Lower Snake River Compensation Plan
Confederated Tribes of the Umatilla Indian Reservation
Evaluation Studies for 1 January 2005 to 31 December 2005

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

Section II
O. mykiss Investigations in Lookingglass Creek and Other Grande Ronde River Tributaries

Section III
Assistance Provided to LSRCP Cooperators and Other Projects

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Table of Contents

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

Maximum stream flow recorded in 2005 was 489 CFS. Mean daily stream flows above 100 CFS were recorded continuously from 12 March-7 June 2005. Maximum daily water temperatures ranged from 11.8-21.7^{o}C at 3 sites in Lookingglass Creek and Jarboe Creek. Catches of spring Chinook salmon adults at the Lookingglass Hatchery trap from 30 May-7 September 2005 totaled 25 unmarked (15 males, 10 females) and 44 adipose-clipped (32 males, 12 females). All unmarked fish were euthanized at the trap. Adipose-clipped fish were held at Lookingglass Hatchery and outplanted upstream of the hatchery on 2 August 2005. An additional 20 adults from collected at the Catherine Creek trap were outplanted above the Lookingglass Hatchery trap on 2 August 2005. Spawning ground surveys from 16 August-26 September 2005 yielded 29 redds and 28 carcasses above and 10 redds and 12 carcasses below the Lookingglass Hatchery trap. Estimated total returns to the stream (collected at the Lookingglass Hatchery trap or spawners below the trap) were 66 unmarked and 35 adipose-clipped. Naturally-produced brood year 2003 outmigrants totaled 6,296 (SE 1,531), mean FL of outmigrants sampled between 18 August 2004-5 July 2005 was 95.7 mm and outmigrants per redd were 630. A total of 98,023 hatchery-reared brood year 2003 progeny of Catherine Creek captive broodstock were released from Lookingglass Hatchery from 18 March-29 March 2005. Mean FL was 113.4 mm, median arrival timing to Lower Granite Dam was 30 April 2005, and survival to Lower Granite Dam was 0.5182. Management of spring Chinook salmon in Lookingglass Creek is in transition, phasing out Rapid River stock and phasing in Catherine Creek stock 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. Spring releases in 2004 and 2005 of brood year 2002 and 2003 fish should produce more adult returns. Releasing adequate numbers of smolts in the spring and allowing adequate numbers of adults to spawn naturally above Lookingglass Hatchery on a consistent basis are critical to restoring a self-sustaining population.

1.2 Introduction

The native Lookingglass Creek stock of spring Chinook salmon was functionally extirpated within a few years of the establishment of Lookinglass Hatchery (LH) in 1982. Lookingglass Creek is within the "usual and accustomed" areas of gathering for the Confederated Tribes of the Umatilla Indians (CTUIR). CTUIR, along with the Oregon Department of Fish and Wildlife (ODFW) as comanagers, in the 1990's began efforts to reestablish natural production of spring Chinook salmon in Lookingglass Creek. Fertilized eggs from Rapid River (Idaho) stock fish were hatchery-reared and released into Lookingglass Creek. After sufficient adults returned, they were used as broodstock. Until 1992, no Rapid River stock adults were intentionally released above the Lookingglass Hatchery trap to spawn naturally, except for a small number in 1989, due to concerns about pathogens in the hatchery water supply. From 1992-1994, and in 1996-1997, some adults were released above the hatchery trap but none were released from 1998-2003. The last Rapid River stock juvenile release from Lookingglass Hatchery occurred in 2000. Reintroduction was continued using a Grande Ronde Basin endemic stock (Catherine Creek) starting in 2001. Potential hatchery-origin adult returns in 2005 included Catherine Creek stock releases into Lookingglass Creek in 2001, 2002, and 2004 (Table 1). Annual reports describing the historical efforts at reestablishing natural production of spring Chinook salmon in Lookingglass Creek are available at http://www.fws.gov/lsnakecomplan/Publications.html. Zimmerman and Patterson (2002) described current stock management practices for the Grande Ronde Basin.

Table 1. Hatchery-produced spring Chinook salmon released into Lookingglass Creek, 2001-2004.

BY	Release Date	No. Released	Mean weight (g)	Marks*
2000	24 September 2001[a]	51,864	17.8	AD clip/CWT/PIT
2001	28 May 2002[a]	17,539	7.0	AD clip/CWT
2003	8 April 2004[b]	53,195	21.35	AD clip/CWT/PIT

* *AD = adipose, CWT = coded wire tag, PIT=PIT tag*

[a] *presmolt releases*

[b] *smolt release*

CTUIR has evaluated the reintroduction of spring Chinook salmon into Lookingglass Creek since 1992, describing production (e.g. adult returns, redds, outmigrant abundance) and life history (e.g. adult and juvenile run timing, survival) metrics and comparing performance of the endemic and reintroduced stocks, as well as year-to-year comparisons of the reintroduced stock. Ultimate goals are to reestablish a self-sustaining population of spring Chinook salmon, restore balance to the ecosystem, and provide for tribal harvest.

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. Lookingglass Creek flows 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 (Figure 1). Little Lookingglass Creek is the only major tributary. Four minor tributaries are Lost Creek, Summer Creek, Eagle Creek, and Jarboe Creek. Lookingglass Creek and Little Lookingglass Creek (the largest tributary) are the main spawning areas for spring Chinook salmon. Lookingglass Hatchery is located at rm 2.3 on Lookingglass Creek.

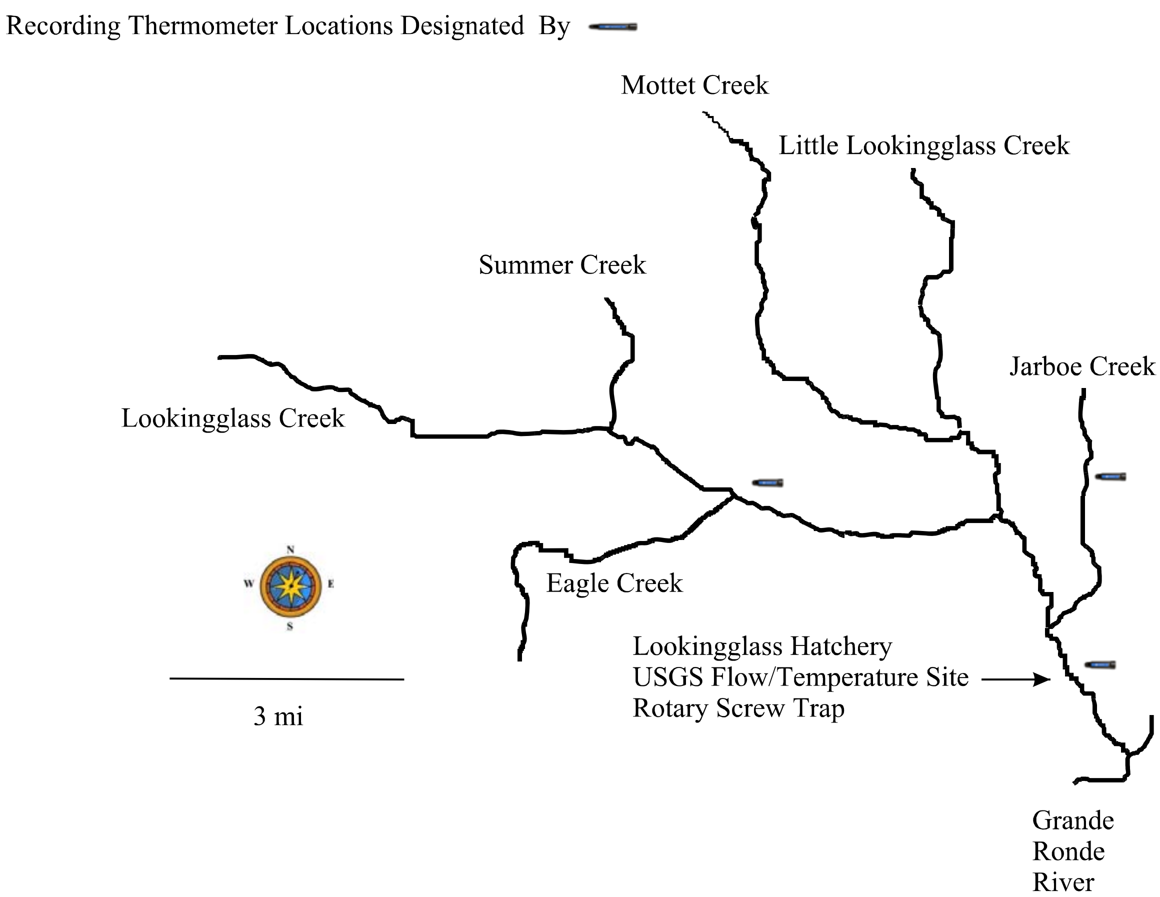

Figure 1. Map of the Lookingglass Creek basin showing the locations of major tributaries, temperature and flow recorders, screw trap (after 13 July 2005) and Lookingglass Hatchery.

1.4 Methods

1.4.1 Stream Flow and Temperature

We obtained and summarized Lookingglass Creek stream flow and water temperature data collected in 2005 by the United States Geological Survey (USGS) near Lookingglass Hatchery. Data for the site USGS13324300 Lookingglass Creek near Looking Glass, OR are available at
http://waterdata.usgs.gov/or/nwis/uv/?site_no=13324300&PARAmeter_cd=00065,00060
Additional water temperature data was obtained from UNF data loggers in Lookingglass Creek and Jarboe Creek.

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 installed the trap on 22 February 2005 and operated it until 9 September 2005. ODFW LH staff usually checked the trap three times a week. Adult spring Chinook salmon captured in the Lookingglass Hatchery trap were unmarked progeny of marked and unmarked fish spawning naturally (probably including some unmarked strays from other streams), and returns of juveniles reared at Lookingglass Hatchery. All adult spring Chinook salmon captured in the trap were enumerated, examined and scanned for fin clips, opercle punches and other marks and tags, measured (nearest mm FL), and sex and maturity status determined. We assumed unclipped adults were Rapid River origin or strays from other streams. Unclipped adults were euthanized and scale samples collected. Permanent impressions of scales were made in cellulose acetate and examined with a microfiche reader. Criteria for annuli from Mosher (1969) were used. Week of capture was designated by the first day of the week (e.g. week of 1 January included 1-7 January).

Ad-clipped adults collected at the Lookingglass Hatchery trap and identifiable as Catherine Creek captive broodstock and some captive broodstock returns to the Catherine Creek trap were placed in a holding pond at Lookingglass Hatchery for later release above the trap to spawn naturally. Ad-clipped conventional broodstock progeny adults from other streams (Lostine River, upper Grande Ronde River, Catherine Creek) were identified by a visual implant elastomer tag, placed in the respective holding ponds, and later used as hatchery broodstock.

Spawning ground surveys (Parker et al. 1995) were conducted weekly during August and September 2005 in designated units of the stream (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 carcasses recovered on spawning ground surveys for CWT recovery. Snouts and recovery data were provided to the ODFW CWT laboratory in Clackamas, OR. Release and recovery data for the various codes used were later obtained from the Regional Mark Processing Center database maintained by the Pacific States Marine Fisheries Commission (http://www.rmpc.org/).

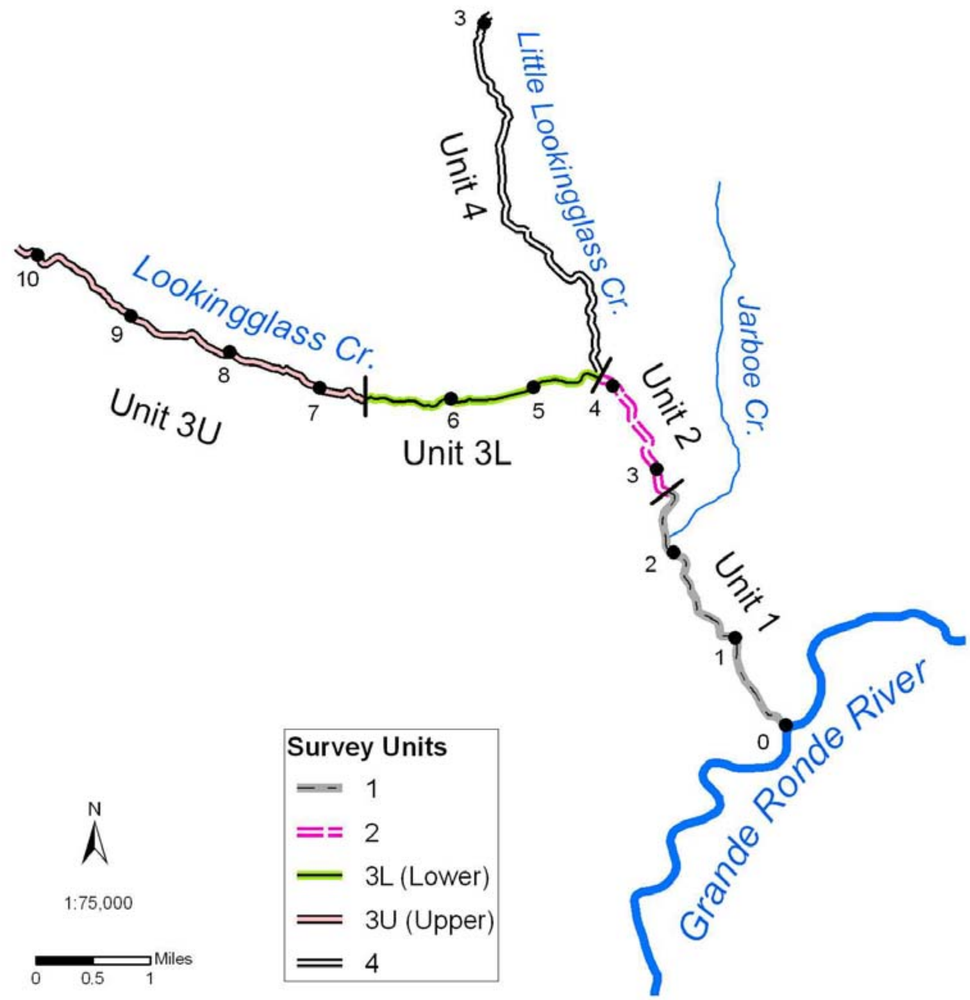

Figure 2. Spawning ground survey unit designations and river miles for Lookingglass Creek (modified from Burck 1993).

A tribal harvest was held on 18-19 June 2005, with a harvest quota of 10 ad-clipped fish. Harvest of unmarked fish was unlimited. We checked fishers at a station near the mouth of Lookingglass Creek to collect harvest data.

Recoveries of ad-clipped carcasses above the Lookingglass Hatchery trap by brood year, stock, and release location were obtained by using the actual recovered CWT fractions by code from spawning ground surveys and multiplying by the number of fish 1)transported from Catherine Creek and outplanted, or 2)caught at the Lookingglass Hatchery trap and outplanted. The same CWT fractions were used to apportion ad-clipped fish in the tribal harvest. Only CWT codes from BY 2000 and 2001 were used for Catherine Creek outplants and harvest, since all those fish were ≥ 640 mm FL.

Spawners below the trap were estimated using the product of redds and a fish per redd value of 2.5. Most published fish/redd values range from 2-3.5; we used a conservative value of 2.5. Ad-clipped and unclipped spawners were apportioned using the fractions caught at the trap. Ad-clipped spawners by brood year, stock, and release location were apportioned using CWT recoveries from spawning ground surveys. Unclipped fish from each brood year were determined using the scale age distribution of fish euthanized at the trap and recovered on spawning ground surveys. Total returns to Lookingglass Creek were estimated from the total number of fish released above the trap, those euthanized at the trap, tribal harvest, and spawners below the trap.

