Snake River Fall Chinook

Lyons Ferry Hatchery

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The Snake River fall Chinook program at Lyons Ferry Hatchery is a cooperative program involving private, state, federal, and tribal agencies and is funded by Lower Snake River Compensation Plan

Introduction and Background

This paper summarizes historical information as well as obstacles and adaptations pertaining to the Snake River fall Chinook (*Oncorhyncus tshawytscha*) program at Lyons Ferry Hatchery (LFH), operated by Washington Department of Fish and Wildlife (WDFW) from inception in 1983 to the present (2012).

Fall Chinook populations steadily declined during the 1960's and 1970's due to the construction of the three Hells Canyon Complex dams (built and operated by Idaho Power Company, 1958-1967) and the four lower Snake River dams (1961-1975) constructed and operated by the US Army Corps of Engineers (USACOE). The Lower Snake River Compensation Plan (LSRCP) was created and approved by Congress in 1976 due to the severe population declines and requirements for mitigating the effects of the four lower Snake River dams. The goal of the LSRCP fall Chinook program was for hatchery compensation/mitigation for and expected 48% loss through the dams (13,300 adults), plus 5,000 for loss of spawning habitat. The remaining 52% (14,400) were expected to be self-sustaining, equaling 32,700 adults annually back to the Snake River. The original hatchery production estimate in order to reach this goal was 9.16 million hatchery sub-yearling smolts released at 90 fish per pound (fpp), with an assumed smolt to adult return (SAR) of 0.2%, to provide 18,300 fall Chinook adults and jacks to the Snake River. It was also assumed that 54,900 adults and jacks would be harvested downstream of the Snake River and 18,300 would be harvested within the Snake River by commercial, tribal, and sport fisheries (Milks et al. 2012).

After the LSRCP was approved by Congress it took time to fund, design, and construct a hatchery facility to fulfill the mitigation goals set forth. Biologist felt that the fall Chinook runs were so depressed that there was a risk that the population may become extirpated before the hatchery could be built. Therefore, an egg bank program was initiated in 1976. There were two goals associated with this program: 1) provide temporary adult holding and juvenile rearing until Lyons Ferry Hatchery was built and 2) maintain the genetic integrity of the Snake River fall Chinook stock. Juveniles were reared at Kalama Hatchery on the lower Columbia River and released there and returning adults were held, spawned, and the progeny were reared as yearlings. Adults were originally collected in 1976 at Little Goose Dam (LGO), the third dam on the Snake River system, and then then shifted to Ice Harbor Dam (IHR), the lowest dam on the Snake River system, in 1977. Adults were transferred to both Hagerman (southern Idaho) and Kalama (lower Columbia Basin) hatcheries for holding, spawning, and juvenile rearing. Juveniles reared at Hagerman Hatchery were reared as sub-yearlings and released into the lower Snake River. Those reared at Kalama Hatchery were marked and released into the Kalama River and recaptured upon return to maintain the population and exclude the effects of Columbia and Snake River dams (Bugert et al. 1995). This accomplished the goal of preserving the stock. The egg bank program was terminated in 1983 when Lyons Ferry Hatchery came on line in 1984. The first release at LFH was brood year (BY) 1983 yearlings in April of 1985.

Trapping continued at IHR in addition to LFH when the adult trap was finished in 1987. In 1987, state biologists began to notice an increasing number of strays being detected at IHR. By 1989, the high proportion of stray hatchery Chinook from outside the Snake River Basin (mostly from

Umatilla River releases) detected in the LFH brood stock prompted management changes in an effort to maintain genetic integrity of the Snake River fall Chinook (Bugert el al. 1995, Mendel 1998). All juveniles released from BY1989 were 100% coded wire tagged or blank wire tagged and released as sub-yearlings and progeny from unknown origin and known strays were shipped to Klickitat Hatchery for release. Trapping continued at IHR, but from 1991-1993 only adipose fin clipped fish were kept for brood stock and after 1993 all trapping stopped at IHR. Returning adults from BY1989 were not used for brood stock and by 1994 all brood stock was collected at Lower Granite Dam (LGR) and LFH to try and curb the stray issue. The limited availability of suitable brood stock that could be collected at LFH and Snake River dams in 1990 through 1996 severely constrained hatchery production and blocked planned smolt releases upstream of LGR. Hatchery releases in the entire Snake River Basin were reduced from as high as 4-5 million per year from 1986 to 1990 to only 224,439 sub-yearlings and no yearling releases in 1991. Yearling smolt production was emphasized for several years thereafter to increase survival and adult returns (Mendel 1998). Total hatchery releases in the Snake River Basin remained well below one million smolts until 1997.

In 1996 the Snake River fall Chinook program was modified with the implementation of the Fall Chinook Acclimation Program (FCAP) by the Nez Perce Tribe. This program was intended to shift hatchery releases upstream and increase spawning escapement above LGR. This program consists of three acclimation facilities located at Pittsburg Landing (Hells Canyon Snake River, ID), Big Canyon (Clearwater River, ID), and Captain John Rapids (Snake River, downstream of the Grande Ronde River, WA). Lyons Ferry Hatchery currently raises both sub-yearling and yearling fall Chinook for the FCAP program. Fish are transferred from LFH, acclimated, and released at these three sites. The first release was in 1996 at Pittsburg Landing (Lyons Ferry Complex Annual Operations Plan, 2012).

The Hells Canyon Complex constructed by Idaho Power Company (IPC) consists of Hells Canyon Dam, Oxbow Dam, and Brownlee Dam along the borders of Oregon and Idaho. Due to the construction of these dams 530 miles of fall Chinook spawning habitat was degraded and/or eliminated. IPC was required to mitigate for this loss so they funded a portion of the construction of LFH in return for 1.3 million eyed eggs annually once the egg take goal of 12 million eggs per year was achieved at LFH. With the lack of brood stock and high stray rates, the annual egg take goal of 12 million was not realistic or ever achieved, but IPC did receive their first shipment of eyed eggs in 2000.

With all the different releases between LFH, the FCAP facilities, and IPC the United States vs. Oregon Management Agreement outlines the entire Snake River fall Chinook program in a single table, labeled *B4B* (Table 1). This table is a series of priorities, 1-17, so in the event of brood stock shortages these priorities will be followed, meaning some of the priorities will not be met on low egg take years. The US v. OR Management Agreement also outlines all the requirements that need to be met annually by all parties involved, including brood stock collection (hatchery and natural origin), trap rates, hatchery marking and tagging rates, collection for reconstruction, monitoring and evaluation, etc. The transportation study smolt releases were completed with BY2011 sub-yearlings and released in 2012.

