Lower Snake River Compensation Plan
Confederated Tribes of the Umatilla Indian Reservation
Evaluation Studies for 1 January 2007 to 31 December 2007

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Evaluation of Reestablishing Natural Production of Spring Chinook Salmon in Lookingglass Creek, Oregon, Using an Endemic Stock (Catherine Creek)

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

1.1 Abstract

Peak flow of 474 CFS in Lookingglass Creek occurred 2 May 2007. Maximum daily water temperatures varied from 11.8.-22.9 ^{o}C at 4 different sites in Lookingglass Creek and Jarboe Creek.

Spring Chinook salmon adults caught at the Lookingglass Hatchery trap from 14 May-3 September 2007 totaled 217 (197 hatchery-, 20 natural-origin). Unmarked adults >660 mm FL were assumed to be Rapid River stock and euthanized (n=10) or released below the trap (n=2). The remaining 7 natural-origin returns were kept for outplanting above the weir to spawn naturally (n=6) or used for conventional broodstock (n=1). Returns with ad-clips and coded wire tags were assumed to be returns or progeny of Catherine Creek captive broodstock liberated into Lookingglass Creek and used for conventional broodstock (n=65). Females spawned at Lookingglass Hatchery (n=23) had a mean fecundity of 2,959. Hatchery-origin (Catherine Creek captive broodstock progeny or age 3 returns of natural-origin produced in Lookingglass Creek) were also outplanted upstream of the hatchery after 3 August 2007 (n=73). Spawning ground surveys from 23 August-19 September 2007 yielded 32 redds above the trap and 22 below. Carcass recoveries totaled 20 above the trap and 21 below. Estimated total returns to the stream were 271. Hatchery-origin totaled 247 (218 ad-clipped and 29 unclipped with coded wire tags) and natural-origin (unmarked) totaled 24. Smolt-to-adult ratios for brood year 2002 were 0.311% (hatchery-origin) and 2.033% (natural-origin).

Spring Chinook salmon brood year 2005 outmigrants were estimated at 15,732 (562/redd). Total numbers of outmigrants caught in the screw trap, PIT- tagged and released were 265 (fall 2006), 622 (winter 2006), and 29 (spring 2007). Mean FL of fall, winter and spring groups of PIT tagged fish ranged from 83.5-102.1 mm. Survival probabilities to Lower Granite Dam ranged from 0.2557-0.5911 and median arrival dates to Lower Granite Dam ranged from 20 April-12 May 2007. A field group of 785 natural-origin brood year 2005 parr collected above the hatchery trap were PIT-tagged and released from 1-3 August 2006. Mean FL was 73.6 mm, survival probability to Lower Granite Dam was 0.1944, and median arrival timing to Lower Granite Dam was 2 May 2007.

Management of spring Chinook salmon in Lookingglass Creek is in transition, as Rapid River stock is being phased out and Catherine Creek stock is phased in to restore a self-sustaining population. The first two hatchery-releases (September 2001 and May 2002) failed to produce any significant adult returns, probably due to the release timing. Releases of brood year 2003 and 2004 smolts in 2005 and 2006 have been more successful. Releasing adequate numbers of smolts in the spring and allowing adequate numbers of adults to spawn naturally above Lookingglass Hatchery on consistent basis are critical to restoring a self-sustaining population.

1.2 Introduction

Lookingglass Creek is within the "usual and accustomed" areas of gathering for the Confederated Tribes of the Umatilla Indians (CTUIR). The native Lookingglass Creek stock of spring Chinook salmon was extirpated within a few years after establishment of Lookingglass Hatchery (LH) in 1982. The Oregon Department of Fish and Wildlife (ODFW) attempted to retain the endemic stock, but when that failed, began reintroduction efforts using non-endemic stocks, including Imnaha River, Wind River (Washington), Carson Hatchery (Washington), and Rapid River (Idaho), eventually settling on Rapid River. CTUIR as comanagers in the early 1990s began participation in the reintroduction efforts. The Rapid River (Idaho) stock was replaced with Catherine Creek stock (native to the Grande Ronde River basin) beginning in 2001. Annual reports describing the historical efforts by CTUIR at reestablishing natural production of spring Chinook salmon in Lookingglass Creek are available at http://www.fws.gov/lsnakecomplan/CTUIR_Reports.html. Our goals are to reestablish a self-sustaining population of spring Chinook salmon and restore harvest opportunities for tribal members in Lookingglass Creek. These goals are consistent with the overall mission statement of the CTUIR Department of Natural Resources:

"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 utilizing 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.**"**

Similarly, the CTUIR DNR Fisheries Program mission statement reads:

"To provide sustainable harvest opportunities for aquatic species of the first food order by protecting, conserving and restoring native aquatic populations and their habitats.**"**

1.3 Study Area

The Lookingglass Creek watershed is in the Blue Mountains of northeast Oregon with the headwaters at an elevation of 4,870 feet above sea level. Flow is to the southeast for 15.5 river miles (rm) through the Umatilla National Forest (UNF) then through private land before entering the Grande Ronde River at rm 85, at an elevation of 2,355 feet above sea level. Lookingglass Creek has five major tributaries: Lost Creek (rm 10.75), Summer Creek (rm 10.25), Eagle Creek (rm 8.25), Little Lookingglass Creek (just below rm 4.25), and Jarboe Creek (just below rm 2.25). Lookingglass Creek and Little Lookingglass Creek (the largest tributary) are the only major areas where spring Chinook salmon spawning takes place with any regularity. LH is located at rm 2.3 on Lookingglass Creek.

1.4 Methods

1.4.1 Stream Flow and Temperature

We summarized Lookingglass Creek stream flow data collected in 2007 by the United States Geological Survey (USGS). Stream flows at USGS station 1332430 (Lookingglass Creek near Lookingglass, Oregon at rm 2.3) near L H (Figure 1). Real-time and historical flow and temperature data are available at: http://waterdata.usgs.gov/or/nwis/uv/?site_no=13324300&PARAmeter_cd=00065,00060 Stream temperature data were obtained from electronic recording devices operated by UNF and USGS. The numbers and locations of temperature recorders used in the past varied; four were used in 2007. UNF temperature recorders were located in Lookingglass Creek below the mouth of Eagle Creek, at the "springs" site near Lost Creek, and in Jarboe Creek near the UNF boundary. The USGS temperature recorder was located with the flow gauge near Lookingglass Hatchery.

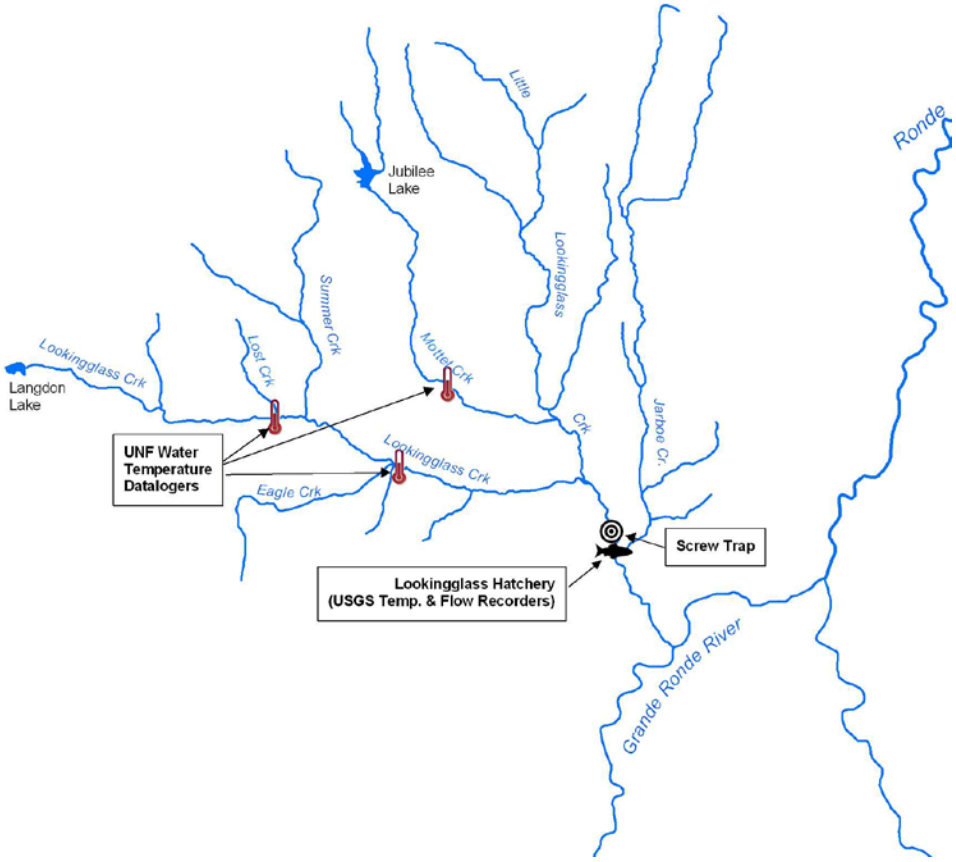


Figure 1. Map of the Lookingglass Creek basin showing the locations of major tributaries, temperature and flow recorders, screw trap and the Lookingglass Hatchery complex.

1.4.2 Adult Spring Chinook Salmon

Adult spring Chinook salmon returning to Lookingglass Creek were diverted into a hatchery trap using a picket weir at the LH water intake. ODFW LH staff installs the weir pickets and trap by 1 March and remove them in mid- to late September each year. ODFW LH staff checks the trap at least 3 times (Monday, Wednesday, Friday) a week, or more frequently if needed.

Adult spring Chinook salmon captured in the LH trap in 2007 were from Lookingglass Creek natural production, hatchery-reared Catherine Creek stock captive broodstock progeny, and hatchery-reared returns from other Grande Ronde Basin stocks. Juveniles released from LH during 2004-2006 totaled 298,531 (Table 1).

Table 1. Hatchery-produced spring Chinook salmon released into Lookingglass Creek, BY 2002-2004.

BY	Release Date	No. Released	Mean weight (g)	Marks*
2002	8 April 2004	52,545	21.35	Ad/CWT/PIT
2003	29 March 2005	62,122	19.85	Ad/CWT/PIT
2003	29 March 2005	31,445	22.15	Ad
2004	6 November 2005	19,038	11.76	Ad/CWT
2004	5 April 2006	121,637	14.29	Ad/CWT/PIT

* *Ad = adipose clip, CWT = coded wire tag, PIT=PIT (passive integrated transponder) tag*

All spring Chinook salmon captured in the trap were counted, examined and scanned for fin clips, opercle punches and other marks and tags, measured (mm FL), and sex and maturity status determined. Unclipped returns without CWT were euthanized. We assumed unclipped returns without CWT were either naturalized Rapid River stock or strays from other streams. Unmarked returns with CWT and/or VIE (visual elastomer implant) tags were upper Grande Ronde River, Catherine Creek, or Lostine River stocks, and these were placed in the appropriate holding ponds for later use as hatchery broodstock. Week of capture was designated by the first day of the week (e.g. week of 1 January included 1-7 January). Permanent impressions of scales from unmarked (natural-origin) returns were made using heat and pressure. Impressions were read with a microfiche reader and annuli counted using criteria from Mosher (1969).

Ad-clipped adults with coded wire tags present were placed in a holding pond at Lookingglass Hatchery for later release above the weir to spawn naturally or for use as hatchery broodstock. All ad-clipped adults released above the weir were measured (mm FL), sexed, and a small amount of tissue from the right opercle removed with a round paper punch. Opercle punches were used to distinguish any carcasses recovered above the weir that were not in the original release group. Tissues taken with the opercle punch were preserved for later genetics analysis. Managers have been determining the disposition of returns to the stream based on a sliding scale (Appendix A).
Data and tissues obtained from adults spawned at LH included FL (mm), sex, marks/tags, snouts from hatchery-origin, and scales from natural-origin. Egg weights (0.1 g) were

obtained from groups of 20 from each female spawned at the hatchery using an electronic balance. Fecundity was estimated using an electronic egg counter for the entire group of newly-fertilized eggs, then subtracting mortalities observed until hatching.

Spawning ground surveys (Parker et al. 1995) were conducted during August and September 2007 to assess natural spawning. Surveys were conducted in designated units about weekly after adults were outplanted above the LH weir (Figure 2). Only completed redds were counted (Lofy and McLean 1995) and flagged to eliminate double counting. Carcasses were enumerated and FL, sex, marks, and percent spawned recorded. Tails were cut off to prevent double sampling. Snouts were taken from any ad-clipped and some unclipped carcasses for CWT recovery.

Total returns to Lookingglass Creek were estimated from the total number of fish released above the weir, those euthanized or spawned as broodstock at LH, redds counted below the trap multiplied by 2.5 fish/redd (Park 1990), and adjusted by the fractions of clip, age, and various CWT observed in carcass recoveries or seen at the trap. Ages were assigned based on age-FL (cm) keys developed for hatchery-origin (634 ages 3-5 based on CWT data) and natural-origin (228 ages 3-5) returns to Lookingglass Creek from 2002-2008. Hatchery-origin returns <61 cm FL were assigned age 3, from 61-85 cm FL age 4, and >85 cm FL age 5. Natural-origin returns <60 cm FL were assigned age 3, 60-79 cm FL age 4, and >79 cm FL age 5. Smolt-to-adult ratio was estimated for a brood year by summing the returns at ages 3-4-5 and dividing by the number of outmigrants surviving to Lower Granite Dam.

Snouts and biological data were collected from carcasses and sent to the ODFW CWT laboratory in Clackamas, OR for recovery of tags and posting of data on the Regional Mark Processing Center database maintained by the Pacific States Marine Fisheries Commission (http://www.rmpc.org/).

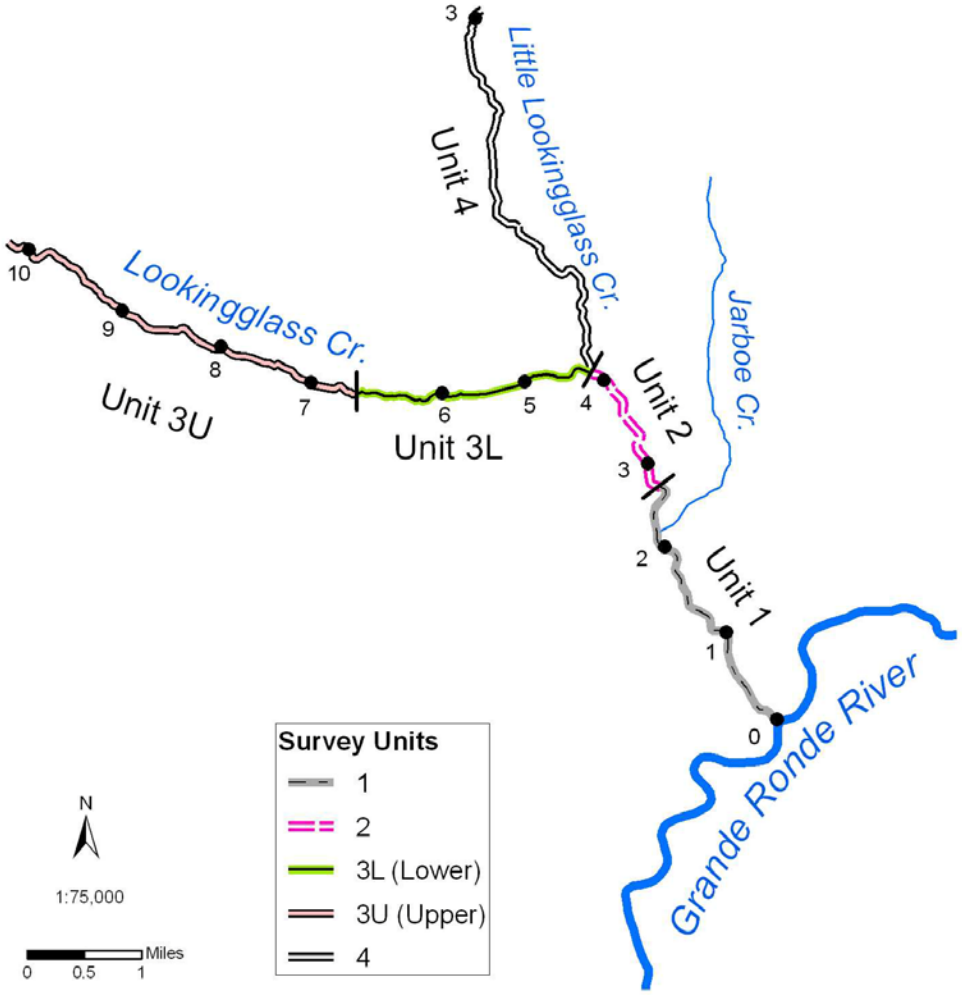


Figure 2. Spawning ground survey unit designations and river miles for Lookingglass Creek (modified from Burck 1993).

1.4.3 Juvenile Spring Chinook Salmon

We monitored seasonal growth of natural-origin BY 2005 juvenile spring Chinook by obtaining fork lengths (mm) of 50 fish collected by seining at several locations (rm 0.25, 2.5, 5.5, and 7.0) above and below the Lookingglass Hatchery trap reach below the weir in June, July, August, and September 2007 on the 20th of each month +/- 5 d.

BY 2005 parr (designated as the "field group") were collected by snorkeling/seining in primary spawning and nursery areas above LH in Lookingglass Creek (approximately rm 3-10) during August 2007. Parr were measured (mm FL), weighed (0.1 g), PIT-tagged according to standard procedures (PIT Tag Steering Committee 1999) and released where collected. Life history for the field group was compared to groups of parr collected during similar periods with similar methods and PIT-tagged by ODFW in the Minam and Lostine Rivers and Catherine Creek (Jonasson et al. 2006).

We operated a 1.52 m diameter rotary screw trap (Roper and Scarnecchia 1996) at rm 2.5 on Lookingglass Creek to collect outmigrating natural and hatchery-produced juvenile spring Chinook salmon. The trap is located about 125 m below the water intake. The screw trap was operated continuously during 2006-2007 except for brief periods during the spring freshet and when iced up in winter. The trap was usually checked three times per week or more frequently if catches or flows were high. All outmigrants were identified, counted, examined for external marks, scanned with a PIT tag reader, measured to the nearest mm FL, and weighed to the nearest 0.1 g. Outmigrants were PIT-tagged (PIT Tag Steering Committee 1999) or marked with a lower caudal fin clip and released about 100 m above the trap to estimate trap efficiency. Recaptures of field group parr PIT-tagged and released in August 2006 were treated as unmarked and released below the screw trap. They were not reused for trap efficiency.

