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Lower Snake River Compensation Plan
Confederated Tribes of the Umatilla Indian Reservation
Evaluation Studies for 1 January 2012 to 31 December 2012

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 2012 totaled 147. Adults released above the Lookingglass Hatchery weir totaled 926 and spawning ground surveys yielded 314 redds. Brood year 2007 recruits per spawner were 2.2 for adults only. We estimated 13,749 (81/redd) brood year 2010 juveniles outmigrated from above Lookingglass Hatchery during migration year 2012. Fall 2011 outmigrants were 34% of the total, winter 2011 49%, and spring 2012, 17%. Survival probabilities to Lower Granite Dam ranged from 0.149-0.354 for summer, fall, winter, and spring PIT-tag groups. Smolt equivalents (outmigrants surviving to Lower Granite Dam) totaled 3,319. Brood year 2007 smolt-to-adult ratio was 4.8 for adults only. Median arrival dates at Lower Granite Dam of brood year 2010 outmigrants ranged from 18 April-27 April. 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 4 brood years.

1.2 Introduction/Study Area/Methods

This is the latest in the series of 20 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 data from studies of 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).

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 147 in run year (RY) 2012. Returns were 3 (2%), age 3, 129 (88%) age 4, and 15 (10%) age 5 (Table 1). Total NOR returns includes those caught at the LH trap and unpunched, unclipped carcasses recovered above the LH weir. Age composition of NOR returns in past years has been dominated by age 4, but age 3 returns were high in 2009-2011, comprising 11-24% of returns.

Completed brood year (BY) 2007 returns were 152, higher than during the Rapid River reintroduction era and the second-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
					2004	7	46	9	62
					2005	4	69	9	82
					2006	24	124	14	162
					2007	17	120	15	152

Released above the LH weir

A total of 926 adults were released above the LH weir after they swam into the trap from 22 May-7 September 2012. We released 831 hatchery-origin (HOR) and 95 NOR. There was a total of 532 females released and 92% were HOR. The early years of the current reintroduction era saw low numbers released above the LH weir (Figure 1). The number released in 2012 was the highest during any of the 3 eras (endemic, Rapid River reintroduction, current reintroduction). HOR fish were 100% of the adults released above the LH weir in 2004-2007 and 80-90% in 2008 and 2010-2012. HOR made up 34% of the adults released in 2009. Few HOR jacks are released above the LH weir. 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.

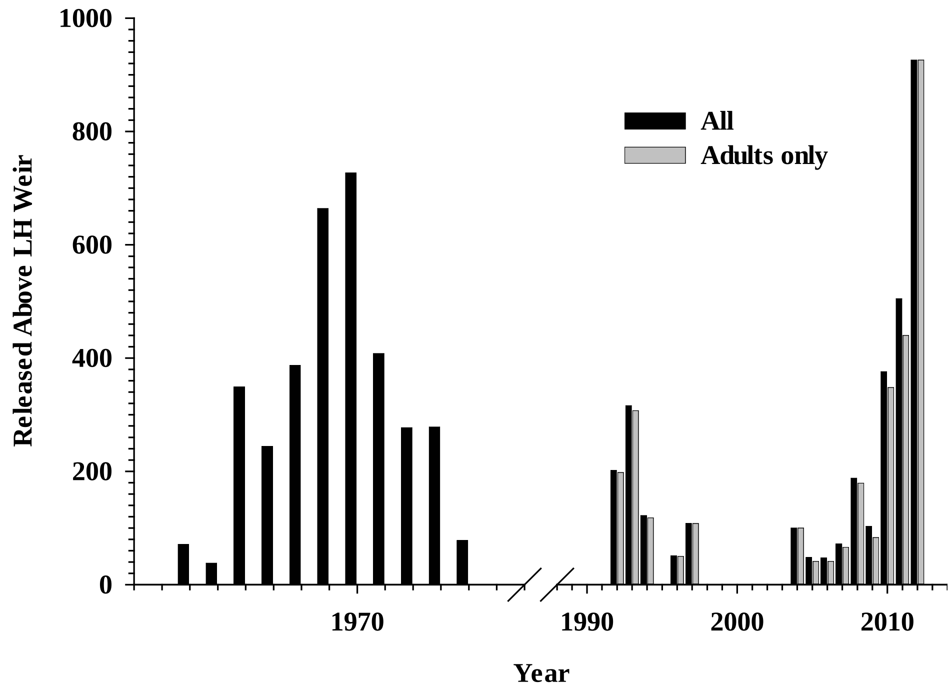

Figure 1. Spring Chinook salmon released above the LH weir to spawn in nature.

Spawning Ground Surveys

We completed 28 spawning ground surveys on Lookingglass Creek (LGC) from 24 July 24-19 September 2012 and counted 447 redds (Table 2). Redds observed in Units 2, 3L, 3U, and 4 above the LH weir totaled 314. Redds in Units 3U and 3L were the same as Unit 3 of Burck 1993, and comprised 75% of the total redds above the LH weir. Peak numbers of new redds above the LH weir were observed in late August and in late August and early September below. Weather and visibility conditions were generally excellent during the survey period.

Table 2. New redds observed on surveys of LGC by date and unit, 2012.

	Unit				
Period	1	2	3U	3L	4
7/24				1	
8/10-8/31	89	21	126	80	38
9/5-/9/19	44	10	10	19	9
Totals	133	31	136	100	47
%	30	7	22	30	11

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 reported by Burck (1993).

