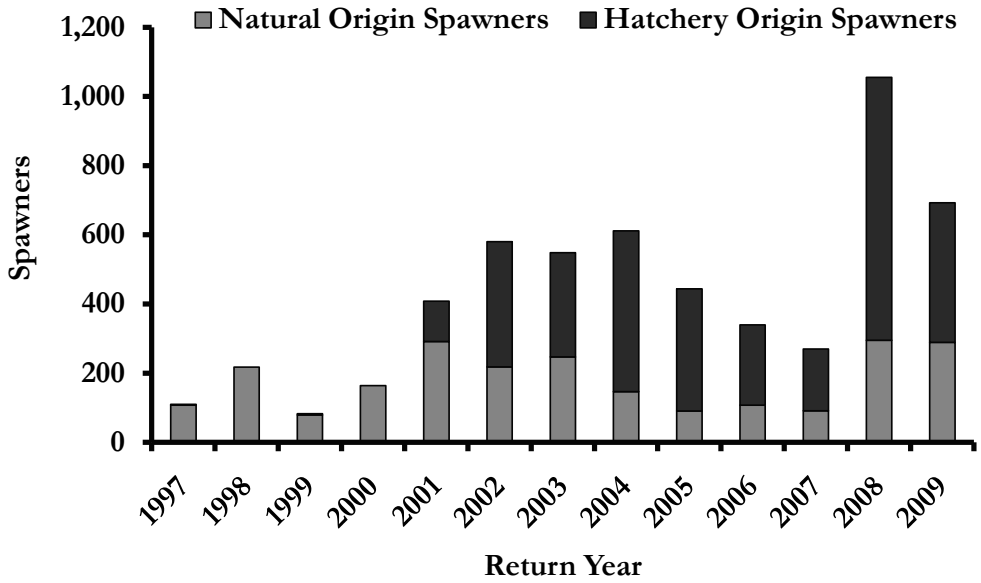

Figure 10. Adult age 4 and 5 spawner abundance by origin in the Lostine River from 1997 to 2009.

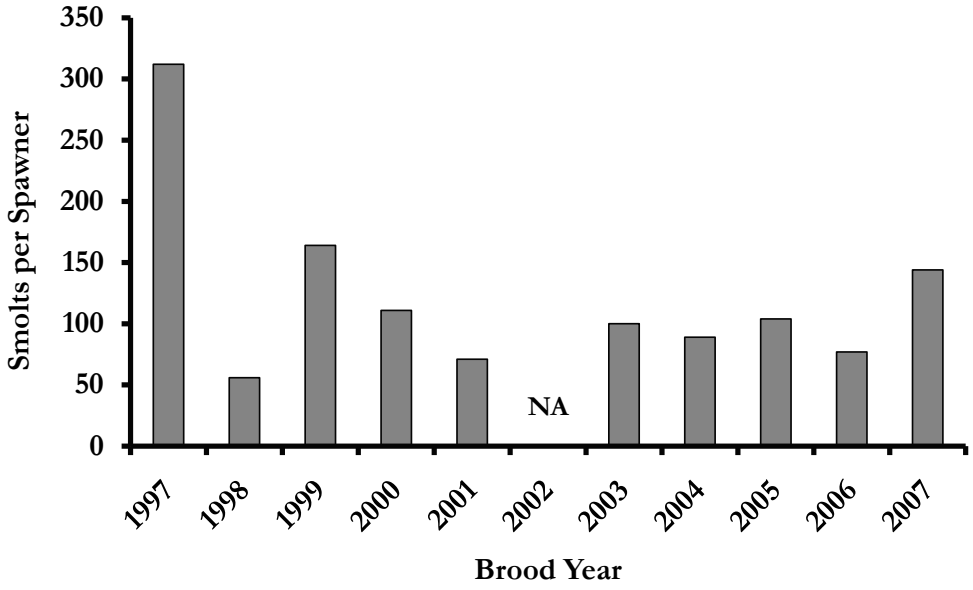

Figure 11. Natural smolts per spawner in the Lostine River from brood years 1997 to 2007.

