# Annual Progress Report
# Lower Snake River Compensation Plan
# Confederated Tribes of the Umatilla Indian Reservation
# Evaluation Studies for 1 January 2013 to 31 December 2013

# Evaluation of Reestablishing Natural Production of Spring Chinook Salmon in Lookingglass Creek, Oregon, Using a Local Stock (Catherine Creek)

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# 1 SECTION I. EVALUATION OF REESTABLISHING NATURAL PRODUCTION OF SPRING CHINOOK SALMON IN LOOKINGGLASS CREEK, OREGON, USING A LOCAL STOCK (CATHERINE CREEK)

## 1.1 Abstract


The objective of this study is to evaluate reintroduction of spring Chinook salmon in Lookingglass Creek above the Lookingglass Hatchery weir using standard sampling methods for anadromous salmonids in the Columbia River Basin. Natural-origin returns to the Lookingglass Hatchery trap in 2013 totaled 124. Adults released above the Lookingglass Hatchery weir totaled 223 and spawning ground surveys yielded 60 redds. Brood year 2008 recruits per spawner was 0.8 for adults only. We estimated a minimum of 21,517 (101/redd) brood year 2011 juveniles outmigrated from above Lookingglass Hatchery during migration year 2013. Fall 2012 outmigrants were 33% of the total, winter 2012 50%, and spring 2013 18%. Survival probabilities to Lower Granite Dam ranged from 0.106-0.497 for summer, fall, winter, and spring PIT-tag groups. Smolt equivalents (outmigrants surviving to Lower Granite Dam) totaled 5,925. Brood year 2008 smolt-to-adult ratio was 1.3 for adults only. Median arrival dates at Lower Granite Dam ranged from 4-10 May 2013 for brood year 2011 outmigrants. Life history and productivity metrics for spring Chinook salmon in the current reintroduction era have been generally similar to the endemic and Rapid River reintroduction eras and also to the Catherine Creek donor stock. Recruits per spawner has been above replacement for 3 of 5 brood years.

## 1.2 Introduction/Study Area/Methods

This is the latest in the series of 21 annual progress reports documenting the success of reintroducing spring Chinook salmon to Lookingglass Creek, tributary to the Upper Grande Ronde River in the Snake River Basin in northeastern Oregon. We focus this report on results and discussion, as there were no significant changes to the methods reported previously (Boe et al. in review). A population estimate of outmigrating parr was made for the period 15-30 June 2012 using fin-clipped fish and the estimation method described by Burck (1993). Metrics are described by Hesse et al. (2006) and correspond to the basic categories of abundance, productivity, and diversity for viable salmon populations (McElhany et al. 2000). Results from the current reintroduction era were compared to those of the extirpated endemic stock (Burck 1993) and the Rapid River reintroduction era for brood years (BY) 1992-1994 and 1996-1997. Survival estimates for other populations in the Grande Ronde Subbasin were also used in comparisons (Anderson et al. 2011, Jonasson et al. 2013, 2014).

This project is guided by the Confederated Tribes of the Umatilla Indian Reservation (CTUIR) Department of Natural Resources (DNR) Mission Statement (Jones et al. 2008)

***"To protect, restore, and enhance the First Foods - water, salmon, deer, cous and huckleberry – for the perpetual cultural, economic and sovereign benefit of the CTUIR. We will accomplish this using traditional ecological and cultural knowledge and science to inform: 1) population and habitat management goals and actions; and 2) natural resource policies and regulatory mechanisms.***

and the CTUIR Department of Natural Resources, Research, Monitoring and Evaluation Mission Statement:

***"We will accomplish (CTUIR DNR Mission Statement) by using traditional ecological and cultural knowledge and science to inform: 1) population and habitat management goals and actions, and 2) natural resource policies and regulatory mechanisms."***

## 1.3 Results/Discussion

### 1.3.1 Adults

#### 1.3.1.1 Abundance

*NOR (natural-origin) returns to the Lookingglass Hatchery (LH) weir*
NOR returns to the LH weir totaled 124 in run year (RY) 2013. Returns were 64 (52%) age 3, 50 (40%) age 4, and 10 (8%) age 5 (Table 1). Total returns includes those caught at the LH trap and any unpunched, unclipped carcasses recovered above the LH weir. Age composition of NOR returns in past years has been dominated by age 4, but substantial numbers of age 3 returns occurred in 2009-2011 and 2013, percentages ranging from 11-52.

Completed brood year (BY) 2008 returns were 169, higher than during the Rapid River reintroduction era and the highest during the current reintroduction era.

Table 1. NOR returns to LH weir for RY, completed BY and age at return.

| Returns by RY | | | | | Returns by Completed BY | | | | |
|---|---|---|---|---|---|---|---|---|---|
| | Age | | | | | Age | | | |
| RY | 3 | 4 | 5 | Totals | BY | 3 | 4 | 5 | Totals |
| 2007 | 7 | | | 7 | 1992 | 9 | 101 | 17 | 127 |
| 2008 | 4 | 46 | | 50 | 1993 | 3 | 79 | 25 | 107 |
| 2009 | 24 | 69 | 9 | 102 | 1994 | 0 | 32 | 5 | 37 |
| 2010 | 17 | 124 | 9 | 150 | | | | | |
| 2011 | 30 | 120 | 14 | 164 | 1996 | 5 | 51 | 15 | 71 |
| 2012 | 3 | 129 | 15 | 147 | 1997 | 5 | 34 | 5 | 44 |
| 2013 | 64 | 50 | 10 | 124 | | | | | |
| | | | | | 2004 | 7 | 46 | 9 | 62 |
| | | | | | 2005 | 4 | 69 | 9 | 82 |
| | | | | | 2006 | 24 | 124 | 14 | 162 |
| | | | | | 2007 | 17 | 120 | 15 | 152 |
| | | | | | 2008 | 30 | 129 | 10 | 169 |

*Released above the LH weir*

A total of 223 adults were released above the LH weir after they swam into the trap during 2013. We released 129 hatchery-origin (HOR) and 94 NOR adults. Of the 94 NOR released, 31 were adults and the remainder jacks. There was a total of 91 females released and 77% were HOR. The early years of the current reintroduction era saw low numbers released above the LH weir (Figure 1). Fish counts increased to a high of 926 in 2012, and then decreased again in 2013. HOR fish were 100% of the adults released in 2004-2007 and 79-90% in 2008 and 2010-2013. HOR made up 34% of the adults released in 2009. Few HOR jacks are released. The numbers released during most years of the reintroduction eras were much lower than during the endemic era. In 1964 and 1965, the weir and trap was not operating effectively and a substantial number of returns made it past the weir without being trapped.

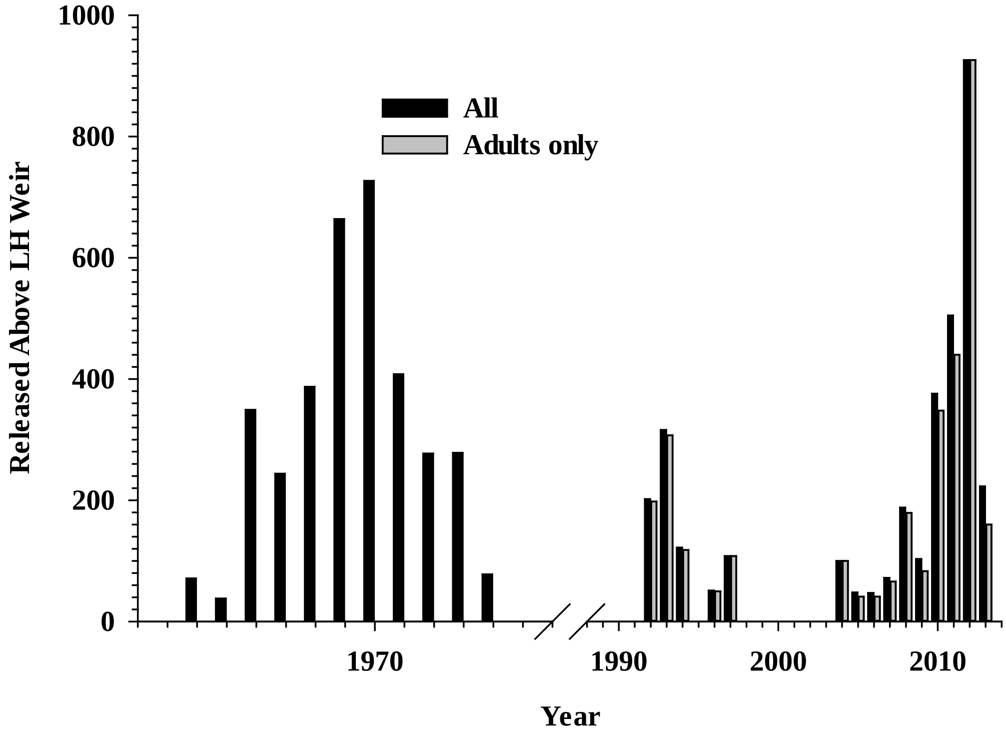

Figure 1. Spring Chinook salmon released above the LH weir to spawn in nature.