1.4.3 Juvenile Spring Chinook Salmon

We collected a "field" group of parr by snorkel seining at several locations in Lookingglass Creek above the hatchery trap during August, measured (mm FL), weighed (0.1 g) and PIT-tagged according to standard procedures (PIT Tag Steering Committee 1999), and released. Life history for the field group was compared to similar groups of parr collected 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 0.1 until 12 July 2005 on Lookingglass Creek to collect outmigrating natural and hatchery-produced juvenile spring Chinook salmon. We moved the trap to above the "flume hole" at rm 2.4 on 13 July 2005. We attempted to operate the screw trap continuously during 2004-2005, but jamming from debris, high water temperatures, and other factors caused some interruptions. The trap was usually checked 3 times/week or more frequently if catches or flows were high. All fish were identified, enumerated, examined for external marks, scanned with a PIT tag reader, measured (FL mm), and weighed (0.1 g). All fish were marked with a lower caudal fin clip and released about 300 ft above the trap to estimate trap efficiency. DARR 2.0 (Bjorkstedt 2005) was used to estimate outmigrating natural-origin spring Chinook salmon juveniles (excluding precocials). 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” program options and assumed recaptures occurred in the same period as release.

An outmigrating brood year of juvenile spring Chinook salmon from Lookingglass Creek has the following pattern: an unknown (but probably small) number leave as fry (30-45 mm FL) in March-June during high water. Most juveniles outmigrate as presmolts from August-November at lengths of 50-90 mm FL. A much smaller number outmigrate as 70-100 mm smolts during February-June, up to 18 months after spawning.

Naturally-produced juvenile spring Chinook collected by the screw trap could be distinguished into two groups based on size. During January-May of 2005, naturally-produced (unmarked) BY 2004 juveniles were distinguished from BY 2003 naturally-produced juveniles by their much smaller size (30-45 mm FL) and lower abundance. BY 2004 naturally-produced juveniles were not marked or used in estimates of trap efficiency. Production and performance of BY 2004 natural-origin spring Chinook salmon will be described in the 2006 annual report

BY 2003 hatchery-origin juveniles (Catherine Creek captive broodstock progeny) were released from Lookingglass Hatchery on 29 March 2005. These fish were adipose-clipped and coded-wire tagged and a portion PIT-tagged prior to release into Lookingglass Creek. These fish rapidly passed out of Lookingglass Creek on their way to the ocean and were ignored in the screw trap catch.

We estimated survival, capture probability, and travel time to Lower Granite Dam for PIT-tagged hatchery-origin BY 2003 juvenile spring Chinook salmon released on 29 March 2005 by querying the PIT tag database maintained by the Pacific States Marine Fisheries Commission at http://www.ptagis.org/ and using PitPro (Westhagen and Skalski 2006). 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). We estimated arrival timing at Lower Granite Dam using daily PIT tag detections 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. Due to the low number of outmigrants for BY 2003, we did not PIT tag any.

We monitored seasonal growth (FL, weight) of natural-origin juvenile spring Chinook salmon by seining fish at several locations above and below the Lookingglass Hatchery trap from June-September 2005. Fish were sampled on the 20th of each month, +/- 5 d.

1.5 Results

1.5.1 Stream Flow and Temperature

Stream flow ranged from 50-60 CFS during the first two weeks of January, the last two weeks of February, and the first week of March 2005 (Figure 3). A brief increase to 103-161 CFS occurred from 18 January 2005-23 January 2005. Flow increased to 107 CFS on 12 March 2005 and remained above 100 CFS through 7 June 2006. Flows above 300 CFS were recorded only on 27-30 March 2005 and 27 April 2005. The maximum CFS of 489 was recorded on 28 March 2005.

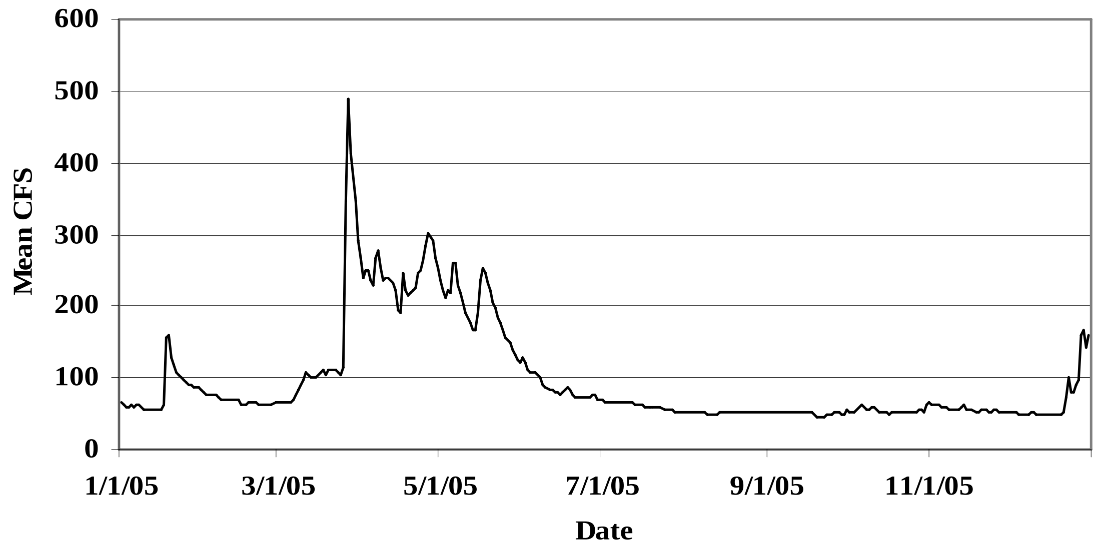

Figure 3. Mean daily streamflows in Lookingglass Creek at the USGS gauging station near Lookinglass Hatchery, 2005.

Water temperatures at the USGS site began rapidly increasing in May 2005 (Figure 4). Maximum temperatures exceeding 16°C were observed on 20 d from 28 May 2005-10 July 2005, and for 24 consecutive days beginning on 11 July 2005. The maximum temperature recorded was 18.9 °C on 12 July 2005. Data were not available after early August due to equipment malfunction (Jo Miller, personal communication). Water temperatures at the Eagle Creek site peaked at 11.8°C on 21 June 2005 and 12 July 2005 (Figure 5). The mean temperature remained near 8°C from late June 2005 through early August 2005, declining to about 6°C by mid-October 2005. Water temperatures at Jarboe Creek were the highest of the three sites during 2005 (Figure 6). Maximum temperatures exceeding 20°C were recorded for 17 d from 12 July 2005-22 August 2005. The maximum temperature of 21.7 °C was recorded on 1 August 2005. Mean daily temperatures were exceeded 16°C for 23 d from 6 July 2005-22 August 2005.

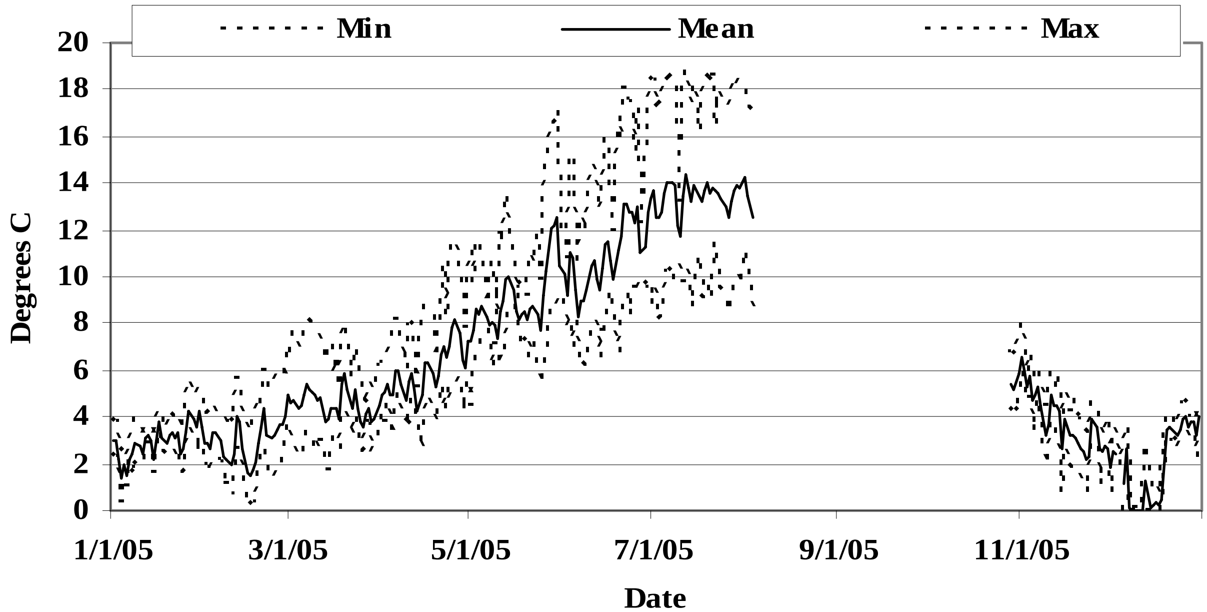

Figure 4. Water temperatures in Lookingglass Creek near Lookingglass Hatchery, 2005.

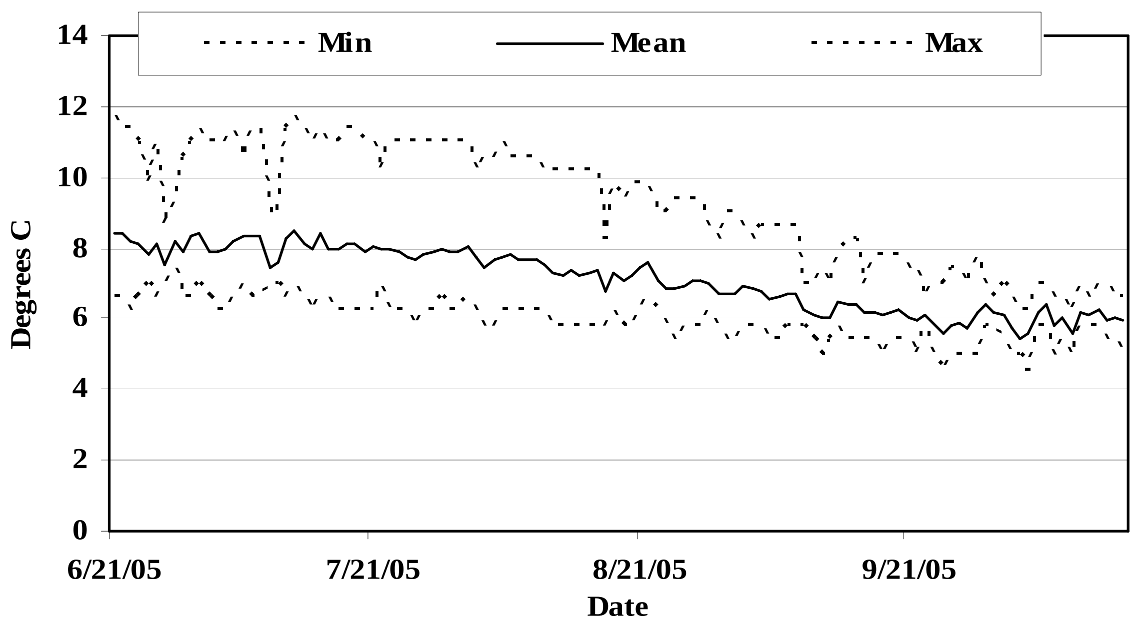

Figure 5. Water temperatures in Lookingglass Creek at the site below Eagle Creek, 2005.

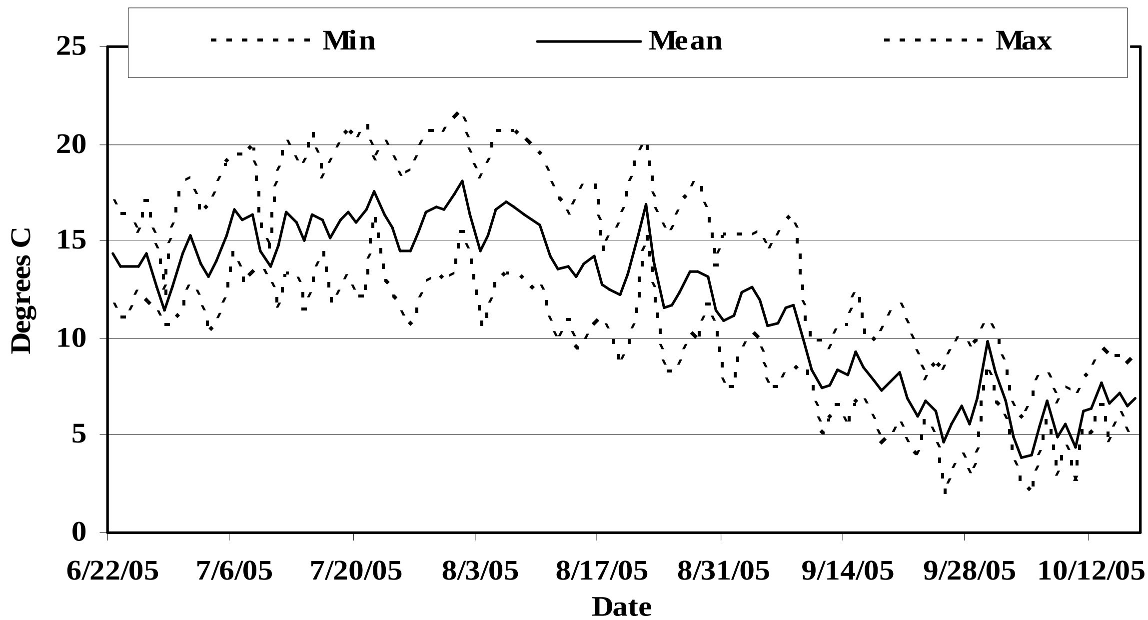

Figure 6. Water temperatures in Jarboe Creek, 2005.

1.5.2 Adult Spring Chinook Salmon

1.5.2.1 Catherine Creek Outplants

A total of 20 hatchery-origin (captive broodstock progeny) spring Chinook salmon collected at the Catherine Creek trap was transported to Lookingglass Creek, held, and released at approximately rm 6.5 on 2 August 2005 with those collected at the Lookingglass Creek trap. FL ranged from 64-84 with most from 66-74 cm (Figure 7). Dates of capture at the Catherine Creek trap ranged from 18 May 2005-12 August 2005.

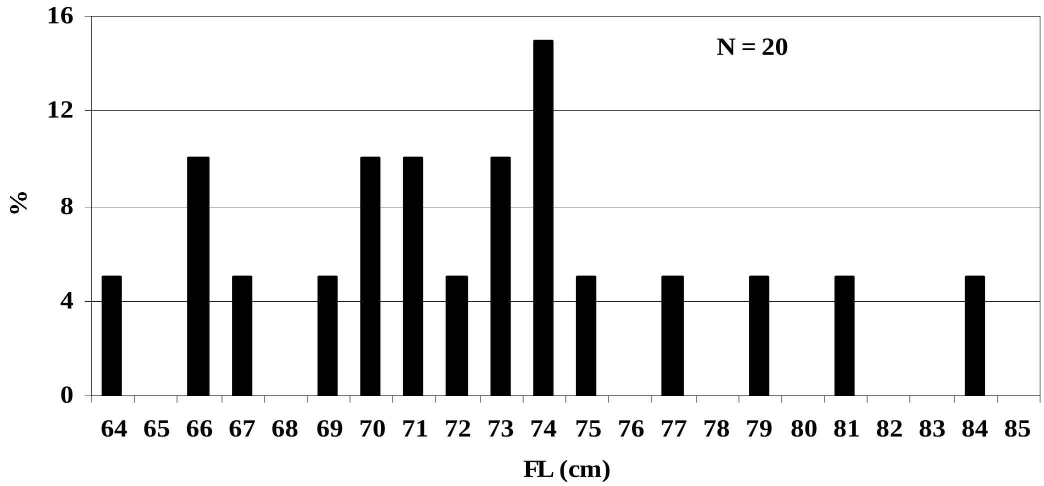

Figure 7 FL frequency of Catherine Creek stock spring Chinook salmon adults outplanted to Lookingglass Creek, 2005.