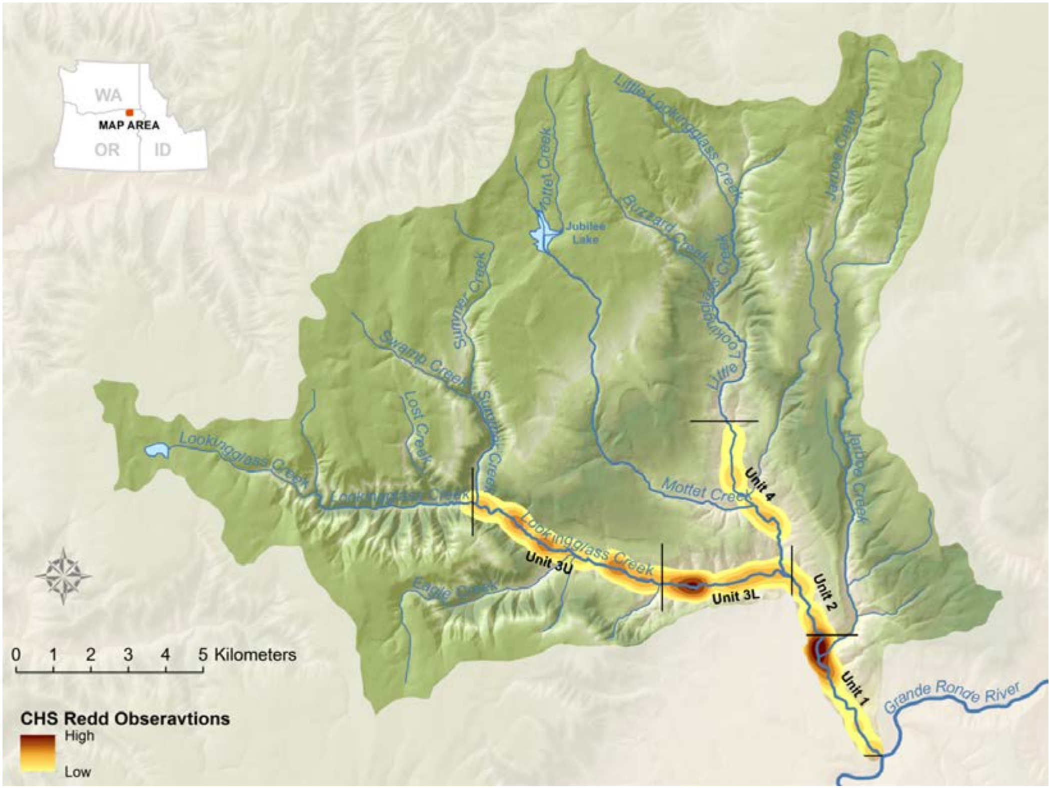

Figure 2. Distribution of spring Chinook salmon redds in LGC by unit, 2012.

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). Smaller percentages of redds in Unit 4 that occurred during some recent years may have resulted from releases made above the mouth of Little Lookingglass Creek (LLGC) at rkm 6.6. Fish may be reluctant to move downstream, then upstream into a tributary.

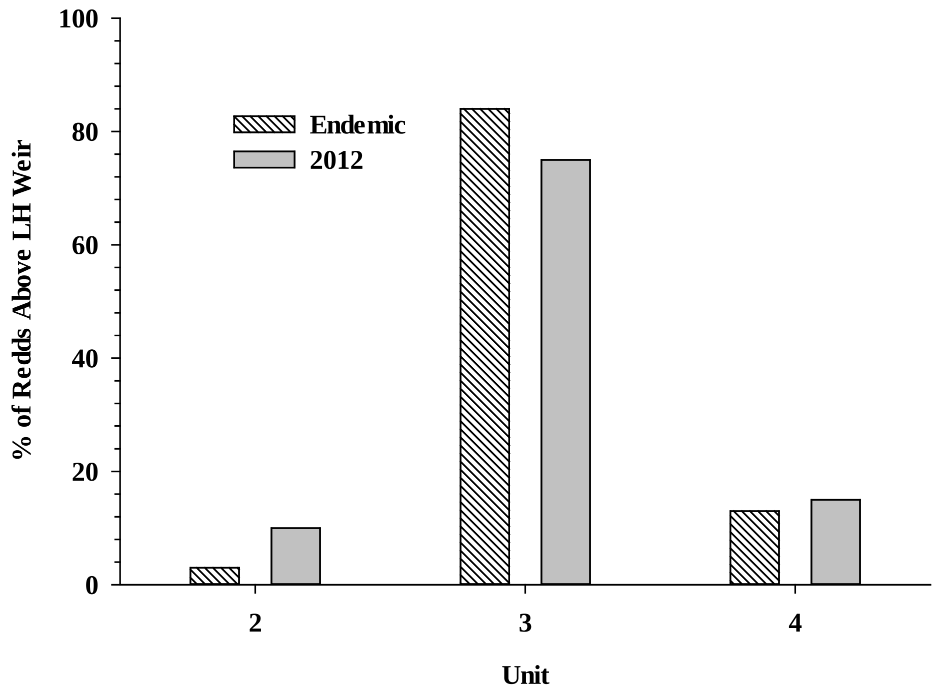

Figure 3. Percentages of spring Chinook salmon redds above the LH weir by unit for 1965-1969 (endemic era means) and 2012 (current reintroduction era).

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

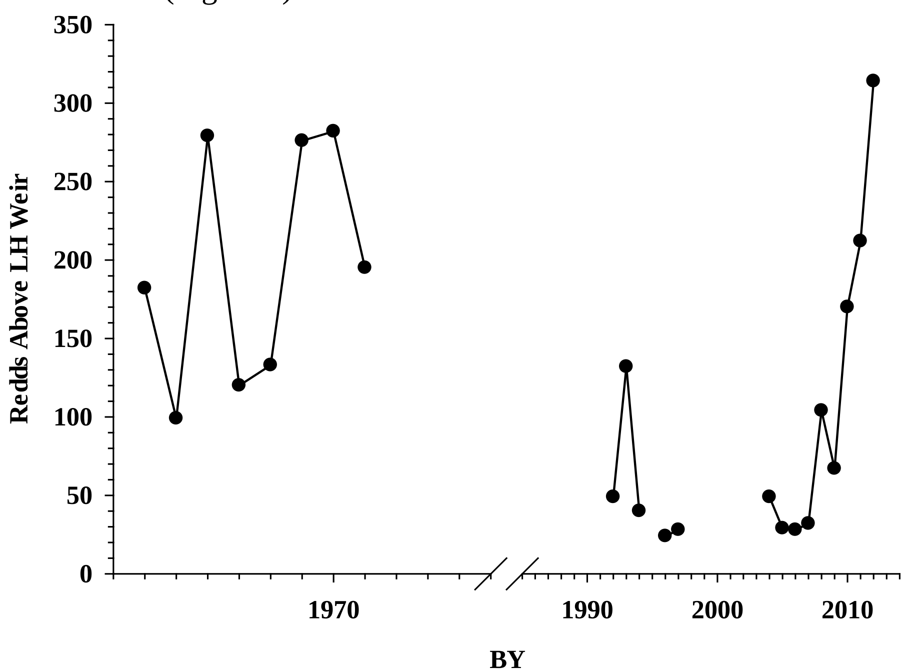

Figure 4. Spring Chinook salmon redds above the LH weir for 1965-1969 (endemic era), 1992-1994, 1996-1997 (Rapid River reintroduction era), and 2004-2012 (current reintroduction era).

Carcass Recoveries

There were 11 carcass recoveries above the LH weir from 6-19 July 2012, including 9 HOR and 2 NOR. All had been opercle-punched, 6 were females and none of the females had spawned.

Carcass recoveries above the LH weir on or after 24 July 2012 totaled 222 jacks and adults, and a single HOR precocial male. Carcass recovery efficiency for fish opercle-punched and released above the LH trap was 22%. Carcasses recovered below the LH weir totaled 95; including 27 that had been caught at the LH weir, released upstream, then swam back downstream over the weir before the carcass weir upstream of LH weir was installed. Opercle-punched carcasses recovered below the LH weir also included 18 trapped at the Catherine Creek (CC) weir and released below the LH weir to provide for a tribal fishery. Scavengers and predators seem to have increased in recent years, rapidly get to carcasses, and lower the number of carcasses sampled.