*Spawning Ground Surveys*
We completed 24 spawning ground surveys on Lookingglass Creek (LGC) from 18 July 18-19 September and enumerated 107 redds (Table 2). The first redd was observed on 20 August and the last on 12 September. Sixty redds were observed in Units 2, 3L, 3U, and 4 above the LH weir and 47 in Unit 1 below the LH weir. Redds in Units 3U and 3L were the same as Unit 3 of Burck 1993, and comprised 92% of the total redds above the LH weir. Peak numbers of new redds above the LH occurred in late August and below weir in early September. Weather and visibility conditions were generally excellent during the survey period. Spawning activity was earlier in Units 3U and 3L than Unit 1.

Table 2. New redds observed on surveys of LGC by date and unit, 2013.

| | Unit | | | | |
|---|---|---|---|---|---|
| Period | 1 | 2 | 3U | 3L | 4 |
| 7/18-7/22 | 0 | 0 | | | |
| 8/16-8/28 | 14 | 2 | 20 | 25 | 1 |
| 9/3-/9/19 | 33 | 2 | 5 | 5 | 0 |
| | | | | | |
| Totals | 47 | 4 | 25 | 30 | 1 |
| % | 44 | 4 | 23 | 28 | 1 |

There were strong clusters of redds at the upper end of Unit 3L and in the area near LH in Unit 1 (Figure 2). Redds were more evenly distributed in Units 2, 3U and 4.

Spawn timing and redd distributions above the LH weir were similar to the patterns observed by Burck (1993).

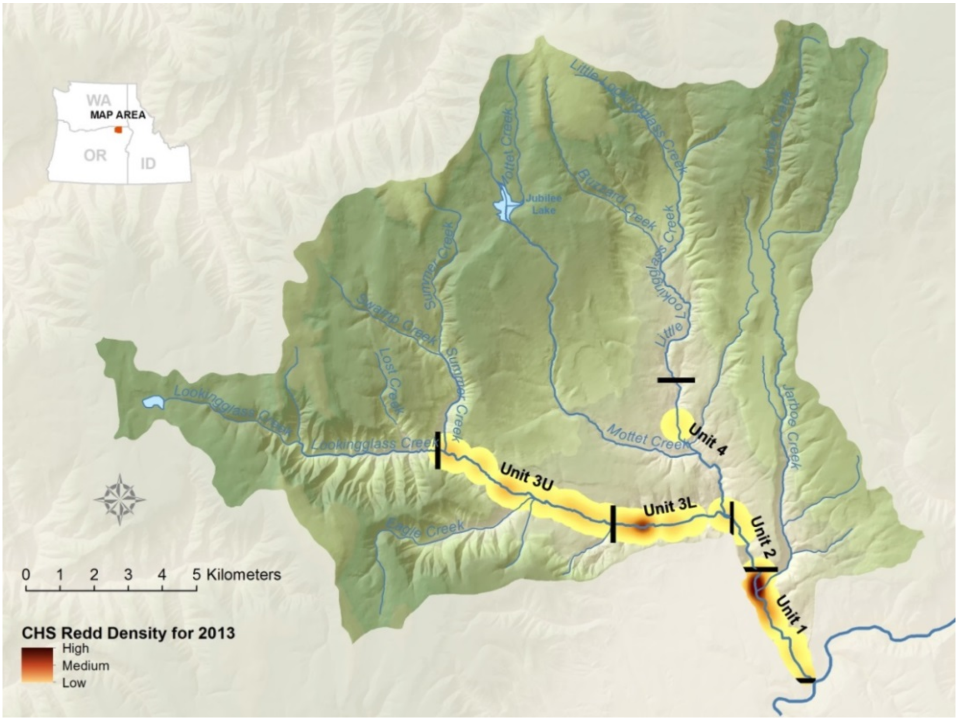


Figure 2. Distribution of spring Chinook salmon redds in LGC by unit, 2013.

Burck (1993) observed about 84% of the redds above the LH weir in what we designate as Units 3U and 3L, and 13% in Unit 4 (Figure 3). The smaller numbers of redds we have observed in Unit 4 during some years may be due to releasing fish above the mouth of Little Lookingglass Creek (LLGC) at rkm 6.6.

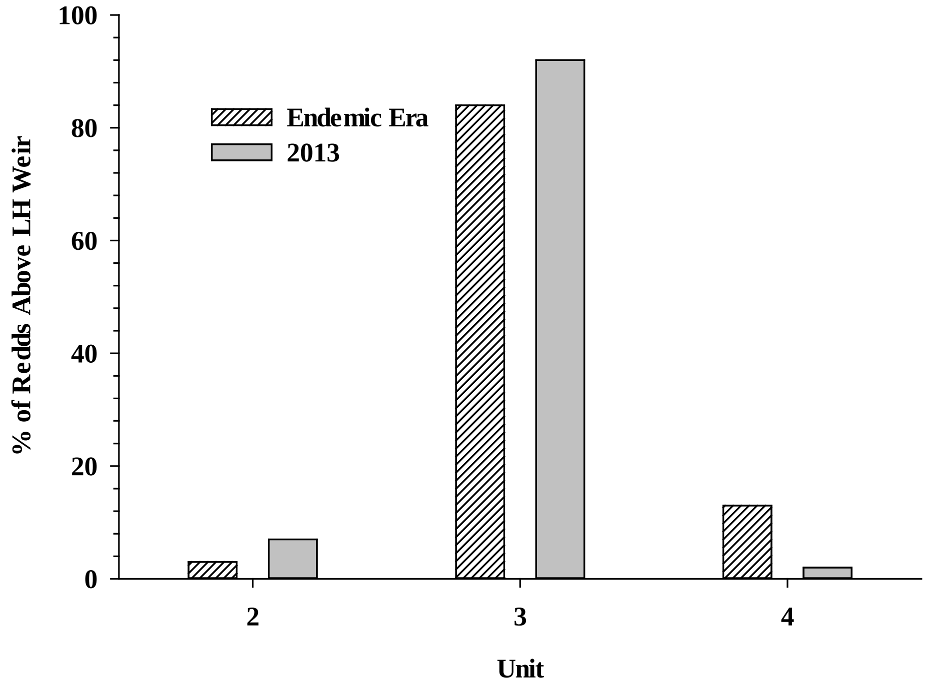

Figure 3. Percentages of Spring Chinook salmon redds above the LH weir by unit for 1965-1969 (endemic era means) and 2013.

Redd numbers above the LH weir have varied widely during the current reintroduction era, but with the exception of 2012 have generally been below those of the endemic era (Figure 4).

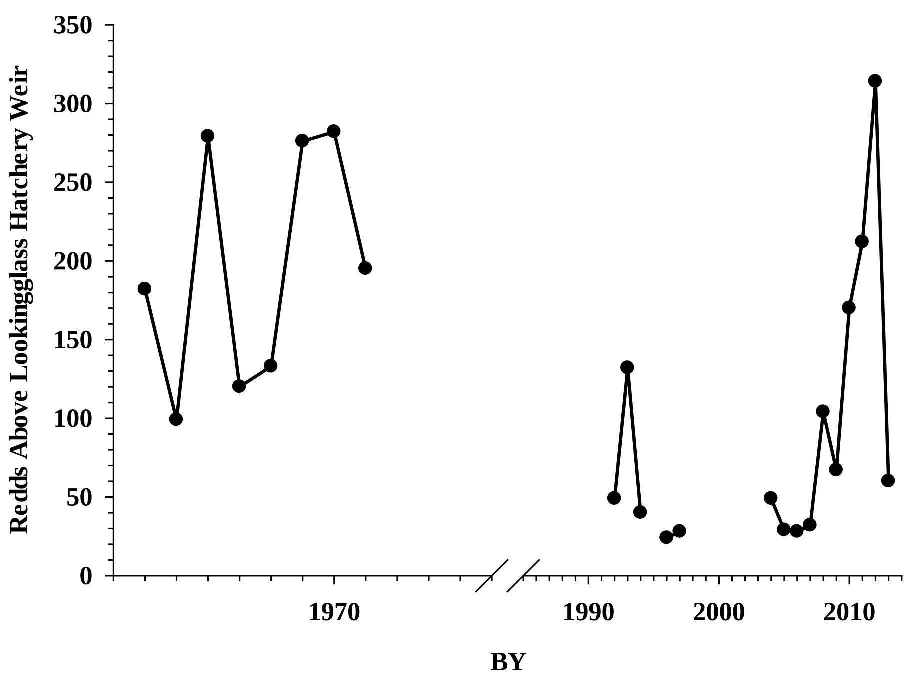

Figure 4. Spring Chinook salmon redds above the LH weir for 1965-1969 (endemic era), 1992-1994, 1996-1997 (Rapid River reintroduction era), and 2004-2013 (current reintroduction era).

*Carcass Recoveries*

There were 9 carcass recoveries above the LH weir from 26 June-16 August and 8 were opercle-punched. Four each were HOR and NOR and one was of unknown origin. Five of the 9 carcasses recovered were female and none of them had spawned.