The Lookingglass Hatchery adult trap was operated from 22 February 2005-9 September 2005. Operation was continuous except for brief periods (1-2 d) during the spring freshet in April and May. Flows decreased from 129-56 CFS during late May to late July and mean daily water temperatures increased from 8.3-14.3^{o}C. Flows were stable at around 50-53 CFS in early September.

Unclipped (Rapid River stock) caught from 30 May 2005-28 August 2005 totaled 25, including 10 females and 15 males (Figure 8). All but 2 were in the 63-79 cm FL groups (Figure 9).

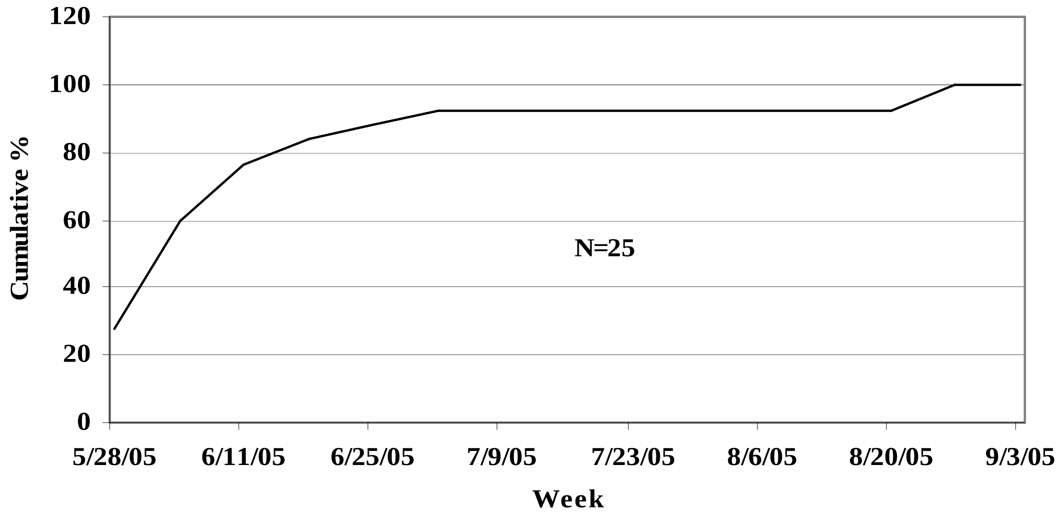

Figure 8. Cumulative % of total catch by week for unclipped (Rapid River stock) spring Chinook salmon caught at the Lookingglass Hatchery adult trap, 2005.

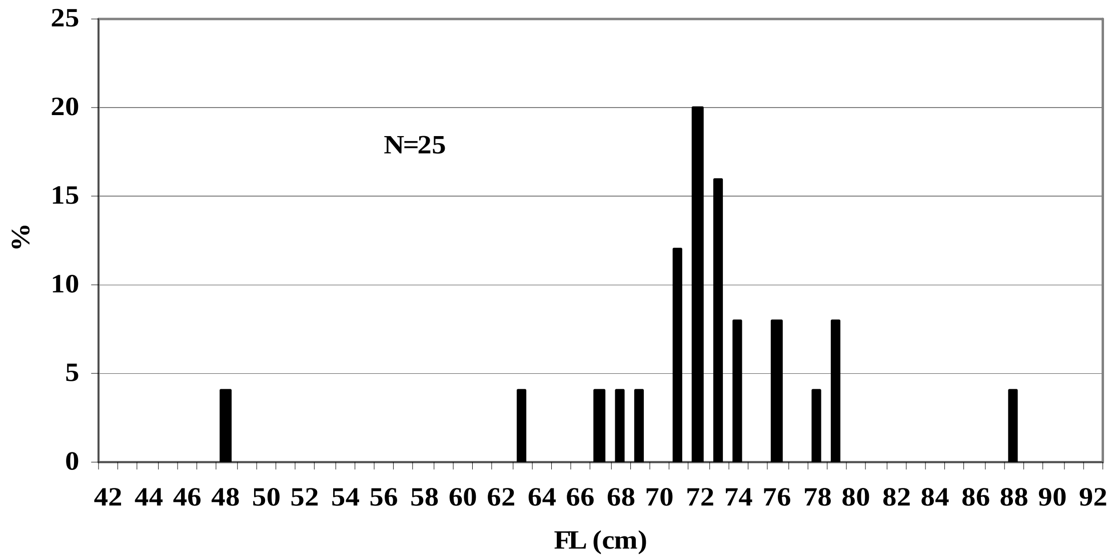

Figure 9. Length frequency for unclipped (Rapid River stock) spring Chinook salmon caught at the Lookingglass Hatchery adult trap, 2005.

Ad-clipped adults collected from 30 May 2005-7 September 2005 totaled 44, including 32 females and 12 males (Figure 10). Thirty-two (73%) were caught between 30 May 2005-6 July 2005 and twelve from 20 July 2005-7 September 2005. Seven were identified as Catherine Creek conventional broodstock progeny (4), upper Grande Ronde

River conventional broodstock progeny (2), or Lostine River stock (1) and used as conventional broodstock at Lookingglass Hatchery for their respective streams. There appeared to be little difference in arrival timing at the trap if these seven were excluded. FL ranged from 42-92 cm (Figure 11). Eleven of the thirty-seven Catherine Creek captive brood progeny (30%) and two of the other seven fish (29%) were in the 42-54 cm FL groups

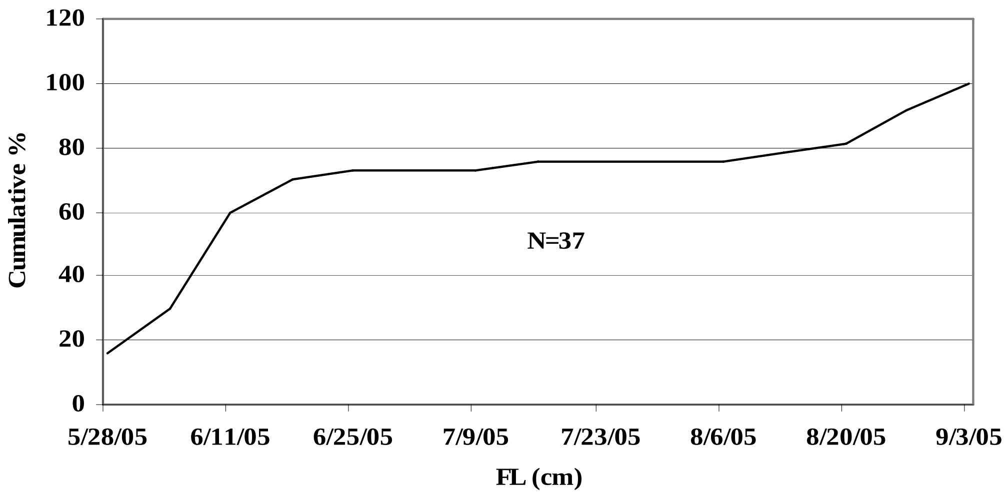

Figure 10. Arrival timing at the Lookingglass Hatchery adult trap for ad-clipped spring Chinook salmon (Catherine Creek captive brood progeny), 2005.

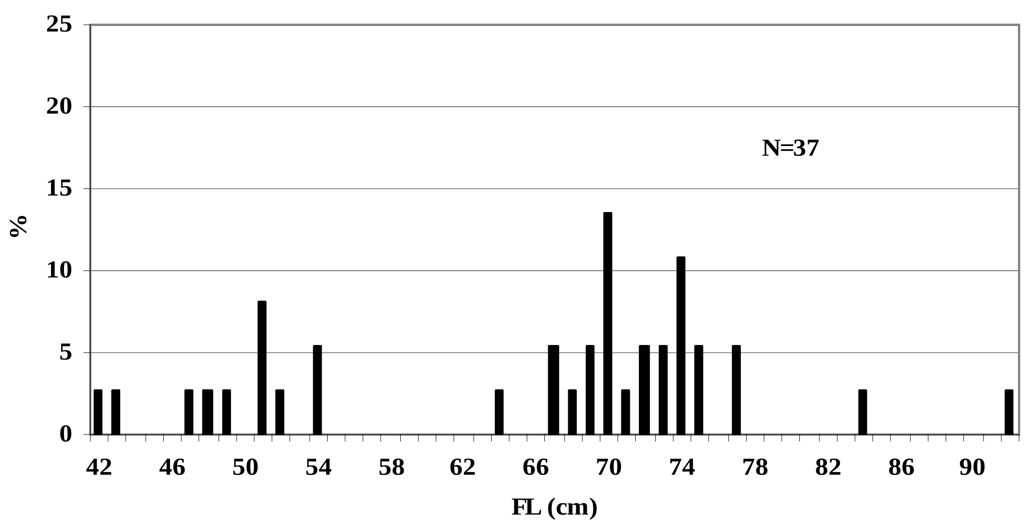

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Figure 11 FL frequency for ad-clipped spring Chinook salmon caught at the Lookingglass Hatchery adult trap, 2005.

1.5.2.2 Tribal Harvest

The estimated tribal harvest of fish on 18-19 June 2005 was 5 ad-clipped fish from 64-81 cm FL (3 males, 2 females), and one unmarked 74 cm FL female

1.5.2.3 Spawning ground surveys

Spawning ground surveys were completed from 16 August 2005-26 September 2005. The first redd was observed on 16 August 2005 and the last on 26 September 2005. Unit 1 was surveyed 4 times, and Units 2-4 were surveyed 5-6 times each. The largest number of new redds was observed on 31 August 2005. Twenty-nine redds were observed above the Lookingglass Hatchery trap and ten below (Figure 12). Weather and visibility conditions were generally excellent during the survey period. Fish per redd above the Lookingglass Hatchery trap was 1.97 (57/29).

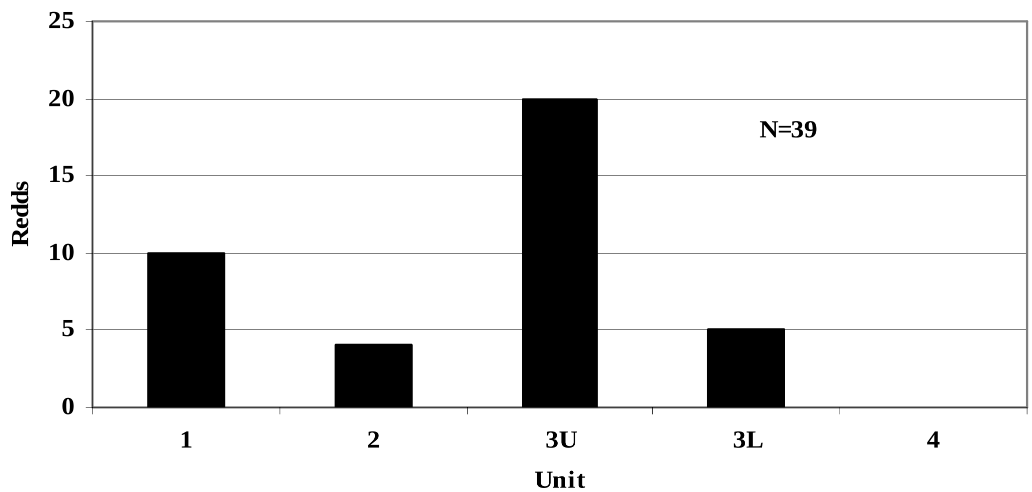

Figure 12. Spring Chinook salmon redds by unit, Lookingglass Creek, 2005.

1.5.3 Carcass Recoveries

Carcass recoveries above the trap totaled 28, including 26 with ad-clips and opercle punches and 2 ad-clipped but with opercle punch status unknown. CWT recoveries from 27 carcasses allowed assignment to 3 brood years and 3 stocks (Table 2). Most carcasses were from 63-81 cm FL (Figure 13). Sex composition was 14 females and 13 males and 1 unknown. Females recovered from 9 September 2005-22 September 2005 (N=12) were 95-100% spawned out, 1 recovered on 31 August 2005 was a prespawning mortality (0% spawned) and 1 recovered on 14 September 2005 did not have percent spawned data recorded. Four ad-clipped males (75-84 cm FL) were recovered on the barrier weir.

Table 2. Recovery data for ad-clipped spring Chinook salmon carcasses recovered above the Lookingglass Hatchery trap on spawning ground surveys, 2005.

BY	Stock	Release Location	Recoveries
2000	Catherine Creek	CCAF	2
2001	Catherine Creek	CCAF	13
2001	upper Grande Ronde River	UGRAF	10
2002	Catherine Creek	Lookingglass Hatchery	2
Total			27

CCAF=Catherine Creek acclimation facility, UGRAF=upper Grande Ronde R. acclimation facility

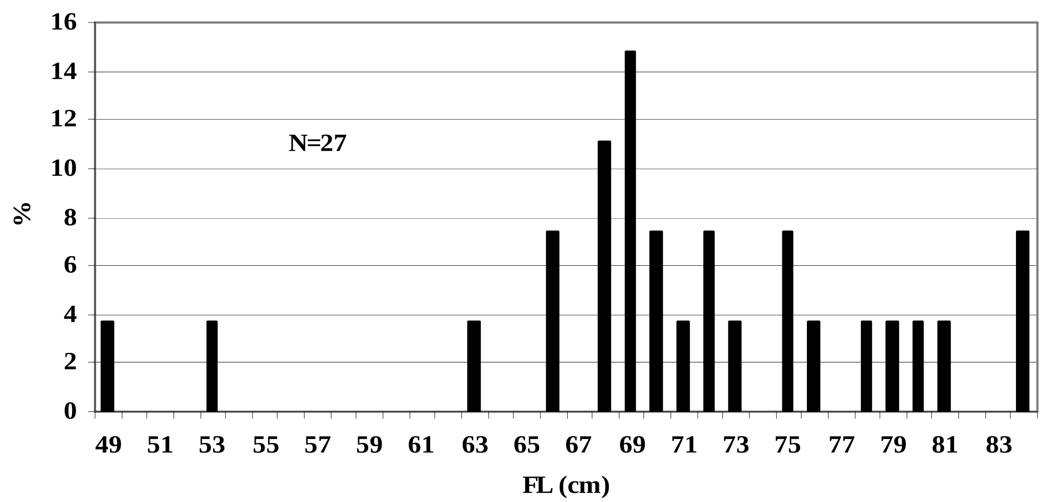

Figure 13. FL (cm) distribution for ad-clipped spring Chinook salmon carcasses recovered above the Lookingglass Hatchery trap on spawning ground surveys, 2005.

A total of 8 unclipped carcasses was recovered below the trap, including 6 males and 2 females. Three of the males ranged from 50-57 cm FL and the other three from 710-745. The two females were 70 and 89 cm FL. The two females were both 100% spawned out and recovered on 9 and 11 September 2005.

A total of 4 ad-clipped carcasses was recovered below the trap, including a 53 cm FL male and 3 females from 66-71 cm. The 66 cm female had an opercle punch, meaning it had been outplanted above the barrier weir, then dropped back over the barrier weir and past the adult trap. CWT data for 3 of the 4 ad-clipped carcasses indicated they were BY 2001 Catherine Creek stock and released from the Catherine Creek acclimation facility.