The population estimate of adults just prior to the start of regular spawning ground surveys on 24 July 2012 was 937. Fish per redd was 2.98 (Table 3). There were 131 females sampled above the LH weir during regular spawning ground surveys and 23 (17.56%) were prespawn mortalities. Females sampled below the LH weir during the regular spawning ground surveys totaled 137 and prespawning mortality was 7.30%. Higher prespawn mortality above the weir may have been due to handling at the trap. 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.

Table 3. Fish/redd and prespawning mortality for natural spawning spring Chinook salmon above LH weir, 2004-2012.

	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	17.56
Means	1.94	2.12	6.11

Snouts sampled from above the LH weir totaled 175 and 95 below. Most snouts were scanned shortly after recovery and only those with wire were sent to the ODFW CWT lab for recovery. There were 6 codes represented in the HOR carcasses recovered above the

LH weir. All were from BY 2008, and 90 of 94 carcasses were from LGC conventional broodstock. Three were CC stock released in CC, and one was Upper Grande Ronde River (UGR) stock. There were 8 CWT codes represented from carcasses sampled below the LH weir, 6 from BY 2008 releases and 2 from BY 2009. LGC conventional broodstock carcasses totaled 37, 5 were CC stock released in CC, and 3 were UGR stock.

1.3.1.2 Life History

Length-at-Age

Mean FL at age was 9 mm greater for NOR than HOR at age 4, and 39 mm greater for HOR at age 5, using sexes combined data (Table 4). At age 3, mean FL was 34 mm greater for HOR females than males. At age 5, mean FL was 18 mm greater for HOR males than females. 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, 2012.

Origin	Sex	Age	$\bar{X}$ FL	Range	SE	N
NOR	M	4	733	602-865	22	16
NOR	F	4	681	634-750	28	4
NOR	Both	4	723	602-865	18	20
NOR	M	5	846			1
NOR	F	5	819	751-900	25	5
NOR	Both	5	824	751-900	21	6
HOR	M	3	481	340-610	7	36
HOR	F	3	515	470-574	23	4
HOR	Both	3	484	340-610	7	40
HOR	M	4	725	535-875	7	100
HOR	F	4	707	546-850	4	150
HOR	Both	4	714	535-875	4	250
HOR	M	5	863	812-930	21	5

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

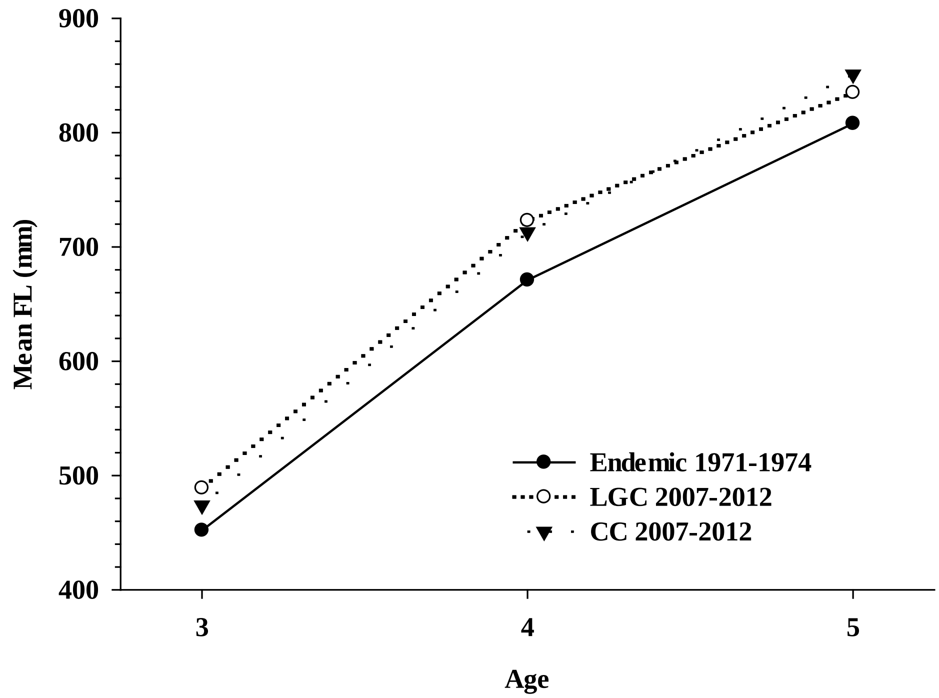

Figure 5. FL (mm) at age for LGC NOR spring Chinook salmon adults, 1971-1974 (endemic era), 2007-2012 (current reintroduction era), and CC NOR.

1.3.1.3 Productivity

Recruits/spawner (R/S)

BY 2007 R/S for adults (excluding jacks) was higher than the 4 BY average of 1.8 (Table 5).

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		
2009	109	84	95	74		
2010	371	342	363	334		
2011	500	431	470	405		
2012	937	937	772	772		

[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 41% of the possible days during January-June 2011, 90% during July-December 2011, and 74% during January-June 2012.

A total of 3,681 BY 2010 sac fry or fry were collected in the screw trap during January-May 2011, with 89% in March. There were 2 mortalities. A mark/recapture experiment was conducted from 23 March-29 March using 250 fish marked with Bismark Brown dye and resulted in a recovery rate of 6%. A sample of 224 outmigrants was fin-clipped and used to estimate abundance from 15 June-July 15. Trap efficiency was 12% and gave an estimate of 2,740.

First-time captures in the screw trap during MY 2012 totaled 4,991 from 16 July 2011-15 June 2012 and mortalities were 0.4%. The outmigrant estimate for July 16, 2011-June 30, 2012 was 11,009 (SE 504). Adding 2,740 parr from 15 June-15 July gave a total of 13,749. The MY 2012 total was less than the MY 2006-2012 mean (Table 6). MY 2012 outmigrants/redd was the lowest of 7 MY and less than half that of the previous MY. The mean outmigrants per redd for the endemic and Rapid River reintroduction eras were 340 and 391, respectively.

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
Means*		14,267	68	273

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

Outmigrants/redd and redds above the LH weir were highly variable over the endemic, Rapid River reintroduction, and current 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.