Carcass recoveries above the LH weir on or after 20 August totaled 45 and recovery efficiency for fish released above the weir was 22%. Carcasses recovered below the LH weir totaled 91. Opercle-punched carcasses recovered below the LH weir included 5 HOR and 2 NOR jacks and 3 HOR adults. Scavengers and predators seem to have increased in recent years, and rapidly get to carcasses, lowering the number of carcasses sampled.

The population estimate of jacks just prior to the start of regular spawning ground surveys on 20 August 2013 was 56, and the adult estimate was 154. Fish per redd were 3.50 for all ages and 2.56 for adults only (Table 3). There were 14 females sampled above the LH weir during regular spawning ground surveys and all were 100% spawned out. Prespawning mortality has ranged from 0-18.2% during the current reintroduction era. Females sampled below the weir during the regular spawning ground surveys totaled 39 and prespawning mortality was 2.6%. Burck (1993) reported prespawning mortality rates of 0-4.7%. He observed “sorehead” or what is now called “headburn” on some Chinook, and this was a particular problem in 1969. This condition has been also been observed occasionally since the current reintroduction began, but not appeared significant.

Table 3. Fish/redd and prespawning mortality for natural spawning spring Chinook salmon above LH weir, 2004-2013.

| | Fish/redd | | |
|---|---|---|---|
| BY | Adults only | Jacks and Adults | Prespawning mortality |
| 2004 | 2.04 | 2.04 | 0.00 |
| 2005 | 1.45 | 1.72 | 8.33 |
| 2006 | 1.95 | 2.13 | 0.00 |
| 2007 | 2.06 | 2.25 | 8.33 |
| 2008 | 1.73 | 1.83 | 0.00 |
| 2009 | 1.25 | 1.63 | 12.50 |
| 2010 | 2.01 | 2.18 | 2.27 |
| 2011 | 2.03 | 2.36 | 6.00 |
| 2012 | 2.98 | 2.98 | 17.58 |
| 2013 | 2.56 | 3.50 | 0.00 |
| Means | 2.01 | 2.26 | 5.50 |

We collected 48 snouts above the LH weir and 51 below. Most snouts were scanned shortly after recovery, and those with CWT were sent to the ODFW CWT laboratory for dissection and recovery. Raw counts of CWT from 30 HOR carcasses sampled above the LH weir showed 5 CWT codes present from BY 2009, 2010, and 2011 releases. All

CWT were from LGC conventional brood stock releases except 1 each from the Upper Grande Ronde River (UGR) and Catherine Creek (CC). There were 9 CWT codes from BY 2009, 2010, and 2011 releases represented in 28 HOR carcasses sampled from below the LH weir. There were 18 CWT from LGC conventional brood stock, 9 from the UGR, and 1 from the Lostine River.

#### 1.3.1.2 Life History

*Length at Age*

HOR tended to be larger than NOR at ages 4 and 5 (Table 4). Mean FL was 10 mm greater for NOR than HOR at age 3, 23 mm greater for HOR at age 4, and 5 mm greater for HOR at age 5, using sexes combined data. At age 4, mean FL was 19 mm greater for NOR males than females and 21 mm greater for HOR males. At age 5, mean FL was 26 mm greater for NOR females than males and 22 mm greater for HOR males. Burck (1993) observed mean FL-at-age of NOR males and females equal at age 4 and 5 mm greater for females at age 5.

Table 4. Mean FL(mm) at age by sex and origin of LGC spring Chinook salmon, 2013.

| Origin | Sex | Age | $\bar{X}$ FL | Range | SE | N |
|---|---|---|---|---|---|---|
| NOR | M | 3 | 527 | 410-595 | 29 | 7 |
| NOR | M | 4 | 717 | 680-752 | 8 | 7 |
| NOR | F | 4 | 698 | 650-770 | 7 | 18 |
| NOR | Both | 4 | 703 | 650-770 | 6 | 25 |
| NOR | M | 5 | 819 | 738-900 | 81 | 2 |
| NOR | F | 5 | 845 | 825-870 | 13 | 3 |
| NOR | Both | 5 | 835 | 738-900 | 27 | 5 |
| HOR | M | 3 | 517 | 384-631 | 3 | 220 |
| HOR | M | 4 | 738 | 430-840 | 10 | 51 |
| HOR | F | 4 | 717 | 639-792 | 5 | 59 |
| HOR | Both | 4 | 726 | 430-840 | 5 | 110 |
| HOR | M | 5 | 857 | 820-894 | 37 | 2 |
| HOR | F | 5 | 835 | 800-890 | 11 | 8 |
| HOR | Both | 5 | 840 | 800-894 | 11 | 10 |

NOR FL at age for LGC during current reintroduction era has been similar to the CC stock, and both have been larger at all ages than during the endemic era (Figure 5).

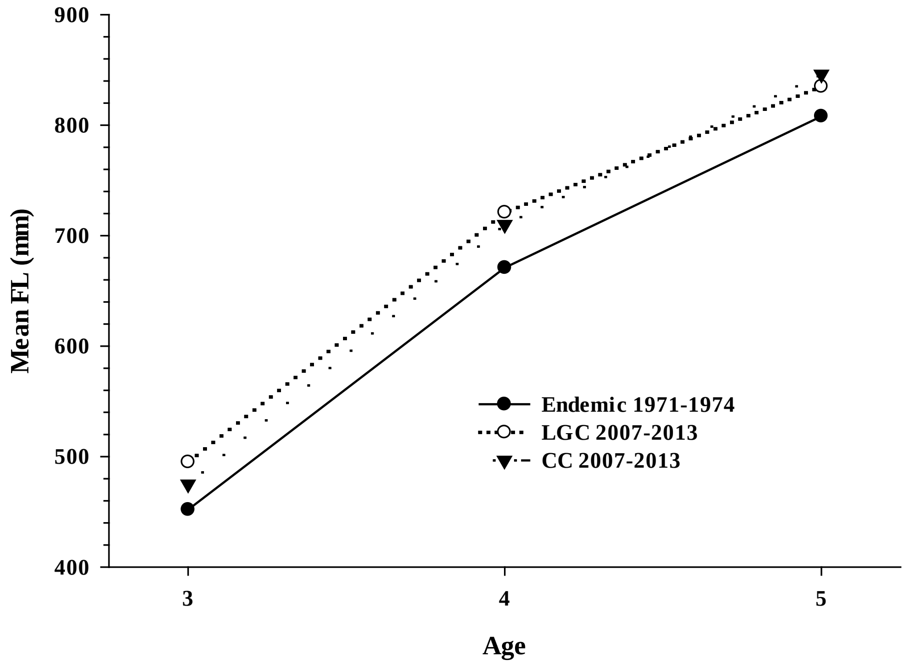


Figure 5. Mean FL (mm) at age for LGC NOR spring Chinook salmon, 1971-1974 (endemic era), 2007-2013 (current reintroduction era), and CC NOR.

### 1.3.1.3 Productivity

*Recruits per Spawner (R/S)*

BY 2008 R/S for adults (excluding jacks) was lower than the 5 BY average of 1.6 (Table 5). R/S for BY 2001-2005 CC NOR (adults+jacks) ranged from 0.1-0.7 (Feldhaus et al. 2012[ab]) and increased to 2.2 in BY 2006 and 3.2 in BY 2007 (Feldhaus et al. 2014[ab]).

Table 5. Population estimates, spawners, and R/S for LGC NOR spring Chinook salmon.

| | Population[a] | | Spawners[b] | | R/S Spawners | |
|---|---|---|---|---|---|---|
| BY | All | Adults | All | Adults | All[c] | Adults[d] |
| 2004 | 100 | 100 | 100 | 100 | 0.6 | 0.6 |
| 2005 | 50 | 42 | 46 | 39 | 1.8 | 2.0 |
| 2006 | 60 | 55 | 60 | 55 | 2.7 | 2.5 |
| 2007 | 72 | 66 | 66 | 61 | 2.3 | 2.2 |
| 2008 | 190 | 180 | 190 | 180 | 0.9 | 0.8 |
| 2009 | 109 | 84 | 95 | 74 | | |
| 2010 | 371 | 342 | 363 | 334 | | |
| 2011 | 500 | 431 | 470 | 405 | | |
| 2012 | 937 | 937 | 772 | 772 | | |
| 2013 | 210 | 154 | 210 | 154 | | |

[a] *Fish present above LH weir prior to start of regular spawning ground surveys*
[b] *Adjusted for prespawning mortality*
[c] *(Sum of BY X returns at ages 3, 4, and 5)/BY X All spawners*
[d] *(Sum of BY X returns at ages 4 and 5)/BY X Adult spawners*

### 1.3.2 Juveniles

#### 1.3.2.1 Abundance

*Outmigrants*
The rotary screw trap was fished 74% of the time during January-June 2012, 79% of the time during July-December 2012, and 91% of the time during January-June 2013. We collected 2,349 fry or parr from 6 January-11 June, with 29% in March and 59% in April. Mortalities totaled 12 or 0.5% of the catch. The population estimate for June 15-30 using fin-clipped parr totaled 1,937. First-time captures during June 15-30 was 365.