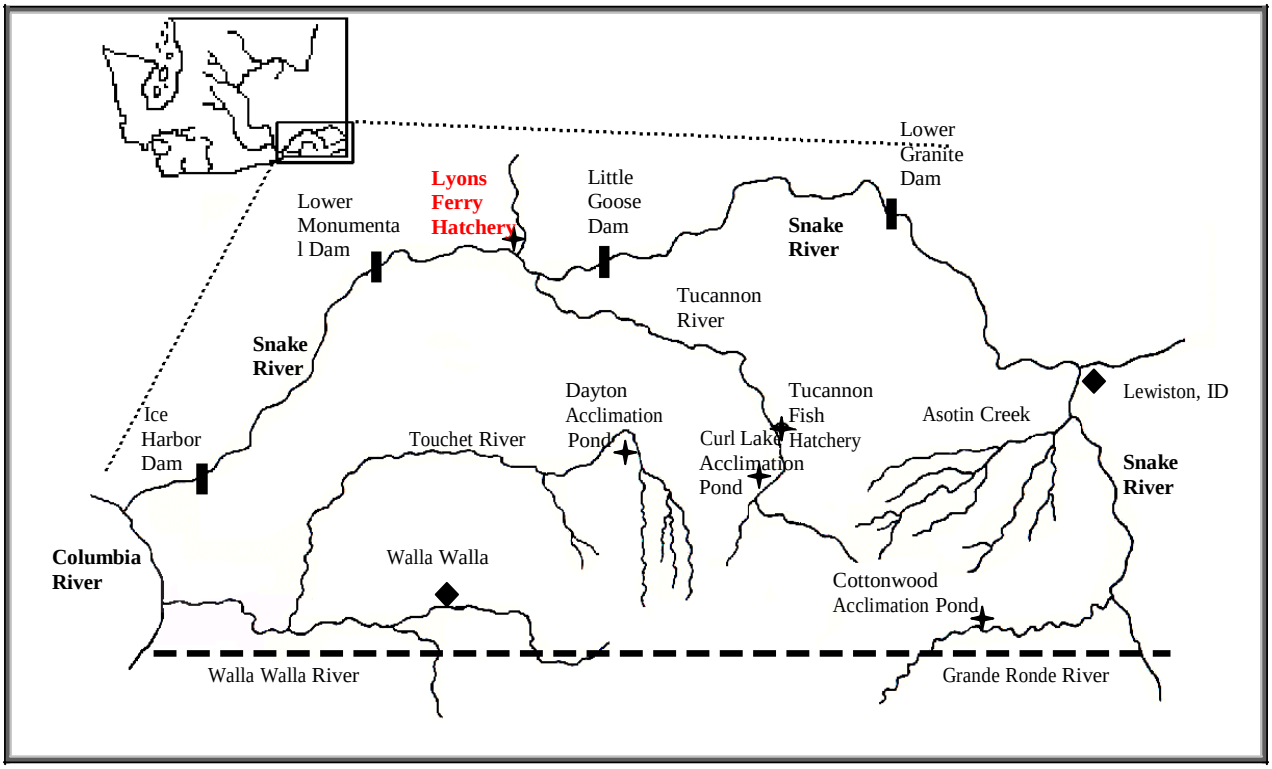
Table 1. Snake River fall Chinook salmon production priorities for LFH per the *UsvOR* Management Agreement, Table *B4B*, and agreed upon by members of the SRFMP for Brood Years 2008-2017.

Priority	Production Program				
	Rearing Facility	**Number**	**Age**	**Release Location(s)**	**Marking**
1	Lyons Ferry	450,000	1+	On station	225KAdCWT 225K CWT
2	Lyons Ferry	150,000	1+	Pittsburg Landing	70K AdCWT 80K CWT only
3	Lyons Ferry	150,000	1+	Big Canyon	70K AdCWT 80K CWT only
4	Lyons Ferry	150,000	1+	Captain John Rapids	70K AdCWT 80K CWT only
5	Lyons Ferry	200,000	0+	On station	200K AdCWT
6	Lyons Ferry	500,000	0+	Captain John Rapids	100K AdCWT 100K CWT only 300K Unmarked
7	Lyons Ferry	500,000	0+	Big Canyon	100K AdCWT 100K CWT only 300K Unmarked
8	Lyons Ferry	200,000	0+	Pittsburg Landing	100K AdCWT 100K CWT only
9	Oxbow	200,000	0+	Hells Canyon Dam	200K AdCWT
10	Lyons Ferry	200,000	0+	Pittsburg Landing	200K Unmarked
11	Lyons Ferry	200,000	0+	Direct stream evaluation Near Captain John Rapids	200K AdCWT
12	DNFH/Umatilla	250,000	0+	Transportation Study[a]	250K PIT Tag only
13	Irrigon[b]	200,000	0+	Grande Ronde River	200K AdCWT
14	DNFH/Umatilla	78,000	0+	Transportation Study[a]	78K PIT tag only
15	Umatilla	200,000	0+	Hells Canyon Dam	200K AdCWT
16	Irrigon[b]	200,000	0+	Grande Ronde River	200K Unmarked
17	Umatilla	600,000	0+	Hells Canyon Dam	600K Ad only
TOTAL	**Yearlings**	**900,000**			
	Sub yearlings	**3,528,000 (of which 328,000 are for Transportation Study)**			

[a] USACOE Transportation Study wild surrogate groups direct stream released into the Clearwater and mainstream Snake River
[b] for logistical purposes, fish are reared at Irrigon in lieu of Lyons Ferry. (LSRCP)

Lyons Ferry Hatchery

The LFH is located at river kilometer 98 on the Snake River, just below the confluence of the Palouse River. This facility is supplied with one hundred percent 11°C well water with a maximum water flow of 120 cubic feet per second (~54,000 gallons per minute). At maximum production the fall Chinook program uses 25 - 10'x100'X2.8' raceways, 5 - 10'x88'x3.5', 3 - 8.5'x150'x4.4', 3 - 10.2'x150'x4.4' , 1 - 90'x1,100'x10' rearing pond, with a max flow at peak production of 28,000 gallons per minute.