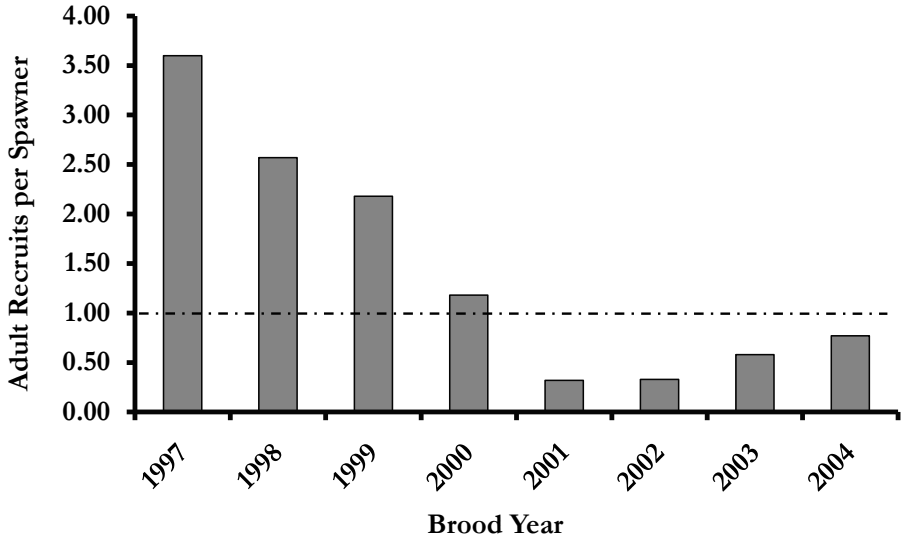

Figure 12. Lostine River natural Chinook salmon progeny per parent ratios from brood years 1997 to 2004.

No differences were observed in the size at return of age four natural and hatchery females. Natural age 5 females were statistically larger than age 5 hatchery females but the difference is probably not biologically significant (Figure 13). There was no significant difference between the average fecundity of age 4 or age 5 natural and hatchery Chinook salmon females from 2004 to 2009 (Figure 14). But there were significantly fewer age 5 hatchery Chinook salmon and significantly more age 3 hatchery

Chinook salmon returning per brood year than natural Chinook salmon (Figure 15). No significant differences ($p > 0.05$) were found between recovery locations of natural and hatchery female carcasses in the Lostine River (Figure 16).

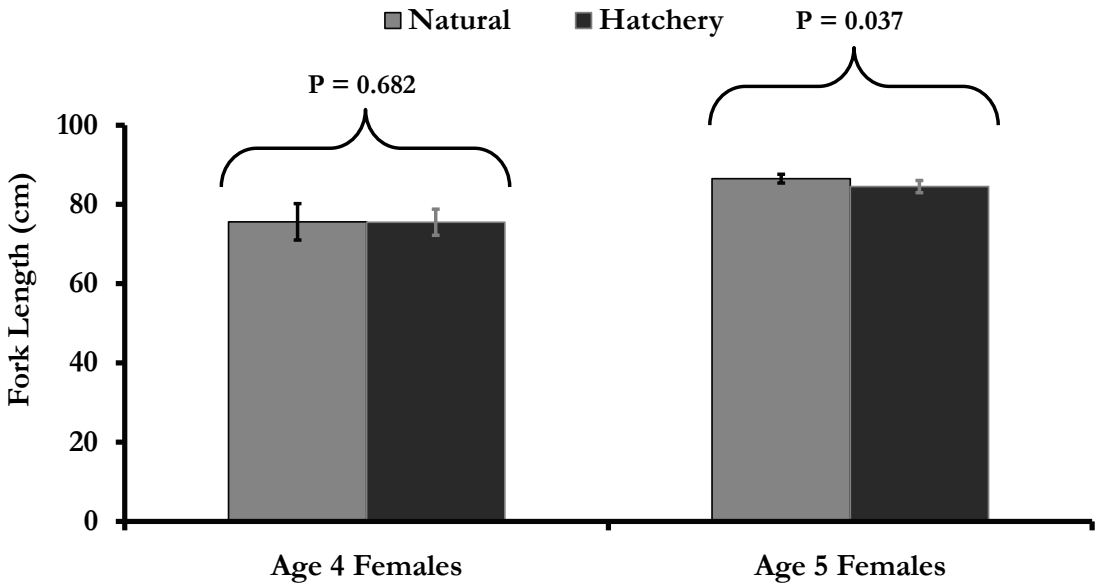

Figure 13. Average size at return of natural and hatchery Lostine River Chinook salmon from brood years 1997 to 2004.