MY 2013 first-time captures in the screw trap, including recaptures of the 2012 field group, totaled 7,417 with 0.4% mortalities. Estimated outmigrants were 19,580 (SE 1,185). Adding the June 15-30 parr gave a total of 21,517. The MY 2013 outmigrant total was above the mean and the second-highest observed during the current reintroduction era (Table 6). The mean outmigrants per redd for the endemic and Rapid River reintroduction eras were 340 and 391, respectively. Mean for 9 BY of the current reintroduction era is 252 and has shown a general decline since BY 2005.

Table 6. LGC NOR spring Chinook salmon outmigrant summary[a].

| BY | MY | Outmigrants | Redds AW[b] | Outmigrants/Redd |
|---|---|---|---|---|
| 1965 | 1967 | 48,374 | 99 | 489 |
| 1966 | 1968 | 93,625 | 279 | 336 |
| 1967 | 1969 | 40,166 | 120 | 335 |
| 1968 | 1970 | 42,031 | 133 | 316 |
| 1969 | 1971 | 61,987 | 276 | 224 |
| | | | | |
| 1992 | 1994[c] | 8,713 | 49 | 178 |
| 1993 | 1995 | 65,082 | 132 | 493 |
| 1994 | 1996 | 6,707 | 40 | 168 |
| | | | | |
| 1996 | 1998 | 14,713 | 24 | 613 |
| 1997 | 1999 | 14,140 | 28 | 505 |
| | | | | |
| 2004 | 2006 | 9,404 | 49 | 192 |
| 2005 | 2007 | 14,091 | 29 | 486 |
| 2006 | 2008 | 12,208 | 28 | 436 |
| 2007 | 2009 | 7,847 | 32 | 245 |
| 2008 | 2010 | 30,289 | 104 | 291 |
| 2009 | 2011 | 12,279 | 67 | 183 |
| 2010 | 2012 | 13,749 | 170 | 81 |
| 2011 | 2013 | 21,517 | 212 | 101 |
| | | | | |
| Means* | | 15,173 | 86 | 252 |

*[a]PIT tags only used for estimates except MY 2012-2013*
*[b]AW=above the LH weir, [c] Trapping began in November 1993, *BY 2004-2011*

The scatterplot of outmigrants/redd and redds above the LH weir displayed high variability over the endemic and both reintroduction eras, but the pattern suggested negative density-dependence (Figure 6). BY 1992 was omitted from Figure 6 since a late start to trapping likely missed a substantial part of the outmigration.

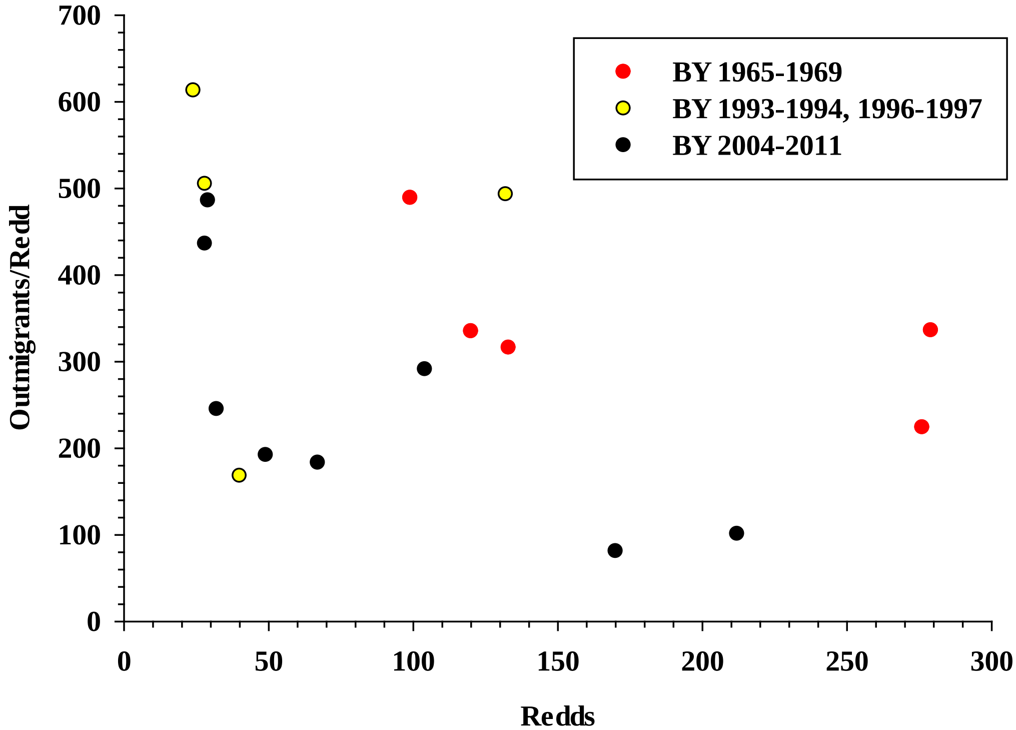


Figure 6. Scatterplot of outmigrants/redd and redds above the LH weir for BY 1965-1969 (endemic era), 1994-1994 and 1996-1997 (Rapid River reintroduction era), and 2004-2011 (current reintroduction era).

### 1.3.2.2 Life History

*Monthly sampling*

BY 2011 parr sampled during 2012 totaled 209 in July, 165 in August and 248 in September. Few parr were found at the LLGC site. Mean FL increased in a generally linear pattern from July-September at all sites except rkm 4.0 (Figure 7). Cause of the decline at rkm 4.0 from August to September may have resulted from nonrepresentative sampling or perhaps larger fish moved downstream. Size of parr sampled on a particular sampling date showed a general pattern of increase from upstream to downstream sites in the mainstem LGC. Burck (1993) also observed smaller fish in upstream areas and larger fish downstream.

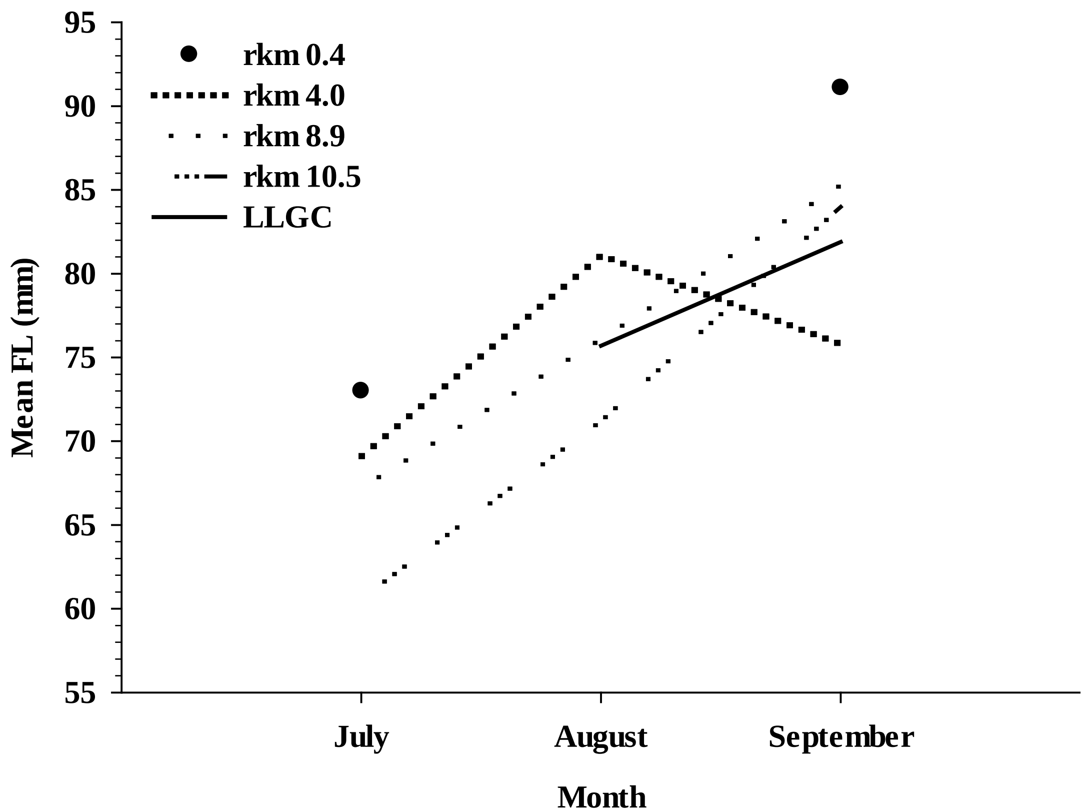

Figure 7. Mean FL (mm) of LGC BY 2011 NOR spring Chinook salmon parr, 2012.

Mean FL of parr sampled at the rkm 8.9 site in July was negatively related to density as represented by redds above the LH weir (Figure 8). Burck (1993) reported a similar negative relationship between summer parr growth and density.

Mean K ranged from 1.20-1.30 for 11 site/date combinations in LGC from July-September in 2012. Mean K were 1.24-1.27 in LLGC during August-September. There did not appear to be any trends over the summer at any of the sites. Burck (1993) reported that mean K increased from April-September, then decreased. Most means for a given site and sampling date combination were from 1.0-1.1 (Burck 1993). The larger K values seen in 2012 may have been related to the lower outmigrant production. MY 2011 outmigrants in MY 2011 were about one-third of the average Burck (1993) reported.