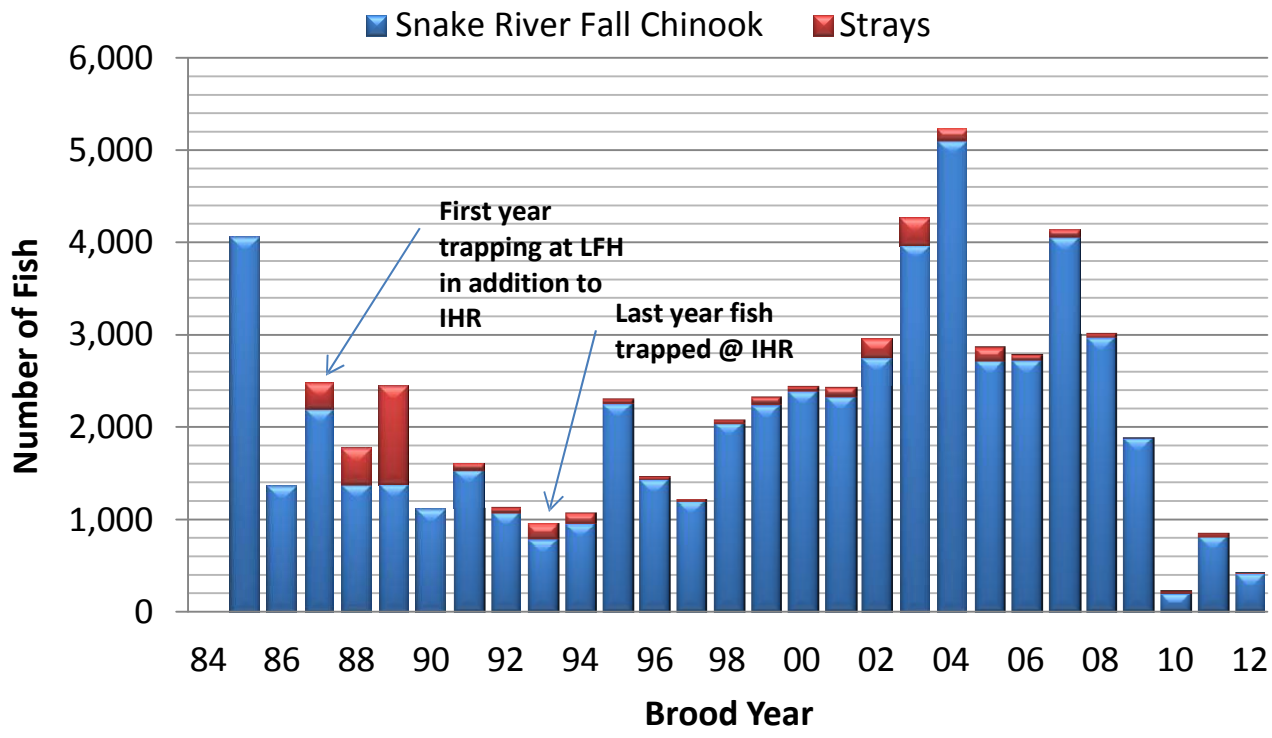
Brood stock Collection

Brood stock collection has occurred at multiple facilities over the last 30 years. The first collection facility was located at Little Goose Dam (LGO) during the first year of the egg bank program in 1976. Starting in 1977 all trapping was shifted to Ice Harbor Dam (IHR) as well as at LFH when the adult ladder and trap were finished in 1987. By 1989 the rate of out of basin of basin hatchery strays in the brood stock at LFH exceeded 40% and management changes were implemented to release all BY1989 juveniles as sub-yearlings with coded wire tags (CWT) or a blank wire tags (BWT) (Figure 1). The intent was to exclude returning adults and jacks from BY1989 in order to maintain the genetic integrity of the Snake River fall Chinook. Brood stock collection continued at IHR but only adipose fin clipped adults were collected from 1991-1993 and after BY1993 all trapping ceased at IHR.

Trapping began at LGR in 1990 to supplement brood stock collection at LFH and then became joint contributor after trapping ceased at IHR. The alarmingly high numbers of hatchery strays

prompted managers to conduct a radio telemetry study to determine adult fall Chinook movement and why so many hatchery strays were incorporated into the brood stock (Mendel and Milks 1997). The results of that study confirmed that Columbia River fall Chinook were dipping into the Snake River and then after crossing IHR most were returning downstream. Since the collection facility was located at the first dam on the Snake River, this inflated the numbers of strays being used for brood stock. Moving the other brood stock collection facility to LGR decreased the number of strays in the brood stock significantly.

Figure 1. Brood stock collection at Lyons Ferry Hatchery, including Ice Harbor Dam. After 1993 brood stock collection numbers in this figure were from Lyons Ferry Hatchery only.

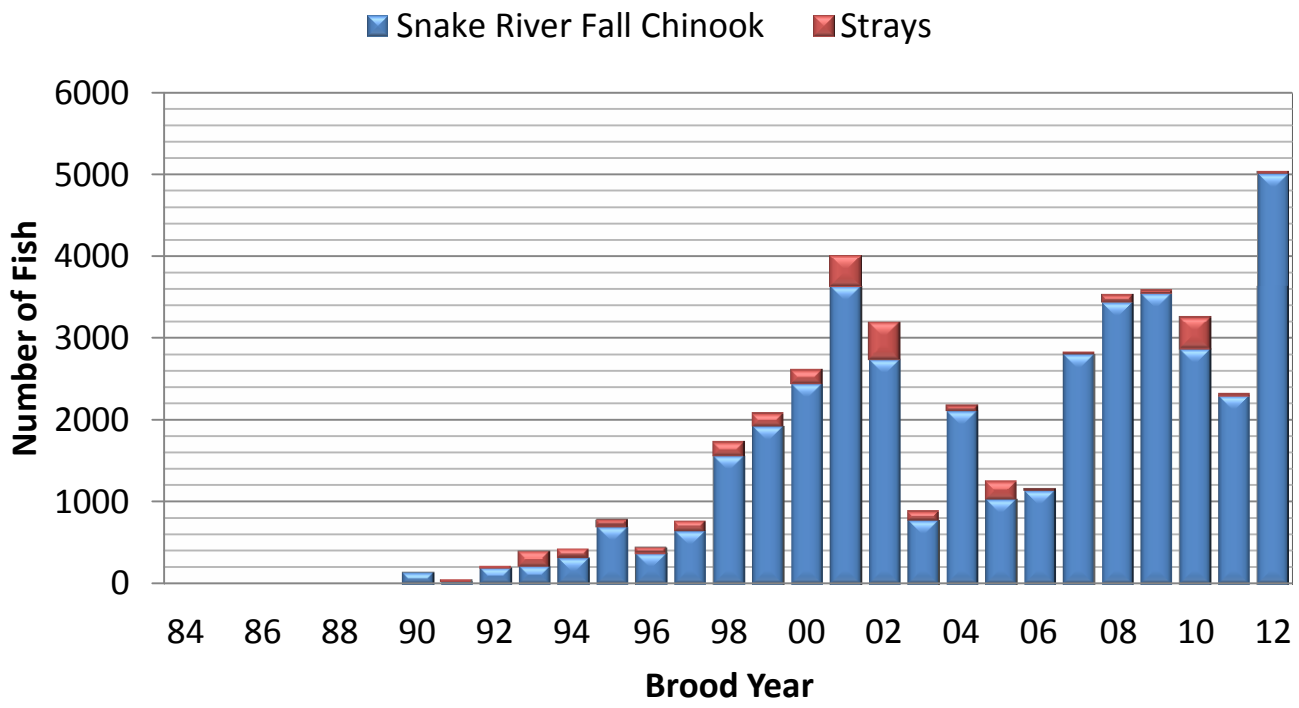


Currently brood stock collection occurs at two different trapping facilities, LGR (rkm 173) and LFH (rkm 98). The primary collection facility has shifted to LGR within the last three years due to the accessibility of more sub-yearling hatchery returns and the high percentage of natural origin fish compared to LFH (Figure 2). The trapping at LGR is operated by the National Oceanic and Atmospheric Administration Fisheries (NOAAF) and adults are shared between LFH and Nez Perce Tribal Hatchery (NPTH). LFH receives 70% and NPTH receives 30% of the adults collected for brood stock. The trapping of fall Chinook officially starts as early as 18-August and continues until the third week of November, depending on the run timing and brood stock needs. The trap is shut down any time the water temperature is 70° or higher. Some years this is not an issue, but others it can limit brood stock collection in the early part of the season.