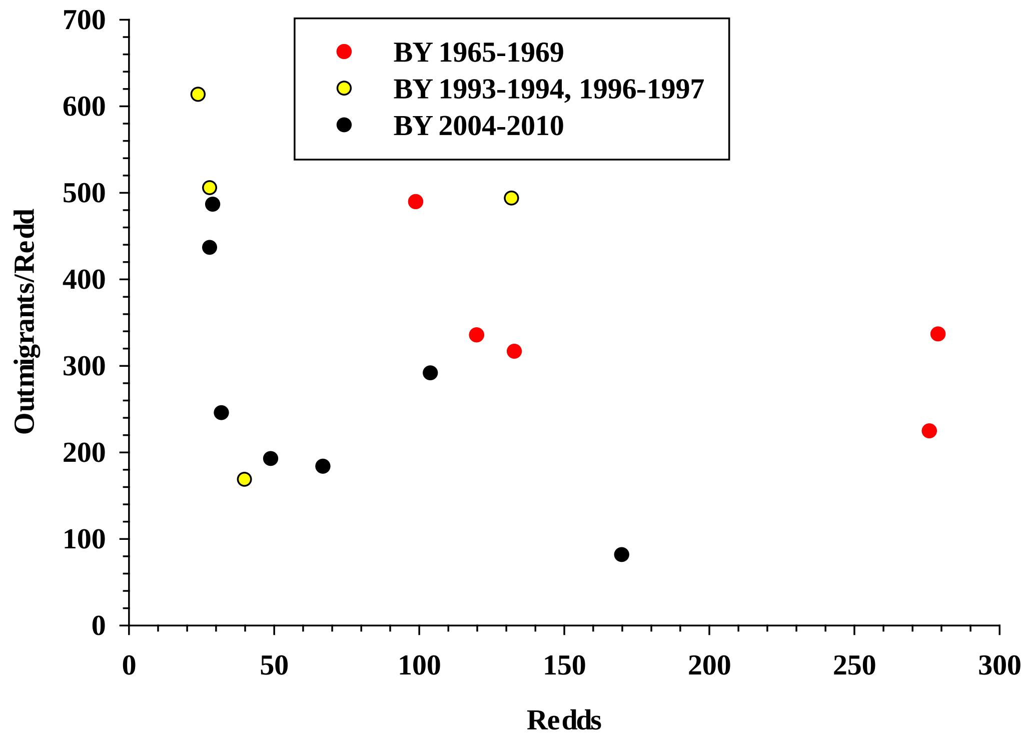

Figure 6. Scatterplot of outmigrants/redd and redds above the LH weir for BY 1965-1969 (endemic era), 1993-1994 and 1996-1997 (Rapid River reintroduction era), and 2004-2010 (current reintroduction era).

1.3.2.2 Life History

Monthly sampling

BY 2010 parr were sampled at 3 sites during July and August 2011 (Figure 7). Mean FL was greater at the most downstream site near the mouth of LGC on both dates. Burck (1993) observed smaller fish in upstream areas and larger fish downstream on a given sampling date. 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 1.16-1.36 at the rkm 0.4, 8.9, and 10.5 sites during July and August. Mean K decreased 0.11 from July to August at the rkm 0.4 site, increased 0.07 at the rkm 8.9 site, and decreased 0.02 at the rkm 10.5 site. 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 2011 may have been related to density, as BY 2010 outmigrants were much less than reported by Burck (1993).

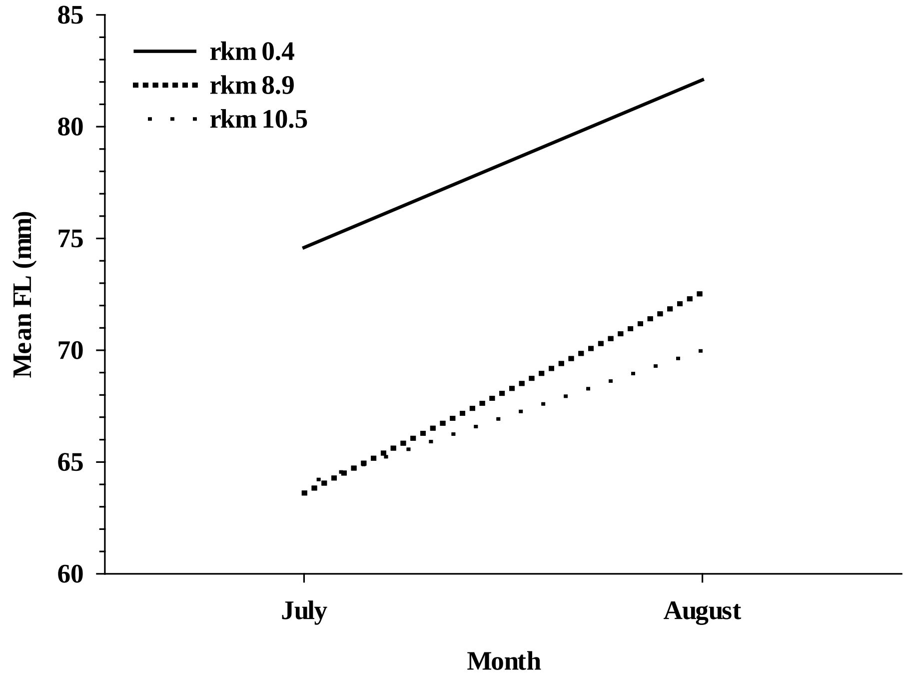

Figure 7. Mean FL (mm) of LGC BY 2010 NOR spring Chinook salmon parr, 2011.

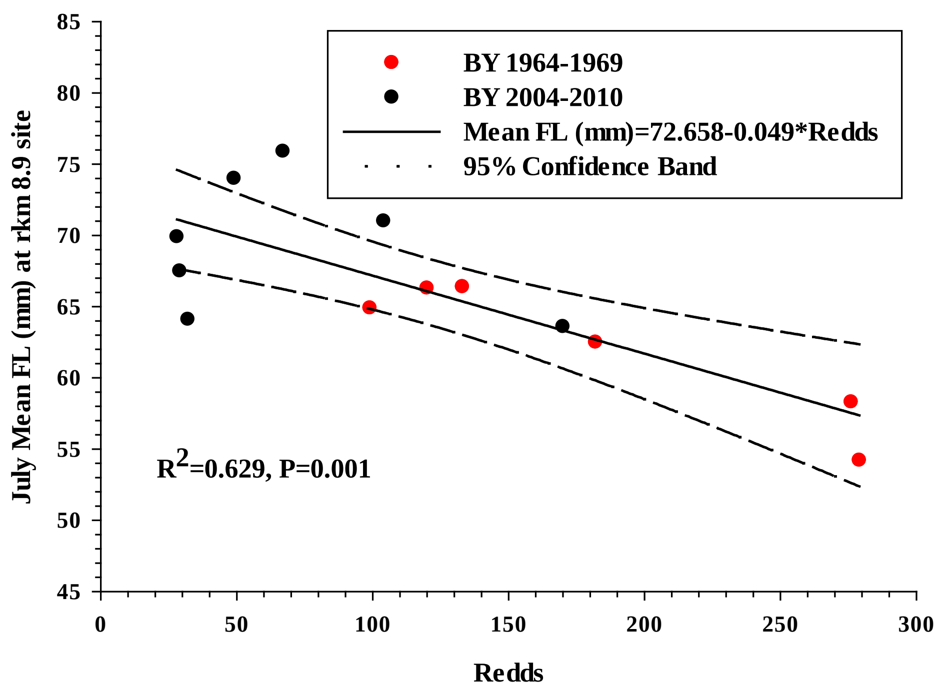

Figure 8. Regression of mean FL (mm) of LGC NOR spring Chinook salmon parr and redds above the LH weir, BY 1964-1969 (endemic era), 2004-2010 (current reintroduction era).