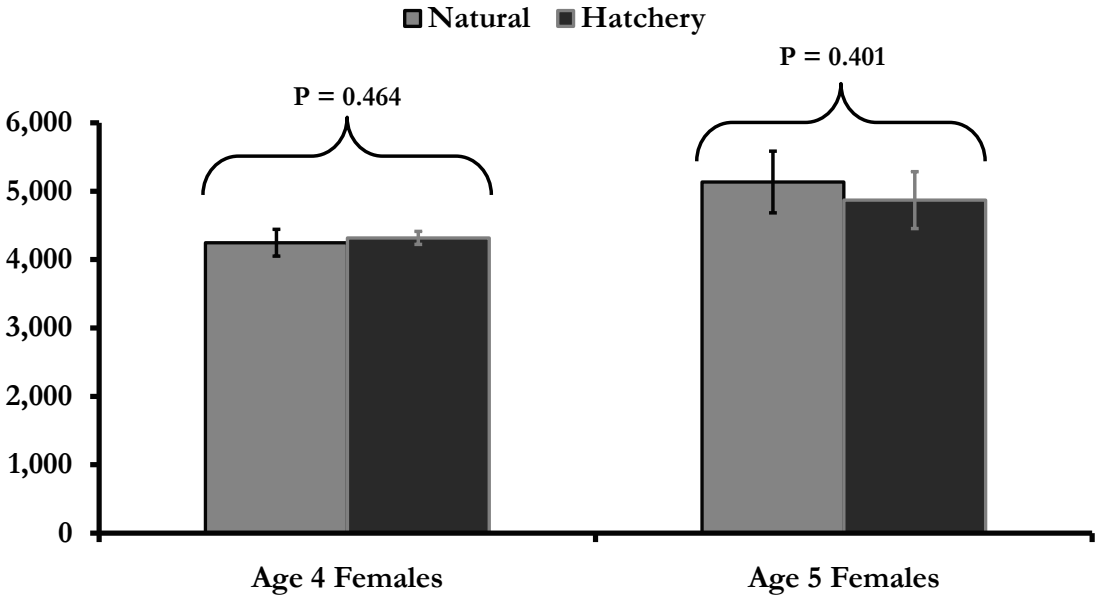

Figure 14. Average fecundity of natural and hatchery Lostine River Chinook salmon from 1997 to 2009.

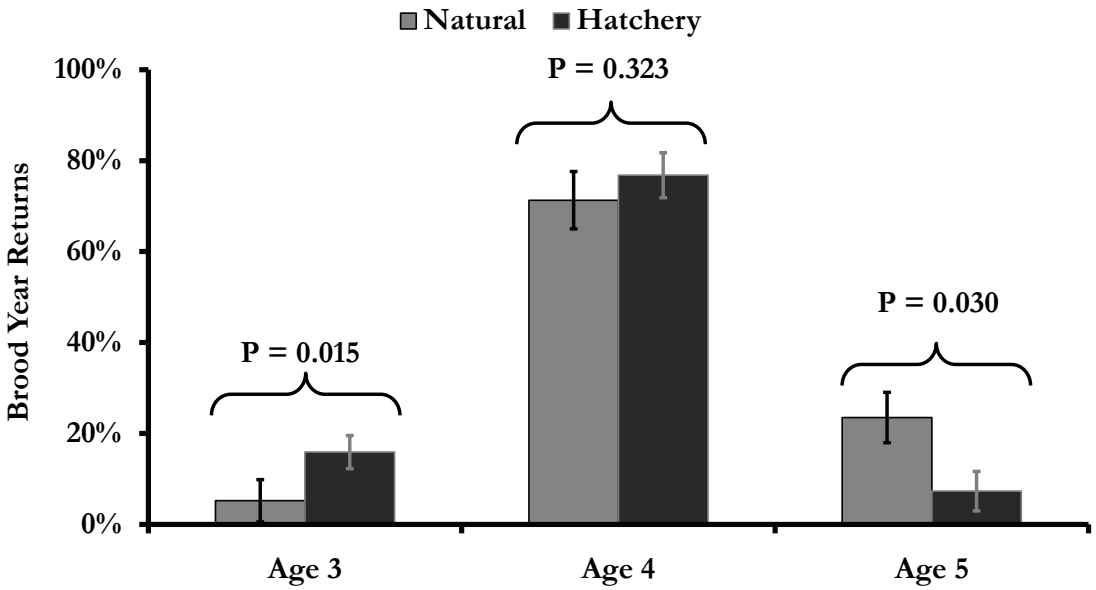

Figure 15. The average percent of Lostine River natural and hatchery Chinook salmon returns by age from brood year 1997 to 2004.