We used DARR 2.0 (Bjorkstedt 2007) to estimate the numbers of outmigrating natural and hatchery-origin spring Chinook juveniles. DARR 2.0 uses stratified mark-recapture data and pools strata if capture probabilities are similar. We used the "one trap" and "no prior pooling of strata" options.

Juvenile spring Chinook collected at the screw trap could be distinguished into groups based on marks or size. During January-May of 2007, naturally-produced (unmarked) BY 2006 juveniles were distinguished from BY 2005 naturally-produced juveniles by their much smaller size and lower abundance. BY 2006 naturally-produced juveniles were not marked or used in estimates of trap efficiency; production and performance of BY 2006 natural-origin spring Chinook salmon will be described in the 2008 annual report. The "fall" group of natural-origin BY 2005 fish was caught, PIT-tagged and released from 24 August-30 September 2006, the "winter" group from 1 October-31 December 2006, and the "spring" group from 1 January-26 May 2007.

We estimated survival, capture probability, and travel time using the Pacific States Marine Fisheries Commission PIT tag database at http://www.ptagis.org/ and PitPro (Westhagen and Skalski 2007). To estimate arrival timing at Lower Granite Dam, daily

PIT tag detections were expanded for spill using flow data from the U. S. Army Corps of Engineers, Portland District website (http://www.nwd-wc.usace.army.mil/perl/dataquery.pl?k=id:LWG), and calculating a daily expansion factor [(Powerhouse Outflow+ Spill) /Powerhouse Outflow]. Median arrival timing at Lower Granite Dam for each group was the date that 50% of the expanded detections had occurred. We used the standard configuration, and excluded the *.rcp file. Observation sites, in downstream order, were Lower Granite Dam, Little Goose Dam, Lower Monumental Dam, McNary Dam, John Day Dam, Bonneville Dam, and the Estuary Towed Array (Juvenile). Lower Granite Dam was used as the last recapture site.

1.5 Results

1.5.1 Stream Flow and Temperature

Sustained flows of about 100 cubic feet per second (CFS) occurred from January-February 2007. The spring freshet began in late March with a peak flow of 474 CFS recorded on 2 May (Figure 3). April had the highest average monthly flow of 311.7 CFS. Flows began diminishing in mid-May, returning to base levels near 50 CFS in late July.

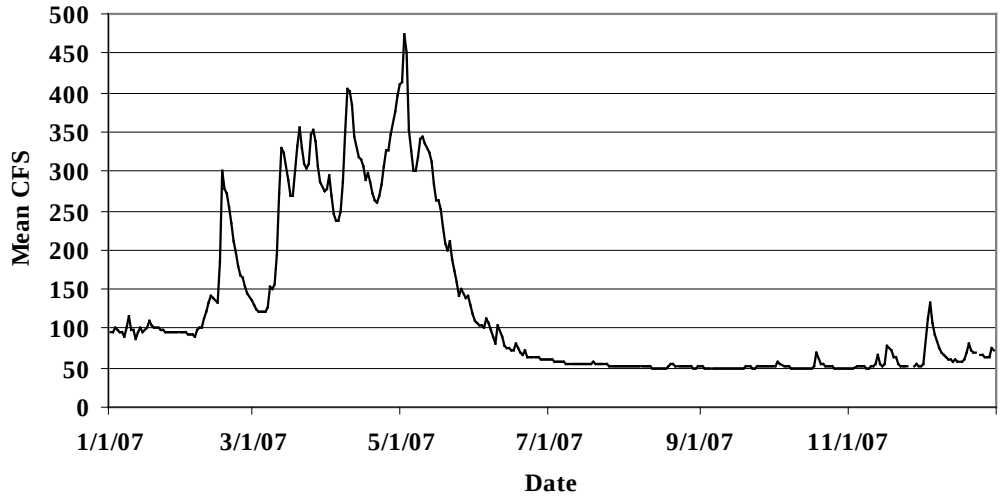


Figure 3. Mean daily streamflows for Lookingglass Creek at the USGS gauging station near Lookingglass Hatchery, 2007.

Water temperatures at the USGS site began rapidly increasing in May (Figure 4). The highest daily maximum of 19.1^{o}C was recorded on 6 July. Daily maxima from 18.0-18.9 ^{o}C were recorded on 13 dates in July (n=10) and June (n=3). Water temperatures at the Eagle Creek site peaked at 11.8^{o}C on 6-7 July (Figure 5). Daily maxima of 11.4 ^{o}C were recorded on 13 dates in July (n=12) and June (n=1). The highest daily maximum temperature at the "springs" site was 17.5^{o}C (Figure 6). Daily maxima from 16.0-17.1 ^{o}C were recorded on 25 dates in July (n=23) and August (n=2). The highest daily maximum temperature in Jarboe Creek of 22.9^{o}C was recorded on 6 and 14 July (Figure 7). Daily maxima from 20.2-22.9 ^{o}C were recorded on 24 days in July.

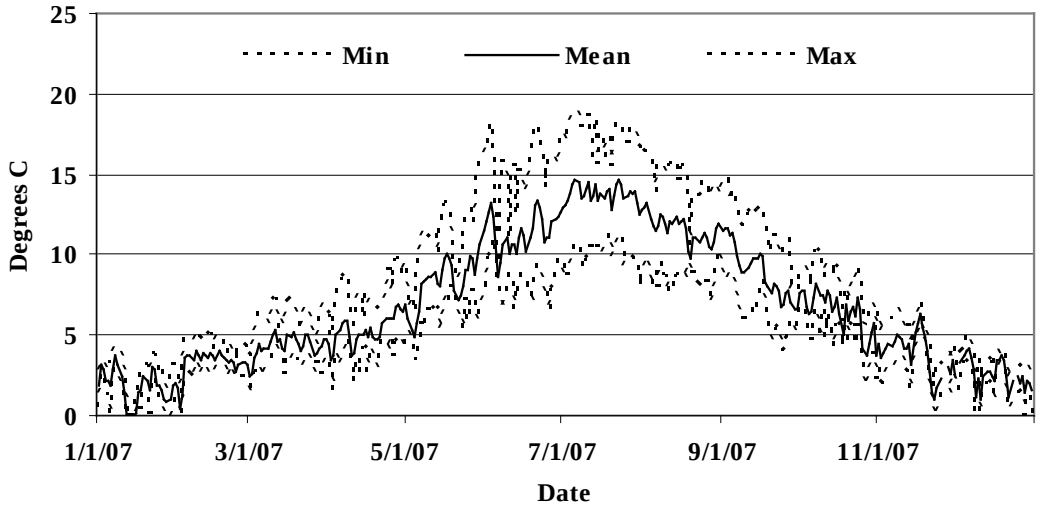


Figure 4. Water temperatures in Lookingglass Creek at the USGS gauging station near Lookingglass Hatchery, 2007.

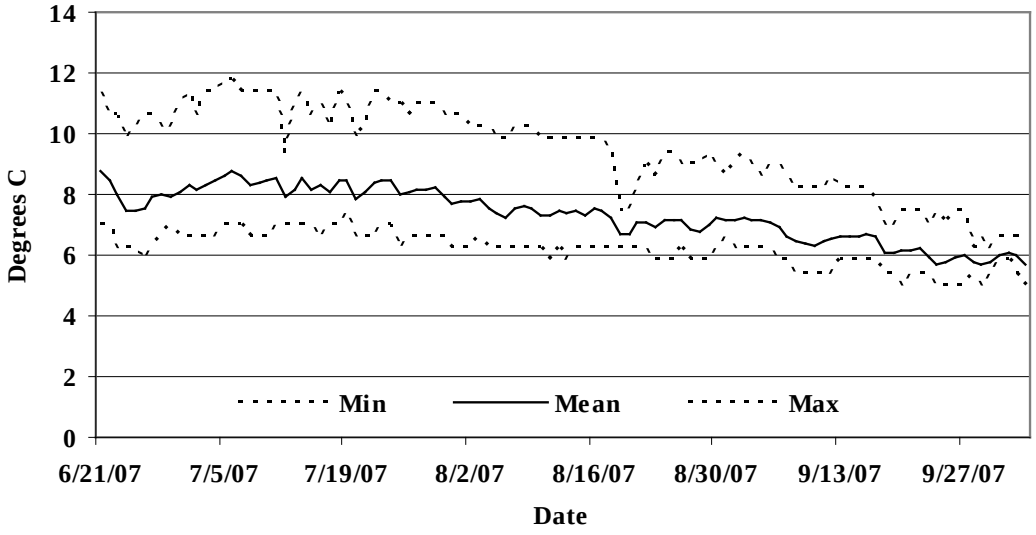


Figure 5. Water temperatures in Lookingglass Creek at the Umatilla National Forest site near the mouth of Eagle Creek, 2007.

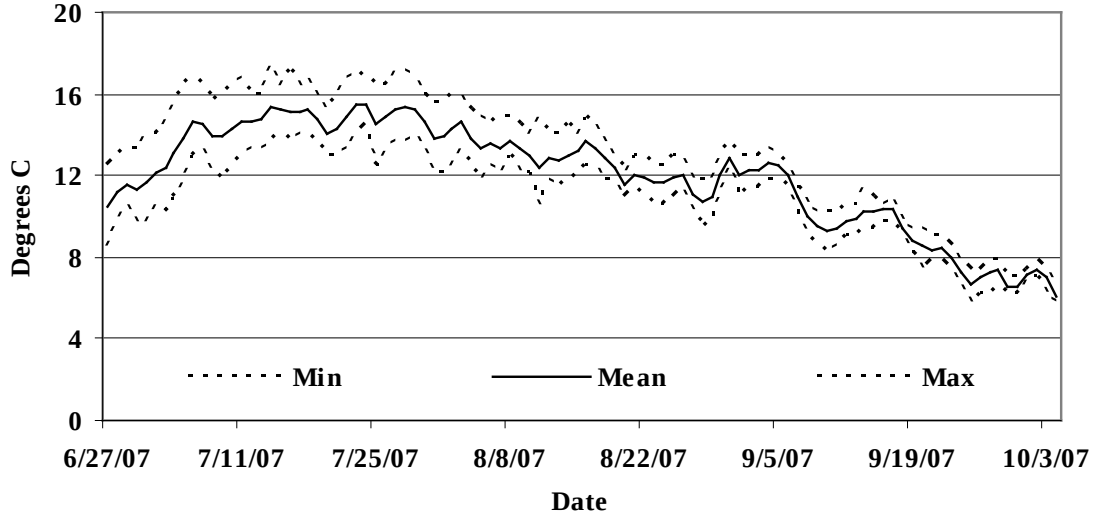


Figure 6. Water temperatures in Lookingglass Creek at the Umatilla National Forest "springs" site, 2007.

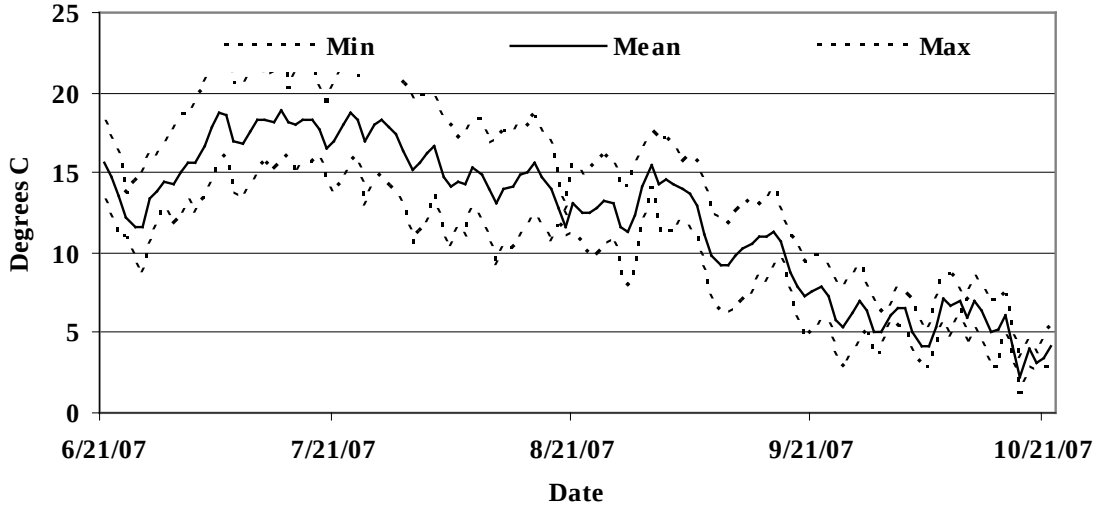


Figure 7. Water temperatures in Jarboe Creek, 2007.

1.5.2 Adult Spring Chinook Salmon

1.5.2.1 Lookingglass Hatchery Trap

The LH adult trap was operated continuously from 2 April-22 September 2007, except for brief periods (1-2 d) during the spring freshet (April, May).

A total of 217 returning adults (65 females and 152 males) were collected. The first and last of both sexes were collected on 14 May and 3 September, respectively. Most (87%) were caught during the weeks of 14 May-25 June (Figure 8) with few caught during July. Catches increased slightly as spawning activity began in August. Two strong modes in the length frequency distribution were evident (Figure 9).

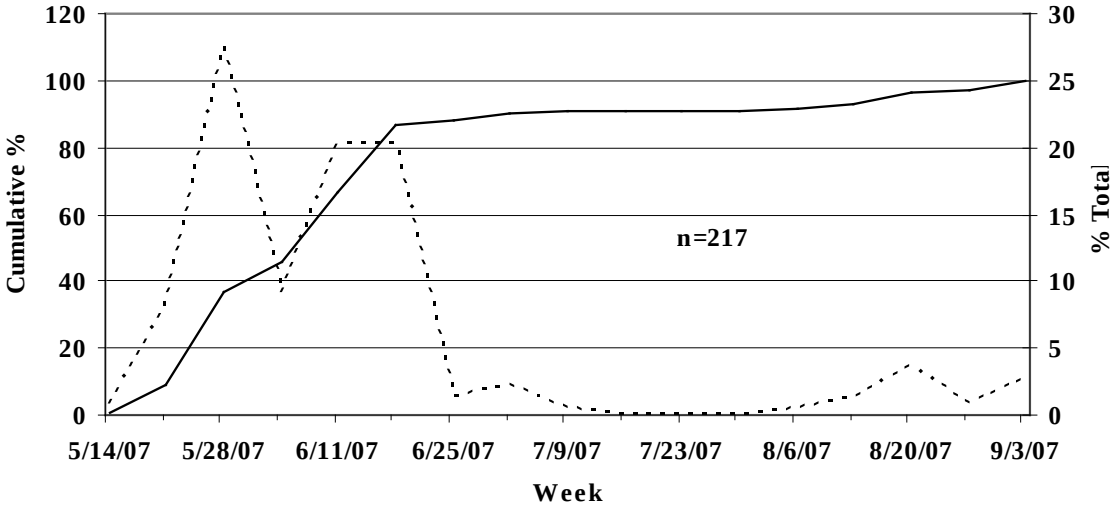


Figure 8. Percentage of total catch (dashed line) and cumulative % catch (solid line) by week of spring Chinook salmon caught in the Lookingglass Creek adult trap, 2007.

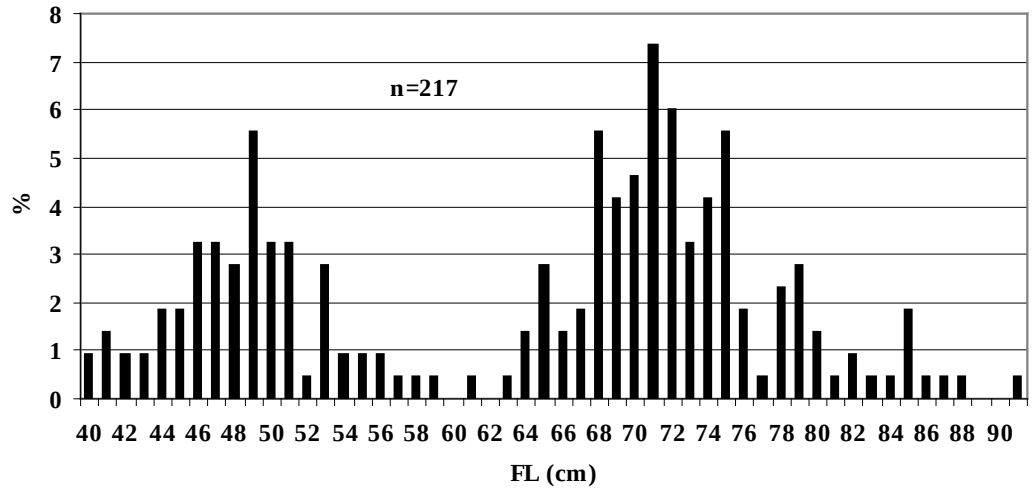


Figure 9. FL frequency of spring Chinook salmon caught in the Lookingglass Creek trap, 2007.

1.5.2.2 Unmarked

Severn unmarked (unclipped without CWT or VIE) returns from 42-53 cm (all assumed to be age 3 males) were caught from 28 May-3 September. These were assumed to be progeny of the first group of Catherine Creek stock that were released into Lookingglass Creek in September 2001, but some may have been progeny of Rapid River stock that spawned below the hatchery weir. Thirteen (5 females, 8 males) unmarked (unclipped without CWT or VIE) returns ≥ 66 cm were caught from 28 May-27 August, with 85% during the weeks of 28 May-18 June (Figure 10). All were assumed to be naturalized Rapid River stock (Figure 11).