Precocials
There were 21 NOR precocials collected during the 6-10 August collection of summer parr for PIT-tagging. These precocials were PIT-tagged to determine their fate. Two (80, 83 mm FL) were recaptured in the screw trap on 9 or 10 October 2011. Five were interrogated in the hydrosystem the following spring. FL of those interrogated ranged from 79-85 mm. These results suggest that the precocial life history may be more diverse than previously thought, or perhaps these were misidentified as precocials. The size range of those interrogated or recaptured was considerably larger than the mean length of the non-precocial parr that were PIT-tagged or those collected during monthly sampling in August.

NOR precocials caught in the screw trap from 8 August-30 September totaled 15 and mean FL of 14 was 140.1 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 47% for fall 2011, 39% for winter 2011 and 13% for spring 2012 (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, 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 during 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
	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 the risk of higher mortality, since outmigrants moving into the Grande Ronde River encountered higher water temperatures and more predators and competitors. A similar pattern seems to be present during the current reintroduction era, although based only on raw counts (see comments in paragraph above).

There were 99 recaptures of the BY 2010 field group in the screw trap (Figure 9). Percentages of recaptures by season were 39% fall 2011, 48% winter 2011, and 12% spring 2012.

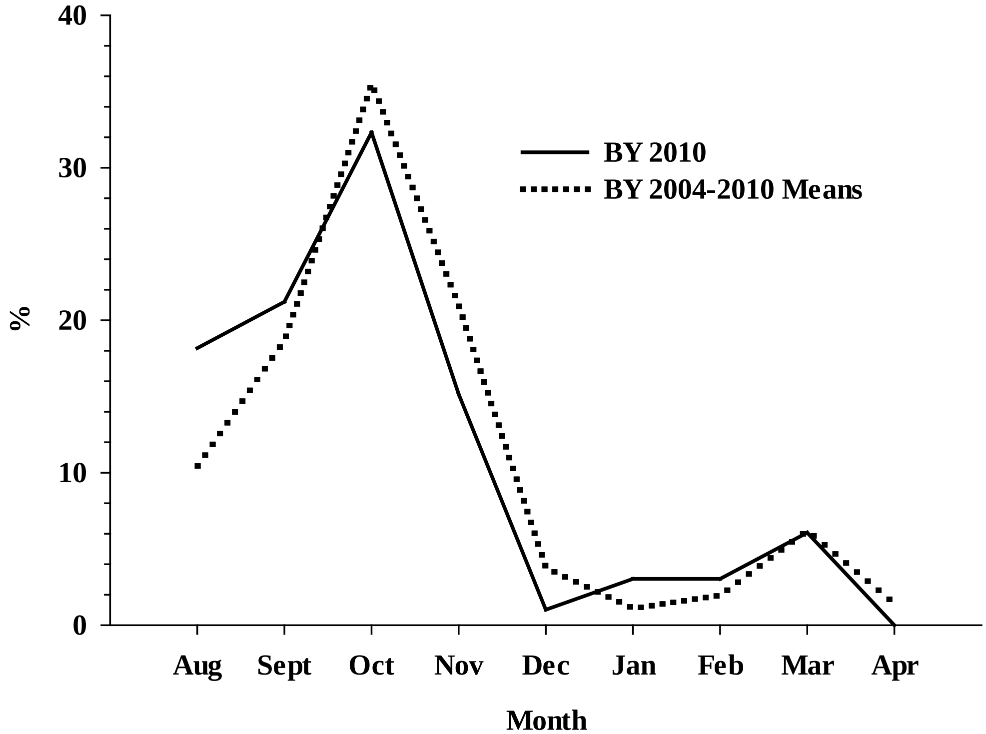

Figure 9. Percentages of recaptures in the LGC screw trap by month and MY of PIT-tagged NOR spring Chinook salmon summer parr.

Size of outmigrants in the screw trap catch by season

Median FL increased from fall 2011 to spring 2012 for outmigrants (Figure 10). The increase was substantial from fall 2011 to winter 2011 as smaller fish recruited to the catch from summer through fall. The difference was less from winter 2011 to spring 2012. Burck (1993) reported that larger fish caught in the trap during October and November appeared to be disproportionate to the general population sampled by seining. He suggested that there may have been greater numbers of large fish outmigrating at that time or possibly larger fish remaining upstream shifted habitats and were not at the sites sampled by seining.

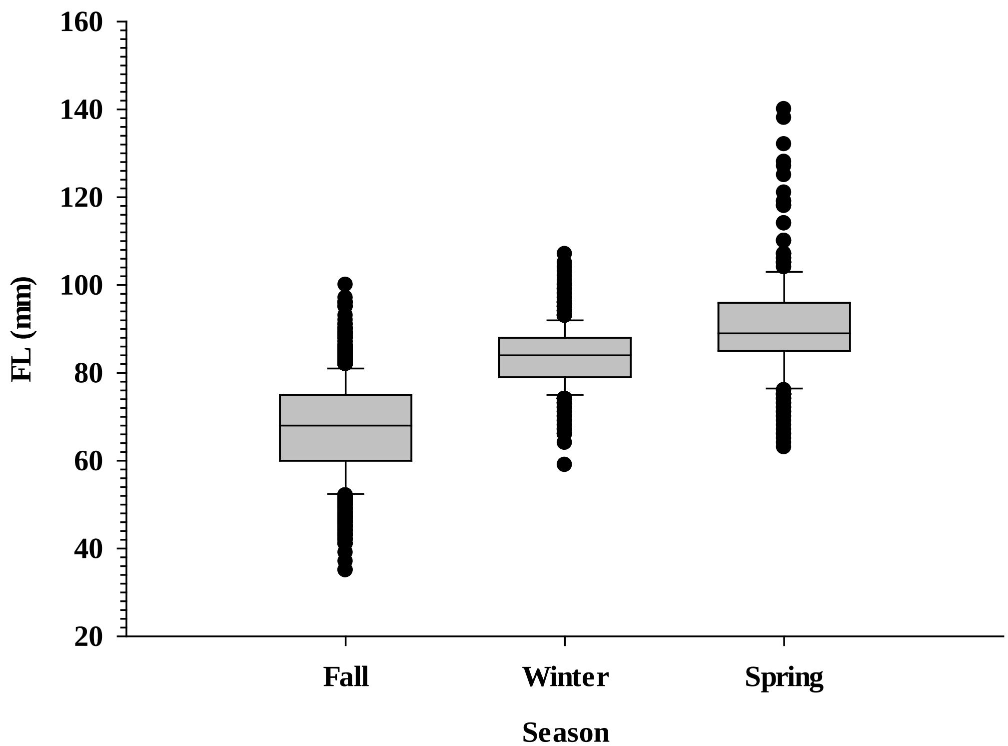

Figure 10. Box plots of FL (mm) by seasonal group for NOR BY 2010 spring Chinook outmigrants caught in the LGC screw trap, MY 2012.