1.5.3.1 Length and Age at Recovery

Age 4 fish were most common for both unclipped and ad-clipped groups (Table 3). Unclipped age 3 males were longer than ad-clipped, but the reverse occurred for age 4 males. Unclipped age 4 females were longer than ad-clipped.

Table 3. Summary of FL data by clip, sex, and age for spring Chinook salmon collected at the Lookingglass Hatchery adult trap or on spawning ground surveys and aged using scales (Clip = "None") or CWT (Clip = "Ad"), 2005.

Clip	Sex	Age	$\bar{X}$ FL	Range	SE	n
None	M	3	536.7	480-570	28.5	3
Ad	M	3	518.3	490-535	14.2	3
None	M	4	731.5	675-780	9.0	11
Ad	M	4	755.5	695-810	13.2	10
None	M	5	795			1
Ad	M	5	840			1
None	F	4	721.4	685-740	5.5	11
Ad	F	4	686.9	630-730	6.7	15
None	F	5	880			2
Ad	F	5	840			1

1.5.3.2 Total Returns to the Stream

There was no way to distinguish stocks separately for the adults that swam in to the Lookingglass Hatchery trap and those that were caught at the Catherine Creek trap and transported to Lookingglass Hatchery. Both groups were released above the Lookingglass Hatchery trap to spawn naturally. CWT recoveries both above and below the Lookingglass Hatchery trap and stock identification data that was collected at the trap were used to assign stock and age composition of hatchery-origin adults.

Hatchery-origin returns outnumbered those of natural (Rapid River stock) origin (Table 4). Among hatchery-origin returns, BY 2001 (age 4) were more numerous than BY 2000 (age 5), and BY 2003 (age 3) were about a third as abundant as age 4. Catherine Creek and upper Grande Ronde River stocks were similar in abundance of BY 2001. All BY 2002 returns were probably Catherine Creek stock released from Lookingglass Hatchery in 2004.

Table 4. Estimated returns to Lookingglass Creek by brood year, stock, and release location for adult spring Chinook salmon, 2005.

			Recoveries				
BY	Stock[a]	Release Location[b]	Above Trap	Harvest	Below Trap	Trap*	Total Returns
2000	CC	CCAF	2		1		3
	BY 2000 Totals		2		1		3
2001	CC	CCAF	13	3	6	2	24
2001	UGR	UGRAF	10	2	5	2	19
2001	LOS	LRAF	1	0	0	1	2
	By 2001 Totals		24	5	11	5	45
2002	CC	LOOH	11		5	2	18
	BY 2002 Totals		11		5	2	18
2000	RR				1	3	4
2001	RR			1	8	21	30
2002	RR				0	1	1

[a] *CC=Catherine Creek, CC (LKG)=Catherine Creek released from Lookingglass Hatchery, UGR=upper Grande Ronde River, LOS=Lostine River*
[b] *CCAF=Catherine Creek acclimation facility, UGRAF=upper Grande Ronde R. acclimation facility, LRAF=Lostine R. acclimation facility LOOH=Lookingglass Hatchery*
[*] *euthanized at trap or spawned at Lookingglass Hatchery*
*** rounded to the nearest whole number*

1.5.4 Juvenile Spring Chinook Salmon

1.5.4.1 Brood Year 2003 Natural Production

We operated the rotary screw trap continuously during 2004-2005, except for periods of high debris or flow, midsummer with little fish movement, and some periods of high mortality due to mink predation. Days not operated (in parentheses) were: April 2004-May 2004(32), July 2004-August 2004(31), October 2004-December 2004(21), January 2005-February 2005(21), March 2005(6), and May 2005-June 2005(6).

BY 2003 fish were caught from 2 April 2004-5 July 2005. Because of the low numbers caught, data were grouped into 3 periods to use in DARR 2.0; 2 April 2004-14 September 2004, 16 September 2004-29 September 2004, and 1 October 2004-5 July 2005. DARR 2.0 reduced these to a single period for the BY 2003 outmigrant estimate of 6,296 +/- 1,531. There were 326 first-time captures (253 from 16-29 September) and 309 clipped and released, and 16 recaptures (13 from 16-29 September). The first-time captures on two dates (16 and 17 September) totaled 217, or 67 of the total. There were 10 mortalities (7 due to mink), and 11 precocials ranging from 91-135 mm FL.
Mean FL (mm), weight (g), and K factor for outmigrants sampled from 18 April-19 July 2004 were 67.8 (range 38-104, N=16, 5.4 (range 2.0-9.4, N=12), and 1.20 (range 0.84-1.54, N=12), respectively Mean FL (mm), weight (g), and K factor for outmigrants sampled from 18 August 2004-5 July 2005 were 95.7 (range 76-151, N=209, 10.3 (range 4.6-39.7, N=204), and 1.15 (range 0.80-1.45, N=204), respectively. Outmigrants per redd were 630 (10 redds in 2003).

1.5.4.2 Brood Year 2003 Hatchery Production

A total of 98,023 ad-clipped (66,578 ad-clipped with CWT, 31,445 ad-clip only) BY 2003 progeny of Catherine Creek captive broodstock were released from Lookingglass Hatchery into Lookingglass Creek beginning (volitional release) on 18 March 2005 and ending with forceout of remaining fish on 29 March 2005. Those PIT-tagged in October 2004 at Lookingglass Hatchery totaled 990. Mean FL of PIT-tagged fish was 113.4 mm (range 63-171) and mean weight was 18.0 g (7.8-49.2). Median arrival date at Lower Granite Dam was 30 April 2005 for 372 actual and 380 expanded detections. Harmonic mean travel time was 41.141 d (SE=0.430). Survival was 0.5182 (SE=0.0171) and capture probability was 0.7266 (SE=0.0216).

1.5.4.3 Brood Year 2004 Field Group

A total of 481 BY 2004 spring Chinook salmon parr were collected from several locations above the Lookingglass Hatchery trap from 9-12 August 2005, PIT-tagged and released. Mean FL was 73.2 mm (N=481, SE=0.3), mean weight was 5.2 g (N=481, SE=0.1), and mean K was 1.29 (N=481, SE=0.01). Survival, migration timing and arrival timing of these fish to Lower Granite Dam will be reported in the 2006 annual.

1.5.4.4 Brood Year 2004 Growth

Growth of BY 2004 spring Chinook salmon parr was generally slowest for fish from Little Lookingglass Creek (Figure 14). Mean FL at several stations was dispersed in July but the difference in mean FL diminished later in the season. Sample sizes for each combination of date and site ranged from 16-59.

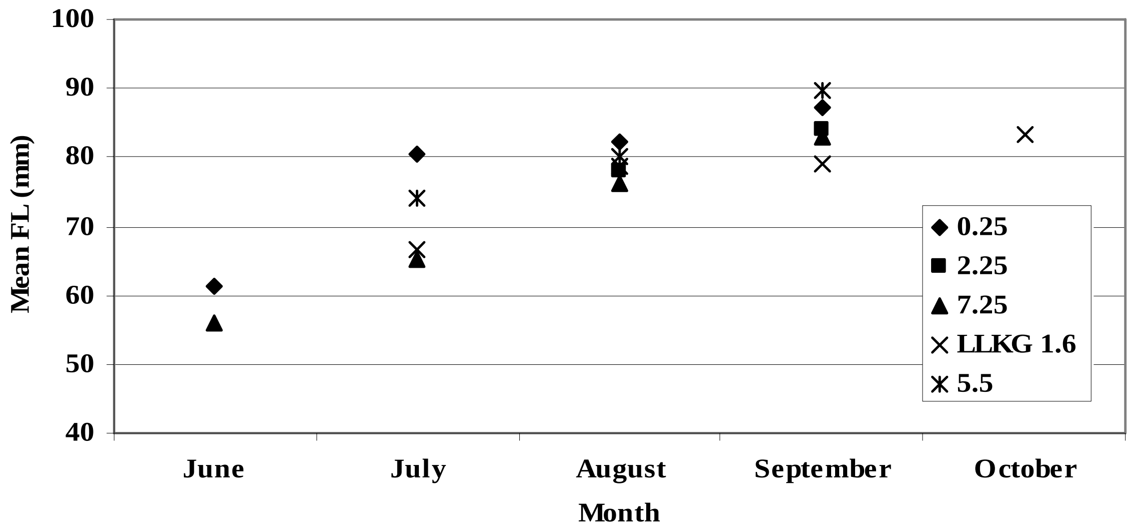

Figure 14. Mean FL (mm) for BY 2004 juvenile spring Chinook salmon by site, Lookingglass Creek, 2005 (sites in rm for Lookingglass Creek mainstem, LLKG 1.6 is rm 1.6 above the mouth of Little Lookingglass Creek).

1.6 Discussion

Mean daily flow for Lookingglass Creek in January 2005 was similar to the 1983-2005 water year average reported by Herrett et al. (2005). However mean daily flows for February-June 2005 were only 54-73% of the long-term average. Snow pack characteristics at higher elevations in the watershed, together with local weather and warming patterns in the spring are main determinants of both volume and timing of stream flows in the early part of the year. Later in the year, base flows of near 50 CFS are maintained by numerous springs in the upper reaches of the watershed.

Maximum daily temperatures at the Lookingglass Hatchery and Jarboe Creek sites often exceeded 14-18^{o}C, and may have negatively affected growth, smoltification, disease risk, and adult migration of salmonids (Richter and Kolmes 2005). Water temperatures at the various sites were affected by the amount of shading from solar radiation. The site near Eagle Creek is located in an incised reach with good shading from both riparian vegetation and steep slopes, and is a significant bull trout spawning area. The Lookingglass Creek floodplain downstream of Eagle Creek begins to open up more, reducing the amount of shading and resulting in higher temperatures. Similarly, the Jarboe Creek site is located in an area with less shading than the Eagle Creek sites.

Management of spring Chinook salmon in Lookingglass Creek is in transition, phasing out Rapid River stock, and phasing in Catherine Creek stock, as efforts to restore a self-sustaining population continue. The first two hatchery-releases (September 2001 and May 2002) failed to produce any significant adult returns. Fall releases yield more returns than those in the spring. The May 2002 release was of fish that were reared under high water temperatures for less than a year, but had achieved a size normally seen in hatchery fish reared for 15-16 months. Spring releases in 2004 and 2005 of brood year 2002 and 2003 fish after a more normal 18 month rearing cycle may produce more adult returns.

The number of adults outplanted to spawn naturally above the Lookingglass Hatchery trap was lower than in 2004 and resulted in a lower number of redds. Higher numbers of hatchery-origin smolts will need to be released in order to achieve the numbers of adult returns required to sustain the population from natural production.

Spring Chinook spawners below the Lookingglass Hatchery trap in 2003 (none were outplanted above the trap) produced 10 redds and 630 outmigrants/redd. This was above the range of outmigrants per redd of 230-493 produced by the endemic stock from 1965-1969 (data from Burck 1993).

Adult spring Chinook salmon adults return to Lookingglass Creek and spawn below the Lookingglass Hatchery trap and are not enumerated or biological data collected at the trap. Estimates of total spawners below the trap, sex, age, and mark status have to be inferred from redd counts and observations of fish collected at the trap. Fish that spawn below the trap include substantial numbers from other stocks, some (e.g. upper Grande Ronde River, Lostine River) that were reared as juveniles at Lookingglass Hatchery.

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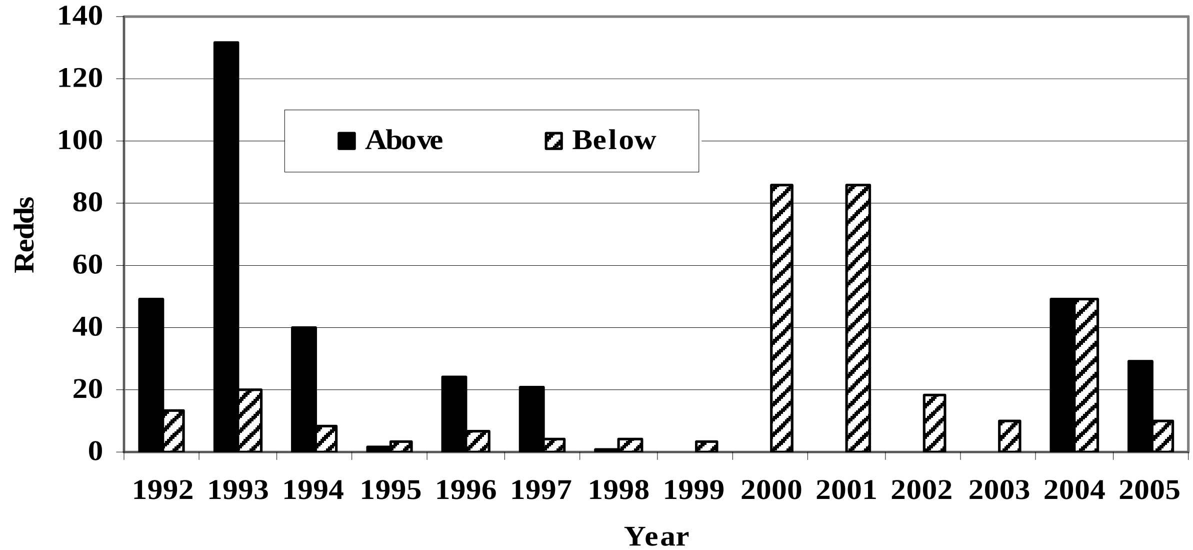
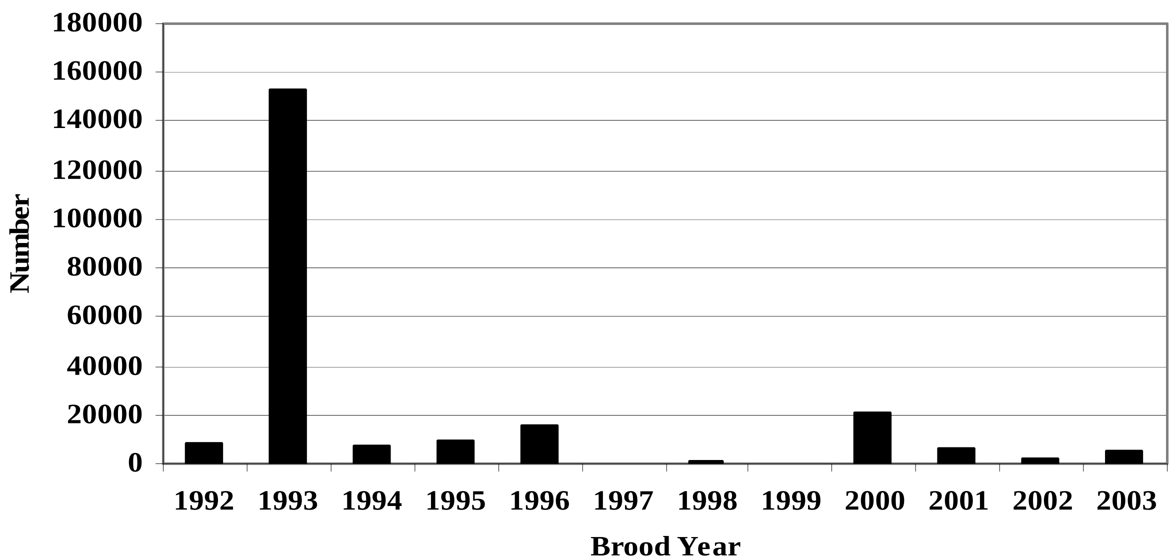
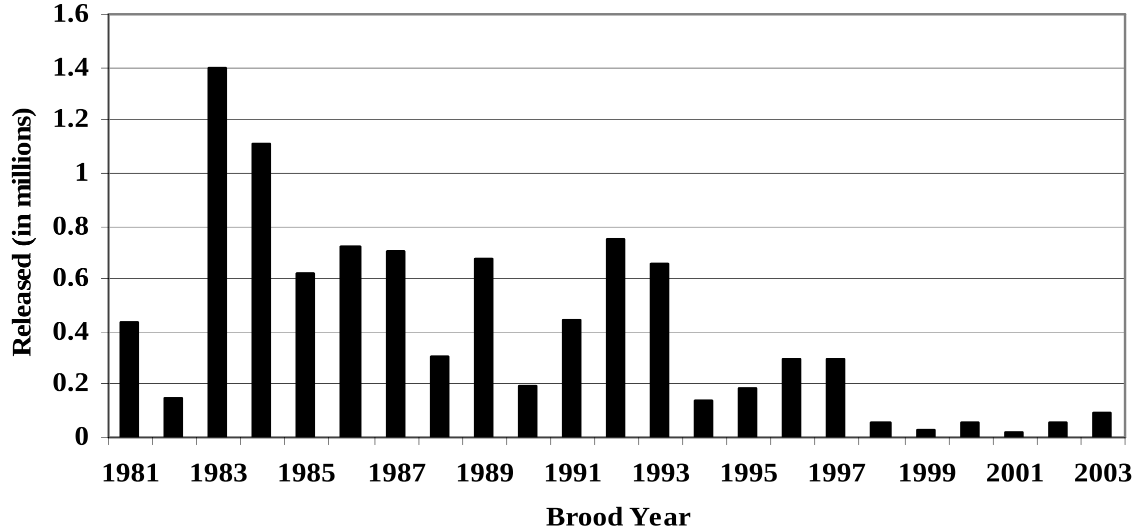
1.8 Appendix Figures



Appendix Figure 1. Spring Chinook salmon redds above and below the Lookingglass Hatchery trap, 1992-2005.