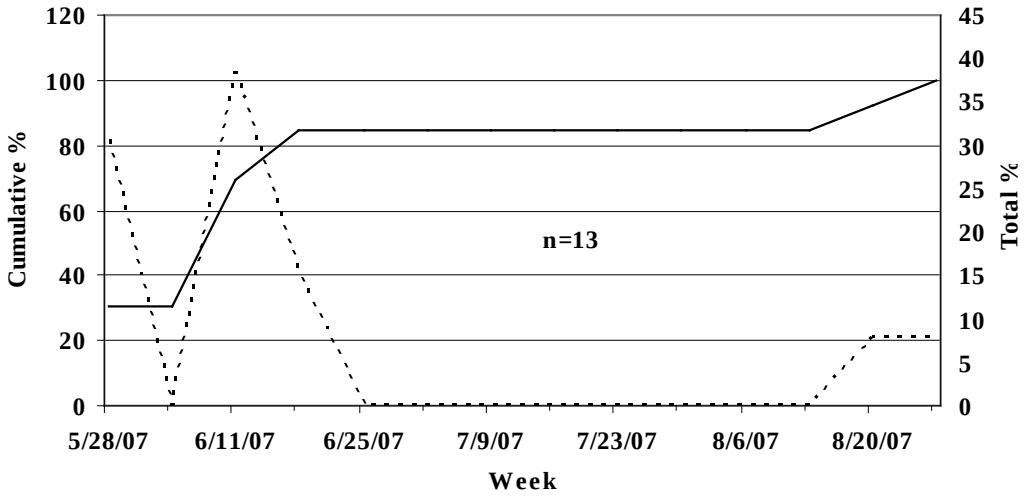


Figure 10. Percentage of total catch (dashed line) and cumulative % catch (solid line) by week for unclipped (naturalized Rapid River stock) spring Chinook salmon ≥ 66 cm FL caught in the Lookingglass Hatchery adult trap, 2007.

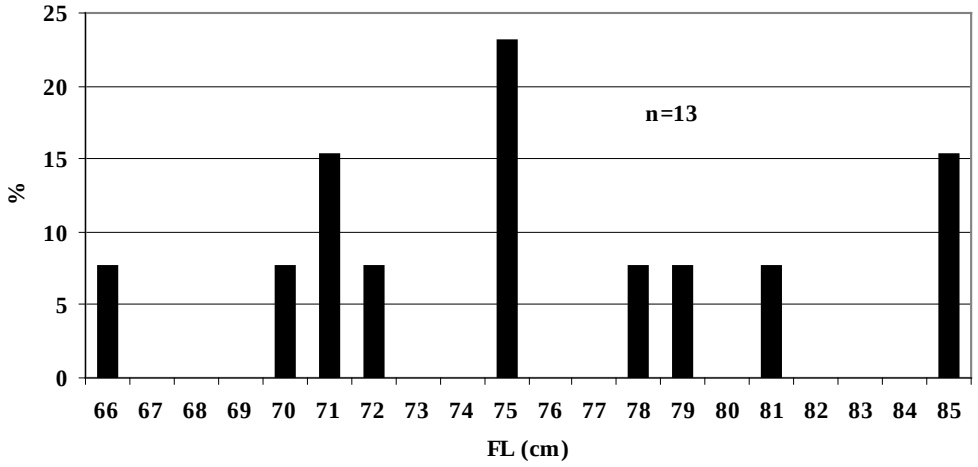


Figure 11. FL frequency for unclipped (naturalized Rapid River stock) spring Chinook salmon ≥ 66 cm FL caught in the Lookingglass Hatchery adult trap, 2007.

1.5.2.3 Marked

Marked (hatchery-origin) returns totaled 197 (60 females, 137 males). Most were ad-clipped but some were unclipped with CWT. The majority (89%) were caught during the weeks of 14 May-25 June (Figure 12). Few were caught during July but catches increased slightly as spawning activity began in August. Similar to the overall length distribution, two strong modes were evident (Figure 13). Hatchery-origin totals included 9 Catherine Creek conventional broodstock progeny from 49-78 cm, 1 Catherine Creek captive broodstock progeny (44 cm) and 23 upper Grande Ronde River stock conventional broodstock progeny from 40-88 cm. Thirty-two ad-clipped jacks from 415-595 mm FL were euthanized at the trap.

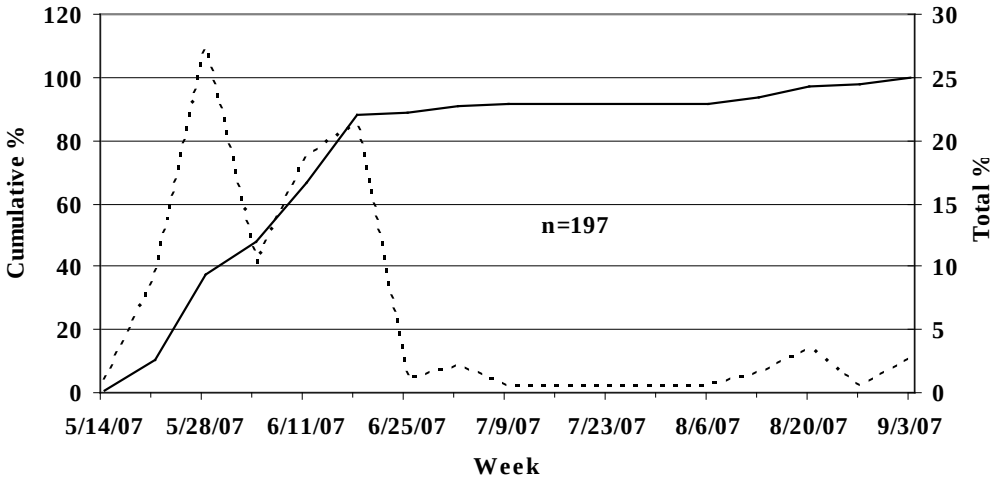


Figure 12. Percentage of total catch (dashed line) and cumulative % catch (solid line) by week for hatchery-origin spring Chinook salmon caught in the Lookingglass Hatchery adult trap, 2007.

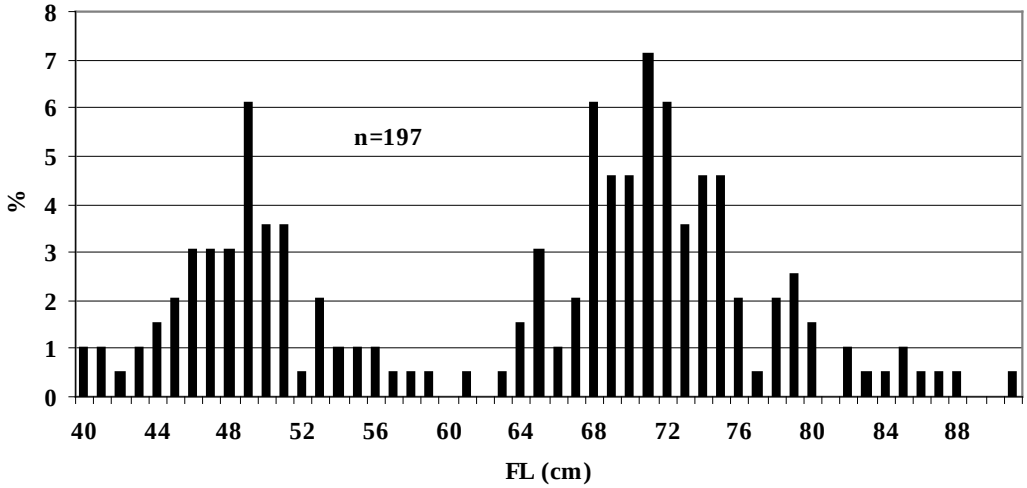


Figure 13. FL frequency for hatchery-origin spring Chinook salmon caught in the Lookingglass Hatchery adult trap, 2007.

1.5.2.4 Outplants

Returns collected before 23 June and destined for natural spawning above the LH trap (Catherine Creek captive broodstock progeny) were held in a pond at LH and outplanted at rm 7 on 3 August. Outplants totaled 34 females and 39 males, and ranged from 42-91 cm (Figure 14). Any Catherine Creek captive broodstock progeny caught after 23 June were either passed above the barrier weir at the ford (rm 3.0) or taken to the USFS 62 bridge and outplanted. Six of the seven unmarked (no ad-clip, VIE tag, or CWT) males from 42-53 cm caught in the Lookingglass Hatchery trap were outplanted above the hatchery weir and the seventh was used for Lookingglass Creek conventional broodstock.

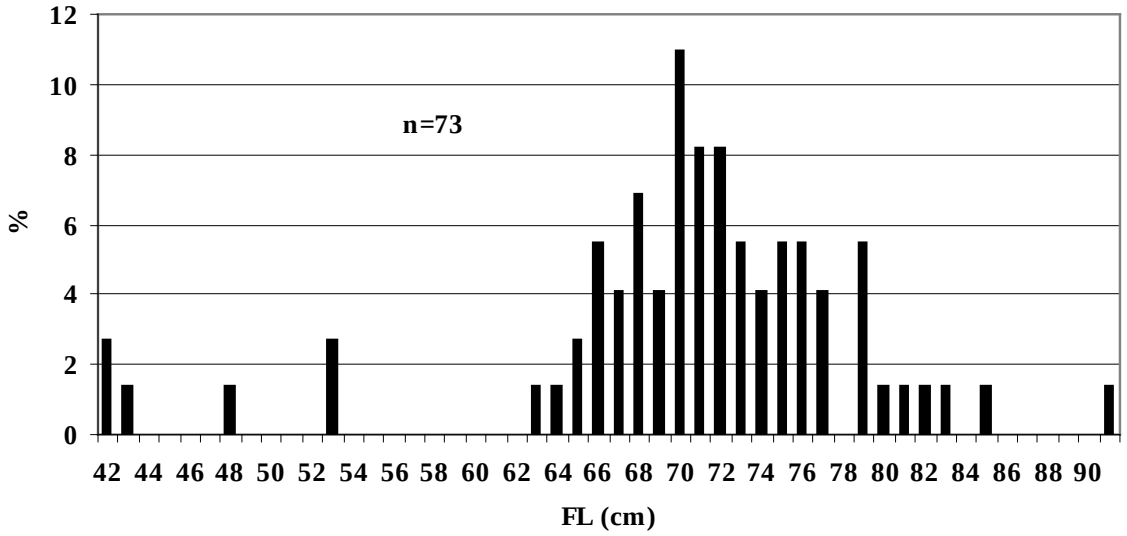


Figure 14. FL frequency for hatchery-origin spring Chinook salmon caught in the Lookingglass Hatchery adult trap and outplanted above the weir to spawn naturally in 2007

1.5.2.5 Conventional Broodstock Spawning

Returns to the Lookingglass Hatchery weir identified for conventional broodstock use and held at the hatchery totaled 65. FL was not recorded for 3 of the returns spawned (Figure 15).

Two females died while being held at Lookingglass Hatchery. Remaining females were spawned on 29 August (n=8), 6 September (n=14) and 11 September (n=1). Spawners included one collected at the upper Grande Ronde River trap but later identified as Lookingglass Creek origin. Mean FL of the 23 spawned females was 723.1 mm (range 643-873) and mean weight was 3.5 kg (range 2.5-5.6). Mean weights of 23 groups of eggs ranged from 0.18-0.28 g (median 0.21). Mean fecundity for 23 females was 2,959 (range 1,517-4,121).

Four ad-clipped males from 450-805 mm FL died while being held at Lookingglass Hatchery. Ad-clipped males spawned totaled 39 and mean FL was 591.6 mm (range 420-890). One natural-origin male spawned was 465 mm FL.

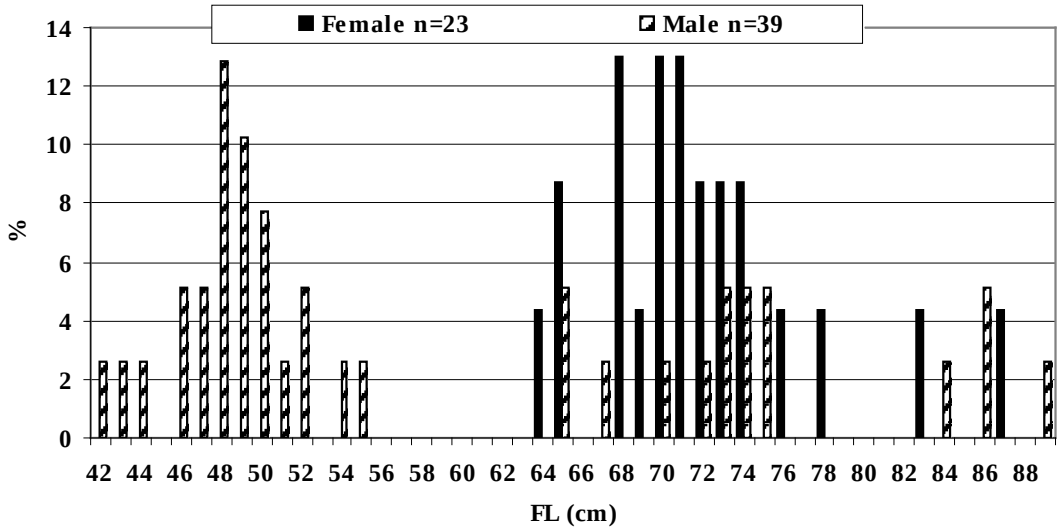


Figure 15. FL frequency distribution by sex of spring Chinook salmon used as Lookingglass Creek conventional broodstock at Lookingglass Hatchery, 2007.

1.5.2.6 Spawning Ground Surveys

Spawning ground surveys were conducted from 23 August-19 September 2007 (Table 2). The first redds were observed on 23 August and the last on 12 September. More redds were observed above the trap (n=32) than below (n=22). The peak number of new redds below the trap occurred on 29 August (n=10); the peak number above the trap (n=11) occurred on two dates, 30 August and 6 September. Additional surveys of Sections 3U and 3L on 19 and 27 September yielded additional carcasses. Weather and visibility conditions were generally excellent during the survey period.

Table 2. New redds observed on surveys of Lookingglass Creek by date and unit, 2007.

Unit	Dates	New redds
1	23, 29 August ; 1, 7, 12, 19 September	22
2	23, 30 August; 1, 6, 12, 19 September	2
3U	23, 30 August; 1, 6, 12, 19 September	23
3L	23, 30 August; 1, 6, 12, 19 September	7
4	24, 30 August; 7 September	0

1.5.2.7 Carcass Recoveries

Carcass recoveries totaled 20 above the trap (7 males, 13 females), including 6 on the barrier weir. All recoveries above the trap were ad-clipped and opercle-punched (Table

3). Since all recoveries were opercle-punched, it is unlikely that any unpunched returns made it past the hatchery or barrier weirs. One of the barrier weir recoveries was an unspawned female. The remaining 12 females were 95-100% spawned out. Female carcasses were recovered on 24 August (1), 30 August (2), 6 September (3), 12 September (3), 19 September (2), and 27 September (2).

Table 3. Carcass recovery summary for spring Chinook salmon, Lookingglass Creek, 2007.

	Unit				
	1	2	3L	3U	Totals
Females	15	7	2	4	28
Ad-clip/opercle punch		7	2	4	13
Ad-clip/no opercle punch	12				12
No ad-clip/opercle punch					
No ad-clip/no opercle punch	3				3
Males	6	2	2	3	13
Ad-clip/opercle punch	1	2	2	3	8
Ad-clip/no opercle punch	2				2
No ad-clip/opercle punch					
No ad-clip/no opercle punch	3				3

Carcass recoveries below the trap totaled 21 (15 females, 6 females). The total included 15 ad-clipped (including 1 male with an opercle punch) and 6 unclipped. Eleven ad-clipped female carcasses were 100% spawned out and one was 0%. Three unclipped females were 100% spawned out. Ad-clipped females were recovered from 29 August-19 September, with the largest numbers recovered on 7 September (n=5) and 19 September (n=3). FL frequency distributions for carcasses recovered above and below the trap were similar, with most in the 62-78 cm groups (Figure 16).

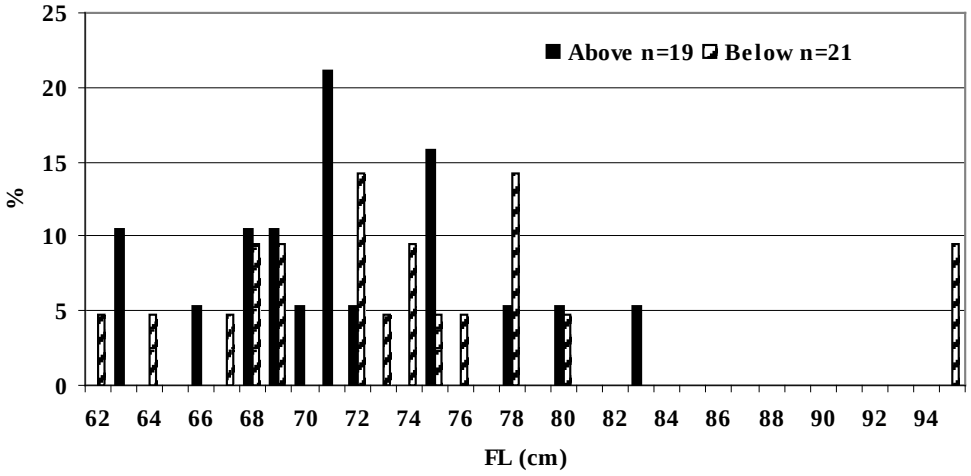


Figure 16. FL distribution for spring Chinook salmon carcasses recovered above and below the Lookingglass Hatchery trap on spawning ground surveys, 2007.

1.5.2.8 Total Returns to the Stream

Tables 4-6 were constructed from data collected at the LH trap, and based on visual identification in addition to presence/absence of VIE and CWT. Ages 3-5 were represented in all groups of returns, and in most cases, age 4 dominated. Most ad-clipped returns were either Lookingglass Creek or Catherine Creek captive broodstock released into Lookingglass Creek (Table 4). A substantial number of returns were strays from the upper Grande Ronde River (Table 5). Unmarked returns thought to be ages 4 and 5 were euthanized (Table 6). Smolt-to-adult ratios were 0.311% for the April 2004 Lookingglass Hatchery brood year 2002 release group and 2.033% for the brood year 2002 group of natural outmigrants from Lookingglass Creek.

Table 4. Catch at the Lookingglass Hatchery trap (LHT), disposition, and estimated total returns for ad-clipped spring Chinook salmon, 2007*.