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

Mean FL were 66.6, 73.9, 83.9, and 90.1 mm for summer, fall, winter and spring outmigrants PIT-tagged and released (Figure 11). Mean weights increased from 3.5-8.3 g from summer to spring. Mean K was 1.14 for the summer group, then decreased to 1.04-1.07 for the fall, winter and spring groups. Sample sizes for were 925 for summer parr PIT-tagged from 8-10 August 2011 and ranged from 213-596 for the fall winter, and spring groups of outmigrants caught at the screw trap. Median tagging dates were 7 September, 26 October, and 22 February, respectively.

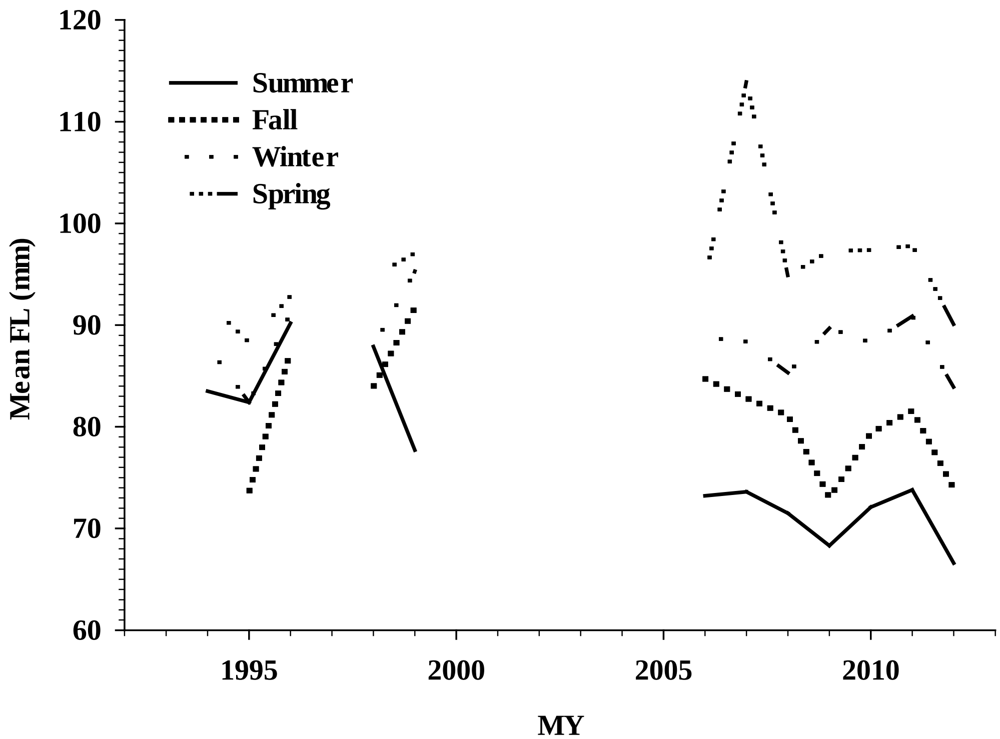

Figure 11. Size of LGC juvenile NOR spring Chinook salmon captured by snorkel-seining or screw trapping, PIT-tagged and released, MY 1994-1996, 1998-1999, and 2006-2012.

Survival probabilities (SE) to LGD were 0.149 (0.017), 0.185 (0.022), 0.271 (0.024), and 0.354 (0.039) respectively for the summer, fall, winter, and spring groups of MY 2012. Survival probabilities for summer parr of several Grande Ronde Subbasin populations showed a decreasing trend for MY 1992 through 2004, then increased for several years before decreasing again recently (Figure 12). Survival was more variable between populations for the fall/winter groups and without any clear trend (Figure 13). For the spring groups, the Minam River usually had highest survival, but all 3 populations have declined in recent years (Figure 14). CC usually showed lower survivals than the other populations for both winter and spring groups. Population differences are probably the result of distances outmigrants must travel and the varying environmental conditions encountered

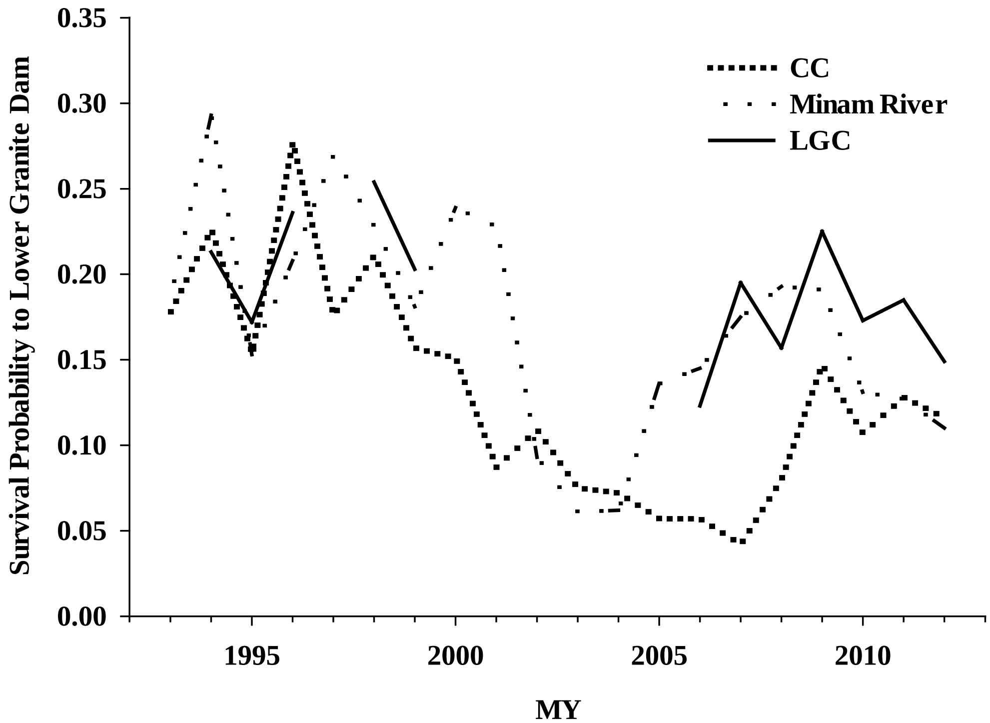

Figure 12. Survival probabilities of Grande Ronde River Subbasin NOR spring Chinook salmon summer parr captured by snorkel-seining, MY 1993-2012.