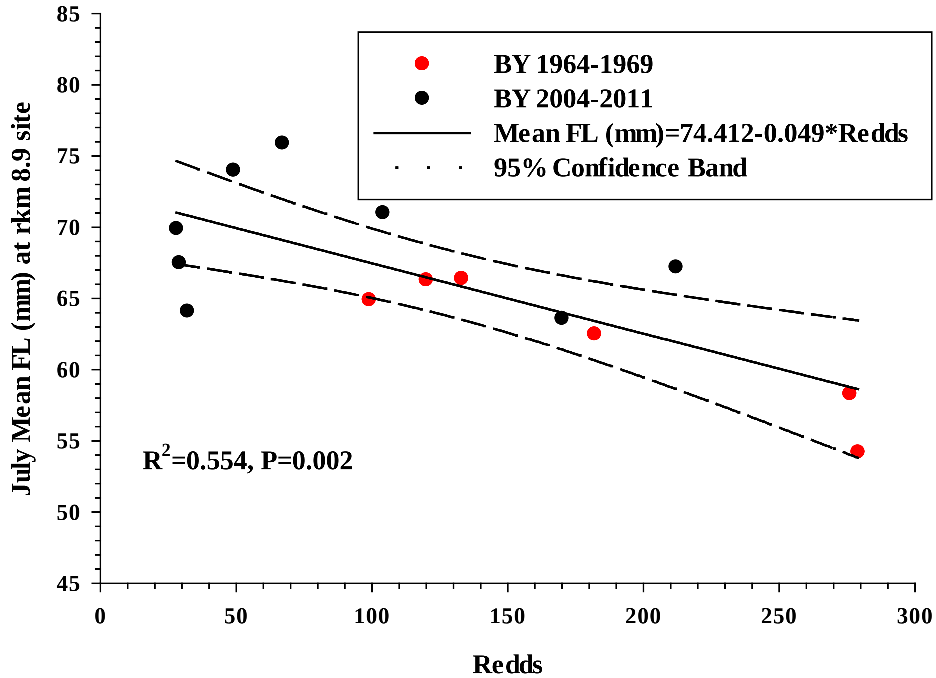


Figure 8. Regression of mean FL (mm) of LGC NOR spring Chinook salmon parr and redds above the LH weir for BY 1964-1969 (endemic era), 2004-2011 (current reintroduction era).

*Precocials*

There were 20 NOR precocials caught in the screw trap from 16 July-14 September ranging from 115-200 mm with a mean FL of 161.3 mm. Burck (1993) typically caught precocials from early August through early October, and recorded sizes from 77-152 mm FL.

*Outmigration timing*

Outmigrants by season estimated from the screw trap catch were 33% for fall 2012, 50% for winter 2012, and 18% for spring 2013 (Table 7). Burck (1993) observed outmigration beginning shortly after emergence and continuing for up to 18 months, and a similar pattern has been observed for both reintroduction eras. Using Burck's data from June to the following June, higher percentages left during the fall season of June-September (Table 7), than winter (October-December) or spring (January-June). For both reintroduction eras, higher percentages left during winter. When fall and winter were combined, the percentages were similar for the endemic and both reintroduction eras. A similar pattern of most outmigrants leaving "early" or in the July-January period occurs for CC outmigrants (Anderson et al. 2011).

Table 7. Seasonal outmigration* of LGC NOR spring Chinook salmon summary.

| BY | MY | Jun-Sept % | Oct-Dec % | Jan-Jun % |
|---|---|---|---|---|
| 1965 | 1967 | 62 | 30 | 8 |
| 1966 | 1968 | 67 | 25 | 8 |
| 1967 | 1969 | 75 | 19 | 6 |
| 1968 | 1970 | 66 | 21 | 13 |
| 1969 | 1971 | 83 | 12 | 5 |
| | Means | 71 | 21 | 8 |
| | | | | |
| 1992 | 1994 | | 72 | 28 |
| 1993 | 1995 | 59 | 29 | 12 |
| 1994 | 1996 | 39 | 59 | 3 |
| | | | | |
| 1996 | 1998 | 24 | 36 | 40 |
| 1997 | 1999 | 46 | 43 | 11 |
| | Means | 42 | 48 | 19 |
| | | | | |
| 2004 | 2006 | 43 | 47 | 10 |
| 2005 | 2007 | 33 | 64 | 2 |
| 2006 | 2008 | 36 | 44 | 20 |
| 2007 | 2009 | 16 | 64 | 21 |
| 2008 | 2010 | 21 | 55 | 24 |
| 2009 | 2011 | 9 | 69 | 22 |
| 2010 | 2012 | 34 | 49 | 17 |
| 2011 | 2013 | 26 | 55 | 20 |
| | Means | 27 | 56 | 17 |

* *MY totals may not sum to 100 due to rounding*

Obtaining an accurate estimate of January-June outmigrants is difficult because of high flow and debris during the spring and the small size of fish limiting the marking options available. Numbers leaving LGC during June, July and August are relatively low as flows decrease and water temperatures increase. Low flows make screw trapping difficult, as the cone may turn very slowly, or become “hung up” on rocks in the shallow water. We used deflectors on the bank to direct as much flow as possible into the cone. The bypass trap Burck (1993) used may have been more efficient during May-August, or perhaps the pattern we have observed is more characteristic of the donor CC stock and how progeny have performed in LGC.

Burck (1993) suggested density dependent movement of outmigrants, with more leaving early as fry or small parr in BY when there were more redds. He suggested that this movement was habitat-related and a tradeoff of higher growth for higher mortality, since outmigrants moving into the Grande Ronde River encountered higher water temperatures and more predators and competitors. Based on raw counts, a similar pattern seems to be present during the current reintroduction era (see comments in paragraph above).

There were 192 recaptures of the BY 2011 summer parr group in the screw trap. The highest monthly percentage of 60% occurred in October 2012 (Figure 9). Percentages of recaptures by season were 30% fall, 64% winter, and 7% spring. Recaptures have been variable, but show a general pattern of higher numbers in the fall.

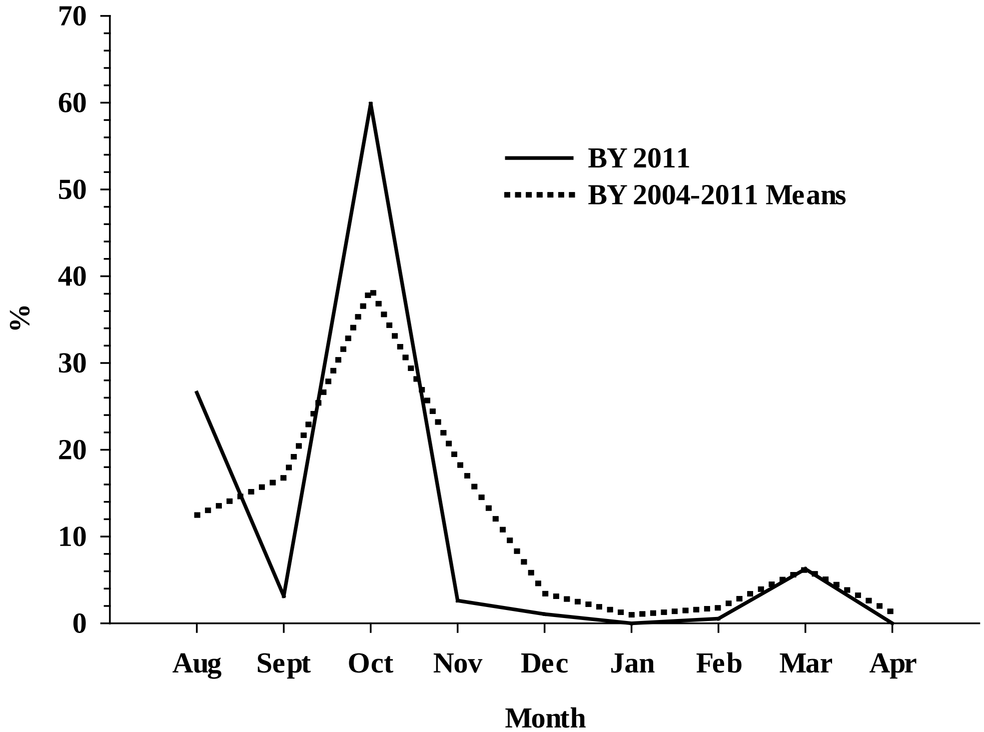


Figure 9. Percentages of recaptures in the LGC screw trap by month and MY of PIT-tagged spring Chinook salmon summer parr.

*Size of outmigrants in the screw trap catch by season*
Median FL increased from fall 2012 to spring 2013 (Figure 10). The increase was substantial from fall 2012 to winter 2012 as smaller fish recruited to the catch from the summer to the fall. The difference was less from winter 2012 to spring 2013.