Stock/Rear[a]	Age[b]	LHT	Euthanized	Spawn Ab-LHT[c]	Spawn LH[d]	Spawn Bel-LHT[e]	Total Returns
CC-Co	3	2			2		2
LKG/CC	3	58	33		25	15	73
Totals		60	33		27	15	75
CC-Co	4	7			7	2	9
LKG/CC	4	104		66	38	26	130
Totals		111		66	45	28	139
LKG/CC	5	3		1	2	1	4
Totals		3		1	2	1	4

* *Rounded to nearest whole number*

[a] *CC=Catherine Creek, Co=Conventional broodstock progeny, LKG/CC= Lookingglass Creek or Catherine Creek captive broodstock progeny released into Lookingglass Creek*

[b] *age 3 <61 cm FL, age 4 61-85 cm FL, age 5 >85 cm FL*

[c] *Spawn Ab-LHT=released above the Lookingglass Hatchery trap to spawn naturally*

[d] *Spawn LH=conventional broodstock spawned at Lookingglass Hatchery*

[e] *Spawn Bel-LHT=estimated spawners in the 2.4 mi reach below Lookingglass Hatchery, from reddsx2.5 fish/redd and catch by age, mark, and release group at the Lookingglass Hatchery trap*

Table 5. Catch at the Lookingglass Hatchery trap (LHT), disposition, and estimated total returns for hatchery-origin upper Grande Ronde River stock conventional broodstock progeny (CWT, adipose fin intact) spring Chinook salmon, 2007*.

Age[a]	LHT	Spawn LH[b]	Spawn Bel-LHT[c]	Total Returns
3	12	12	3	15
	12	12	3	15
4	10	10	3	13
	10	10	3	13
5	1	1	<1	1
	1	1	<1	1

* *Rounded to nearest whole number*

[a] *age 3 <61 cm FL, age 4 61-85 cm FL, age 5 >85 cm FL*

[b] *Spawn LH=conventional broodstock spawned at Lookingglass Hatchery*

[c] *Spawn Bel-LHT=estimated spawners in the 2.4 mi reach below Lookingglass Hatchery, from reddsx2.5 fish/redd and catch by age, mark, and release group at the Lookingglass Hatchery trap*

Table 6. Catch at the Lookingglass Hatchery trap (LHT), disposition, and estimated total returns for unmarked spring Chinook salmon, 2007*.

Age[a]	LHT	Euthanized	Spawn Ab-LHT[b]	Spawn LH[c]	Spawn Bel-LHT[d]	Total Returns
3	7		6	1	2	9
Age 3 Totals	7		6	1	2	9
4	10	9			3	12
Age 4 Totals	10	9			3	12
5	3	2			[e]	3
Age 5 Totals	3	2			[e]	3

* *Rounded to nearest whole number*

[a] *age 3 <60 cm FL, age 4 60-79 cm FL, age 5 >79 cm FL*

[b] *Spawn Ab-LHT=released above the Lookingglass Hatchery trap to spawn naturally*

[c] *Spawn LH=conventional broodstock spawned at Lookingglass Hatchery*

[d] *Spawn Bel-LHT=estimated spawners in the 2.4 mi reach below Lookingglass Hatchery, from reddsx2.5 fish/redd and catch by age, mark, and release group at the Lookingglass Hatchery trap*

[e] *estimated age 5 spawners below the trap was less than , however 1 age 5 unmarked return captured at the trap was released below*

1.5.2.9 CWT Recoveries

CWT recoveries (raw recoveries without any expansion) came from carcasses recovered on the spawning grounds, above and below the LH trap, returns euthanized at the LH trap, and returns spawned at LH (Table 7). Most were recovered from fish spawned at LH. Ages 3 and 4 were dominant. CWT codes for tag status "1" (tag present and read) were dominated by returns released as smolts from Lookingglass Creek. Age 3 returns were primarily from returns to Lookingglass Creek in 2004 that were spawned at LH. Ages 4 and 5 returns were primarily from captive broodstock returns to the Catherine Creek trap and spawned at Lookingglass Hatchery.

Snouts that were tag status "2" (tag not present) totaled 31, including 3 age 3 (based on FL), 27 age 4, and 1 without any FL. A substantial portion of the age 4 snouts were tag status "2" and were probably from a group of 31,445 ad-clip only smolts released from Lookingglass Hatchery in the spring of 2005.

Tag status "1" and "2) codes expanded for total returns showed similar patterns to the raw CWT data (Tables 8, 9). Age 3 recoveries were dominated by codes 94216 and 94217 (progeny of returns to Lookingglass Creek and released from LH). Age4 recoveries were dominated by code 93824 (Catherine Creek captive broodstock progeny released from LH). Tag code totals in Table 9 for ages 4 and 5 does not add to the same totals as in Tables 4 because a)CWT data were not available for two snouts of fish spawned at Lookingglass Hatchery, b)the predicted number of age 5 ad-clipped spawners below the hatchery weir was 1 but two age 5 CWT were recovered, and c)a few returns were assigned ages that later CWT recoveries showed to be different. .

Table 7. Spring Chinook salmon carcass recoveries (raw tag recoveries) by brood year, stock, coded wire tag code, release location, and recovery location, Lookingglass Creek, Lookingglass Hatchery, and Lookingglass Hatchery trap, 2007.

				Recovery Location			
BY	Stock	Tag Code	Release Location	Above LH Trap	At LH Trap	LH	Below LH Trap
2004	CC	93427	CCAF		1	1	
	UGR	94213	UGRAF			12	
	CC	94215	CCAF			1	
	LKG	94216	LOOH		15	9	
	LKG	94217	LOOH		16	11	
	CC	94218	CCAF		1	2	
2003	CC	70753	CCAF			4	
	CC	70754	CCAF	1		5	1
	CC(LKG)	93824	LOOH	9		17	3
	UGR	94035	UGRAF			4	
	UGR	94036	UGRAF			6	
	LOS	94038	LRAF				1
	CC	94039	CCAF			1	1
2002	LOS	93831	LRAF				1
	GR	93833	UGRAF			1	1
	CC	93835	CCAF			1	
	CC	93836	CCAF			1	
	CC(LKG)	93837	LOOH			1	
	CC(LKG)	93838	LOOH			3	
			Totals	10	33	81	8

CC=Catherine Creek, UGR=upper Grande Ronde River, LR=Lostine River, CC/LKG= Catherine Creek captive broodstock progeny released into Lookingglass Creek, LOOH=Lookingglass Hatchery, LRAF=Lostine R. acclimation facility, UGRAF=upper Grande Ronde R. acclimation facility, CCAF=Catherine Creek acclimation facility.

Table 8. Estimated CWT returns (tag status codes "1" and "2", expanded) for age 3 spring Chinook salmon, Lookingglass Creek, 2007.

BY	Stock[a]	Brood Type[b]	Tag Code	Euthanized	Spawn LH[c]	Spawn Bel-LHT[d]	Totals
2004	CC	Capt	93427	1	1	1	3
	GR	Conv	94213		12	3	15
	CC	Capt	94215		1	<1	1
	LKG		94216	15	9	6	30
	LKG		94217	16	11	7	34
	CC	Conv	94218		3	<1	3
Tag status "2"				1	2	1	4
BY 2004 Totals				33	39	18	90

* *Rounded to nearest whole number*

[a] *LKG=naturalized Catherine Creek captive broodstock returns to Lookingglass Creek, CC=Catherine Creek, GR=upper Grande Ronde*

[b] *Capt=Captive broodstock progeny, Conv=Conventional broodstock progeny*

[c] *Spawn LH=conventional broodstock spawned at Lookingglass Hatchery*

[d] *Spawn Bel-LHT=estimated spawners in the 2.4 mi reach below Lookingglass Hatchery, from reddsx2.5 fish/redd and catch by age, mark, and release group at the Lookingglass Hatchery trap*

Table 9. Estimated CWT returns (tag status "1" and "2", expanded) for ages 4 and 5 spring Chinook salmon Lookingglass Creek, 2007.

BY	Stock[a]	Brood Type[b]	Tag Code	Spawn Ab-LHT[c]	Spawn LH[d]	Spawn Bel-LHT[e]	Totals
2003	CC	Conv	70753		4	<1	4
	CC	Conv	70754	3	5	1	9
	CC(LKG)	Capt	93824	30	17	13	60
	GR	Conv	94035		4	1	5
	GR	Conv	94036		6	2	8
	LOS	Conv	94038			1	1
	CC	Capt	94039		1	1	2
Tag status "2"				33	12	12	57
BY 2003 Totals				66	49	31	146
2002	LOS	Conv	93831			1	1
	GR	Conv	93833		1	<1	1
	CC	Capt	93835		1	<1	1
	CC	Capt	93836		1	<1	1
	CC(LKG)	Capt	93837		1	<1	1
	CC(LKG)	Capt	93838		3	1	4
Tag status "2"				1			
BY 2002 Totals				1	7	2	9

* *Rounded to nearest whole number*

[a] *LOS=Lostine R., CC=Catherine Creek, CC(LKG)= Catherine Creek captive broodstock progeny released into Lookingglass Creek, GR=upper Grande Ronde*

[b] *Capt=Captive broodstock progeny, Conv=Conventional broodstock progeny*

[c] *Spawn Ab-LHT=released above the Lookingglass Hatchery trap to spawn naturally*

[d] *Spawn LH=conventional broodstock spawned at Lookingglass Hatchery;*

[e] *Spawn Bel-LHT=estimated spawners in the 2.4 mi reach below Lookingglass Hatchery, from reddsx2.5 fish/redd and catch by age, mark, and release group at the Lookingglass Hatchery trap*

1.5.2.10 Length and Age at Recovery

No scales were collected from unclipped returns in 2007. Ages for natural-origin returns were assumed based on the FL distribution suggestive of different age groups. Growth data (Table 10) for hatchery-origin returns was dominated by age 3 males (55% of the sample). Age 3 males were represented by 5 CWT groups, but 53 of the 57 were from two codes (94216 and 94217). Age 4 males were represented by three CWT groups, with 10 of the 13 tags from tag code 93824. Age 4 returns made up 89% of the female sample. Age 4 females were represented by 5 CWT groups, with 21 of 25 from code 93824

Table 10. Fork length and age at recovery summary by origin and sex for spring Chinook salmon caught at the Lookingglass Hatchery trap or recovered on spawning ground surveys, 2007.

Origin	Sex	Age	$\bar{X}$ FL	Range	SE	n
Natural*	M	3		415-530		7
Natural	M	4		700-790		6
Natural	M	5		850		2
Natural	F	4		660-810		5
Hatchery**	M	3	492.5	415-575	4.7	57
Hatchery	M	4	745.2	630-835	16.4	13
Hatchery	M	5	881.8	845-950	18.5	5
Hatchery	F	4	706.3	630-780	7.1	25
Hatchery	F	5	832.3	785-873	25.6	3

* *Natural=unmarked*

** *Hatchery=ad-clipped*

1.5.3 Juvenile Spring Chinook Salmon

1.5.3.1 Brood Year 2005 Natural Production

The rotary screw trap was operated continuously during the outmigration period for juvenile spring Chinook salmon (essentially June 2006-May 2007), with some exceptions. The trap was not operated on the following dates: 7-15 July 2006, 25 July 2006, 8-19 August 2006, (low flows and high temperatures); 7 November 2006 (debris); 29 December 2006, 31 December 2006 (high flows, debris), 13 January 2007 (debris); 15 February 2007 (cone frozen), 17-21 February 2007 (high flows); 27 February-6 March 2007 (administrative); 9 April 2007 (high debris); 29 April-3 May 2007 (high flows, debris); 5-8 May 2007 (high flows, debris), and 16-22 May 2007 (high flows, debris).

A few BY 2005 outmigrants (approx. 40-60 mm FL) were caught beginning on 6 June 2006, but were not PIT tagged or used for trap efficiency estimates. Substantial numbers

were caught beginning on 11 September 2006 following a rainfall event and accompanying higher flows. Catches remained high through the end of November 2006, with a slight lull during the last two weeks of October. Catches in the spring of 2007 were generally much lower than the fall of 2006.

The total number of first-time captures was 1,528. These included 70 that were measured only, 298 counted only, and 10 mortalities. Recaptures of the field group tagged and released in 2006 totaled 47. Newly-PIT tagged and released for trap efficiency totaled 915. One newly-PIT-tagged was inadvertently released below the trap. The total of fin-clipped and released for trap efficiency (mostly in September and early October) totaled 165. The largest single daily catch (first-time captures and field recaptures) was 335 (2.2% of the estimated total outmigrants) on 27 October 2006. There were 22 naturally-produced precocials caught in August and September that were not included in the outmigrant catch. One precocial was a recapture was from the 2005 field group tagged and released in August 2005. A bull trout captured on 22 August 2007 had a PIT tag in it that was used to tag an 89 mm FL spring Chinook salmon on 23 April 2007. There were also 19 hatchery-origin (ad-clipped) precocials caught during July-September.

Trap efficiency recaptures totaled 125, including 110 PIT-tagged and 15 fin-clipped. The majority (94.3%) of PIT-tagged fish released for trap efficiency were recaptured in 5 d or less. The longest elapsed time between release and recapture for a PIT-tagged fish was 39 days (1 fish). Five other fish ranged from 7-14 d between release and recapture.

Data were initially grouped into 8 periods to use in DARR 2.0; 19 June 2006 (June L)-15 August 2006 (August E), 16-31 August 2006 (August L), 1-30 September 2006 (September), 1-15 October 2006 (October E), 16-31 October 2006 (October L), 1-15 November 2006 (November E), 16 November-31 December 2006 (November L-December), and 1 January-28 May 2007 (January E-May L). DARR 2.0 reduced these to 5 periods for the overall estimate (Table 11). BY 2005 outmigrants per redd were 562 (15,732/28).

Table 11. Naturally-produced BY 2005 juvenile spring Chinook salmon caught in the Lookingglass Creek rotary screw trap, releases and recaptures from trap efficiency tests, estimated number of outmigrants and SE, MY 2007.

Period	u	m	r	C_p	N	SE
June L-August L	109	72	4	0.056	1,962	952
September	258	244	13	0.064	4,043	1,146
October E	438	369	42	0.106	4,137	635
October L	494	205	53	0.398	1,241	528
November E-May L	206	190	13	0.047	4,349	1,413
MY 2007 Total and SE	1,505	1,080	125		15,732	1,996

u=newly caught, unmarked fish (includes fish not marked and released above the trap)
m=newly marked and released above the trap (includes a few fish inadvertently released below the trap)
r=recaptures summed across all time periods
Cp=capture probability (trap efficiency)
N=outmigration estimate
SE=standard error(variance$^{0.5}$)

A total of 916 outmigrants were PIT-tagged, comprised of fall 2006, winter 2006 and spring 2007 groups. The fall 2006 group was tagged from 9 August-29 September 2006 (median 22 September 2006), winter 2006 group from 2 October-8 December 2006 (median 20 October 2006), spring 2007 group from 28 March-25 May 2007 (median 23 April 2007).

Mean FL and weight progressively increased for the fall 2006, winter, 2006, and spring 2007 groups (Table 12). Mean K values varied by only 0.03 between the three groups with the highest mean K occurring for the fall 2006 group.

Survival probability to Lower Granite Dam was about 0.06 greater for the winter 2006 group compared to the fall 2006 group, with the spring 2007 group more than twice that of the fall 2006 group (Table 13). Capture probability was 0.1 higher for the winter 2006 group compared to the fall 2006 group. Travel times ranged from 21.190-214.089 d by group. Arrival timing at Lower Granite Dam was progressively later for each of the three tag groups.

Table 12. FL, weight and K factor summary by group for natural-origin BY 2005 spring Chinook salmon caught in the Lookingglass Creek screw trap, PIT-tagged and released.

	Group		
Statistic	Fall 2006	Winter 2006	Spring 2007
Mean FL (mm)	83.5	88.4	102.1
SE	0.6	0.3	2.7
Min-Max	64-128	67-105	71-150
n	265	622	29
Mean Weight (g)	7.0	7.9	12.9
SE	0.1	0.1	1.3
Min-Max	2.9-19.7	3.2-13.3	4.2-42.5
n	265	615	29
Mean K	1.16	1.13	1.14
SE	0.01	<0.01	0.01
Min-Max	0.66-1.69	0.75-1.75	0.96-1.26
n	265	615	29

Table 13. Survival and capture probabilities, travel time, and arrival timing summary by group for natural-origin BY 2005 spring Chinook salmon caught in the Lookingglass Creek screw trap, PIT-tagged and released.

	Group		
Statistic	Fall 2006	Winter 2006	Spring 2007
Survival Probability	0.2557	0.3175	0.5911
SE	0.0594	0.0428	0.1080
n	265	622	29
Capture Probability	0.4706	0.5758	0.4667
SE	0.1211	0.0860	0.1288
n	265	622	29
Travel Time (d)	214.089	187.399	21.190
SE	3.759	2.139	3.033
n	21	53	8
Median Arrival Date	20 April 2007	1 May 2007	12 May 2007
10%	10 April 2007	12 April 2007	18 April 2007
90%	8 May 2007	15 May 2007	26 May 2007
n	21	53	8
n (expanded)	36	88	15

1.5.3.2 Hatchery Releases

No hatchery-reared juveniles were released into Lookingglass Creek in 2007.

1.5.3.3 Field Groups

A total of 785 BY 2005 spring Chinook salmon parr were collected from several locations above the Lookingglass Hatchery trap from 1-3 August 2006, PIT-tagged and released. Release dates for Catherine Creek, the Minam River, and the Lostine River were 24-27 July 2006, 29-31 August 2006 and 7-10 August 2006, respectively. Means for FL, weight, and K for the Lookingglass Creek fish were the highest of the four streams (Table 14). Median arrival dates at Lower Granite Dam were the same for Lookingglass Creek and the Minam River and between those for Catherine Creek and the Lostine River (Table 15). Harmonic mean travel time was greatest for Catherine Creek. Survival probability to Lower Granite Dam for Catherine Creek was less than 25% of the level for the other three streams. Capture probabilities were variable between the four streams but highest for Lookingglass Creek.

Table 14. FL, weight, and K factor summary for field group natural-origin BY 2005 spring Chinook salmon from Grande Ronde Basin streams, MY 2007.