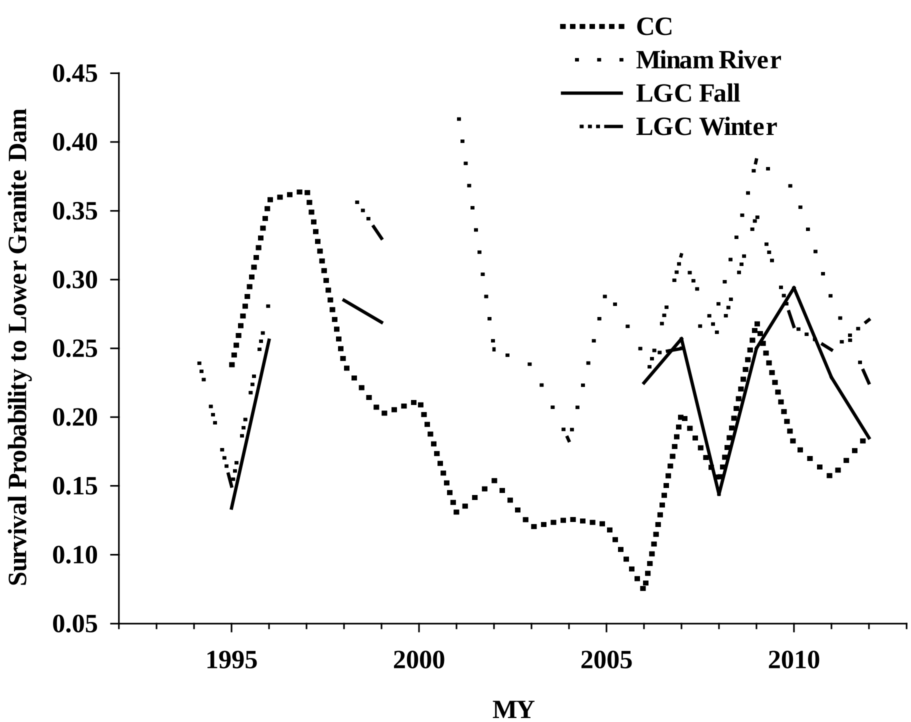

Figure 13. Survival probabilities of Grande Ronde River Subbasin NOR spring Chinook salmon fall and winter outmigrants, MY 1994-2012.

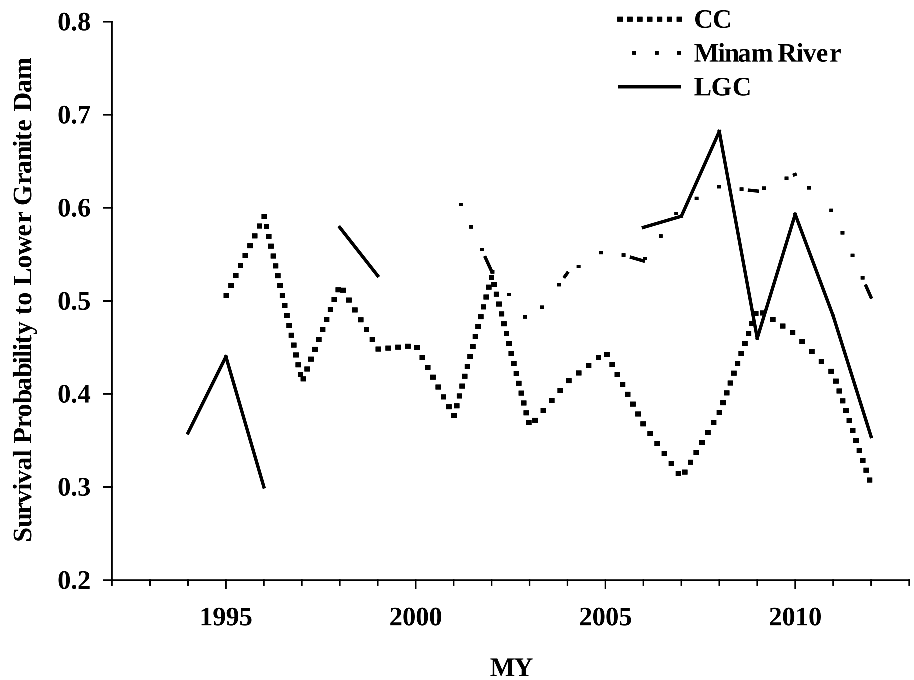

Figure 14. Survival probabilities of Grande Ronde River Subbasin NOR spring Chinook salmon spring outmigrants, MY 1994-2012.

Smolt equivalent (S_{eq}) estimates (outmigrants for each group surviving to LGD) for fall 2011, winter 2011 and spring 2012 were 1,204, 1,464, and 651, respectively, for a BY 2010 total of 3,319. BY 2010 S_{eq} was lower than the BY 2004-2010 mean, and the S_{eq}/spawner of 10 was the lowest (Table 8).

BY 2007 NOR SARs were above the BY 2004-2007 means. The BY 2004-2007 adult only mean of 3.6% is above the mid-range (2-6%) and approached the average (4%) recovery objectives for Snake River Chinook and steelhead (NPCC 2014). Long-term mean SAR for NOR CC spring Chinook salmon was approximately 0.5-1% (Carmichael et al. 2010).

Table 8. S_{eq} to LGD and SAR 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		
2009	3,671	50		
2010	3,319	10		
Mean	4,398*	52*	3.6**	3.2**

[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 2004-2010, **BY 2004-2007*

Median arrival dates at LGD were 27 April for the summer 2011 and spring 2012 groups, 18 April for the fall, and 25 April for the winter 2011 groups. Expanded detections at LGD ranged from 58 for the spring 2012 group to 113 for winter 2011. Median arrival dates were in late April or mid- May for most MY, with fall groups usually arriving earliest and spring groups latest (Figure 15). Travel times varied little within seasonal groups across MY (Figure 16). Summer parr groups for MY 1994-1996 and 1997 were tagged and released in late September. In subsequent years, summer parr were collected in late July or early August.