The secondary trapping facility is at LFH due to the high ratio of hatchery fish to natural origin fish and the preponderance of returns from hatchery yearling releases. In the past, trapping began the first week of September and brood stock was collected until early to the middle of

November. Currently the trap is not opened until late September or early October, depending on whether it is needed to supplement brood stock collection is at LGR.

Figure 2. Adult Fall Chinook Trapping at Lower Granite Dam including strays from 1984 – 2012.

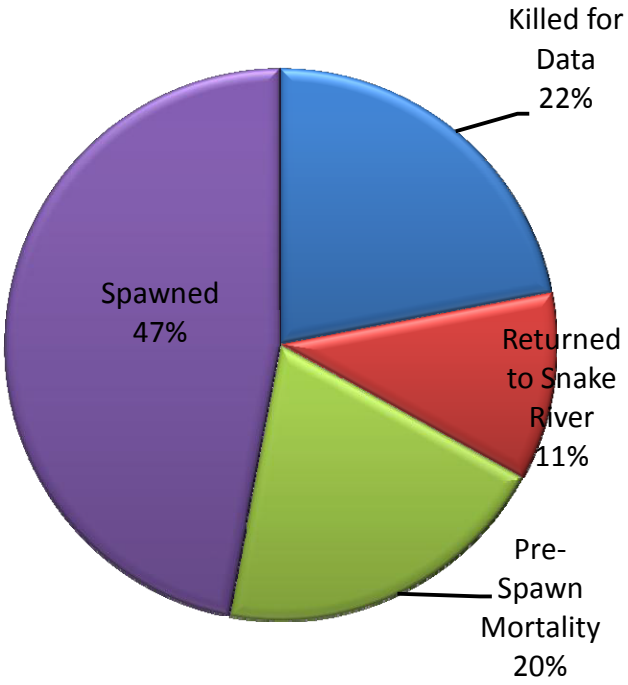


The current brood stock goal is 1,200 adult fall Chinook females based on the 10 year fecundity average of 3,750 eggs/female. Generally more adults are collected than is needed to compensate for pre-spawn mortalities and to meet run reconstruction purposes (Figure 3). Both hatchery and natural origin adults are collected, with an egg take goal of ~4.4 million green eggs.

The methodology for spawning has changed drastically over the years at LFH. Early in the program's history most of the adults were in the 2-salt and 3-salt age class. The age composition shifted over time, and the program was using younger age fish primarily out of the 1-salt and 2-salt age classes (Figure 4). This could be attributed to spawning fish based on length and not age. Age classes were determined at spawning by lengths and CWT's were read only as an origin identifier (i.e. Snake River origin or stray). The CWT's were further examined at a later date for reporting purposes to determine age, release year, and release location. From 2000-2009 the average number of 0-salt and 1-salt fish used in the brood stock was 63% with the highest year being 2007 at 83%. The fishery co-managers agreed to brood stock and spawning management changes that emphasized the use of older, larger adults. Since 2010, CWT's are read on the day of spawning to determine age, release location, and origin (in basin or stray). This has resulted in shifting the age composition of spawned Snake River fall Chinook back to a higher proportion of older age fish, primarily 2-salt and 3-salt. From 2010-2012, 3.2%, 4.6%, and <1%, respectively, 1-salt fish were used in brood stock. The age composition

has not changed as dramatically for females as it has for males, because of the use of "jacks." Large males are now being used multiple times to try and ensure that they are the primary spawners and to compensate for the high incidence of jacks incorporated in the brood stock in past years. Recent findings have shown that jacking is a heritable trait and our past practices could have elevated this problem. Over the last two years the ratio of males and females spawned has been 1:3. The inclusion of 1-salt females (jills) has also been elevated in recent years, but is not a heritable trait that could exacerbate the Snake River run at a population level. Currently, jills included in the brood stock are kept separate until it is determined that egg take goals have been met. Any eggs taken from jills and not needed for the program are released into the Palouse River as unfed fry. If egg take goals are not met, eggs from jills will be included in the fall Chinook program.

Figure 3. Disposition of trapped fall Chinook at LFH (1984-2012 run years).



The overall spawn timing has fluctuated from statistical week 42 to 51 since 1984 (Figure 5). The wide range in some of the early years could be attributed to the lack of brood stock as well as management strategies trying to mimic natural spawning in the Snake River over the complete spawn season. The peak spawn timing in that same time period has fluctuated between week 44 and 47 and between 45 and 46 in the past 19 years.

The average fecundity over the last 10 years (2003-2012) has been 3,750 eggs/female, while the previous nine year average was 3,420 eggs/female. Both averages are significantly lower than the average from 1984-1993, which was 4,150. This could be due to out of basin fish, such as Umatilla River hatchery produced or Hanford Reach fall Chinook dipping into the Snake River that were collected at IHR and spawned at LFH.

Figure 4. Age composition of spawned Snake River fall Chinook, males and females for three different time periods: Brood stock past (1991-1996), Brood stock recent (2004-2009), and the Newest Protocol (2010-2012).