	Stream			
Statistic	Lookingglass Cr.	Catherine Cr.	Minam R.	Lostine R.
Mean FL (mm)	73.6	65.4	71.9	68.9
SE	0.2	0.3	0.3	0.4
Min-Max	54-93	53-83	54-99	53-102
n	785	491	1,000	500
Mean Weight (g)	5.0	3.4	4.2	3.8
SE	<0.1	<0.1	0.1	0.1
Min-Max	2.4-9.4	1.8-7.4	1.5-11.1	1.3-16.0
n	785	489	860	499
Mean K	1.22	1.20	1.10	1.09
SE	<0.01	<0.01	<0.01	0.01
Min-Max	0.90-1.84	0.88-2.08	0.73-1.65	0.68-2.02
n	785	489	860	499

Table 15. Survival and capture probabilities, travel time, and arrival timing summary for field group BY 2005 spring Chinook salmon from Grande Ronde Basin streams, MY 2007.

	Stream			
Statistic	Lookingglass Cr.	Catherine Cr.	Minam R.	Lostine R.
Survival Probability	0.1944	0.0449	0.1836	0.1849
SE	0.0205	0.0094	0.0164	0.0328
n	785	491	1,000	500
Capture Probability	0.4138	0.2273	0.3540	0.2920
SE	0.0509	0.0893	0.0411	0.0646
n	63	5	65	27
Travel Time (d)	269.418	280.963	242.232	267.578
SE	1.648	6.476	1.560	2.296
n	63	5	65	27
Median Arrival Date	2 May 2007	25 April 2007	2 May 2007	9 May 2007
10%	9 April 2007	19 April 2007	11 April 2007	14 April 2007
90%	13 May 2007	19 May 2007	14 May 2007	17 May 2007
n	63	5	65	27
n (expanded)	98	10	99	45

Most of the BY 2005 juveniles PIT-tagged and released in August 2006 and later recaptured in the screw trap occurred during September-November 2006 (Figure 17).

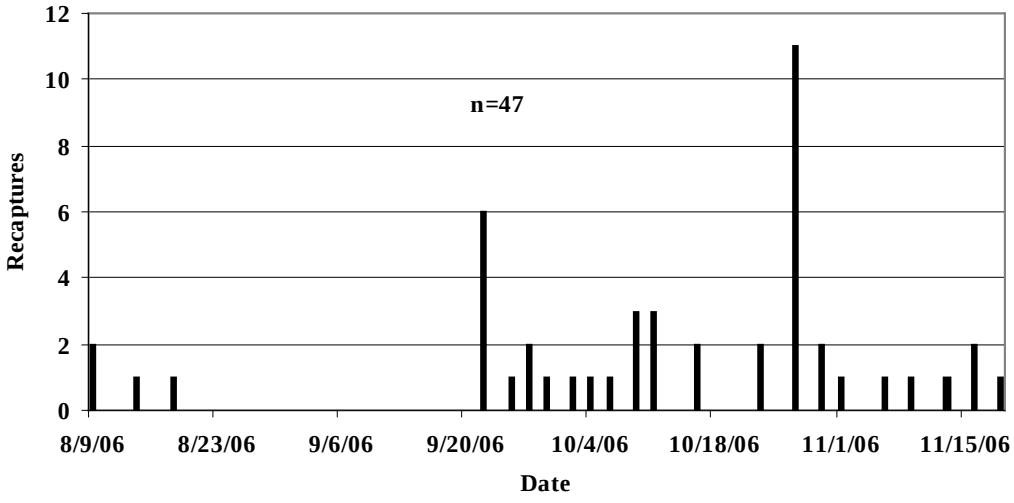


Figure 17. Recaptures of BY 2005 field group natural-origin juvenile spring Chinook salmon in the Lookingglass Creek screw trap by date, MY 2007.

1.5.3.4 Brood Year 2006

Growth of BY 2006 spring Chinook salmon parr collected at rm 0.25 (near the mouth) was greater than at the other two sites (Figure 18). Mean FL at the rm 5.5 and 6.5 sites were similar in June 2007, but was greater at the rm 5.5 site in July and August 2007

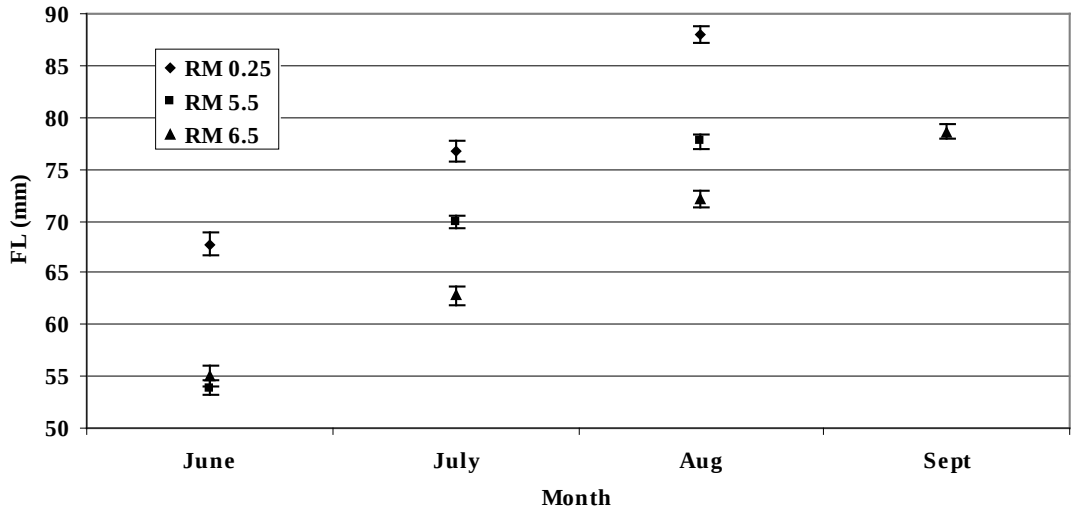


Figure 18. Mean FL (mm, +/- SE) for natural-origin BY 2006 juvenile spring Chinook salmon at rm 0.25, 5.5, and 6.5 sites, Lookingglass Creek, 2007.

1.6 Discussion

Stream flow conditions in Lookingglass Creek during 2007 followed the typical pattern of a spring freshet resulting from snowmelt at higher elevations in the watershed followed by a rapid return to base flows. Occasional spikes in base flows resulted from rainfall events during the summer and fall, or rainfall or warm weather during the winter. Passage and survival conditions in the Snake River-Columbia River migration corridor in 2007 were better than expected, since snowpack and spring flows were lower than normal. Increased survival of juveniles was attributed to high levels of 24 hour spill and the delayed start of the smolt transport program resulting in a lower proportion of the run being transported (DeHart 2007).

Water temperatures at the site near Eagle Creek were not in the ranges detrimental to adult migration or smoltification, of increased disease risk, and lower growth if limited food was available (U. S. Environmental Protection Agency 2003). Temperatures there were in the range where growth may have been sub-optimal under conditions of limited food. Maximum daily temperatures at the Lookingglass Hatchery site during July 2007 were often above 15^{o}C, in the range of impaired smoltification and increased disease risk.

Adult returns in 2007 were below the median (368) and range (244-727) for 8 years from 1966-1973 reported by Burck (1993). Total redds were also below the median (189) and

range (99-279) for brood years 1964-1971 (Burck 1993). Returns of Catherine Creek stock thus far have been low due to the numbers of fish released and the timing of releases. The first liberation of Catherine Creek juveniles was in September 2001, rather than the typical spring release that probably would have had better survival. The May 2002 release was almost a year early and failed to produce any coded wire tag recoveries. No juveniles were released in 2003. Releases of Rapid River stock smolts or presmolts ranged from about 137,000-749,000 (median 301,000) for brood years 1986-1999. Releases of Catherine Creek stock smolts or presmolts ranged from about 17,000-122,000 for brood years 2000-2004, with only one release (spring release of brood year 2004) over 62,000. The brood year 2004 release produced substantial numbers of age 3 fish in 2007 and may produce high numbers of age 4 fish in 2008.

Total BY 2005 juvenile production from adults spawning above the LH trap was 16-38% of the production from BY 1965-1969 (Burck 1993) and about 32% greater than the BY 2004 estimate. Outmigrants per redd ranged from 230-493 (median 341) using data from Burck (1993). BY 2005 outmigrants per redd (562) for Catherine Creek stock spawning above the trap was higher than the range observed by Burck (1993) and more than twice the BY 2004 estimate.

Life history attributes of 2007 returns were similar to the endemic stock for spawn timing and percentage of prespawning mortalities (females). Arrival timing to the hatchery weir in 2007 was concentrated from mid-May through the end of June, compared to a roughly even distribution from early June through early July over the years 1967-1974 for the endemic stock reported by Burck (1993). Higher percentages of "small" (Burck 1993), and "large" returns, and a lower percentage of "medium" returns occurred in 2007 compared to the endemic stock from 1967-1974. "Small", "medium", and "large" categories were ≤ 20 in FL, 21-30 in FL, and ≥ 31 in FL, respectively (Burck 1993). Similar to the size composition, age composition of 2007 returns had higher percentages of ages 3 and 5 and lower percentages of age 4 than reported for the endemic stock. Redd distribution in 2007 differed from the endemic stock due to the limited number of outplants above the weir and outplanting most in the mainstem Lookingglass Creek above the mouth of Little Lookingglass Creek.

The timing of brood year 2005 natural outmigrants from Lookingglass Creek was concentrated during September and October of 2006, earlier than most endemic outmigrants. Burck (1993) reported most outmigrants leaving during the June-August period. The method of capture used by Burck (1993) may be a factor. Low flows inhibit the efficient operation of the screw trap during July and August. Attempts to funnel as much of the flow as possible into the cone of the screw trap are not always successful. Use of a different trapping method during the low flow period in the future may provide better estimates of out migration during the low flow period.

Growth and condition factor of natural outmigrants caught in the screw trap and by seining at the standard station in 2007 indicated mean fork lengths and condition factor were higher than endemic outmigrants caught in the bypass trap or by seining during June-August and summarized by Burck (1993). This may have been due to the much

reduced densities of juveniles in 2007 compared to the endemic stock. The BY 2005 field group from Lookingglass Creek showed some differences in mean FL and condition factor from the other three streams.

Adult returns and juvenile production in 2007 continued to reflect the transition from non-endemic Rapid River stock to endemic Catherine Creek stock. The low numbers of hatchery juveniles released thus far has not resulted in the numbers of returning adults comparable to the extirpated endemic stock. The lack of rearing space at Lookingglass Hatchery will limit the numbers of hatchery-origin juveniles liberated. An assessment of productivity (progeny-per-parent) for the Catherine Creek stock awaits F_1 returns from the first substantial release of smolts (brood year 2004 released in the spring of 2006).

The numbers of returns originating from Lookingglass Creek, Lookingglass Hatchery, and other streams is complicated by the lack of information for the age, sex, size and mark composition of spawners below the Lookingglass Hatchery weir. Carcasses are taken by scavengers or drift quickly out of the stream.

1.7 Literature Cited

Bjorkstedt, E. P. 2007. DARR 2.0: updated software for estimating abundance from stratified mark-recapture data. U. S. Department of Commerce, National Oceanic and Atmospheric Administration-Fisheries, Southwest Fisheries Science Center, NOAA Technical Memorandum NMFS-SWFSC-368, Santa Cruz, California.

Burck, W.A. 1993. Life history of spring Chinook salmon in Lookingglass Creek, Oregon. Oregon Department of Fish and Wildlife Information Report 94-1, Portland.

DeHart, M. 2007. 2007 Fish Passage Center Annual Report. Columbia Basin Fish and Wildlife Authority. Portland, OR.

Lofy, P.T. and M.L. McLean. 1995. Annual Progress Report for 1 January to 31 December, 1992, for the Lower Snake River Compensation Plan. Section I. Evaluation of reestablishing natural production of Chinook salmon in Lookingglass Creek, Oregon, using a non-endemic hatchery stock. U. S. Fish and Wildlife Service Report, Boise, Idaho.

Mosher, K. H. 1969. Identification of Pacific Salmon and Steelhead Trout by Scale Characteristics. U. S. Department of the Interior, Fish and Wildlife Service, Bureau of Commercial Fisheries Circular 317.

Park, D. L. 1990. Status and future of spring Chinook salmon in the Columbia River Basin – Conservation and Enhancement. U. S. Department of Commerce, NOAA Technical Memorandum NMFS F/NWC-187.

Parker, S. J., M. Keefe, and R. W. Carmichael. 1995. Natural escapement of spring Chinook salmon in the Imnaha and Grande Ronde River Basins. Annual progress report, Oregon Department of Fish and Wildlife, to the Lower Snake River Compensation Plan, U. S. Fish and Wildlife Service, Boise, Idaho.

PIT Tag Steering Committee. 1999. PIT Tag Marking Procedures Manual. Version 2.0. Columbia Basin Fish and Wildlife Authority. Available: http://www.pittag.org/Software_and_Documentation/MPM.pdf)

Roper, B. and D. L. Scarnecchia. 1996. A comparison of trap efficiencies for wild and hatchery age-0 Chinook salmon. North American Journal of Fisheries Management 16(1):214-217.

U. S. Environmental Protection Agency. 2003. EPA Region 10 Guidance for Pacific Northwest State and Tribal Water Quality Standards. EPA 910-B-03-002. Region 10 Office of Water, Seattle, WA.

Westhagen, P. and J. R. Skalski. 2006. Program PitPro 4.0. Columbia Basin Research, University of Washington, Seattle.

1.8 Appendix A. Draft Lookingglass Creek Management Guidelines

ODFW proposes aggressive weir management guidelines to expedite adult escapement (Table 1). The intent is to use the hatchery resource is to magnify adult numbers to provide 1) broodstock (170 spawners) to become self-sufficient, 2) escapement of 450 adults above the hatchery, and 3) harvest when escapement predictions exceed 620 adults. The longer-term objective is to modify weir management guidelines to transition escapement above Lookingglass Hatchery and broodstock to naturalized adults.

Table 1. Proposed long-term spring Chinook salmon adult weir management guidelines for the Lookingglass Creek.

Estimated adult escapement to Lookingglass Creek[a]	Ratio of hatchery to natural adults at the mouth	Maximum % of natural adults to retain for broodstock	% of hatchery adults to retain as broodstock	% of adults released above the weir can be of hatchery origin	Minimum % of broodstock of natural origin	% known strays allowed above the weir
≤300 (below)	Any	50	na	na	na	≤5
301-449	Any	≤50	≤50	Any	Any	≤5
450-619	Any	≤25	≤35	Any[b]	≥90	0
≥620[c]	Any					

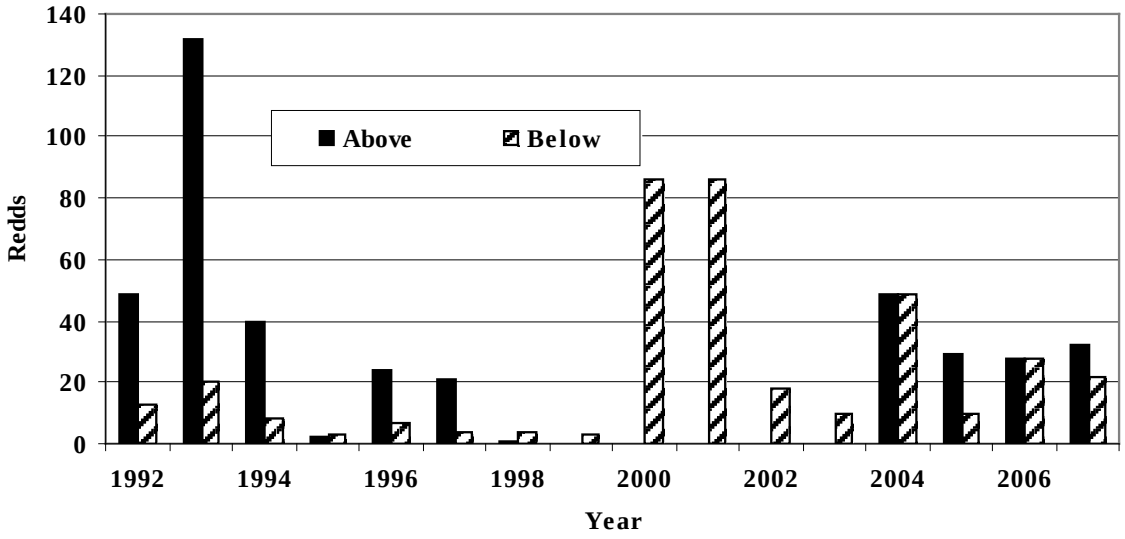
[a] Pre-season or adjusted season estimate for total escapement
[b] Not to exceed 450 total fish, no limit on naturalized adults
[c] Selective sport harvest threshold

In the near term or until there is an established Lookingglass Creek stock, collections will be based on the following agreement:

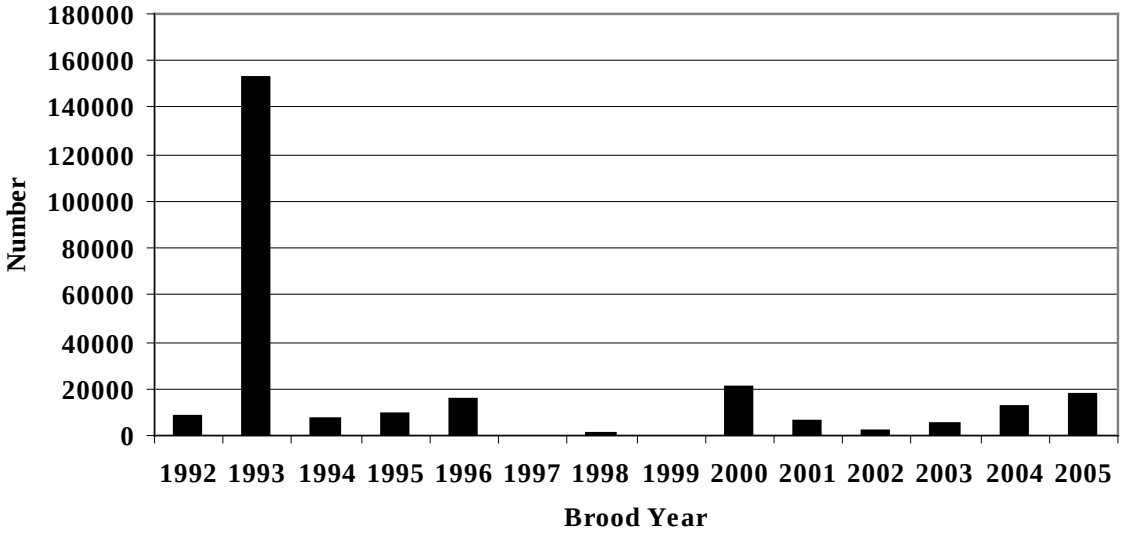
Adults available	Percent to	
(swimins and CC surplus)	Pass	Keep
150	67	33
200	58	42
250	53	47
300	50	50

> 300 adjustments based on brood needs

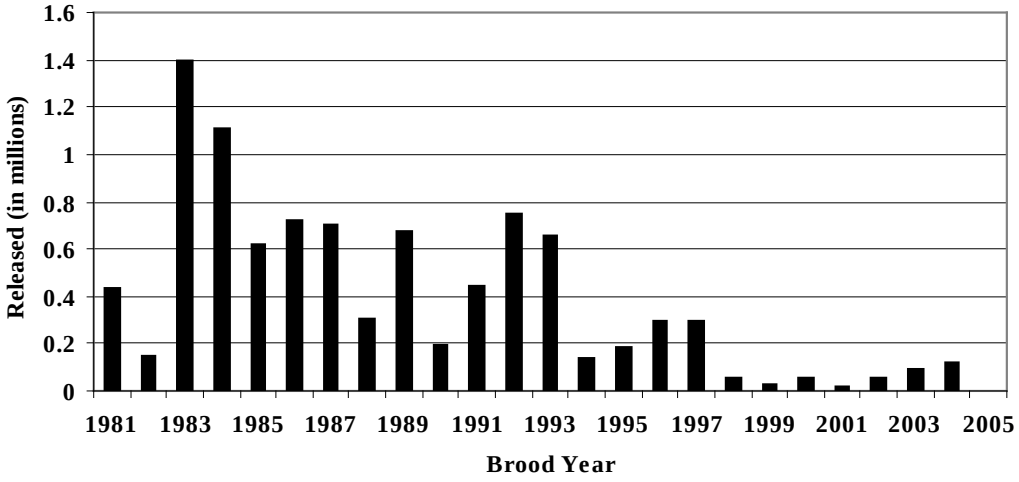
1.9 Appendix Figures



Appendix Figure 1. Spring Chinook salmon redds above and below the Lookingglass Hatchery trap, 1992-2007.