Appendix Figure 2. Lookingglass Creek outmigrant production by brood year, 1992-2003.



Appendix Figure 3. Hatchery releases of juvenile spring Chinook salmon into Lookingglass Creek by brood year, 1992-2003.

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

2.1 Abstract

We collected 198 unmarked (wild) adult summer steelhead at the Lookingglass Hatchery adult trap from 14 March-30 May 2005, including 114 females and 84 males. Five ad-clipped (hatchery-origin) fish were collected. The majority of fish (71.7%) were trapped from 4 April-29 April 2005. A total of 131 redds were recorded on 20.3 mi surveyed from 27 March-8 June 2005. Saltwater age composition was 1.0% age 0 (no saltwater annuli), 52.0% age 1, 46.5% age 2, and 0.5% age 3. Approximately 26,913 (SE 3,849) outmigrants of all sizes left Lookingglass Creek during 2005. The outmigrants leaving during January-April, May, June-August periods differed by less than 1,000. Capture probabilities ranged from 0.03-0.146. Mean FL for outmigrants PIT-tagged and released from 23 June 2004-3 December 2004 was 140.3 mm, median arrival date at Lower Granite Dam was 10 May 2005, and survival to Lower Granite Dam was 0.2647. Mean FL for outmigrants PIT-tagged and released from 28 February 2005-16 May 2005 was 158.7 mm, median arrival date at Lower Granite Dam was 10 May 2005, and survival to Lower Granite Dam was 0.6474. The number of adult summer steelhead in 2005 was higher than in 2004 and also higher than values recorded in the 1970s. The number of outmigrants in 2005 was less than half of that observed in 2004, but considerably above the range recorded in the 1970s. Life history characteristics observed in 2005 were similar to those observed during other years in Lookingglass Creek and 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 (*Oncorhynchus tshawytscha*), sockeye (*O. nerka*), and coho (*O. kisutch*) salmon and summer steelhead (*O. mykiss*) (U. S. Army Engineer District 1975, Nehlsen et al. 1991). Anadromous salmonid stocks throughout the Snake River Basin have experienced severe declines in abundance, principally due to construction and operation of hydroelectric facilities, overfishing, and the loss or degradation of critical spawning and rearing habitat (Nehlsen et al. 1991).

Sport and tribal fisheries for summer steelhead were closed in 1987.. Hatcheries were built in Oregon, Washington and Idaho under the Lower Snake River Compensation Plan administered by the U. S. Fish and Wildlife Service (http://www.fws.gov/lsnakecomplan/index.html) to compensate for losses of summer steelhead due to the construction and operation of the four most downstream Snake River dams. The continued decline in wild summer steelhead populations led to the listing of Snake River populations as threatened under the federal Endangered Species Act of 1973 on 18 August 1997 (Federal Register Volume 62, Number 159).

Comanagers harvest augmentation programs in the Grande Ronde River using non-endemic Wallowa Hatchery stock in the early 1980s and consumptive recreational harvest was reopened in 1986 (Flesher et al. 2004). High stray rates of Wallowa Hatchery stock occurred, particularly in the Deschutes River, and a Biological Opinion that directed the phase out of Wallowa Hatchery stock releases in the Grande Ronde Basin (National Marine Fisheries Service 1999).

Adult return numbers and the genetic structure of wild adult summer steelhead returning to tributaries of the Grande Ronde River are largely unknown. High spring flows make it difficult to trap fish effectively. Burck recorded the number of summer steelhead adults passed above the Lookingglass Hatchery trap from 1965-1974 (unpublished data, summarized by McLean et al. 2001). Additional counts at the Lookingglass Hatchery (LH) adult trap have occurred 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.

CTUIR has collected life history data for juvenile stages of summer steelhead since 1992. CTUIR has shared operation of the Lookingglass Hatchery adult trap with ODFW since 1997. The long-term goal of these activities is to provide a long-term database that can be used to develop management alternatives that will continue the recovery process for summer steelhead and restore balance and proper functioning to the ecosystem.

2.3 Methods

2.3.1 Adults

A picket weir diverted returning fish into a trap near the Lookingglass Hatchery water intake. All adult summer steelhead captured were enumerated, checked for fin clips and other marks or tags, measured (FL mm), and sexed. A paper punch was used to remove opercle tissue and these were preserved in either 70% isopropanol or 95% ethanol. 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 scale impressions were made in cellulose acetate using heat and pressure. A microfiche reader was used to examine impressions, and criteria for annuli were described by (Mosher 1969). An age-length key (Ricker 1975) was used to estimate age composition. Week of capture was designated by the first day of the week (e.g. week of 1 January included 1-7 January). Ad-clipped fish were euthanized and removed from the stream. Unclipped (wild) fish were transported about 0.5 mi upstream and released.

Known or suspected spawning areas in Lookingglass Creek and tributaries were surveyed by walking downstream during March-June 2005 and recording observations of redds, live fish, and carcasses. Survey section, date, time, flow conditions, water temperature, water clarity, and redd visibility were also recorded. New redds were marked with orange flagging attached to nearby vegetation.

2.3.2 Juvenile *O. mykiss*

We operated a 1.52 m diameter rotary screw trap (Roper and Scarnecchia 1996) at rm 0.1 on Lookingglass Creek from 1 January 2005-12 July 2005 to collect outmigrating juvenile *O. mykiss*. The screw trap was moved to the "flume hole" location near Lookingglass Hatchery at approximately rm 2.4 on 13 July 2005. We attempted to operate the screw trap continuously during 2005, but jamming from debris, high water temperatures, and other factors caused some interruptions. The trap was usually checked 3 times a week or more frequently if catches or flows were high. All *O. mykiss* were enumerated, examined for external marks, scanned with a PIT tag reader, measured (FL mm), and weighed (0.1 g). First-time captures of fish >50 mm< 80 mm FL, in good condition (no injuries or obvious disease) were fin-clipped (partial lower caudal) and released. First-time captures of fish ≥ 80 mm FL, in good condition (no injuries or obvious disease) PIT-tagged using standard methods (PIT Tag Steering Committee 1999) and released,. All newly-tagged or clipped fish were released either 100 ft (when trap was near mouth) or 300 ft (when trap was at "flume hole") above the screw trap; recaptures were released 50 ft (when trap was near mouth) or 1,000 ft (when trap was at "flume hole") below the screw trap.

DARR 2.0 (Bjorkstedt 2005) was used to estimate the numbers of outmigrants. DARR 2.0 uses mark-recapture data stratified by time period and pools strata with similar capture probabilities. We used the "one trap" and "no prior pooling of strata" options available in DARR 2.0.

O. mykiss juveniles typically outmigrate from natal stream in the Snake River basin after two growing seasons, but some as early as a few weeks after emergence, and some as old as age 3. *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). Fish outmigrating in the fall move downstream to continue rearing but are not detected at Lower Granite Dam until the following spring. Spring outmigrants move directly downstream and are detected at Lower Granite Dam usually within a month. For comparisons of FL, weight, K factor, arrival timing, travel time, and survival, outmigrants were placed into two groups, "fall 2004" and "spring 2005". These two groups would include almost all of the migration year 2005 fish going to the ocean. The latest date of PIT-tagging in 2004 for the first detection in the hydrosystem in 2005 was used as the starting point for the late 2004 group. All fish PIT-tagged after that date were placed in the fall 2004 group. Similarly, the latest date of PIT-tagging in 2005 for the last detection in the hydrosystem in 2005 was used as the last date for the spring 2005 group. These two groups represented essentially all migrants to the ocean for migration year 2005.

FL and weight at PIT-tagging, travel time, survival and capture probability to Lower Granite Dam data were obtained by querying the PIT tag database maintained by the Pacific States Marine Fisheries Commission at http://www.ptagis.org/.
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 date at Lower Granite Dam for each group was obtained using the date of 50% expanded daily detections as a percentage of the total expanded daily detections for that group.

Survival, capture probabilities, and travel time to Lower Granite Dam were calculated using PitPro software (Westhagen and Skalski 2006). We used the standard configuration, and excluded the *.rcp file and included the mortality 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).

2.4 Results

2.4.1 Adults

Trapping began on 22 February 2005: the first adult summer steelhead was caught on 14 March 2005 and the last on 30 May 2005. Peak catches occurred the weeks of 2 April and 23 April 2005 (Figure 1). Weekly catches increased steadily through 23 April 2005, then tapered off quickly. We captured 198 unmarked prespawn summer steelhead and 3 postspawn females (on 22 April 2005, 9 May 2005, and 6 June 2005). Most (71.7%) of the unmarked, prespawn fish were caught during 4 April-29 April 2005. Females dominated the catch with 57.6% of the total, compared to 42.4% for males (Figure 2). Peak catch of males occurred the week of 2 April 2005 compared to 23 April 2005 for females Postspawn females were 590-700 mm FL. Five ad-clipped (hatchery-origin) prespawn fish were caught on 21 March 2005 (2 females, male), 25 March 2005 (female), and 13 April 2005 (male). FL for ad-clipped fish were 395-710 mm FL. One wild fish was a trap mortality. There were 20 recaptures of previously passed fish from 25 March-9 May 2005, including 15 males and 5 females.

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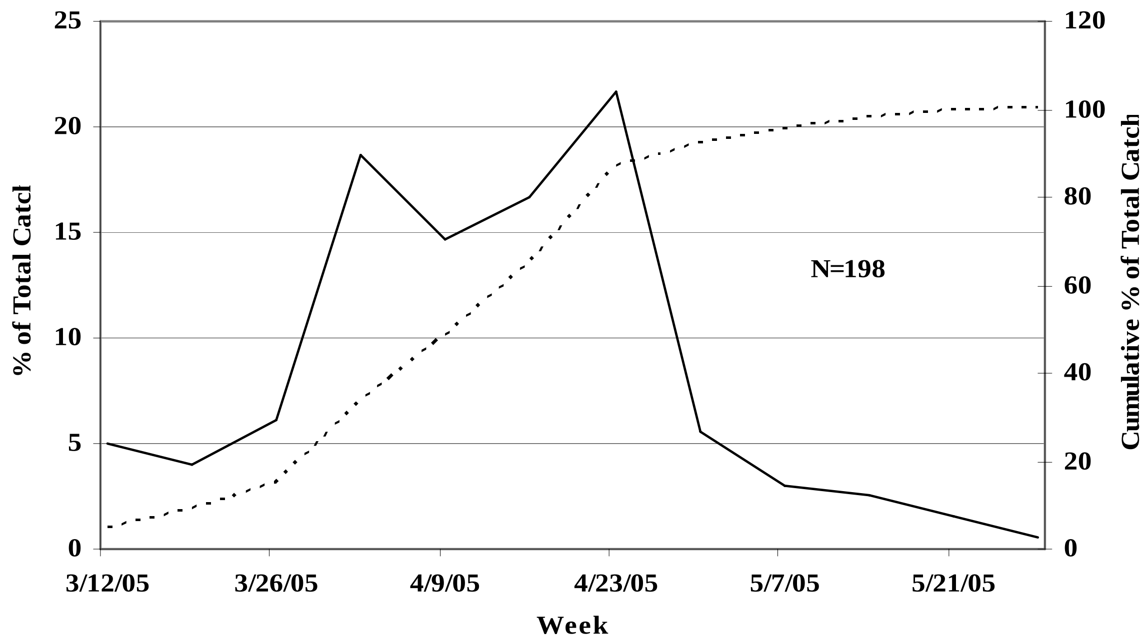

Figure 1. Percent and cumulative percent distribution by week for summer steelhead caught at the Lookingglass Hatchery trap, 2005.

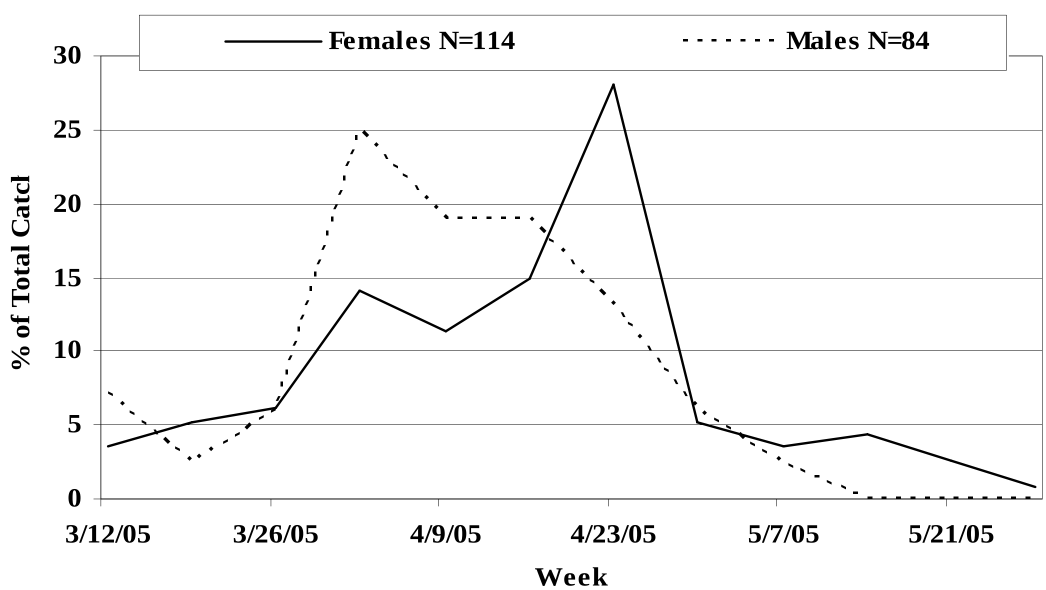

Figure 2. Percentages of total catch by week for male and female summer steelhead caught at the Lookingglass Hatchery trap, 2005.

Modal FL groups for both sexes combined were 55 and 69 cm (Figure 3). The modal FL for males was 58 cm (Figure 3). Females showed a bimodal FL distribution with modes evident at 56 and 70 cm (Figure 4).