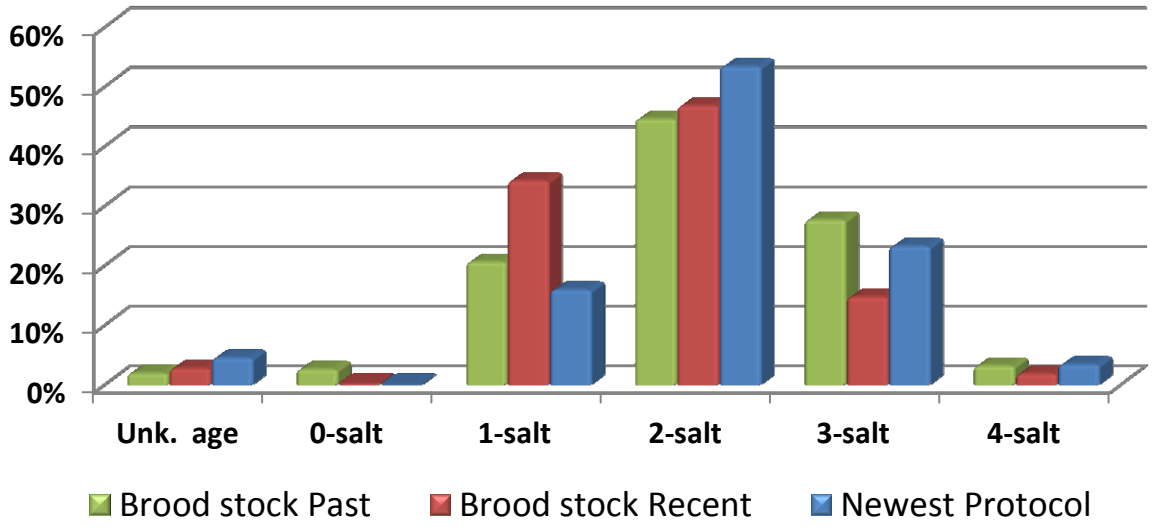
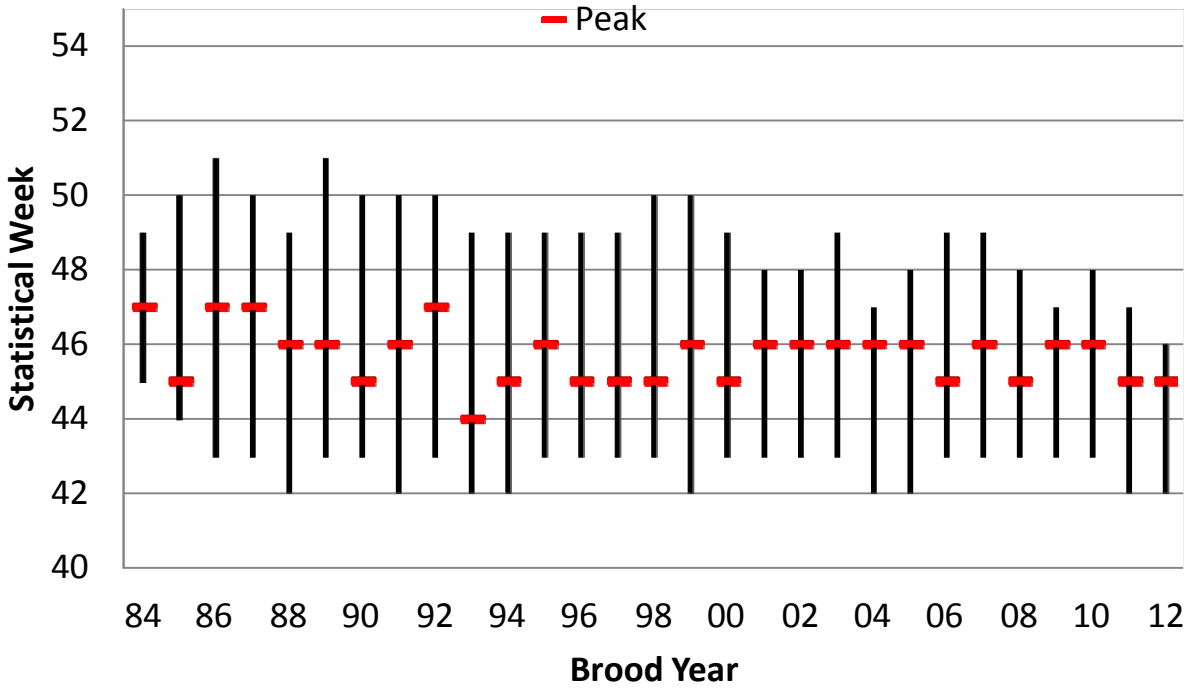
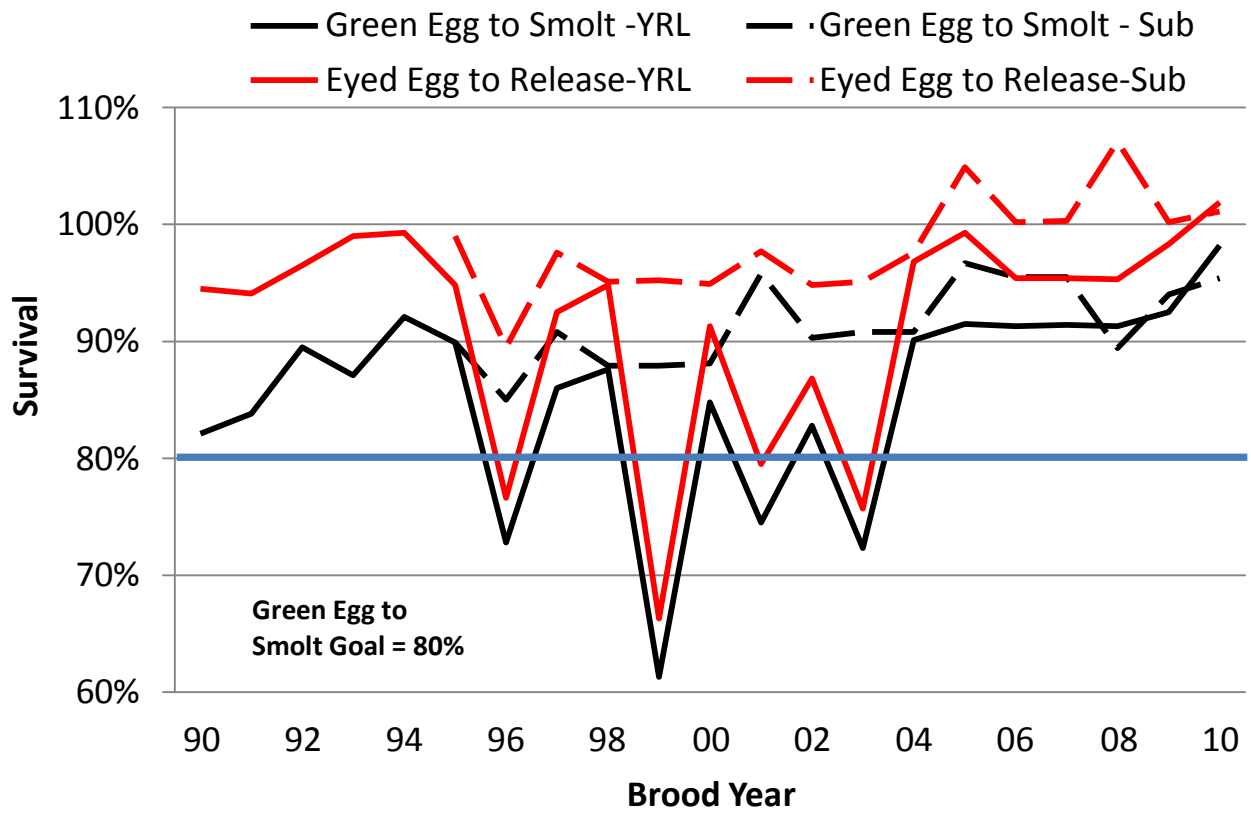


Figure 5. Spawn timing, 1984 – 2012.



The green egg to smolt goal laid out in the 1975 LSRCP document was 80%. This goal has been achieved every year, except during four years since 1990 (Figure 6). The average green egg to smolt survival for yearlings is 85% and 91% for sub yearling, while the eyed egg to release survival for yearling is 92% and 98% for sub yearlings.

Figure 6. Snake River fall Chinook egg to release survival for green eggs and eyed eggs at LFH, 1990 - 2010.



The yearling survival percentages are less because they remain in the hatchery facility longer than the sub yearlings; 16 months compared to five months. For a few years the estimated survival rates for the eyed egg to release exceeded 100%. This was due to low estimates on the number of eggs taken. Eye up rates at LFH have always been exceptionally high averaging 95%, except the very first year LFH was in operation (in 1984 the eye up rate was 78%).