Appendix Figure 2. Spring Chinook salmon outmigrant natural production from Lookingglass Creek, brood years 1992-2005.



Appendix Figure 3. Spring Chinook salmon hatchery-releases of juveniles into Lookingglass Creek, brood years 1992-2005.

2 SECTION II . *ONCORHYNCHUS MYKISS* INVESTIGATIONS IN LOOKINGGLASS CREEK AND OTHER GRANDE RONDE RIVER TRIBUTARIES

2.1 Abstract

A total of 132 unmarked (wild) summer steelhead were caught in the Lookingglass Hatchery adult trap from 2 April-28 May 2007, including 85 females and 47 males. Mean FL of males (653.7 mm) was slightly higher than females (646.0 mm). Age composition was 56.1% 1-salt and 43.9% 2-salt. Recaptures of returns previously passed were observed from 9 April-14 May 2007 and included 9 females and 6 males. No ad-clipped returns were caught. An estimated 17,442 juvenile outmigrants ≥ 80 mm FL left Lookingglass Creek during 2007 with the highest numbers leaving between March and April. Capture probabilities ranged from 0.019-0.104. Mean FL for 382 fish PIT-tagged and released from 23 June-8 December 2006 was 147.7 mm, survival probability to Lower Granite Dam was 0.2089, and median arrival date at Lower Granite Dam was 13 May 2007. Mean FL for 302 outmigrants PIT-tagged and released from 27 March-30 May 2007 was 151.2 mm, survival probability to Lower Granite Dam was 0.3377, and median arrival date at Lower Granite Dam was 15 May 2007. The trap catch of adult summer steelhead in 2007 was higher than the range in the 1970s and similar to the range observed since 2002. Outmigrant abundance in 2007 was similar to the 2005 level, and above the range recorded in the 1970s. Life history characteristics observed in 2007 were similar to those observed during other years in Lookingglass Creek and for other stocks of A-run summer steelhead in the Snake River Basin.

2.2 Introduction

The Grande Ronde River Basin once supported large populations of fall and spring Chinook (*O. tshawytscha*), sockeye (*O. nerka*), and coho (*O. kisutch*) salmon and summer steelhead, and these populations have declined or become extirpated, principally due to construction and operation of hydroelectric facilities, overfishing, and the loss and degradation of critical spawning and rearing habitat for similar reasons (U. S. Army Engineer District 1975, Nehlsen et al. 1991). Many anadromous salmonid stocks in the Snake River Basin have declined to the point of extinction for similar reasons (Nehlsen et al. 1991).

Hatcheries were built in Oregon, Washington and Idaho under the LSRCP to compensate for losses of summer steelhead due to the construction and operation of the four most downstream Snake River dams. Comanagers began augmenting populations in the Grande Ronde River using non-endemic Wallowa Hatchery stock in the early 1980s and sport harvest was reopened in 1986 (Flesher et al. 2007). These harvest-driven hatchery programs have restored sport fisheries natural summer steelhead populations continued to decline and Snake River summer steelhead were listed as threatened under the Endangered Species Act of 1973 on 18 August 1997. Comanagers discontinued off-station releases of Wallowa Hatchery stock summer steelhead into Catherine Creek (1998) and the upper Grande Ronde River (1999) due to high stray rates.

The adult return numbers and the genetic structure of adult summer steelhead returning to tributaries of the Grande Ronde River are largely unknown. High spring flows make it difficult to keep weirs fishing effectively. McLean et al. (2001) summarized unpublished data on the number of summer steelhead adults returning to Lookingglass Creek from 1965-1974. Adult trap counts at the LH weir have also been compiled since 1997, although trap installation dates have varied. The Lookingglass Creek summer steelhead population appears to be doing well in relatively undisturbed habitat with little influence from hatchery fish.

Life history of juvenile *O. mykiss* for several Grande Ronde Basin tributaries was described by Van Dyke et al. (2008) and Reischauer et al. (2007). We have captured juvenile *O. mykiss* in our screw trap since 1992, and began PIT-tagging juvenile *O. mykiss* during the spring of 1999 to investigate their arrival timing and survival to Snake and Columbia River dams.

Collection and analysis of data on native steelhead in Lookingglass Creek and other Grande Ronde Basin tributaries will inform managers and aid in population recovery.

2.3 Methods

2.3.1 Adult Summer Steelhead Returns

A picket weir diverted returning adults into a trap near the Lookingglass Hatchery water intake near rm 2.4. All adult summer steelhead captured were anesthetized in a solution of MS222, counted, examined for marks and tags, measured (mm FL), and sexed. Opercle tissues were removed with a paper punch and preserved in 95% ethanol. Tissues were archived at the CRITFC genetics laboratory at Hagerman, Idaho. Scales were removed from 2-3 rows above the lateral line on a line from the posterior end of the dorsal fin to the anterior end of the anal fin. Permanent impressions were made in cellulose acetate using heat and pressure. Impressions were examined with a microfiche reader using criteria for annuli described by (Mosher 1969). Week of capture was designated by the first day of the week (e.g. week of 1 January included 1-7 January). Ad-clipped (hatchery-origin) returns were euthanized and removed from the stream. Unmarked (wild) adults were transported about 0.5 mi upstream and released. Any ad-clipped returns were removed from the stream and euthanized.

2.3.2 Juvenile *O. mykiss*

We operated a 1.52 m diameter rotary screw trap (Roper and Scarnecchia 1996) at rm 2.4 on Lookingglass Creek just downstream from the Lookingglass Hatchery water intake and adult trap to collect outmigrating juvenile *O. mykiss*. The screw trap was operated continuously during 2007 except for brief periods during the spring freshet. The trap was usually checked 3 times a week or more frequently if catches or flows were high. All *O. mykiss* were counted, examined, scanned with a PIT tag reader, measured (mm FL), and weighed (0.1 g). No clipped fish were expected since no hatchery-origin *O. mykiss* are released into Lookingglass Creek. First-time captures $\geq$ 110 mm FL in good condition

(no injuries or obvious disease) were PIT-tagged using standard methods (PIT Tag Steering Committee 1999). Past data indicated that PIT-tagged outmigrants <110 mm FL are rarely recaptured at the screw trap or detected at mainstem dams on the Snake or Columbia Rivers. Outmigrants ≥ 80 < 110 mm FL received a partial clip (lower caudal). All newly-tagged or clipped outmigrants were released about 300 ft above the screw trap; recaptures were released 1,000 ft below the screw trap. Outmigrants < 80 mm FL were measured and released below the trap without any marks or tags.

DARR 2.0 (Bjorkstedt 2007) was used to estimate the numbers of outmigrants. DARR 2.0 uses mark-recapture data stratified by time period, pooling those with similar capture probabilities. We used the "one trap" and "no prior" pooling of strata options. Catch data were initially grouped by 2-week period (e.g. April L=April16-30, May E=May 1-15). Periods with low catches and few if any recaptures were combined prior to analysis.

O. mykiss juveniles outmigrate from Lookingglass Creek during the entire year, with peaks during the spring (usually March-May) and fall (usually September and October). Fall outmigrants move downstream to continue rearing, probably in the mainstem Grande Ronde River or tributaries between the mouth of Lookingglass Creek and the mouth of the Grande Ronde River, but are not detected at Lower Granite Dam until the following spring, or as much as 2 years later. Most (but not all) spring outmigrants move directly downstream and are detected at Lower Granite Dam within a month. PIT-tagged outmigrants were placed into two groups (fall 2006 and spring 2007) for comparisons of life history. The earliest date of PIT-tagging in 2006 for any detection in the Columbia River-Snake River hydrosystem in 2007 was used as the separation date for the fall 2006 group. All outmigrants PIT-tagged from that date until 31 December 2006 comprised the fall 2006 group. Similarly, the latest date of PIT-tagging in 2007 for the last detection in the hydrosystem in 2007 was used as the separation date for the spring 2007 group. Any outmigrant tagged and released from 1 January 2007 until that date comprised the spring 2006 group. These two groups represented essentially all of migration year 2007 For purposes of estimating survival and migration timing. Beginning with the 2008 annual report, estimates of outmigrants will be made for the migration year (beginning 1 July and ending the following June 30. This will essentially correspond to the fall and spring groups used for survival and migration timing.

FL and weight at PIT-tagging, travel time, survival and capture probability to Lower Granite Dam data were obtained from the PIT tag database maintained by the Pacific States Marine Fisheries Commission (http://www.ptagis.org/). We estimated arrival timing to Lower Granite Dam using daily PIT tag detections expanded for spill and flow data from the U. S. Army Corps of Engineers Portland District website (http://www.nwd-wc.usace.army.mil/perl/dataquery.pl?k=id:LWG) and calculating a daily expansion factor [(Powerhouse Outflow+ Spill) /Powerhouse Outflow]. Median arrival date at Lower Granite Dam for each group was obtained using the date of 50% expanded daily detections. Survival, capture probabilities, and travel time to Lower Granite Dam were estimated using PitPro (Westhagen and Skalski 2006). We used the standard configuration, excluding the *.rcp (recapture) file. Observation sites in downstream order were Lower Granite Dam, Little Goose Dam, Lower Monumental Dam, Ice Harbor Dam,

McNary Dam, John Day Dam, Bonneville Dam, and the Estuary Towed Array (Juvenile). Survival, capture probabilities, and travel time were estimated for only those outmigrants detected during the year following tagging.

2.4 Results

2.4.1 Adult Summer Steelhead Returns

Trapping began on 1 April 2007 and the first male and female summer steelhead were captured on 2 April (Figure 1). The last male was collected on 25 May and the last female on 28 May. .The total catch increased steadily through the week of 7 May, then quickly tapered off. No ad-clipped (hatchery-origin) returns were caught. First time captures were mostly female (Figure 2). Recaptures of returns previously passed occurred from 9 April-14 May, and included 6 males and 9 females.

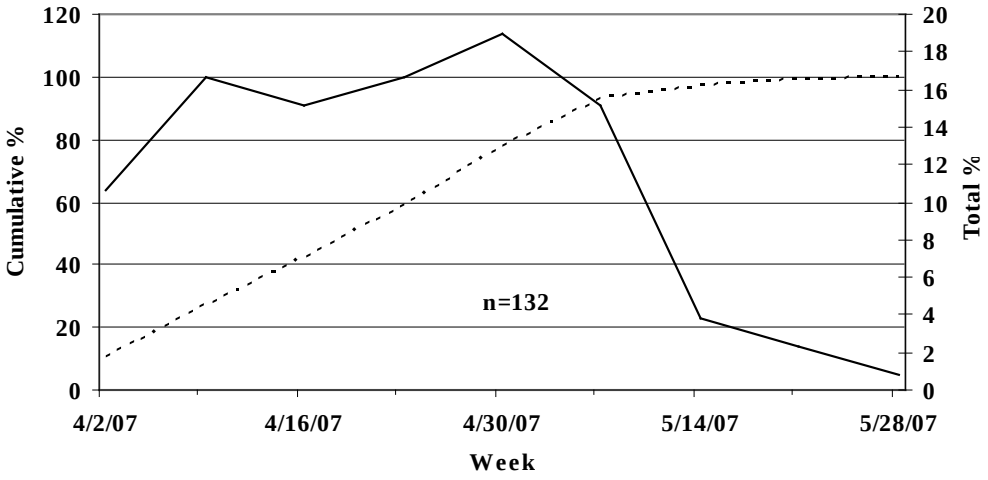


Figure 1. Total percent (solid line) and cumulative % (dashed line) catch by week for summer steelhead caught in the Lookingglass Hatchery trap, 2007.

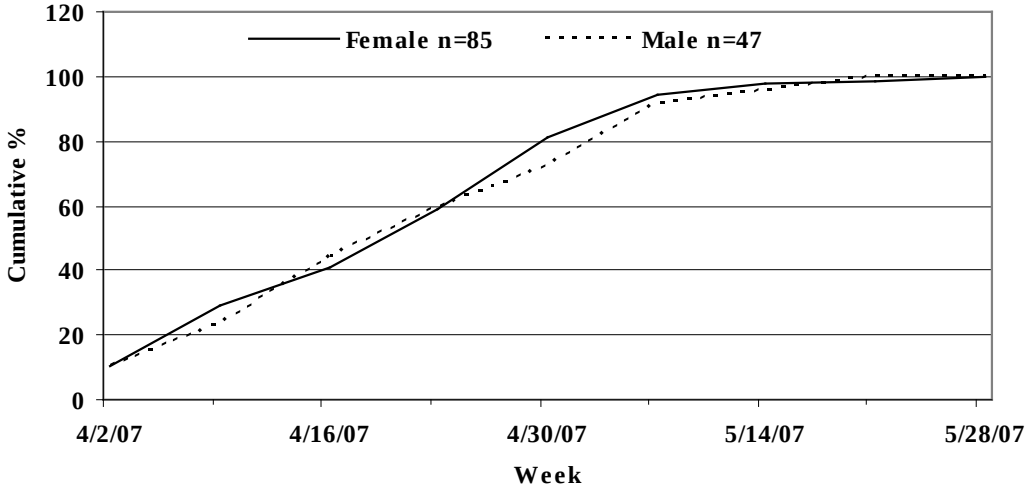


Figure 2. Cumulative percentages of total catch by week by sex for summer steelhead in the Lookingglass Hatchery trap, 2007.

The FL distribution was bimodal for males and females (Figure 3). Mean FL of males was greater than females (Table 1).

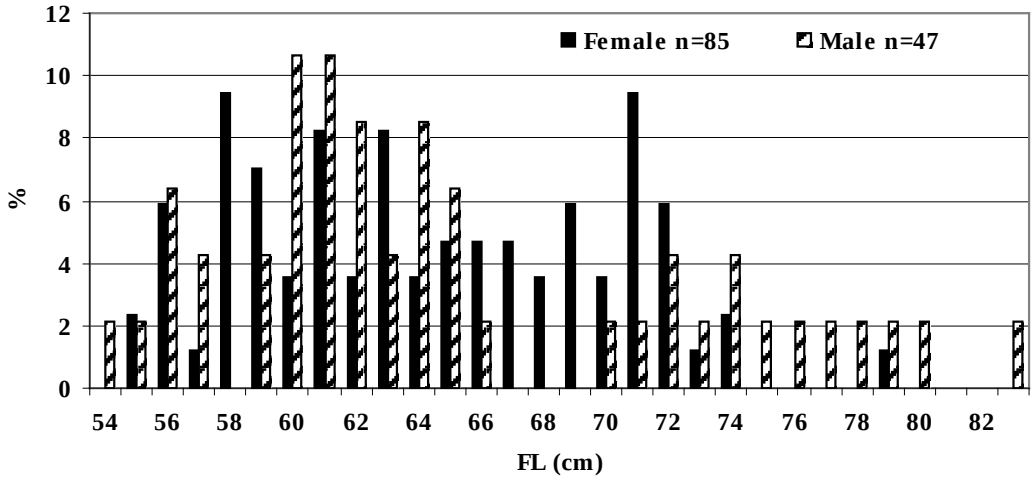


Figure 3. FL frequency by sex of summer steelhead caught in the Lookingglass Hatchery trap, 2007.

Table 1. FL summary by sex for summer steelhead caught in the Lookingglass Creek trap, 2007.

Sex	$\bar{X}$ FL (mm)	SE	Min-Max	n
Male	653.7	10.9	540-832	47
Female	646.0	6.1	550-790	85
All	648.7	5.5	540-832	132

Mean FL of 1-salt and 2-salt males were greater than females of the same ages (Table 2). One-salt fish (56.1% of the total) were more abundant than 2-salt (43.9%, Figure 4)

Table 2. FL summary for summer steelhead caught in the Lookingglass Creek trap by age and sex, 2007.