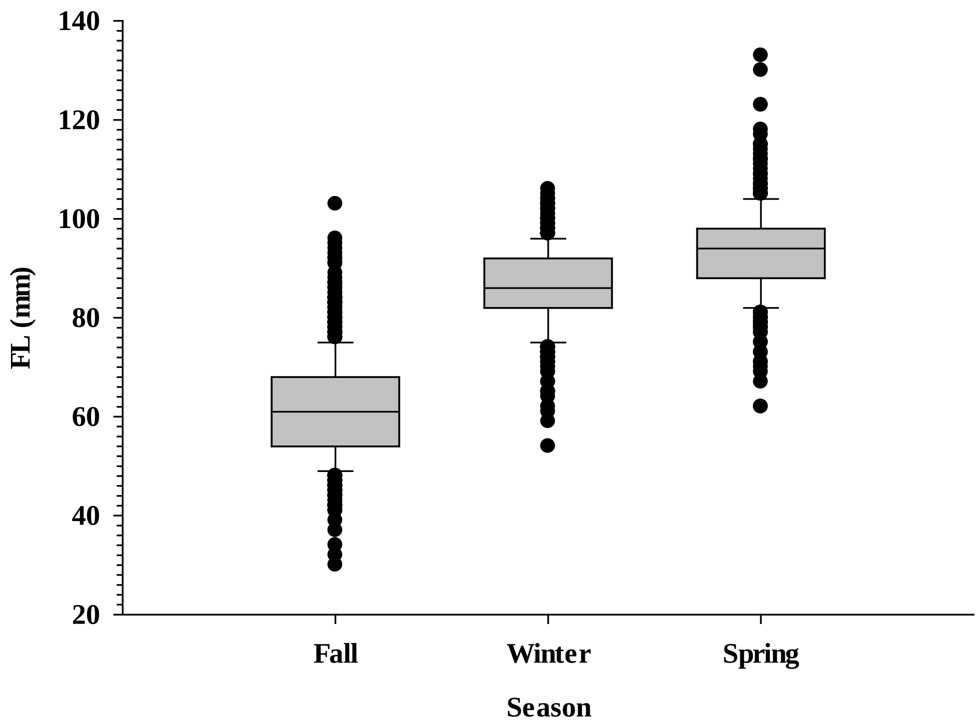


Figure 10. Box plots of FL (mm) by seasonal group for NOR BY 2011 spring Chinook outmigrants caught in the LGC screw trap, MY 2013.

*Size, survival, smolt equivalents, smolt-to-adult ratios, arrival timing, and travel time by PIT-tag group*

Mean FL were 68.9, 70.0, 86.7, and 93.1 for summer, fall, winter and spring outmigrants PIT-tagged and released. Mean weights increased from 3.0-9.0 g from summer to spring. Mean K was 1.05 for the fall group, varied from 1.09-1.11 for the summer, winter, and spring groups. Sample sizes were 982 for tagged from 7-9 August and ranged from 236-374 for fall, winter, and spring groups of outmigrants caught at the screw trap. Median tagging dates were 13 August, 9 November, and 17 March, respectively, for the fall winter, and spring groups.

Trends in mean FL for seasonal groups during the current reintroduction era have been consistent with mean FL (mm) smallest for the summer groups and largest for the spring groups (Figure 11). Larger fish caught in the trap during October and November appeared to be disproportionate to the general population sampled by seining (Burck 1993). Alternatively, he suggested that larger fish remaining upstream may have shifted habitats and were not at the sites sampled by seining.

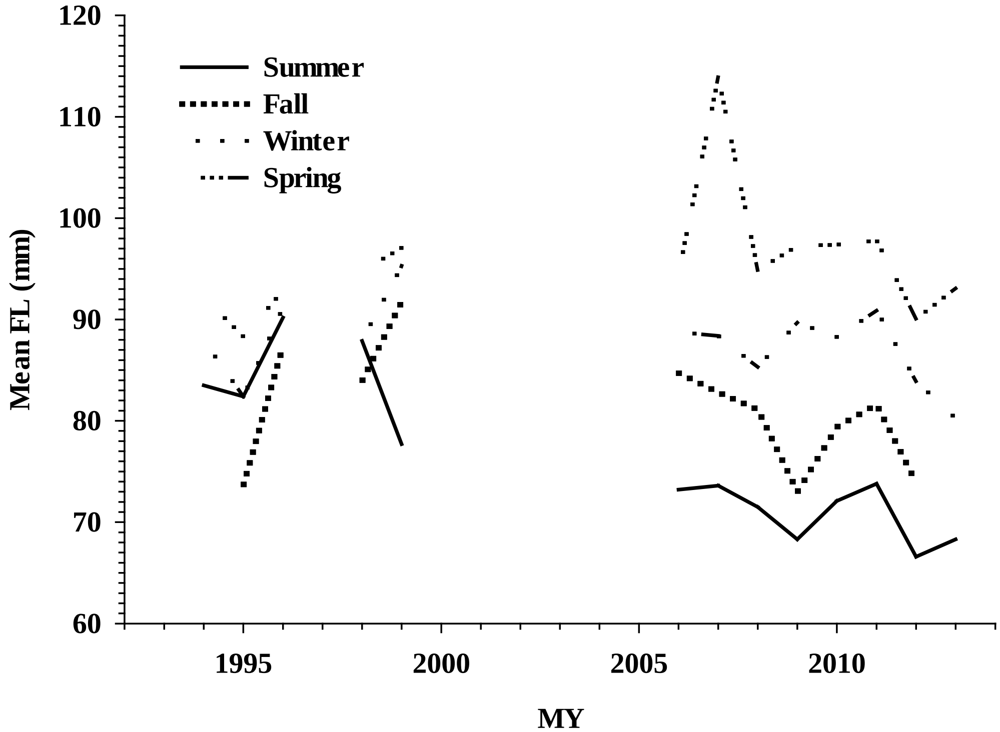


Figure 11. Size of LGC spring Chinook salmon juveniles captured by snorkel-seining or screw trapping, PIT-tagged and released, MY 1994-1996, 1998-1999, and 2006-2013.

Survival probabilities (SE) to Lower Granite Dam (LGD) were 0.146 (0.018), 0.106 (0.039), 0.307 (0.050), and 0.497 (0.060) respectively for the summer, fall, winter, and spring groups of MY 2013.

Survival probabilities for summer parr of several Grande Ronde Subbasin populations showed a decreasing trend from MY 1993 through 2004, then increased for several years before decreasing again recently (Figure 12). Survival was more variable between populations for the fall/winter and spring groups (Figures 13-14). CC usually showed lower survival than the other populations for all seasonal groups. Population differences are likely the result of distances outmigrants must travel and varying environmental conditions that must be faced.

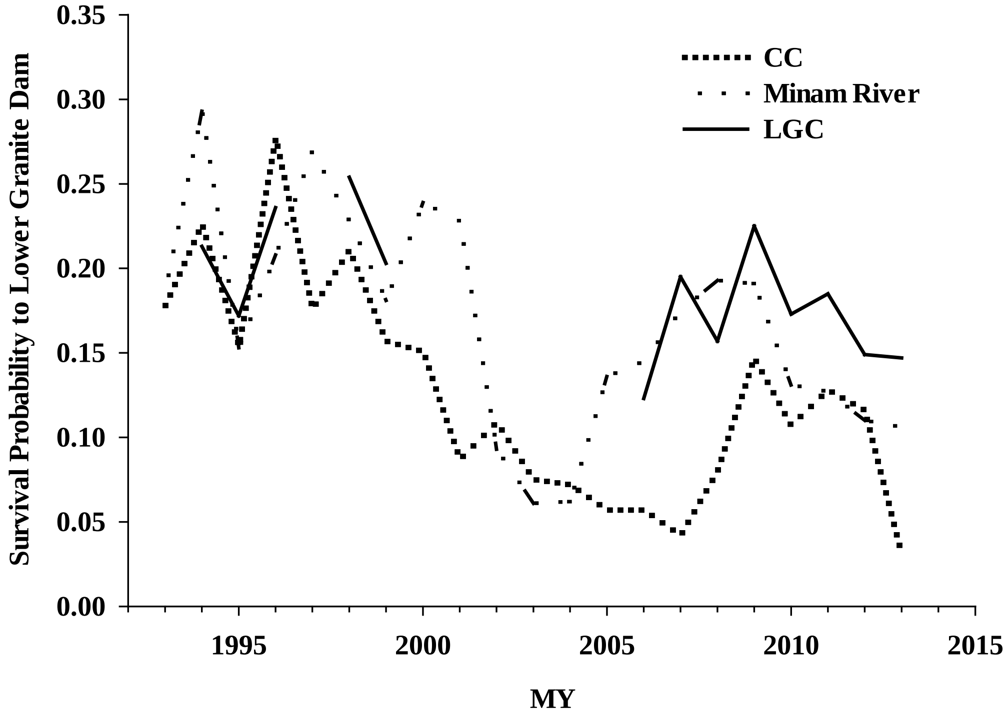


Figure 12. Survival probabilities of Grande Ronde River Subbasin spring Chinook salmon summer parr captured by snorkel-seining, MY 1993-2013.