Fish Health

Two fish diseases have been a problem in fall Chinook at LFH. The two major diseases associated with the fall Chinook at LFH have been bacterial kidney disease caused by *Renibacterium salmoninarum* and bacterial gill disease caused by *Flavobacterium branchiophilum*. Outbreaks from these two diseases have accounted for most of the mortalities in the fall Chinook program through the years.

Bacterial Kidney Disease

During brood stock collection at LGR dam adult females were injected with both erythromycin and oxytetracycline, while the males were injected with just oxytetracycline. Both injections were given in the dorsal sinus at a dosage of 20 mg/Kg of fish. The erythromycin injections were continued at monthly intervals until spawning occurred. Erythromycin was to curb the

vertical transmission of bacterial kidney disease and the oxytetracyline was to prevent other bacterial diseases such as furunculosis and columnaris. Starting in 2013, prespawning injections of antibiotic will be discontinued because of low BKD prevalence and the potential use of carcasses for nutrient enhancement.

All females whose progeny are selected for the yearling program are tested for BKD using the Enzyme-Linked Immunosorbent Assay (ELISA). Eyed egg transfers to Oregon and Idaho are required to be tested for BKD using ELISA. There are four BKD-ELISA categories; below low, low, moderate, and high. The rating determines what program the eyed eggs can be used for (Table 2).

Table 2. Program destinations for eyed eggs based on ELISA optical density results.

Program	Below Low (<0.11)	Low (0.11-0.199)	Moderate (0.2-0.44)	High (≥0.45)	Untested
On-Station Yearlings	X				
On-Station Sub Yearlings	X	X	X	X	X
FCAP Yearlings	X				
FCAP Sub Yearlings	X	X			X
Eyed Eggs to IDFG & ODFW	X	X			

In addition to the antibiotic injections that were given to the adults and the BKD-ELISA testing, a prophylactic feed treatment of Aquamycin-100 (erythromycin) was administered on all the fall Chinook in the yearling program to prevent BKD outbreaks. This treatment was for 28 days and when completed there was an additional 28 day withdrawal period before these fish could be handled. This treatment was generally done when the fish were 120 fish per pound (fpp) and fed at a 1.5% body weight (3% dosage). Post treatment observations were made of fish being emaciated and lethargic as well as an increased length CV (9.0-11.0+). Dropouts were observed every year until the treatment was discontinued for BY2010 on-station yearling group. Dropouts were absent and length CV's decreased (7.0 – 10.0) and there were no signs of BKD throughout the rearing period. With no signs of BKD in the BY2010 on-station yearlings coupled with the ELISA testing, the Nez Perce Tribe agreed to discontinue the prophylactic treatment to the FCAP yearlings. Since the discontinuation, the same results have been observed in all yearling release groups, with a general agreement from everyone of overall healthier fish.

Bacterial Gill Disease

Bacterial gill disease (BGD) has been the most prevalent disease and has been responsible for a majority of the mortality associated with Snake River fall Chinook at LFH. There are a number of factors that could have caused BGD breakouts, such as; high densities during early rearing, high manganese and iron in well water, poor cleaning practices, poor feeding practices, low flows, and/or a combination of these reasons.

There have been many improvements within the last 10 years to curb this disease. The well water at LFH is high in manganese, pushing the allowable limit, as well as high in iron, which bacteria thrive on. This coupled with high ponding densities in the past increased the prevalence of BGD breakouts. The current protocol is not to exceed 0.08 density index for early rearing, fish smaller than 400fpp. Once this limit is reached, the raceways are split evenly into adjacent raceways.

Cleaning practices have also changed throughout the years due to manager preference at LFH. Vacuuming was the preferred technique for cleaning raceways, then due to management changes brooming became the preferred technique. For the last 10 years, due to management changes once again, vacuuming has been reinstated as the preferred method for cleaning all fall Chinook rearing vessels. All raceways are currently vacuumed once a week. High turnover rates in each raceway, 1.2 – 1.9 turnovers/hour have improved pond conditions as well, increasing oxygen content and flushing out fecal material keeping raceways cleaner.

Feed companies have drastically improved their diets to improve fish health as well as increase growth rates. Many diets have vitamin packs to boost the fish's immune system during times of stress such as splitting, marking, and transfer events. Most diets used now are extruded and have a higher nutritional value. Conversion rates on certain starter feeds can exceed 0.5 pounds of feed per pound of growth and with the larger fish on average convert at 0.9 pounds of feed per pound of growth. Having high conversion rates decreases the number of feeding events per day and per week, which in turn decreases the number of times the fish are walked over, decreasing stress. Feed companies also try and reduce the amount of fecal material produced by these different diets for improved fish health so ponds remain as clean as possible as well as effluent water draining back to the river.

In 1992, the USACOE split the two adult ponds into four ponds to reduce the number of adult fall Chinook in the fall back channel during spawning activities. In 2009, LFH obtained funding through the Confederated Tribes of the Umatilla Indian Reservation (CTUIR) to split the adult ponds again, from four to eight, to further decrease the number of fall Chinook adults in the fall back channel during spawning activities. The primary goals for this project was to decrease high stress events for adult fall Chinook and to increase the number of vessels in order to fulfill run reconstruction needs for holding groups separate (fish trapped at different rates). This project also improved rearing conditions for the FCAP sub-yearling groups, which also utilize these rearing vessels. These ponds in the past had high incidence of BGD outbreaks. Splitting these raceways decreased water flow dead spots and increased overall velocities improving the overall flow dynamics within the ponds. We believe this has been a major benefit in not experiencing any BGD outbreaks since 2008.

Predation

Predation, primarily from birds (blue herons, cormorants, and sea gulls) but also otters, has been problematic at LFH. Prior to 2003, the fall Chinook program experienced high losses due to avian predation in all rearing vessels. Estimates ranged from 3% - 20%. In the summer of 2003 the net structure and net were put on Lake #2, which rears the on-station yearlings group.