Sex	Age	$\bar{X}$ FL (mm)	SE	Min-Max	n
Male					
	1-salt	611.2	5.9	554-666	25
	2-salt	736.2	14.7	645-832	13
Female					
	1-salt	599.6	4.4	550-655	40
	2-salt	693.5	4.6	630-740	37

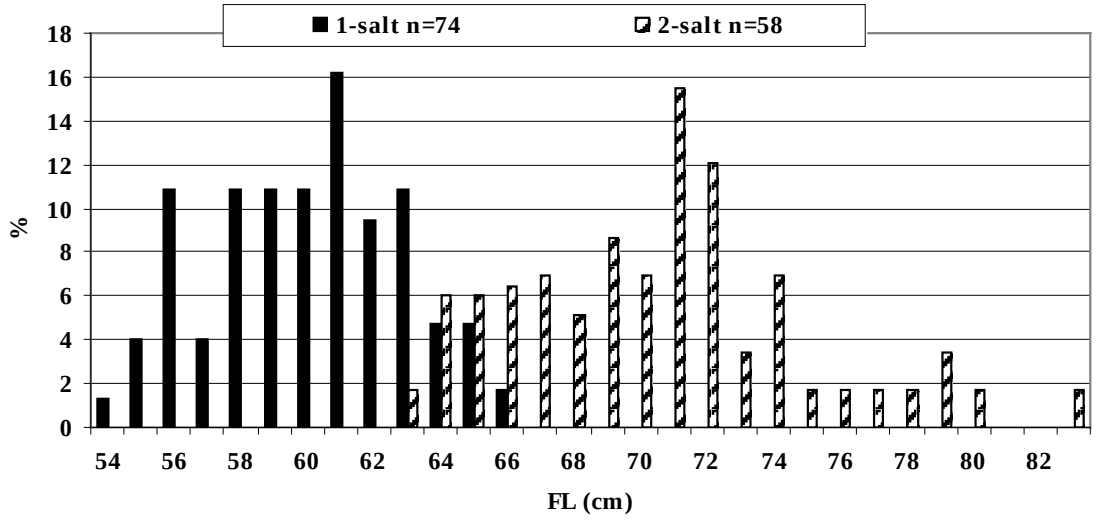


Figure 4. Age-FL frequency for Lookingglass Creek summer steelhead, 2007.

2.4.2 Juvenile *O. mykiss*

The rotary screw trap was operated nearly continuously during 2007. The trap was not operated on the following dates: 13 January (debris); 15 February (cone frozen), 17-21 February (high flows); 27 February-6 March (meeting), 9 April (high debris); 29 April-1 May (high flows, debris); 5-8 May (high flows, debris), 16-22 May (high flows debris), 19-31 July (high water temps, few fish); 6-8 November (high flows, debris); 27 November- 3 December (Thanksgiving holiday). The trap was pulled for the year on 8 December 2007. We combined several two-week periods to give the following 7 periods for initial input into DARR 2.0: March-April E(arly), April L(ate), May E(early), May L(ate), June E(arly), June L(ate), August L(ate)-December L(ate). DARR 2.0 further combined the June E, June L, and August-December periods for a total of 5 periods (Table 3).

Table 3. *O. mykiss* captured in the Lookingglass Creek screw trap, releases and recaptures from trap efficiency tests, outmigrant estimates and standard errors, calendar year (CY) 2007.

Period	u	m	r	C_p	N	SE
late March-late April	176	170	4	0.019	9,410	5,411
early May	117	114	11	0.104	1,124	411
late May	136	132	7	0.056	2,434	1,439
early June	85	85	4	0.047	1,806	881
late June-late December	110	97	4	0.041	2,668	1,305
CY 2007 Totals	624	598	30		17,442	5,718

u=newly caught, unmarked fish
m=newly marked and released above the trap
C_p=capture probability (trap efficiency)
N=outmigrant estimate
SE=standard error (variance$^{0.5}$)

Outmigrants measured but not marked or tagged totaled 174 and 154 (88.5%) were < 80 mm FL (Figure 5). Of those < 80 mm FL, 51.9% were caught from early April-early June and 42.9% in November or December. Five were counted but not measured. There were 6 trap mortalities (68-259 mm FL) occurring from 30 April-23 May.

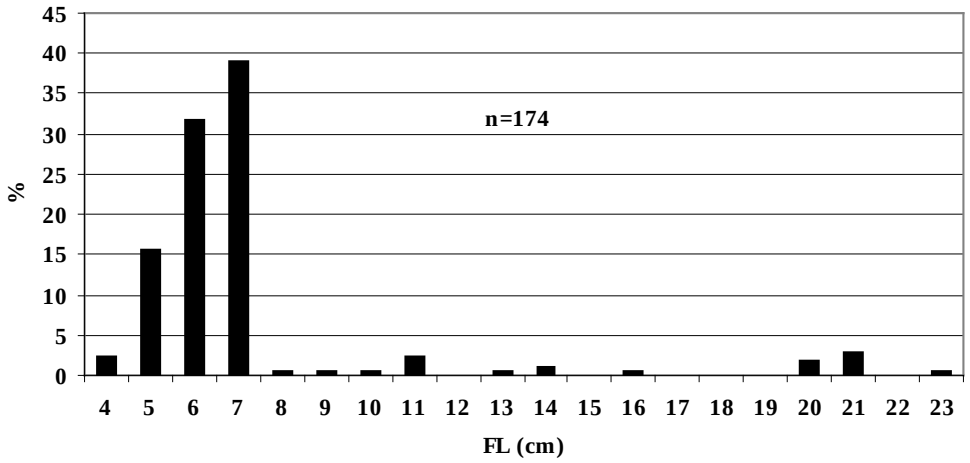


Figure 5. FL frequency for *O. mykiss* measured but not PIT-tagged, Lookingglass Creek, 2007.

Fin-clipped releases totaled 184 with 88.0% from 80-109 mm FL. Most (also 88.0%) were clipped and released during late April-late June (Figure 6). The 5 recaptures of fin-clipped outmigrants were 88-136 mm FL. Percentages of fin-clip recaptures of the number released by FL (cm) group were 0 (< 80 mm and > 139 mm), 2.7 (80-89 mm, 28.6 (110-119), and 100.0 (130-139). Overall, the percentage of fin-clip recaptures was 2.7 (5/184).

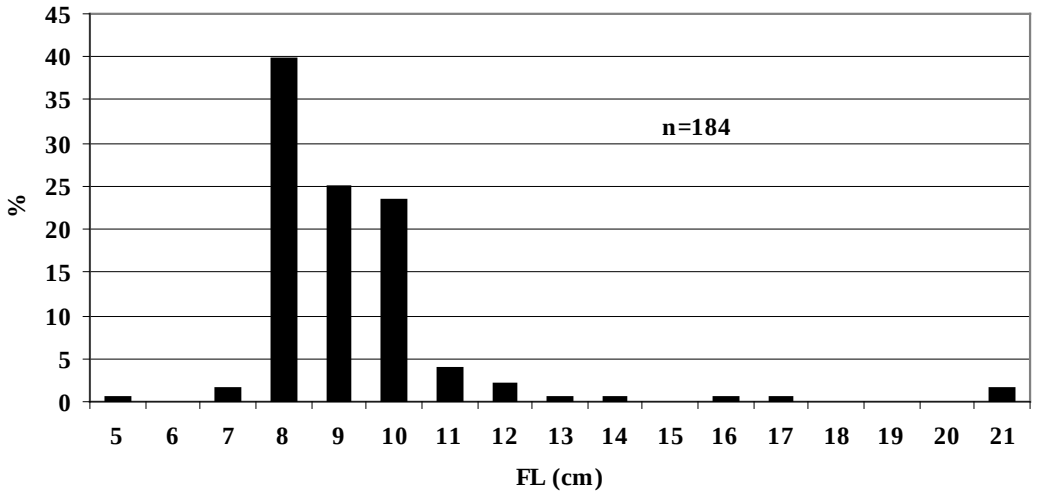


Figure 6. FL frequency for *O. mykiss* fin-clipped and released, Lookingglass Creek, 2007.

Most of the outmigrants PIT-tagged and released (87.8%) occurred from April-June, with much smaller totals during September-December (Figure 7).

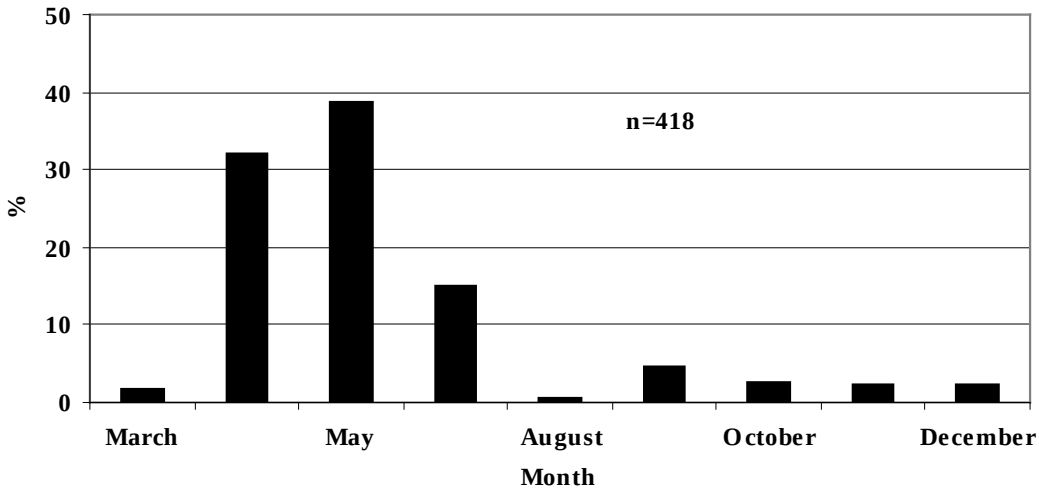


Figure 7. Percentages of *O. mykiss* PIT-tagged and released in Lookingglass Creek by month, 2007.

The majority of PIT-tagged outmigrants ranged from 10-20 cm FL (Figure 8). Figures 7 and 8 exclude a 136 mm fin-clip recapture that was PIT-tagged and released below the trap on 20 June.

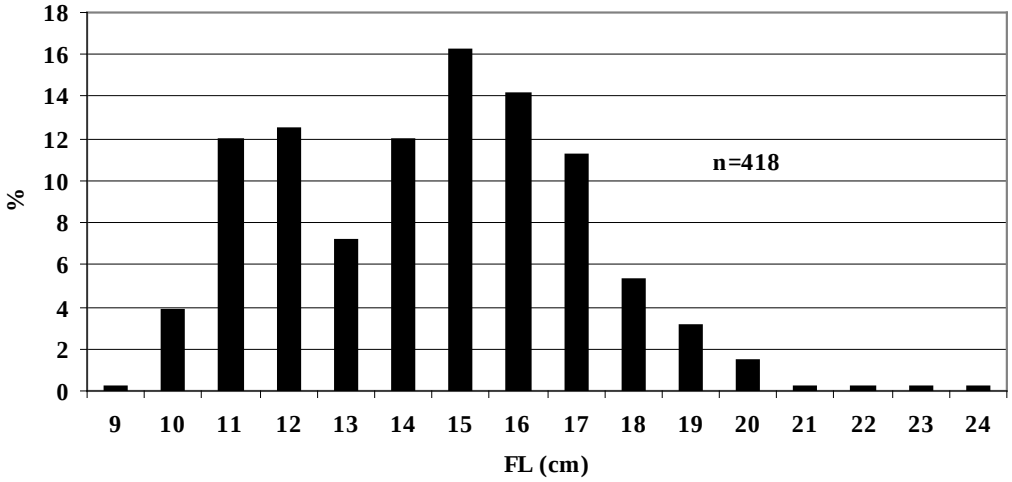


Figure 8. Percentages of *O. mykiss* PIT-tagged and released in Lookingglass Creek by cm group, 2007.

There were no PIT tag trap efficiency recaptures of any fish < 116 or > 178 mm FL. Percentages of recaptures by FL cm group varied compared to those released by FL group. The percentages of recaptures were higher than the percentage released for the 12, 14, 15, and 17 cm groups, but lower for the 10-11, 13, 16 and ≥18 cm groups (Figure 9). Days elapsed between release and recapture in 2007 for 25 PIT-tagged fish ranged from 1-12; 92.0% were recaptured 1-3 d after release.

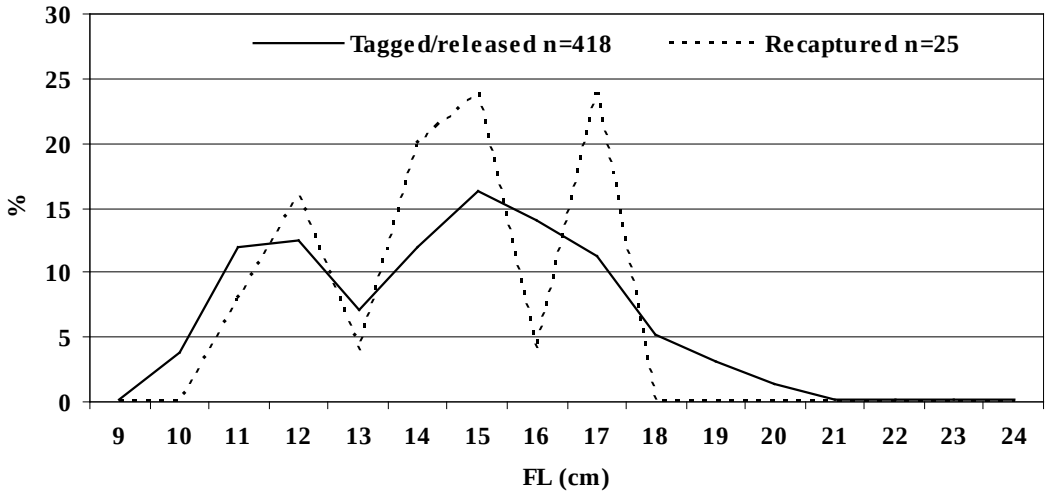


Figure 9. FL comparison of *O. mykiss* caught, PIT-tagged and released and recaptures at the Lookingglass Creek screw trap, 2007.

The range of sizes caught was similar between seasons, except for the 4-6 cm FL groups that were more abundant in September-December (Figure 10). The September-December distribution was more even and bimodal. Mean FL and weights of *O. mykiss* caught in the screw trap were highest during March-April and September-October (Table 4). Mean

K was highest during May, June, and August and lowest in December. The log10 FL (mm)-weight (g) relationship was by the equation log10 weight (g)=-5.03812+log FL (mm)*3.02351.

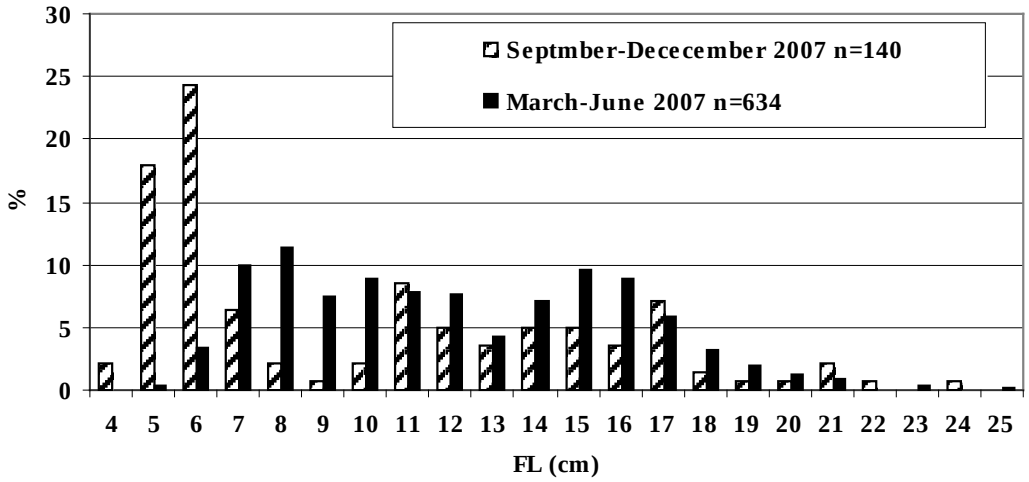


Figure 10. FL frequency for *O. mykiss* captured in the Lookingglass Creek screw trap, 2007.

Table 4. FL (mm), weight (g), and K factor summary by month *O. mykiss* captured in the Lookingglass Creek screw trap, 2007.

	Month									
Statistic	March	Apr	May	June	July	Aug	Sept	Oct	Nov	Dec
FL										
Mean	135.2	143.7	117.8	116.2	68	106.0	149.8	134.7	96.3	77.7
SE	12.6	2.7	2.1	3.1		18.2	7.9	9.7	8.1	4.6
Min	74	54	59	63		40	49	46	52	43
Max	196	218	259	237		178	215	175	222	245
n	10	175	316	133	1	7	28	15	37	60
Weight										
Mean	31.6	36.4	24.3	21.2	3.1	18.9	38.6	31.2	17.8	9.8
SE	7.3	1.7	1.3	1.9		10.8	4.7	4.6	4.6	3.1
Min	4.1	1.5	2.3	2.7		0.5	1.2	1.3	1.2	0.8
Max	80.0	105.8	194.8	148.8		59.6	98.3	61.3	117.8	146.1
n	10	166	297	130	1	5	26	15	37	51
K										
Mean	1.03	1.06	1.11	1.10	0.99	1.11	1.05	1.08	1.01	0.96
SE	0.02	0.01	0.01	0.01		0.16	0.02	0.03	0.02	0.02
Min	0.94	0.80	0.86	0.87		0.78	0.82	0.95	0.81	0.79
Max	1.17	1.39	1.90	1.40		1.71	1.23	1.34	1.48	1.49
n	10	166	297	130	1	5	26	15	37	51

The fall 2006 group was PIT-tagged from 23 June-8 December 2006 (median 4 October 2006) and the spring 2007 group from 27 March-30 May 2007 (median 2 May 2007). Means for FL, weight, and K factor of the fall 2006 group were slightly less than for the spring 2007 (Table 5). Survival and capture probabilities were higher for the spring 2007 group. Median arrival dates for the fall 2006 and spring 2007 groups differed by only 2 d (Table 6).