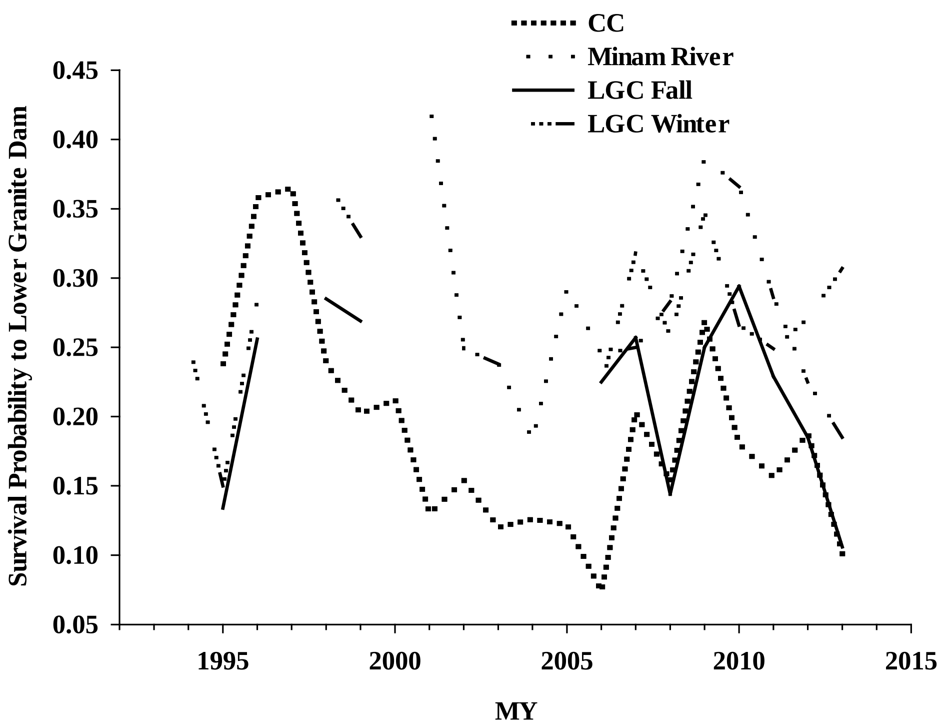


Figure 13. Survival probabilities of Grande Ronde River Subbasin NOR spring Chinook salmon fall and winter outmigrants, MY 1994-2013.

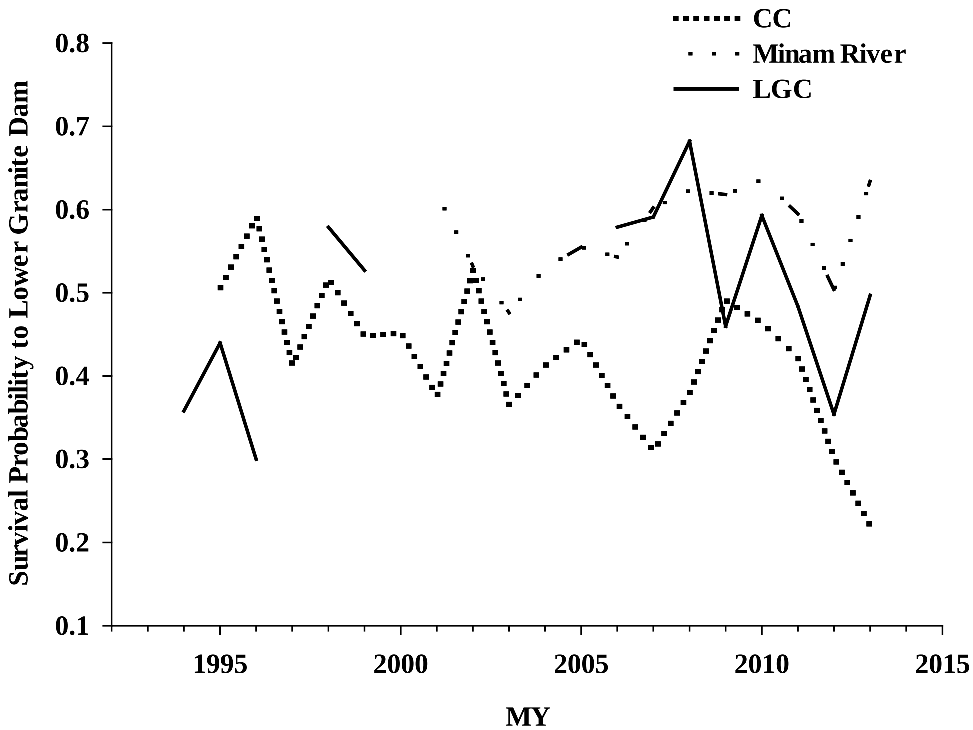


Figure 14. Survival probabilities of spring group Grande Ronde River Subbasin NOR spring Chinook salmon spring outmigrants, MY 1994-2013.

Smolt equivalent estimates (outmigrants for each group surviving to LGD) for fall 2012, winter 2012 and spring 2013 were 742, 3,284, and 1,899, respectively, for a BY 2011 total of 5,925. BY 2011 $S_{eq}$ was the second-highest of 8 BY and higher than the mean, but $S_{eq}$/spawner was second lowest (Table 8).

BY 2008 NOR SARs were about 50% of the BY 2004-2008 means. The BY 2004-2008 adult only mean of 2.8% is within the range (2-6%) and below the average (4%) recovery objectives for Snake River Chinook and steelhead (NPCC 2014). SAR for NOR CC spring Chinook salmon were approximately 0.5-1% (Carmichael et al. 2010).

Table 8. $S_{eq}$ to LGD and SAR[a] for LGC NOR spring Chinook salmon.

| | | | SAR (%) | |
|---|---|---|---|---|
| BY | $S_{eq}$ | $S_{eq}$/spawner[a] | All[b] | Adults[c] |
| 1992 | 2,454 | | 5.2 | 4.8 |
| 1993 | 11,380 | | 0.9 | 0.9 |
| 1994 | 1,839 | | 2.0 | 2.0 |
| | | | | |
| 1996 | 6,371 | | 1.1 | 1.0 |
| 1997 | 4,584 | | 1.0 | 0.9 |
| | | | | |
| 2004 | 2,446 | 24 | 2.5 | 2.2 |
| 2005 | 4,280 | 110 | 1.9 | 1.8 |
| 2006 | 3,669 | 67 | 4.4 | 3.8 |
| 2007 | 2,784 | 46 | 5.5 | 4.8 |
| 2008 | 10,620 | 59 | 1.6 | 1.3 |
| 2009 | 3,671 | 50 | | |
| 2010 | 3,319 | 10 | | |
| 2011 | 5,925 | 15 | | |
| | | | | |
| Means | 4,589* | 48* | 3.2** | 2.8** |

[a] *Adult spawners from Table 5*,
[b] *(Sum of BY X returns at ages 3, 4, and 5)/$S_{eq}$ BY X*
[c] *(Sum of BY X returns at ages 4 and 5)/$S_{eq}$ BY X*
**BY 2004-2011, **BY 2004-2008*

Median arrival dates at LGD ranged from 4-10 May for the four LGC PIT-tag groups in MY 2013. Expanded detections at LGD ranged from 14 for the fall 2012 group to 102 for spring 2013. Median arrival dates were in late April or mid-May for most BY, with spring groups usually arriving earliest and fall groups latest (Figure 15). Travel times were generally similar for MY 2004-2014 within the 4 seasonal groups (Figure 16).

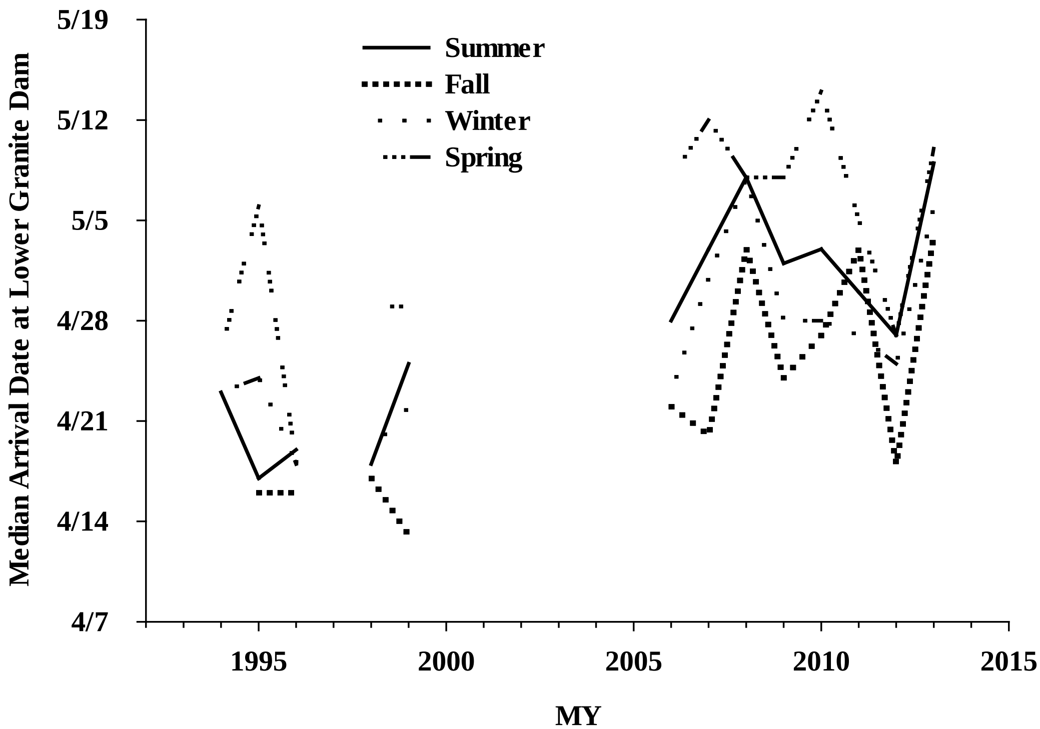


Figure 15. Median arrival dates at LGD for LGC NOR spring Chinook salmon summer parr, and fall, winter, and spring outmigrants, MY 1994-2013.