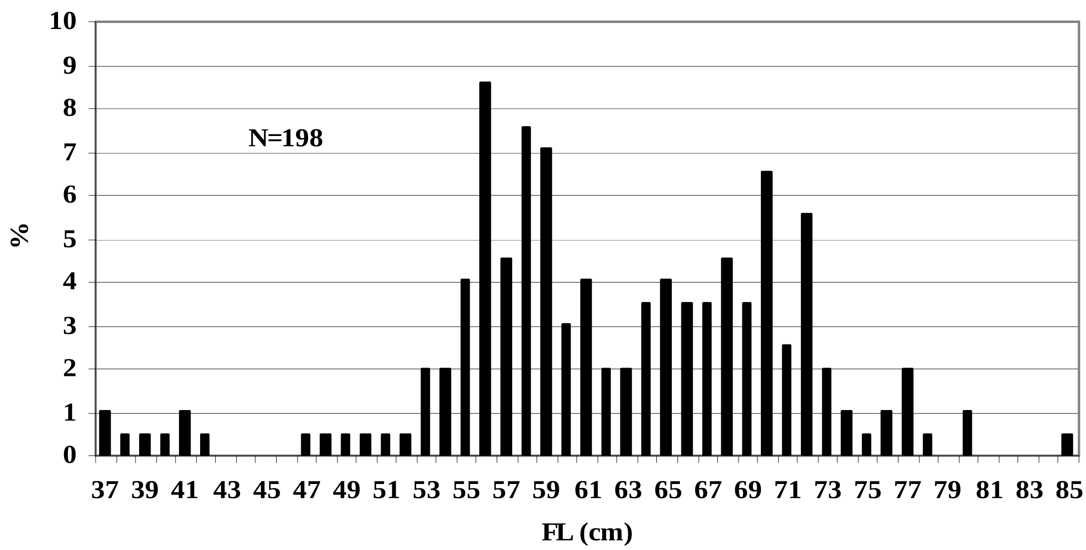

Figure 3. FL frequency of summer steelhead (sexes combined) caught at the Lookingglass Hatchery trap, 2005

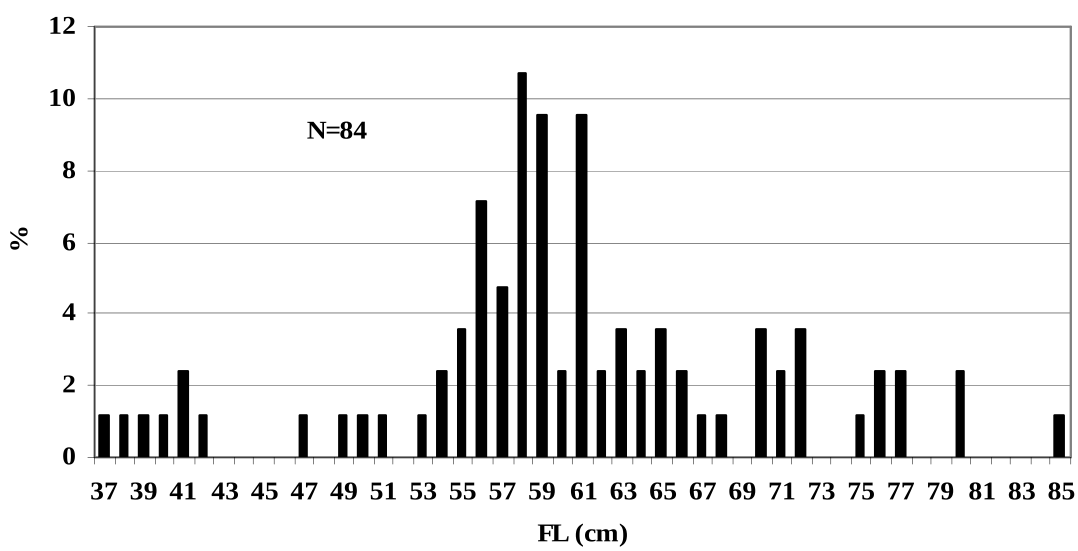

Figure 4. FL frequency of male summer steelhead caught at the Lookingglass Hatchery trap, 2005.

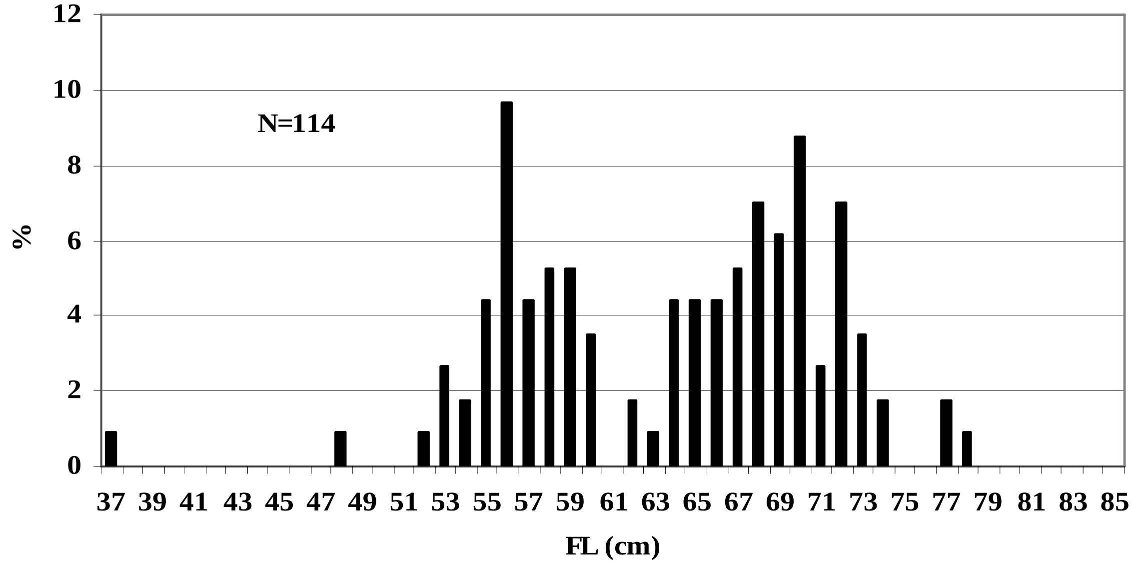

Figure 5. FL frequency of female summer steelhead caught at the Lookingglass Hatchery trap, 2005.

One-salt fish dominated the catch of males but the reverse was true for females (Table 1). Mean FL of 1-salt males was 10.5 mm greater than females of the same age. Mean FL of 2-salt males was 13.8 mm greater than females. The FL distributions of 1-salt and 2-salt fish overlapped with most occurring in the 52-71 cm groups (Figure 5).

An age-length key yielded the following saltwater age distribution for 198 adults: 1.0% age 0, 52.0% age 1, 46.5% age 2, and 0.5% age 3. Freshwater annuli ranged from 0-4. Males (N=76) had one annulus (1), two annuli (54), three annuli (19), and four annuli (2). Females (N=109) had one annulus (4), two annuli (86) or three annuli (19). Two females (55, 64 cm) had spawning checks.

Table 1. FL (mm) summary for summer steelhead caught at the Lookingglass Creek trap and aged using scales, 2005.

Sex	Age	$\bar{X}$ FL	SE	Min-Max	N
Male					
	0-salt	380.0	5.0	375-385	2
	1-salt	577.9	8.3	395-710	57
	2-salt	698.3	27.1	410-850	16
	3-salt	800			1
Female					
	1-salt	567.4	7.4	375-700	38
	2-salt	684.5	5.3	545-780	71

Twenty-one spawning ground surveys were conducted from 27 March-8 June 2005. Flows ranged from 165-301 CFS from 14 April-25 May 2005 when 59.5% of the redds were recorded. Flows fluctuated but showed a generally decreasing trend. Mean daily water temperatures during this time ranged from 4.6-9.2^{o}C with a high of 10.0^{o}C. Temperatures also varied but showed a generally increasing trend. The highest total number of redds was recorded for Unit 3U and the highest redds/mi for section 3L (Table 2). No redds were observed in Summer Creek and only 2 in Mottet Creek. Eleven live fish were observed on redds and three fish off redds. No carcasses were encountered.

Table 2. Lookingglass Creek watershed summer steelhead spawning ground survey summary, 2003.

Stream[a]	Unit	Miles	Surveys	Redds	Redd/mi
LKG	3U	4.0	1	5	1.3
LKG	3U	4.2	7	50	11.9
LKG	3L	1.8	4	38	21.1
LKG	2	1.6	2	8	5.0
LLKG	4	4.4	4	28	6.4
MOT	[b]	1.3	2	1	0.8
SUM	[c]	3.0	1	0	0
Totals		20.3	21	131	6.5

[a] *LKG Lookingglass Creek mainstem, LLKG Little Lookingglass Creek, MOT Mottet Creek, SUM Summer Creek, UNF Umatilla National Forest,* [b] *Mouth upstream to UNF boundary,* [c] *Mouth upstream*

2.4.2 Juvenile *O. mykiss*

The rotary screw trap was operated continuously in 2005, with the following exceptions: 1-18 January 2005, 4-7 February 2005, 14-22 February 2005, 18-23 March 2005 (intermittent operation in evening due to hatchery release), 27-30 May 2005, 15-16 June (dismantled trap and moved to "flume hole" location near Lookingglass Hatchery). The trap was moved to focus on estimating production of spring Chinook salmon outplanted above the Lookingglass Hatchery trap.

O. mykiss totals (first-time captures) for the screw trap in 2005 included 860 fish PIT-tagged and released, 556 fin-clipped and released, 94 measured only, 112 counted only, and 22 mortalities. There were 39 fin-clip recaptures and 58 PIT-tag recaptures. One of the fin-clip recaptures was PIT-tagged and released above the screw trap.

Juveniles <80 mm included 42 fin-clipped (7 in April, 12 in May, 22 in June, and 1 in September), 56 measure only (3 in January, 2 in April, 5 in May, 1 in July, 3 in August, 14 in September, 2 in October, 18 in November, and 8 in December), 1 mortality (May), 21 count only (1 in May, 2 in August, 1 in October, 15 in November, and 2 in December). One fin-clip recapture (May) was < 80 mm FL. A juvenile caught ion 6 April 2005 had been PIT-tagged and released on 22 September 2004 at the ODFW screw trap on the Lostine River.

The FL distribution by season showed that the largest fish were caught during the fall and the smallest during summer (Figures 6-7). Mean FL and weights of *O. mykiss* caught in the screw trap were highest for March, April, and May in 2005 (Table 3). Mean FL and weight was lowest for August. Mean K was highest for May, June and July and lowest for January. The $\log_{10}$ FL (mm)-weight (g) regression produced a good fit (Figure 8). There was a slight negative relationship between FL (mm) and K (Figure 9).

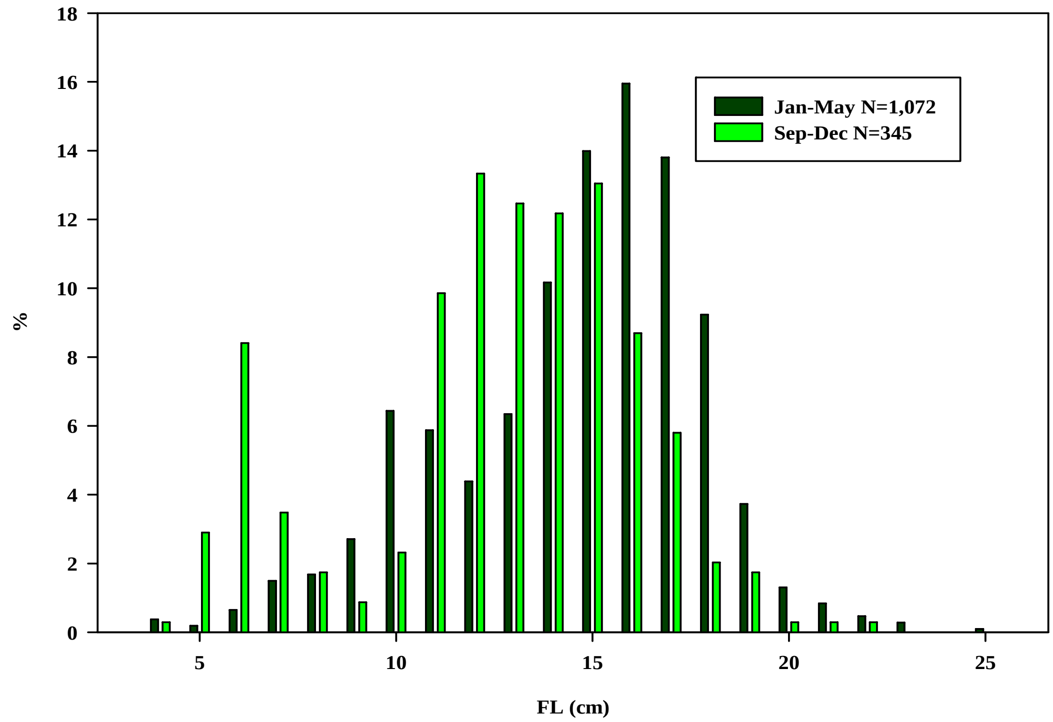

Figure 6. FL frequency for *O. mykiss* captured in the Lookingglass Creek screw trap, January-May and September-December, 2005.

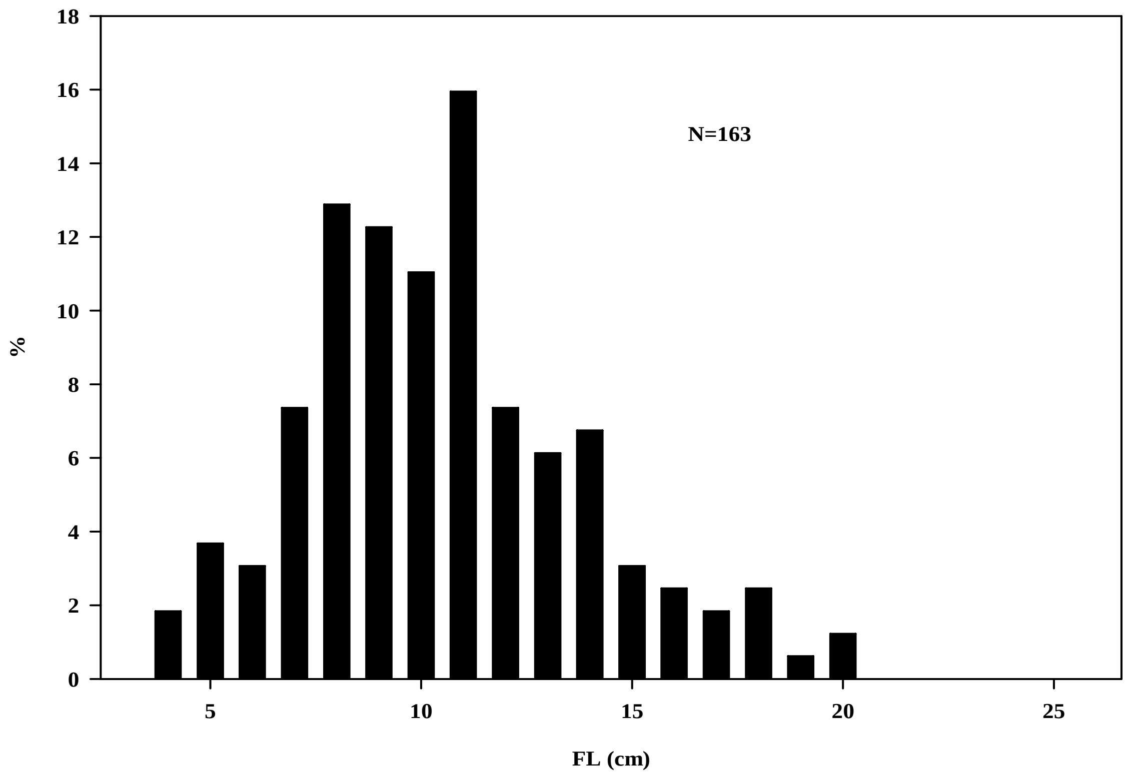

Figure 7. FL frequency for *O. mykiss* captured in the Lookingglass Creek screw trap, June-August, 2005.