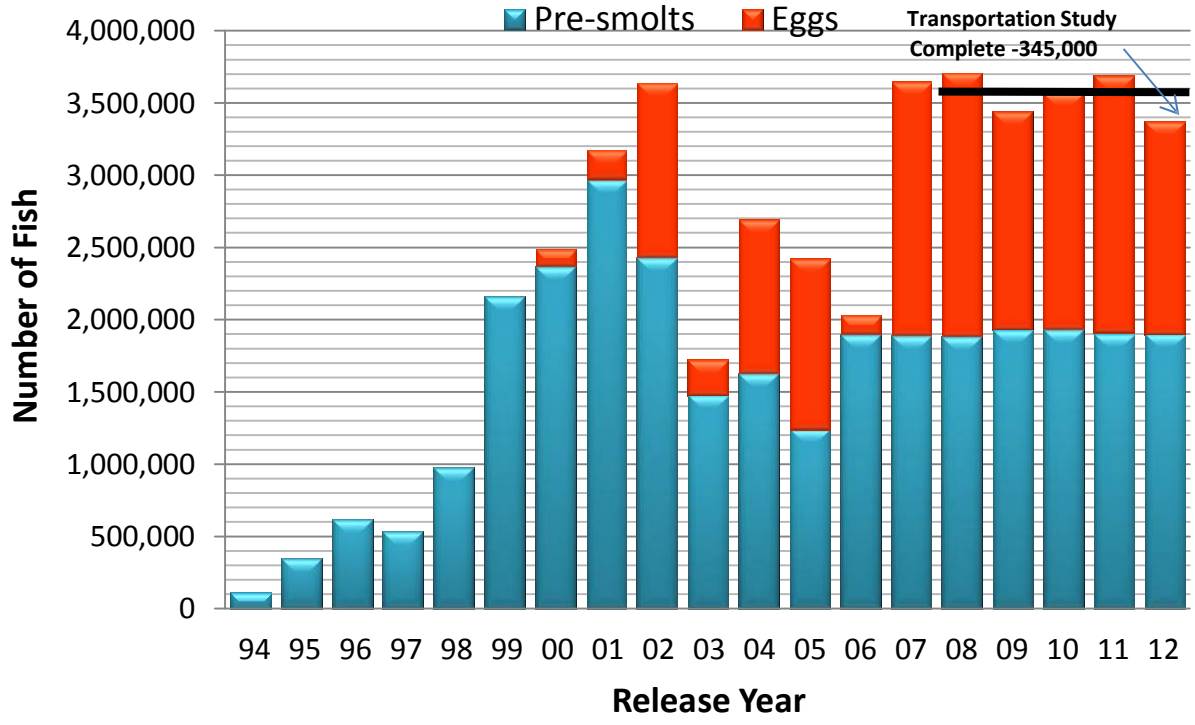
In 2005, the WDFW maintenance crew constructed the net and structure over the 28 raceways on the south side of the hatchery where most of the fall Chinook program exists. In 2006 the 19 raceways on the north side of the hatchery were covered with netting. Today avian predation is nearly nonexistent since these improvements have been made.

Otter predation has occurred in the past along with avian predation. The three lakes have been the primary target for otter predation. Within the last five years LFH obtained permits, which were valid in monthly intervals, through WDFW Patrol Division when otter signs were observed. This occurred periodically over a two year period, generally in the fall and winter months starting in 2009. LFH has periodically observed otter signs but they have not been a problem within the last three years and trapping has ceased.

Transfers/Releases

The low numbers of brood stock availability in the past, coupled with high stray rates, have made transfers and releases inconsistent from year to year. Brood stock collection has been more consistent for the last six years due to good adult returns and few stray hatchery fish (Figure 7). BY2009 was the only year within the last five years that program release goals were not met and IPC was shorted 100,000 eyed eggs.

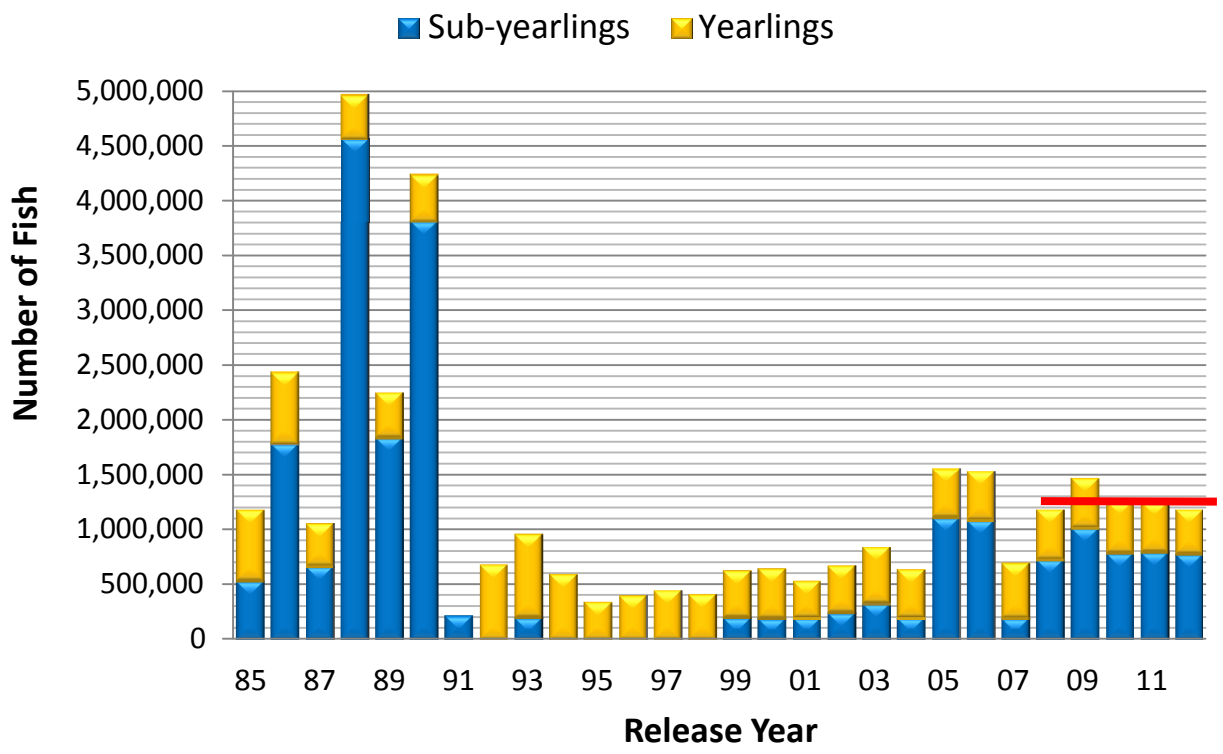
Figure 7. Snake River stock fall Chinook transfers of pre-smolts and eyed eggs, 1994-2012.



BY2011 was the last year of the USACOE transportation study, which was an eyed egg transfer of 345,000. Brood year 2012 shows that program goals were not met but in reality they were.

One hundred less females were taken to compensate for the discontinuation of the transportation study. Program goals have also been met for the on-station sub-yearlings, Couse Ck. sub-yearlings, and on-station yearlings for the past five years (Figure 8). Size goals at transfer to the FCAP facilities and size goals for the LFH releases have been consistently met. Size goals for sub-yearlings at transfer are 75fpp and 50fpp at release. Size goals for yearlings at transfer are 12fpp and 10fpp at release.

Figure 8. LFH Snake River fall Chinook releases, 1983-2012.



Adaptations in Response to Identified Problems

In the 30 years of operation at LFH many problems have occurred with not only brood stock collection but age of brood stock used. For many years males were spawned according to length not actual age. By doing this, 83% of the males used were jacks in 2007. This problem was identified and protocols were set in place and agreed upon by co-managers to increase the length of males trapped and collected for brood stock at LGR. In addition it was agreed to not fertilize eggs with a particular male until the CWT has been read and verified that it was indeed an adult and of Snake River origin. Since this protocol has been implemented, the number of jacks used for spawning has decreased dramatically. From 2010-2012, 3.2%, 4.6% and <1%, respectively, 1-salt fish were used in the brood-stock.