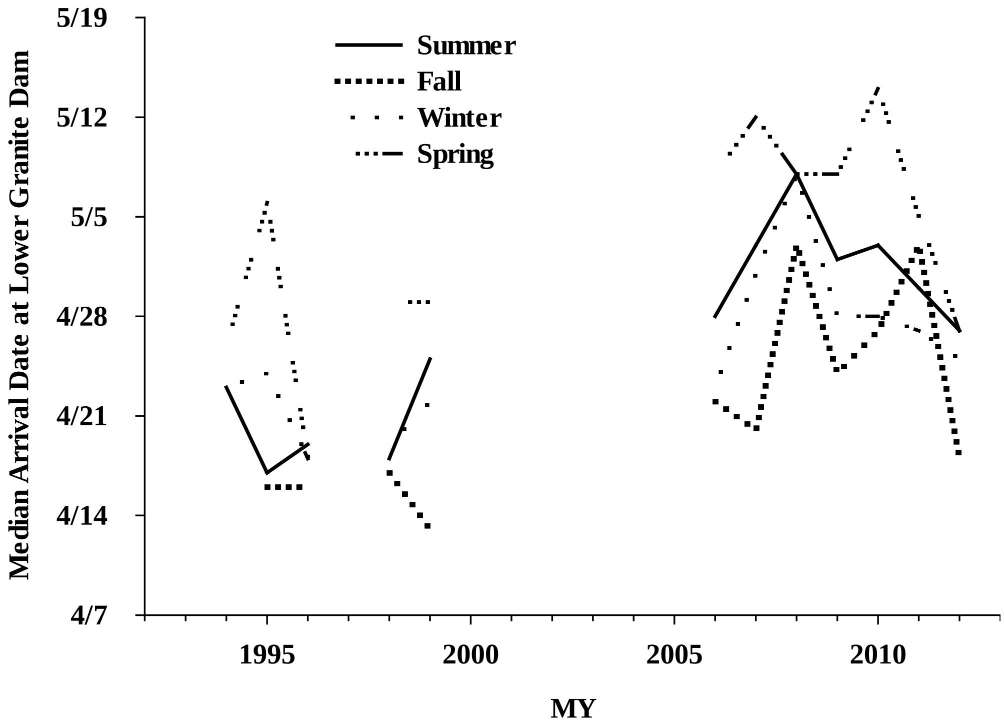

Figure 15. Median arrival dates at LGD for LGC NOR spring Chinook salmon summer parr and fall, winter, and spring outmigrants, MY 1994-2012.

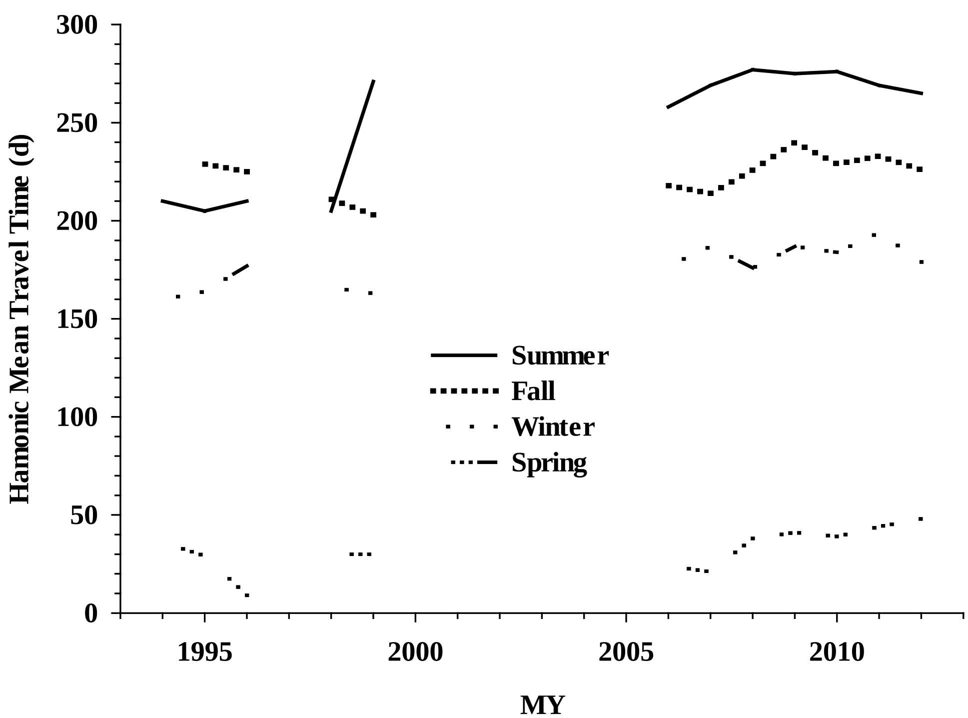

Figure 16. Harmonic mean travel time (d) to LGD for LGC NOR spring Chinook salmon summer parr and fall, winter, and spring outmigrants, MY 1994-2012.

1.4 Summary

Life history 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 observed 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. SARs have been at the lower end of the level needed for population recovery. R/S has been above replacement for 3 of 4 BY and SAR has improved from BY 2005-2007 . These are positive signs, but at this level of productivity, a long period of time will be needed to rebuild and sustain a 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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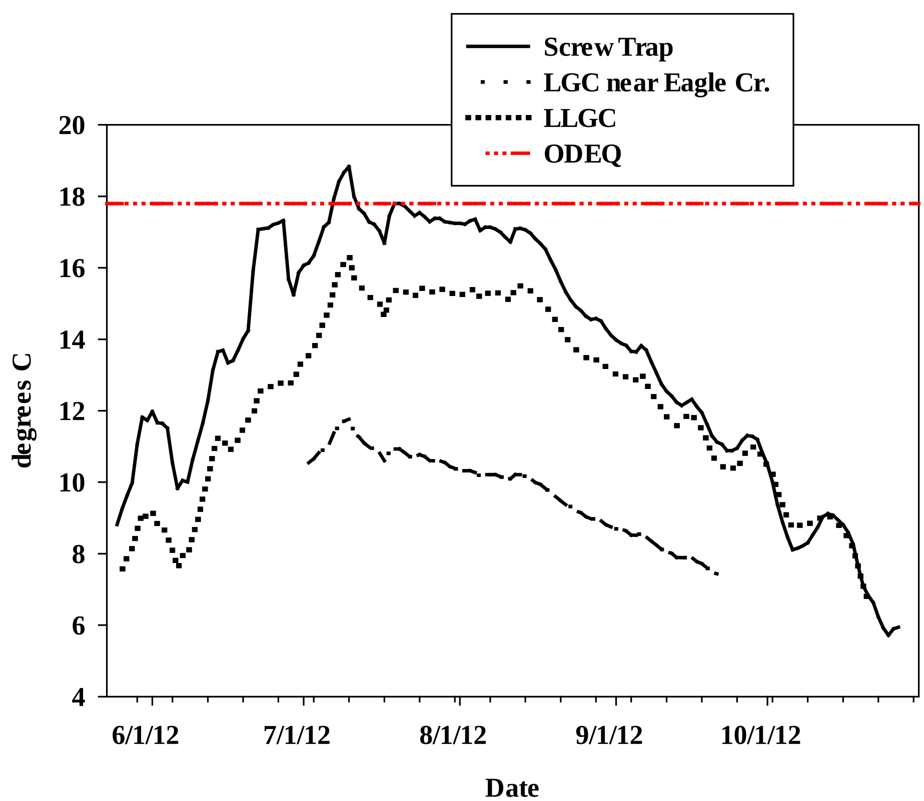
1.6 Appendix Figure B-1. Water temperatures at several locations in LGC and Little LGC during 2012 (7-d average maximum).



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 2012 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 2012. Tissues taken with the opercle punch on adult 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

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