Table 3. FL (mm), weight (g), and K factor summary by month for *O. mykiss* captured in the Lookingglass Creek screw trap, 2005.

	Month											
Statistic	January	February	March	April	May	June	July	August	September	October	November	December
FL												
Mean	106.9	145	159.5	151.9	150.5	109.8	117.4	83.5	128.2	143.3	132.9	110.3
SE	9.8		7.3	1.4	1.4	2.8	6.7	15.9	3.9	5.0	3.1	11.2
Min	40		144	45	43	47	47	48	58	53	49	58
Max	135		191	251	239	205	201	142	196	202	220	190
N	11	1	6	465	589	134	23	6	86	43	131	17
Weight												
Mean	14.2	25.2	50.8	42.1	43.0	22.1	23.4	8.8	25.8	33.8	27.9	20.1
SE	0.4			1.0	1.0	1.8	4.8	4.2	1.8	2.9	1.8	5.9
Min	11.9			2.3	2.7	3.9	6.2	1.1	1.9	1.7	1.0	1.8
Max	15.3			153.7	159.3	93.0	107.2	27.2	69.3	87.0	109.7	66.5
N	8	1	1	459	534	116	22	6	85	43	116	15
K												
Mean	0.74	0.83	1.05	1.07	1.12	1.19	1.11	0.97	1.01	1.01	0.96	1.02
SE	0.04			0.004	0.004	0.01	0.02	0.01	0.01	0.02	0.01	0.04
Min	0.61			0.87	0.52	0.97	0.96	0.92	0.85	0.78	0.84	0.91
Max	0.97			1.43	1.69	1.93	1.32	1.00	1.20	1.31	1.11	1.52
N	8	1	1	459	534	116	22	6	85	43	116	15

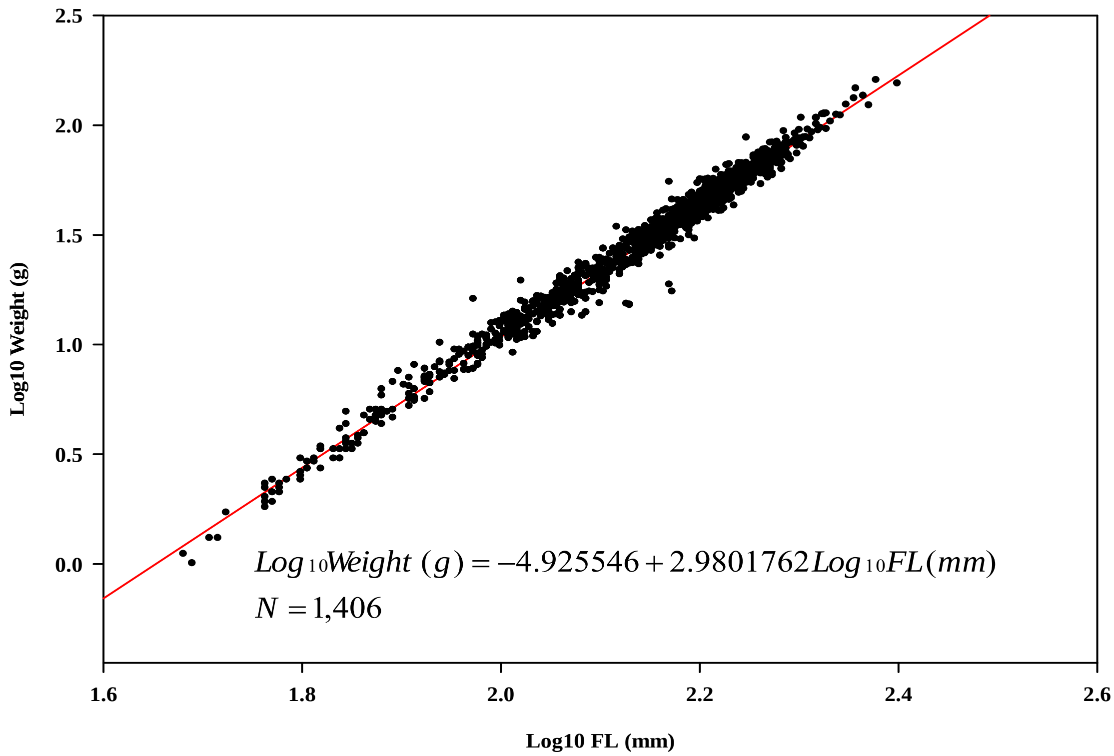

Figure 8. Log_{10} length-weight regression for *O. mykiss* caught in the Lookingglass Creek screw trap, 2005.

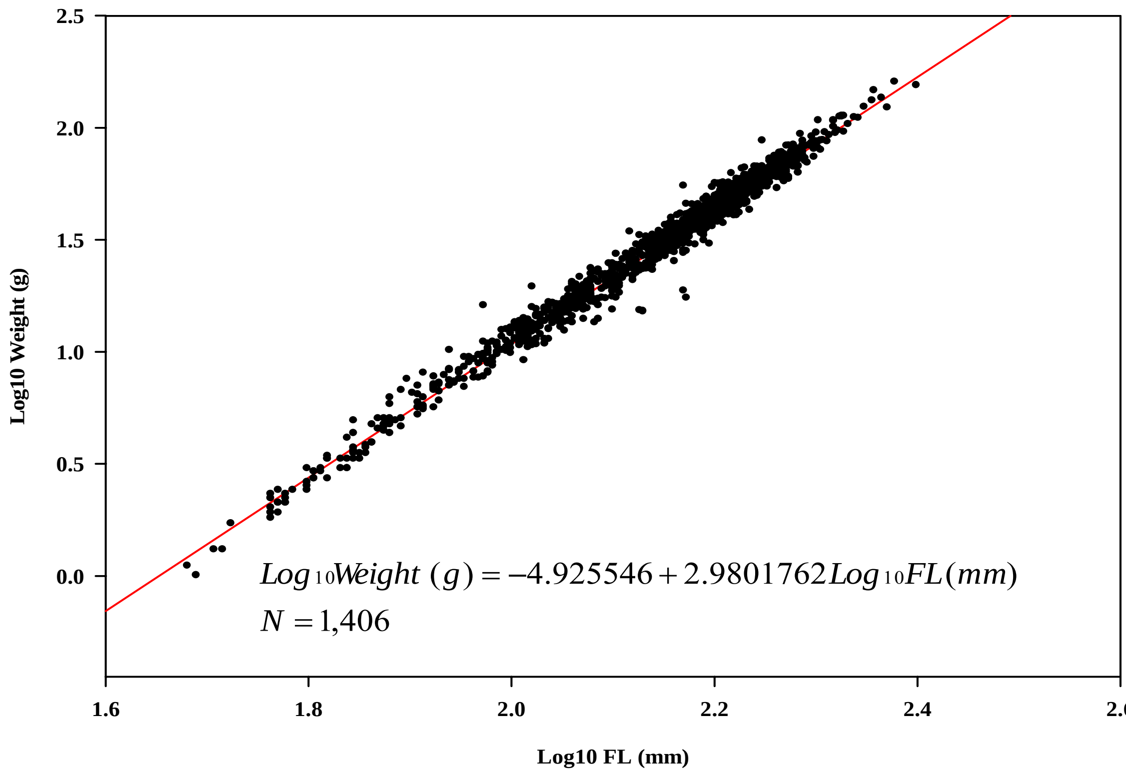

Figure 9. K-FL (mm) regression for *O. mykiss* caught in the Lookingglass Creek screw trap, 2005.

We initially tabulated the numbers of outmigrants caught, marked and released, and recaptures by month. We combined January-April, June-August, September-October, and November-December to make 5 time periods for use in DARR 2.0. DARR 2.0 further combined the June-August and September-October periods into one, yielding 4 time periods. The estimate of outmigrants was 26,913 with SE of 3,849 (Table 3). Fish were captured in the screw trap during all 12 months of the year, with the highest numbers per day being caught during May. The outmigrant estimates for the January-April, May, and June-August periods varied by less than 1,000. The days elapsed between release and recapture for the 58 PIT-tagged fish ranged from 1-74, with 87.9% recaptured between 1-3 d after release. One each was recaptured 4, 5, 12, 16, 18, 38, and 74 d after release. The 58 PIT tag recaptures with FL available ranged from 114-192 mm FL at tagging (mean = 153.5, SE = 2.4). The 39 fin clip recaptures with FL available ranged from 64-188 mm FL (mean 144.3, SE = 5.0). If only outmigrants ≥ 80 mm FL were used the estimate decreased by slightly more than 3,000. Outmigrants were PIT-tagged and released in 11 of 12 months in 2005 (Table 5). The highest numbers were released in May and June (73.3%). During September-November, 21.9% of the total was PIT-tagged. Outmigrants from 8-25 cm were PIT-tagged, but 72.5% were from 14-20 cm FL.

There were disparities in the proportions marked for PIT-tagged outmigrants released and recaptured. The proportions recaptured at the ends of the distributions were lower than released, while at the mid-range, the proportions recaptured were higher than released (Table 5, Figure 10). A similar pattern existed for fin-clipped outmigrants (Table 6, Figure 11).

Table 4. *O. mykiss* captured in the Lookingglass Creek screw trap, releases and recaptures from trap efficiency tests, outmigrant estimates and standard errors, 2005.

	All sizes						≥ 80 mm FL					
Dates	u	m	r	C_p	N	SE	u	m	r	C_p	N	SE
Jan-Apr	489	469	32	0.068	7,225	1,351	477	462	32	0.069	6,931	1,297
May	603	594	44	0.074	8,141	1,178	585	582	43	0.074	7,918	1,159
Jun-Oct	297	264	8	0.03	9,801	3,411	250	241	8	0.033	7,531	2,617
Nov-Dec	255	89	13	0.146	1,746	446	213	89	13	0.146	1,458	372
Totals	1,644	1,416	97		26,913	3,849	1,525	1,374	96		23,839	3,128

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 (variance0.5)

Table 5. *O. mykiss* captured in the Lookingglass Creek screw trap, PIT-tagged and released, by FL (cm) and month, 2005.

	Month											
FL (cm)	February	March	April	May	June	July	August	September	October	November	December	Totals
8								1				1
9			6	2		1		1				10
10			22	11		2		3				38
11			15	10	1	7		2	1	2		38
12			20	4	3	2		12	4	12	1	58
13			42	7	4			9	8	12		82
14	1	3	65	15	5	1	1	13	9	14	2	129
15		1	73	26	3			9	4	19		135
16		1	67	41				10	4	11	1	135
17			60	32				3	4	7		106
18			35	30	1			1	2	3		72
19		1	18	7				2	1	2	1	32
20			7	4		1			1			13
21			4	1						1		6
22			1							1		2
23												
24												
25			1									1
Totals	1	6	438	190	17	14	1	66	38	84	5	858*

* *No FL for 2 tagged in April.*

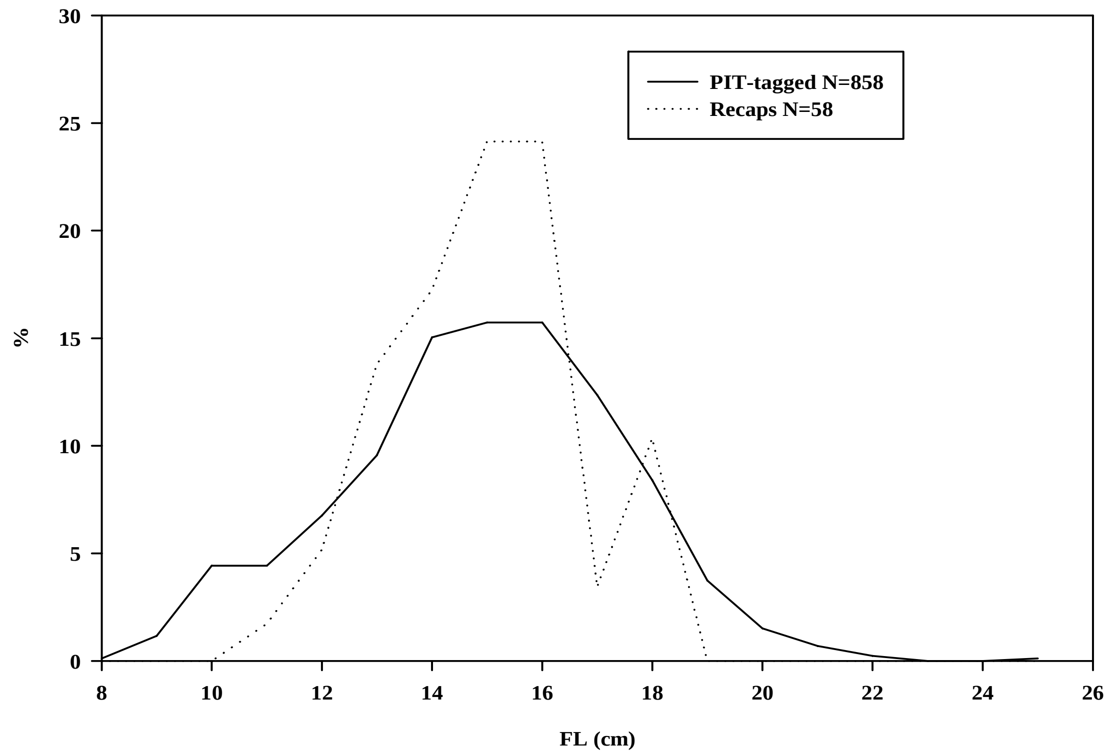

Figure 10. FL comparison of *O. mykiss* caught, PIT-tagged and released and recaptures at the Lookingglass Creek screw trap, 2005.

Table 6. *O. mykiss* captured in the Lookingglass Creek screw trap, fin-clipped and released, by FL (cm) and month, 2005.