Table 5. FL, weight, and K factor summary by group for *O. mykiss* caught in the Lookingglass Creek screw trap, PIT-tagged and released, 2006-6007.

	Group	
Statistic	Fall 2006	Spring 2007
Mean FL (mm)	147.7	151.2
SE	1.1	1.4
Min-Max	101-219	94-218
n	382	302
Mean Weight (g)	36.1	39.7
SE	0.9	1.0
Min-Max	10.9-107.4	7.0-105.8
n	377	296
Mean K	1.05	1.08
SE	0.01	0.01
Min-Max	0.85-1.48	0.82-1.38
n	377	296

Table 6. Survival and capture probabilities, travel time, and arrival timing to Lower Granite Dam by group for *O. mykiss* caught in the Lookingglass Creek screw trap, PIT-tagged and released, 2006-2007.

	Group	
Statistic	Fall 2006	Spring 2007
Survival	0.2089	0.3377
SE	0.0564	0.0577
n	383	302
Capture Probability	0.2125	0.2647
SE	0.0703	0.0591
n	383	302
Travel Time (d)	205.952	12.253
SE	9.521	1.548
n	17	27
Median Arrival Date	13 May 2007	15 May 2007
10%	18 April 2007	5 May 2007
90%	21 May 2007	10 June /2007
n	17	27
n (expanded)	30	46

FL cm groups of fall 2006 PIT-tagged outmigrants detected in the hydrosystem were variable compared with those of the entire fall 2006 PIT-tagged group (Figure 11). Higher numbers of both tagged and detected were in the 13-15 cm groups and there were no detections of outmigrants less than 11 cm. For spring 2007 PIT-tagged outmigrants the percentages both tagged and detected in the hydrosystem were highest at 15 cm (Figure 12). No fish < 13 cm were detected.

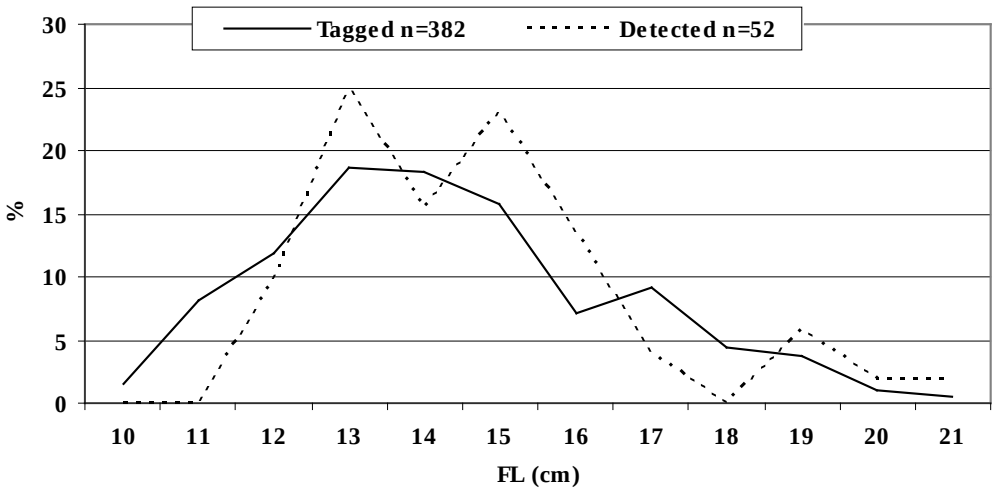


Figure 11. Percentages of *O. mykiss* PIT-tagged and released in Lookingglass Creek, fall 2006 group, and unique detections in the hydropower system by FL group during 2007.

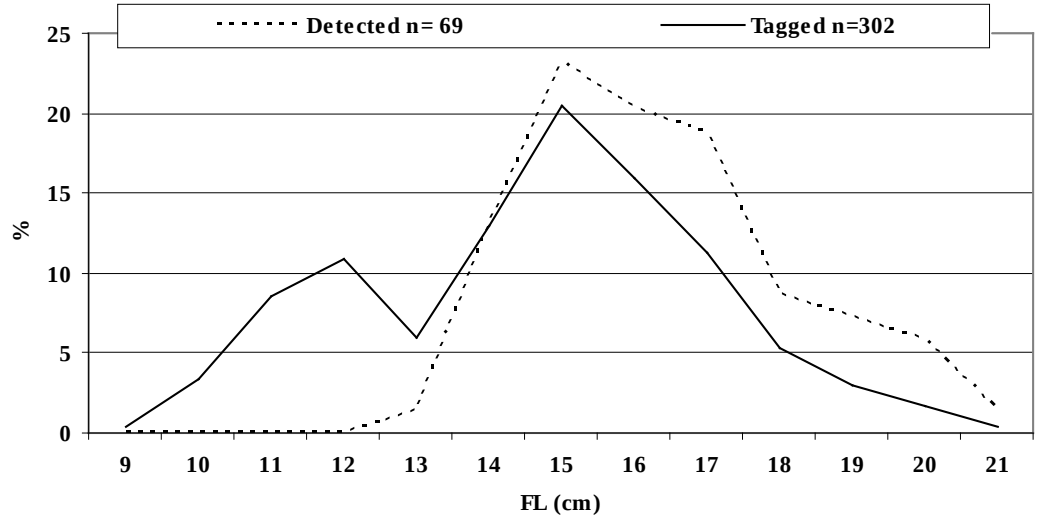


Figure 12. Percentages of *O. mykiss* PIT-tagged and released in Lookingglass Creek, spring 2007 group, and unique detections in the hydropower system by FL group during 2007.

2.5 Discussion

Stream flow conditions in Lookingglass Creek during 2007 followed the typical pattern of a spring freshet resulting from snowmelt at higher elevations in the watershed followed by a rapid return to base flows. Occasional spikes in base flows resulted from rainfall events during the summer and fall, or rainfall or warm weather during the winter. Passage and survival conditions in the Snake River-Columbia River migration corridor in 2007 were better than expected for the lower than normal snowpack and spring flows. Increased survival of juveniles was attributed to higher levels of 24-hour spill and the

delayed start of the smolt transport program reducing the transported proportion of the run (DeHart 2007).

Water temperatures near Eagle Creek were not in the ranges detrimental to adult migration or smoltification or that would increase disease risk, but growth may have been sub-optimal under conditions of limited food (U. S. Environmental Protection Agency 2003). Maximum daily temperatures at the Lookingglass Hatchery site during July 2007 were often >15^{o}C, within the range of impaired smoltification and increased disease risk (U. S. Environmental Protection Agency 2003).

The estimate of adult escapement above the trap in 2007 was the third-highest since 2001. Catches have varied slightly more than two-fold during 2001-2007 (median 180). Catches during 1965-1974 were substantially lower, ranging of 17-120 (median 56).

The estimate of juvenile outmigrants in 2007 was at the low end of the range for Lookingglass Creek since 2001 and slightly higher than the maximum from Mullarkey (1971). His estimates ranged from 7,727-13,261 (median 11,303). The 2007 estimate of outmigrants was comparable to other estimates from the Grande Ronde or Snake River Basins. Bumgarner and Dedloff (2007) reported a range of 13,245-35,051 from the Tucannon River (southeast Washington) for brood years 1995-2003. Van Dyke et al. (2008) reported outmigrant estimates ranging from 6,108-17,845 for 10 years in the upper Grande Ronde River, 19,628-45,799 for 10 years in Catherine Creek, 4,309-37,106 for 9 years in the Lostine River, and 24,846-105,853 for 6 years in the Minam River.

Migration timing for both juveniles and adults during 2001-2007 appear to be different than what was recorded during the 1960's and 1970's (Burck, unpublished data). Peak catches of adults occurred in March or April during 2001-2007, compared to May or June during 1964-1975. The number of juvenile outmigrants in the fall months of September-November were commonly much lower than the following spring during the late 1960's (Mullarkey 1971). In recent years, the number of fall outmigrants appears to be higher relative to spring catches.

Other aspects of both adult and juvenile life history appear to be similar to other the limited data from the region available from earlier years (Olsen et al. 1992) and summaries of life history data for steelhead (Burgner et al. 1992, Busby et al. 1996). Adults spend one (more common for males) or two (more common for females) in the ocean, and mean FL of returning adults is commonly in the 625-675 mm. Juveniles outmigrate all year and at a wide range of sizes, but most commonly, 2 years are spent in freshwater, and outmigrating smolts are 110-200 mm FL.

More detailed analysis of the life history of both adult and juvenile stages of summer steelhead from Lookingglass Creek may provide insights into interspecific relationships and productivity. Spring Chinook salmon production above the trap has been erratic or minimal since 1982. Anadromous habitat in Lookingglass Creek is less affected than many other streams in the Grande Ronde Basin by human activities such as grazing and agriculture, and supports a substantial population of bull trout.

2.6 Literature Cited

Bjorkstedt, E. P. 2007. DARR 2.0: updated software for estimating abundance from stratified mark-recapture data. U. S. Department of Commerce, National Oceanic and Atmospheric Administration-Fisheries, Southwest Fisheries Science Center, NOAA Technical Memorandum NMFS-SWFSC-368, Santa Cruz, California.

Bumgarner, J. D., and J. Dedloff. 2007. Lyons Ferry Complex Hatchery Evaluation: Summer Steelhead Annual Report 2005 Run Year. Washington Department of Fish and Wildlife, Olympia, Washington report to the U. S. Fish and Wildlife Service, Lower Snake River Compensation Plan, Boise, Idaho.

Burgner, R. L., Light, J. T., Margolis, L., Okazaki, T., Tautz, A., and S. Ito. 1992. Distribution and origin of steelhead trout (*Oncorhynchus mykiss*) in the offshore waters of the North Pacific Ocean. International North Pacific Fisheries Commission Bulletin Number 51. Vancouver, Canada.

Busby, P. J., Wainwright, T. C., Bryant, G. J., Lierheimer, L. J., Waples, R. S., Waknitz, F. W., and I. V. Lagomarsino. 1996. Status review of West Coast steelhead from Washington, Oregon, and California. U. S. Department of Commerce NOAA Technical Memorandum NMFS-NWFSC-27. Seattle, WA.

DeHart, M. 2007. Fish Passage Center Annual Report. Columbia Basin Fish and Wildlife Authority. Portland, OR.

Flesher, M. W., R. W. Carmichael, and J. R. Ruzycki. 2007. Summer steelhead creel surveys on the Grande Ronde, Wallowa, and Imnaha rivers for the 2001-02 run year. Oregon Department of Fish and Wildlife Annual Progress Report to the Lower Snake River Compensation Plan, U. S. Fish and Wildlife Service, Boise Idaho.

McLean, M.L, R. Seeger, and P.T. Lofy. 2001. Annual Progress Report for 1 January to 31 December 2000 for the Lower Snake River Compensation Plan. Section I. U. S. Fish and Wildlife Service Report, Boise, Idaho.

Mosher, K. H. 1969. Identification of Pacific Salmon and Steelhead Trout by Scale Characteristics. U. S. Department of the Interior, Fish and Wildlife Service, Bureau of Commercial Fisheries Circular 317.

Mullarkey, W. G. 1971. Downstream movement of juvenile steelhead trout (Salmo gairdneri) in Lookingglass Creek. Oregon Fish Commission Report. Portland, OR>

Nehlsen W., J.E. Williams, and J.A. Lichatowich. 1991. Pacific salmon at a crossroads: stocks at risk from California, Oregon, Idaho and Washington. Fisheries 16 (2):4-20.

Olsen, E., P. Pierce, M. McLean, and K. Hatch. 1992. Stock summary reports for Columbia River anadromous salmonids. Volume II. Oregon Subbasins above Bonneville Dam. Report prepared for Bonneville Power Administration. Project No. 99-108, Contract No. DE-FC79-89BP94402. Portland, OR

PIT Tag Steering Committee. 1999. PIT Tag Marking Procedures Manual. Version 2.0. Columbia Basin Fish and Wildlife Authority. Available: http://www.pittag.org/Software_and_Documentation/MPM.pdf)

Reischauer, A. G., F. R. Monzyk, E. S. Van Dyke, B. C. Jonasson, and R. W. Carmichael. 2007. Investigations into the early life history of naturally produced spring Chinook salmon and summer steelhead in the Grande Ronde River Basin. 2001 Annual Report to the Bonneville Power Administration, Project 199202604, Portland, Oregon.

Roper, B. and D. L. Scarnecchia. 1996. A comparison of trap efficiencies for wild and hatchery age-0 Chinook salmon. North American Journal of Fisheries Management 16(1):214-217.

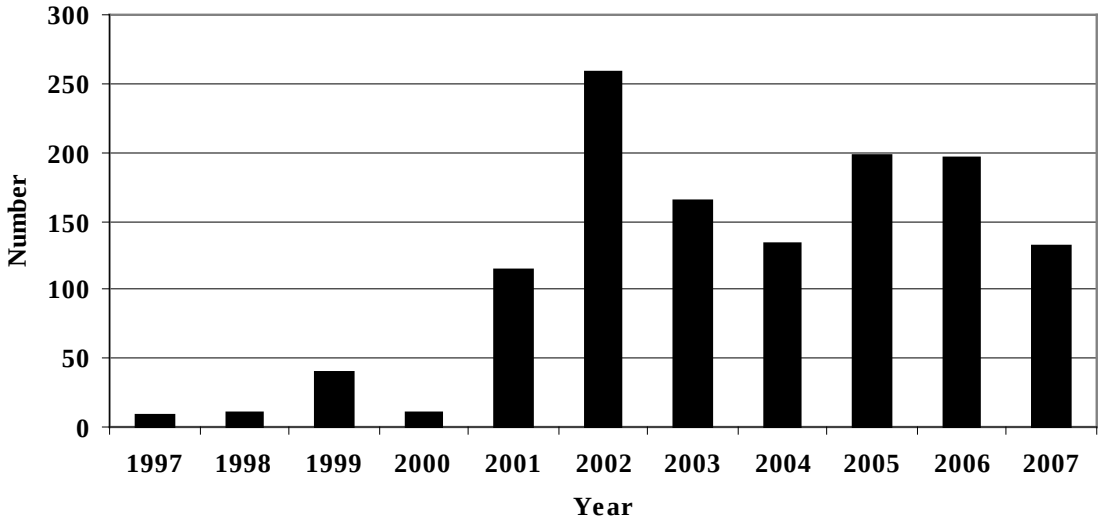
U. S. Army Engineer District. 1975. Special Report. Lower Snake River Compensation Plan. Walla Walla, WA.

U. S. Environmental Protection Agency. 2003. EPA Region 10 Guidance for Pacific Northwest State and Tribal Water Quality Standards. EPA 910-B-03-002. Region 10 Office of Water, Seattle, WA.

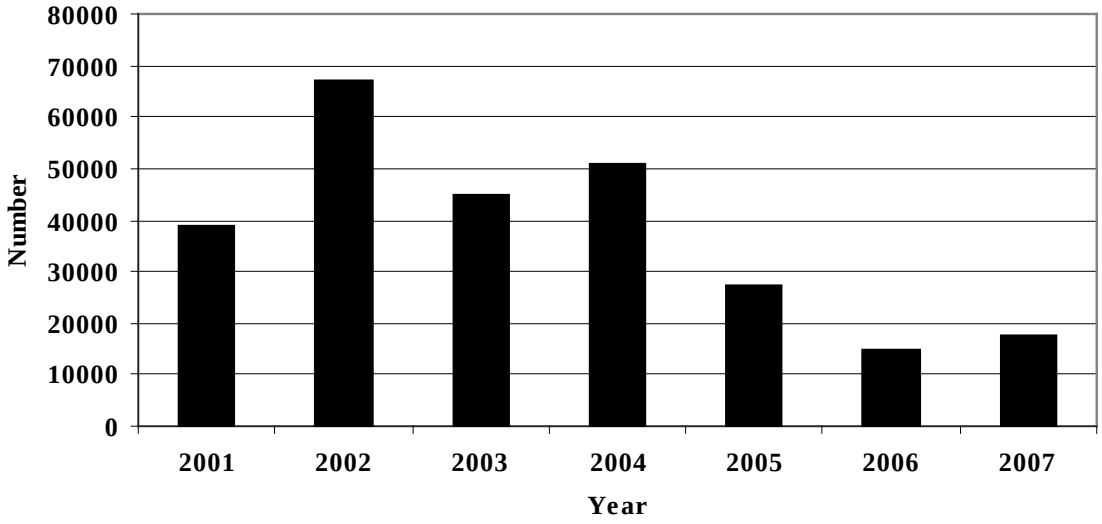
Van Dyke, E. S., J. A. Yanke, J. W. Steele, B. C. Jonasson, and R. W. Carmichael. 2008. Investigations into the early life history of naturally produced spring Chinook salmon and summer steelhead in the Grande Ronde River Basin. Oregon Department of Fish and Wildlife, La Grande, Oregon, Annual Report prepared for the Bonneville Power Administration, Project 1992-026-04, Portland, Oregon.

Westhagen, P. and J. R. Skalski. 2007. Program PitPro 4.0. Columbia Basin Research, University of Washington, Seattle.

2.7 Appendix Figures



Appendix Figure 1. Catch of unclipped (wild) summer steelhead at the Lookingglass Creek trap, 1997-2007.



Appendix Table 2. Lookingglass Creek juvenile *O. mykiss* outmigrant production, 2001-2007.

3 SECTION III ASSISTANCE PROVIDED TO LSRCP COOPERATORS AND OTHER PROJECTS

We provided assistance to LSRCP cooperator ODFW in 2007 for ongoing hatchery evaluation research. Project personnel completed extensive spawning ground surveys for spring Chinook salmon in the Grande Ronde and Imnaha river basins. We provided assistance in pre-release sampling of spring Chinook salmon at LH. Project personnel provided assistance in sampling adult spring Chinook salmon at Oregon LSRCP facilities. Assistance was provided in data summarization and analysis for ODFW monthly and annual progress reports.

We assisted Bonneville Power Administration (BPA) projects with data collection in 2007. We assisted ODFW personnel who have been collecting data on bull trout (*Salvelinus confluentus*) in the Grande Ronde River basin. We have collected fork length and weight data from bull trout we have captured in Lookingglass Creek in our screw trap and those captured in the LH adult bypass.

4 ACKNOWLEDGMENTS

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