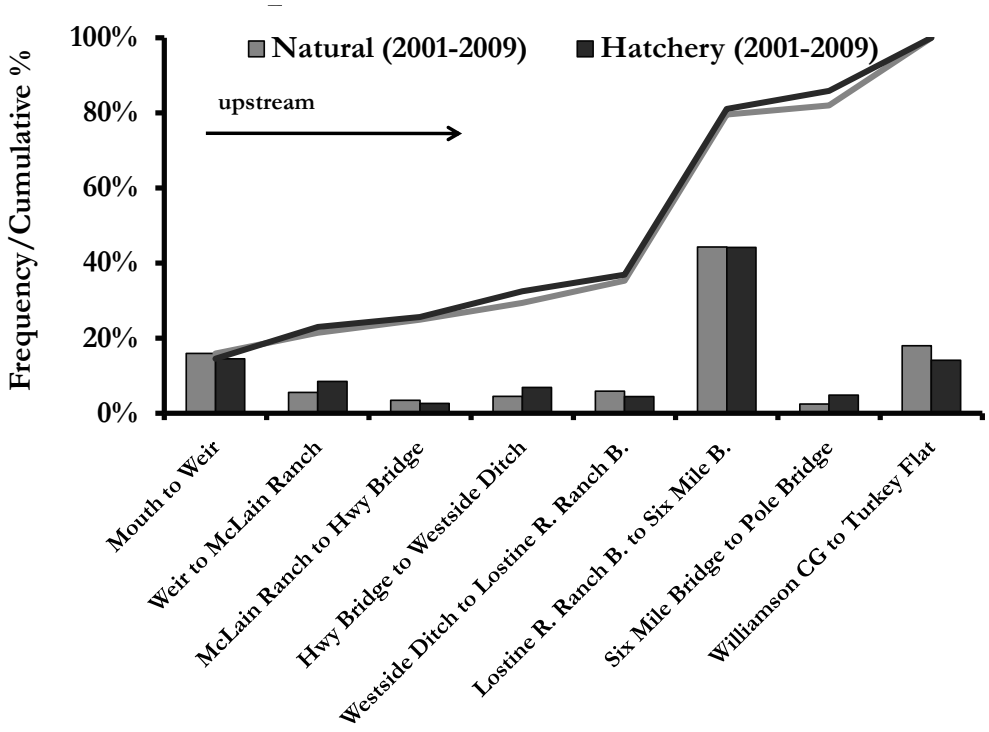

Figure 16. The average and cumulative percentage and frequency of natural and hatchery female carcasses recovered by sections surveyed from 2001 to 2009.

Coded wire tag recoveries revealed that some of the Lostine River hatchery fish did stray. But stray rates were less than 3% of the smolts released and most of the straying occurred above Lower Granite Dam. The loss of Lostine River Chinook salmon at Lookingglass Fish Hatchery due to bacterial kidney disease (*Renibacterium salmoninarum*) was relatively minor from 1999 to 2009 and ranged from 0 to 3,800 fish. An outbreak of infectious hematopoietic necrosis (IHN) in 2005 forced hatchery personnel to euthanize an entire raceway but IHN occurred only in 2005 and 2006 and IHN was not detected in any other years.

Summary:

It appears that supplementation has increased the overall abundance of Lostine River Chinook salmon and provided harvest opportunities. The increase in overall abundance and harvest opportunities has occurred because the production goal of 250,000 smolts has been met by the program. However, there are differences in life history traits, such as fewer returning age 5 hatchery Chinook salmon. And there has been a decrease in adult recruit per spawner ratios but it is not possible to say whether this is due to differences in life history traits or other out-of-basin factors such as poor ocean conditions.

Literature Cited:

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