	Month							
FL (cm)	April	May	June	July	August	September	October	Totals
4			1					1
5			5					5
6	2	2	5			1		10
7	5	10	12					27
8	6	12	17	3				38
9	4	16	19					39
10	3	32	13	1	2		1	52
11	3	34	15	1		3		56
12		20	7					27
13		16	5					21
14		25	3	1				29
15		50	1	1				52
16		62	4					66
17		53	2	1				56
18		34	3					37
19		14	1					15
20		3	1					4
21		2						2
22		4						4
23	1	2						3
Totals	24	404	13	8	2	4	1	556

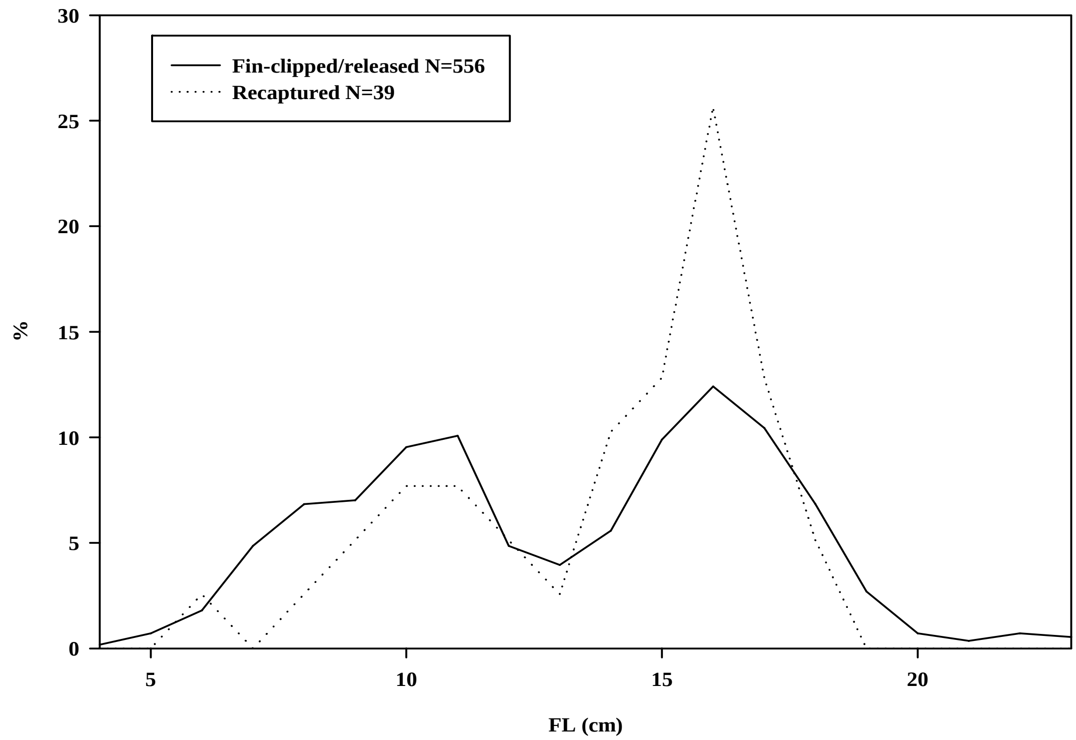

Figure 11. FL comparison of *O. mykiss* caught, fin-clipped and released, and recaptures at the Lookingglass Creek screw trap, 2005.

Mean FL of outmigrants in the fall 2004 group was 18.4 mm less than the spring 2005 group, but standard errors and ranges were similar (Table 7). Mean weights showed a similar pattern between groups. Mean K factors differed by only 0.03 between the two groups.

Table 7. FL, weight, and K factor summary for *O. mykiss* caught in the Lookingglass Creek screw trap, PIT-tagged and released, fall 2004 (23 June 2004-3 December 2004), and spring 2005 groups (28 February 2005-16 May 2005).

	Group	
Statistic	fall 2004	spring 2005
Mean FL (mm)	140.3	158.7
SE	1.2	1.0
Min-Max	77-229	90-251
N	605	633
Mean Weight (g)	32.5	44.8
SE	0.8	0.8
Min-Max	4.5-123.1	6.9-153.7
N	600	623
Mean K	1.05	1.08
SE	0.004	0.003
Min-Max	0.70-1.92	0.83-1.35
N	600	623

Survival to Lower Granite Dam for the fall 2004 group was about 41% of that for the spring 2005 group (Table 8). Capture probabilities were about equal and (harmonic) means of travel time differed by almost 211 d. Median arrival dates for the two groups were the same, but arrival dates the spring 2005 group were concentrated into a smaller time period than the fall 2004 group.

Table 8. Survival, capture probability, travel time, and arrival date to Lower Granite Dam summary for fall 2004 (23 June 2004-3 December 2004) and spring 2005 (28 February 2005-16 May 2005) groups of *O. mykiss* outmigrants from Lookingglass Creek.

	Group	
Statistic	Fall 2004	Spring 2005
Survival	0.2647	0.6474
SE	0.0183	0.0137
N	606	635
Capture Probability	0.7729	0.7565
SE	0.0347	0.0221
N	606	635
Travel Time (d)	221.301	9.975
SE	2.654	0.406
N	606	635
Median Arrival Date	5/10/2005	5/10/2005
10%	4/20/2005	5/1/2005
90%	5/20/2005	5/19/2005
N	243	311
N (expanded)	280	349

Higher proportions of PIT-tagged outmigrants in the 13-14 cm FL groups were detected than released (Figure 10). Smaller fish (7-11 cm) were detected in lower proportions than those released. Proportions PIT-tagged and released were higher than those detected for 9-11 cm outmigrants from the spring 2005 group (Figure x). Proportions PIT-tagged and released from the spring 2005 group 12-15 cm groups. Larger outmigrants (≥ 16 cm) had slightly higher proportions detected than released.

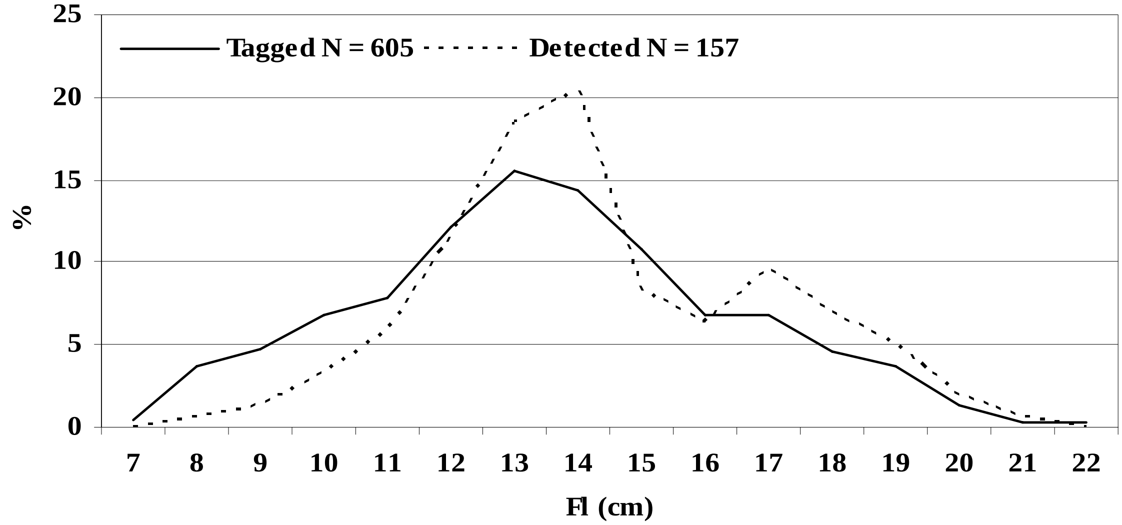

Figure 12. Percentages of *O. mykiss* PIT-tagged and released in Lookingglass Creek, fall 2004 group, and unique detections in the hydropower system by FL group during 2005.

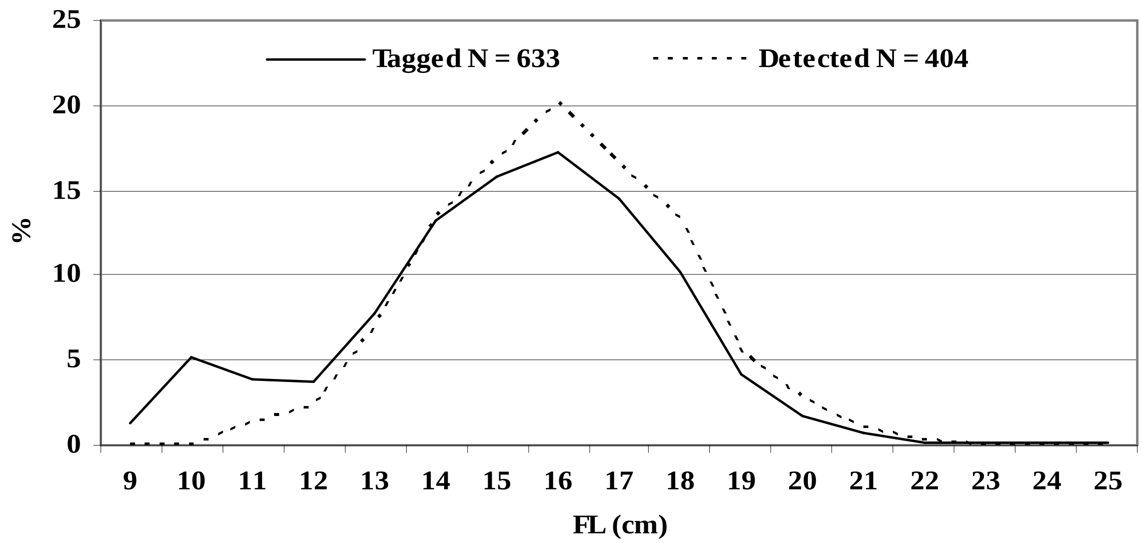

Figure 13. Percentages of *O. mykiss* PIT-tagged and released in Lookingglass Creek, spring 2005 group, and unique detections in the hydropower system by FL group during 2005.

2.5 Discussion

Adult escapement above the trap in 2005 was the second-highest since 2001. Catches have varied slightly more than two-fold during 2001-2005. Catches during 1965-1974 McLean et al. 2001) were substantially lower, with a range of 17-120 (median 56).

The number of juvenile outmigrants in 2005 was less than for 2001-2004, but still considerably higher than the range reported by Mullarkey (1971). His estimates (by migration year) ranged from 7,727-13,261.

Migration timing for both juveniles and adults during 2001-2006 appear to be different than what was recorded during the 1960's and 1970's (Burck, unpublished data). Peak catches occurred in March or April during 2001-2006, compared to May or June during 1964-1975. Juvenile outmigrant catches in the fall months of September-November were commonly much lower than catches in the following spring during the late 1960's (Mullarkey 1971). In recent years, fall outmigrant catches appear 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. Lookingglass Creek has anadromous habitat that is less affected by human activities such as grazing, timber harvest, agriculture, and urban development than many other streams in the Grande Ronde Basin. Cooler water temperatures in the headwaters provide for a thriving population of bull trout.

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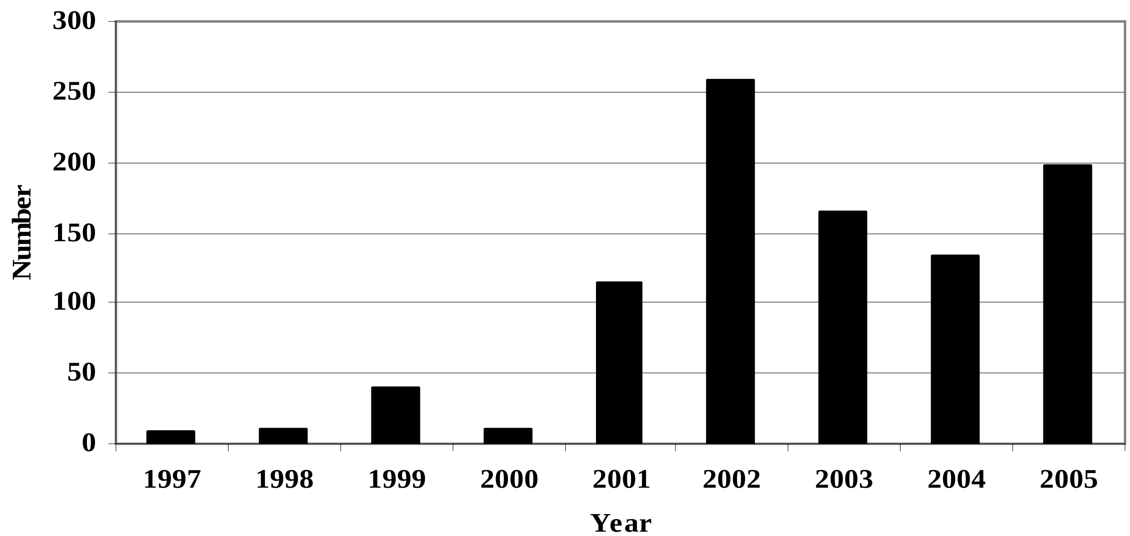
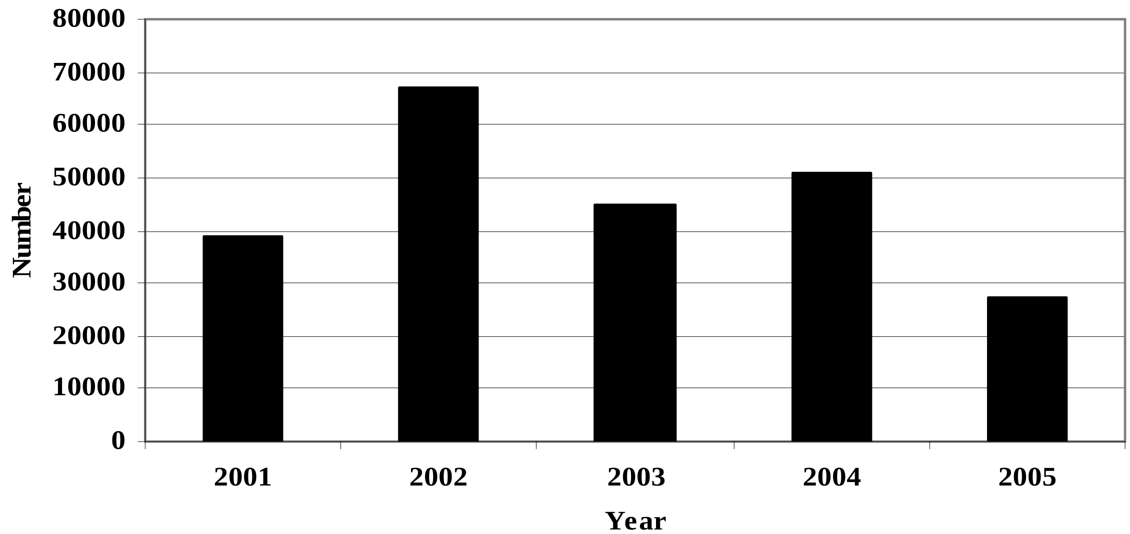
2.7 Appendix Figures



Appendix Figure 1. Total catches of wild (unclipped) adult summer steelhead at the Lookingglass Hatchery trap, 1997-2005.



Appendix Figure 2. Lookingglass Creek juvenile *O. mykiss* production, 2001-2005.

3 SECTION III ASSISTANCE PROVIDED TO LSRCP COOPERATORS AND OTHER PROJECTS

We provided assistance to LSRCP cooperator ODFW in 2005 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. In addition, project personnel provided assistance in sampling adult spring Chinook salmon at Oregon LSRCP facilities and helped with the release of juvenile spring Chinook salmon parr into Lookingglass Creek. Assistance was provided in data summarization and analysis for ODFW monthly and annual progress reports.

We assisted other Bonneville Power Administration (BPA) projects with data collection in 2005. 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. In addition, we have implanted PIT tags in bull trout we have captured in our rotary screw trap. We assisted the conventional adult spring Chinook salmon broodstock collection project in the Grande Ronde River and Catherine Creek in 2005 with weir building and trap checking. This is a BPA project in which CTUIR has the lead in these tributaries.

4 ACKNOWLEDGMENTS

Thanks to Dan Herrig (United States Fish and Wildlife Service) for administering this contract and coordinating project activities between the Confederated Tribes of the Umatilla Indian Reservation (CTUIR) and other agencies. Gary James, Julie Burke, and Celeste Reves (CTUIR) provided technical and administrative support. Mike McLean and the CTUIR O&M team provided valuable support in outplanting adult fish above the Lookingglass Hatchery trap, spawning ground surveys, and dismantling, transporting, and reassembling the screw trap. We appreciate the cooperation of private landowners along Lookingglass Creek and their permitting us to do field work on their properties. Thanks go to members of the Oregon Department of Fish and Wildlife (ODFW) Research and Development Section in La Grande for field and office assistance and providing unpublished data. Jo Miller (United States Geologic Survey) and Stacia Peterson (United States Forest Service) provided stream flow and water temperature data. Lookingglass Hatchery (ODFW) staff tended the adult trap and collected tissues and data, provided the use of hatchery facilities and equipment, and kept an eye on the screw trap for us. Cecelia Noyes of the Grande Ronde Model Watershed did an excellent job in making the maps at the beginning of the report.