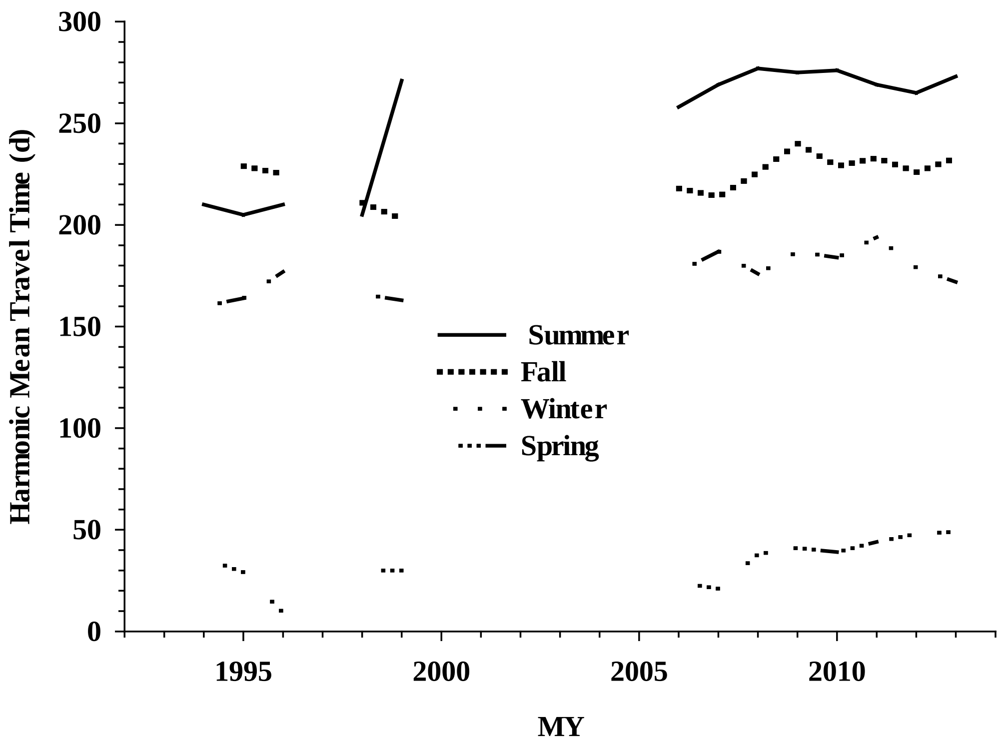


Figure 16. Harmonic mean travel time (d) to LGD for LGC NOR spring Chinook salmon summer parr, and fall, winter, and spring outmigrants, MY 1994-2013.

## 1.4 Summary

Life history and productivity metrics for spring Chinook salmon in the current reintroduction era were generally similar to the endemic and Rapid River reintroduction eras and also to the CC donor stock. Some differences have been seen in juvenile outmigration timing and adult FL-at-age between the LGC endemic stock and the current reintroduction era. Density-related patterns in growth of parr have been observed. Productivity expressed as R/S has been above replacement for 3 of 5 BY, and productivity above replacement will need to be sustained in order to rebuild a persistent, naturally-reproducing population above the LH weir.

## 1.5 Literature Cited

Note: Annual progress reports for the Lookingglass Creek Spring Chinook Reintroduction Project for all years, including the Rapid River reintroduction era, are available at the U. S. Fish and Wildlife Service Lower Snake River Compensation Plan website (http://www.fws.gov/lsnakecomplan/reports.html).

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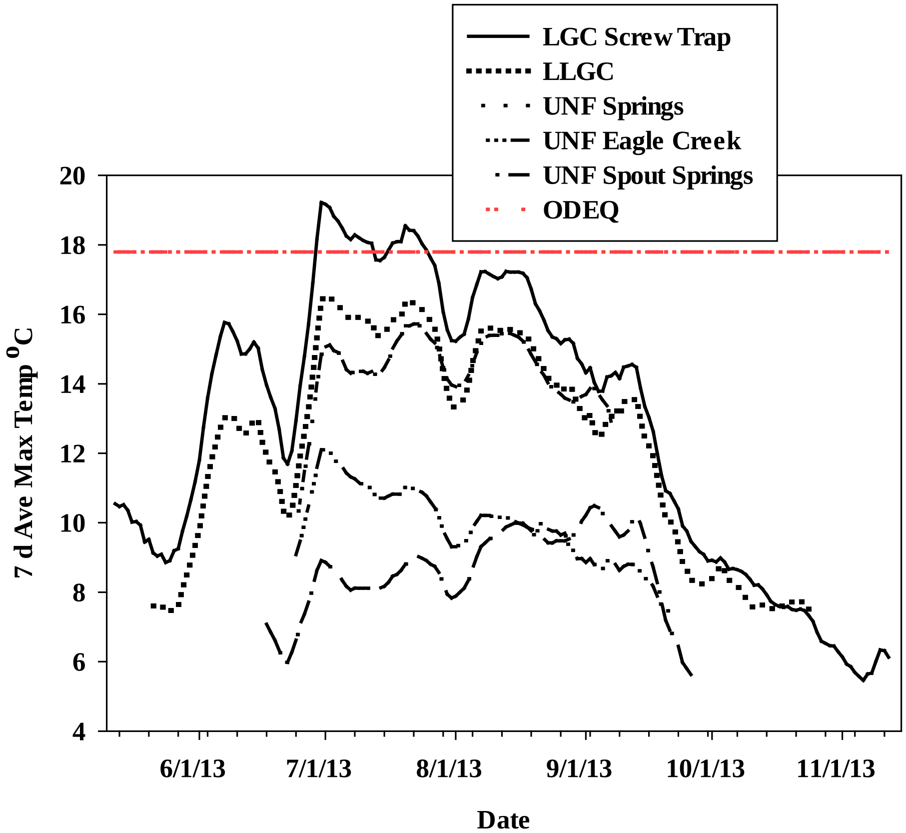
## 1.6 Appendix Figure 1. Water temperatures at several locations in LGC and LLGC during 2013 (7-d average maximum).




# 2 SECTION II ASSISTANCE PROVIDED TO LSRCP COOPERATORS AND OTHER PROJECTS

We provided assistance to Lower Snake River Compensation Plan (LSRCP) cooperator Oregon Department of Fish and Wildlife (ODFW) in 2013 for ongoing hatchery evaluation research. Project personnel completed spawning ground surveys for spring Chinook salmon in the Grande Ronde basin. We provided assistance in pre-release sampling of spring Chinook salmon at LH and adult spring Chinook salmon at Oregon LSRCP facilities.

We assisted Bonneville Power Administration projects with data collection in 2013. Tissues taken with the opercle punch on spring Chinook salmon returns to LGC weir were placed in dry rite in the rain envelopes for a study of relative reproductive success. We assisted ODFW personnel who have been collecting data on bull trout (*Salvelinus confluentus*) in the Grande Ronde River basin by providing estimated fork length data from bull trout captured in the LGC screw trap.

# 3 ACKNOWLEDGMENTS

Thanks to Scott Marshall, Steve Yundt, Chris Starr, Margaret Anderson, Joe Krakker, and Tammy Froscher (LSRCP, United States Fish and Wildlife Service) for administering this contract and coordinating project activities between the CTUIR and other agencies. Gary James, Michelle Thompson, Julie Burke, Celeste Reves, Brandie Weaskus, Dora Sigo, and Lawanda Bronson (CTUIR) provided technical and administrative support. Thanks go to members of the ODFW NE Oregon Fish Research Section for field and office assistance. Darlene Robison (Umatilla National Forest) provided water temperature data. CTUIR O&M staff and CTUIR staff from other projects assisted in various field activities. We thank the private landowners along LGC, including Hancock Forest Properties for allowing us to access and work on their property. ODFW LH staff tended the adult trap, collected tissues and trap data, provided the use of hatchery facilities and equipment, and kept an eye on the screw trap for us. Nicole Novak and Colette Coiner (CTUIR) provided the redd density map. Gene Shippentower (CTUIR) reviewed previous drafts of this report.