High incidence of disease, particularly BKD and BGD has caused high mortality events in past years. Early rearing densities have been reduced, vacuuming weekly instead of brooming raceways, increased flows/turnover rates, improved hatchery practices (disinfection and feeding regimes), and improved diets have all contributed to the reduced prevalence of these

diseases at LFH. There has not been an outbreak of BGD since 2008 and only a very small outbreak of BKD in the BY 2011 on-station sub yearlings, which only accounted for 500 mortalities before fish were released.

Bird netting over all rearing vessels (except the adult ponds) starting in 2003 and obtaining permits to trap otters in the three large lakes has greatly reduced mortality and given us the ability to improve accuracy of release numbers.

With all these changes and improvements that have occurred at LFH since the program inception we've accomplished the following: 1) we have met the egg take goals for the last five years, 2) we've met the green egg to smolt survival 19 out of 23 years, 3) eyed eggs transfer goals have been met four out of the last five years, 4) transfers to the FCAP facilities have been met for the last eight years, 5) and sub yearling and yearling releases on-station at LFH have been met the last five years.

Critical Data Gaps within the Fall Chinook Program

Sub-yearlings reared in the adult ponds do not contain representative CWT groups to determine if they are surviving at different rates based on mark type. Limited prior data on these groups suggests that mark types (clipped fish) are surviving at a higher rate compared to unclipped fish. The Snake River Lab evaluation crew would like to mark these fish again in order to obtain current survival and return data post raceway improvements.

The SRL has been PIT tagging the on-station yearlings with 30,000 (15% of total released) tags annually since 2006 to obtain an accurate account of downstream survival of smolts and adult returns associated with all release groups. PIT tagging has been done on the sub-yearlings since 2011 and we would like to continue to do this in order to get a more accurate account of survival of the out migrating sub yearling smolts, as well as sub yearling adult returns.

Parental based tagging (PBT) was implemented in BY2011 and will be continued in the future to ensure an accurate account of hatchery origin and natural origin adults. A tissue sample collected from all spawned fish. Geneticists are able to take that information, and the crosses, and provide a complete make-up of all progeny produced from the hatchery program. Tissue samples will then be taken at LGR in future run years and a better accounting of hatchery and natural origin fish in the run will be determined. This will be an improvement to current methods. BY2016 will be the first year with a complete dataset. After BY2016 all brood stock analyzed will be known.

A radio telemetry study was done in the past to evaluate the fidelity of the FCAP yearling adults returning to their respective release sites. There is a similar study starting in 2013 to evaluate the fidelity of the FCAP sub yearling adults. This telemetry study will also look at the returning adults associated with the LFH on-station sub-yearling and yearling releases that return to LGR and then fall back below the dam, which will help biologists complete the run reconstruction.

References

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Milks, D., A. Grider, and M. Schuck. 2012. Lyons Ferry Hatchery Evaluation – Fall Chinook Salmon Annual Report: 2010. Report to LSRCP, Boise, ID.

LFH Snake River Fall Chinook Program - List of Figures

Figure 1

Year	Snake River Fall Chinook	Strays
84	0	
85	4,076	
86	1,370	
87	2,197	287
88	1,380	393
89	1,374	1079
90	1,123	
91	1,538	67
92	1,074	47
93	790	155
94	956	109
95	2,256	40
96	1,431	31
97	1,197	25
98	2,047	33
99	2,250	73
00	2,391	48
01	2,340	96
02	2,766	201
03	3,972	311
04	5,111	133
05	2,730	139
06	2,738	56
07	4,062	76
08	2,984	38
09	1,885	8
10	199	11
11	820	25
12	414	1

Figure 2

Year	Snake River Fall Chinook	Strays
84		
85		
86		
87		
88		
89		
90	143	
91	37	25
92	204	21
93	221	184
94	325	115
95	703	90
96	381	74
97	653	121
98	1572	179
99	1934	162
00	2452	178
01	3645	375
02	2753	451
03	784	118
04	2122	71
05	1040	231
06	1148	21
07	2812	30
08	3449	95
09	3559	41
10	2877	393
11	2303	29
12	5026	17

Figure 3

*Numbers supplied by Snake River Lab

%	
Killed for D	22
Returned t	11
Pre-Spawn	20
Spawned	47

Figure 4

*Created by Snake River Lab, Mark Shuck and Debbie Milks

	unknown	0 salt	1 salt	2 salt	3 salt	4 salt
1991-1996	1.8%	2.5%	20.5%	44.5%	27.6%	3.1%
2005-2009	2.6%	0.1%	34.1%	46.7%	14.6%	1.7%
2010-2012	4.4%	0.0%	15.8%	53.3%	23.1%	3.3%

Figure 5

Brood Yea	High	Low	Peak
84	49	45	47
85	50	44	45
86	51	43	47
87	50	43	47
88	49	42	46
89	51	43	46
90	50	43	45
91	50	42	46
92	50	43	47
93	49	42	44
94	49	42	45
95	49	43	46
96	49	43	45
97	49	43	45
98	50	43	45
99	50	42	46
00	49	43	45
01	48	43	46
02	48	43	46
03	49	43	46
04	47	42	46

Figure 6

Year	Green Egg to Smolt -YRL	Green Egg to Smolt - Sub	Eyed Egg to Release-YRL	Eyed Egg to Release-Sub
90	0.82	0.85	0.945	0.98
91	0.84		0.941	
92	0.90	0.91	0.965	0.984
93	0.87		0.99	
94	0.92		0.993	
95	0.90	0.90	0.948	0.99
96	0.73	0.85	0.766	0.895
97	0.86	0.91	0.925	0.976
98	0.88	0.88	0.948	0.951
99	0.61	0.88	0.663	0.952
00	0.85	0.88	0.913	0.949
01	0.75	0.96	0.795	0.977
02	0.83	0.90	0.868	0.948
03	0.72	0.91	0.757	0.951
04	0.90	0.91	0.968	0.976
05	0.92	0.97	0.993	1.049
06	0.91	0.96	0.954	1.002
07	0.91	0.96	0.954	1.003
08	0.91	0.89	0.953	1.071
09	0.93	0.94	0.983	1.002
10	1.0	1.0	1.019	1.011

05	48	42	46
06	49	43	45
07	49	43	46
08	48	43	45
09	47	43	46
10	48	43	46
11	47	42	45
12	46	42	45

Figure 7

Year	Pre-smolts	Eggs
94	117532	
95	347256	
96	624480	
97	535215	
98	981250	
99	2163943	
00	2369919	115891
01	2967905	200064
02	2437092	1195067
03	1476089	250400
04	1633896	1053278
05	1243201	1180000
06	1896086	127564
07	1891606	1761500
08	1884371	1810800
09	1935561	1507300
10	1940300	1630000
11	1909300	1785600
12	1892300	1480000

Figure 8

Year	Pre-smolts	Eggs
94	117532	
95	347256	
96	624480	
97	535215	
98	981250	
99	2163943	
00	2369919	115891
01	2967905	200064
02	2437092	1195067
03	1476089	250400
04	1633896	1053278
05	1243201	1180000
06	1896086	127564
07	1891606	1761500
08	1884371	1810800
09	1935561	1507300
10	1940300	1630000
11	1909300	1785600
12	1892300	1480000