Lower Snake River Compensation Plan
Confederated Tribes of the Umatilla Indian Reservation
Evaluation Studies for 1 January 2003 to 31 December 2003

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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

Lookingglass Creek streamflows during the 2003 spring freshet ranged from 200-450 cubic feet per second (CFS) from 6 March 2003 to 12 June 2003, with a brief spike over 500 CFS. Maximum water temperature near Lookingglass Hatchery was just under 20^{o}C during July.

We collected 77 spring Chinook salmon adults (32 unmarked, 45 AD-clipped) at the Lookingglass Hatchery adult trap from 22 May-8 September 2003. All fish were euthanized. Age composition of unmarked fish was 9 age 3 males, 15 age 4 (6 males, 9 females), and 8 age 5 (1 male, 7 females). Age composition of AD-clipped fish collected at the trap was 13 age 3 males, 11 age 4 (5 males, 6 females), and 21 age 5 (9 males, 12 females).

Six spawning ground surveys were completed below the trap from 28 August-22 September 2003 and yielded 10 completed redds and 10 carcasses. Carcasses included 7 AD-clipped, 2 unmarked, and 1 undetermined. A survey above the trap on 5 September 2003 yielded no redds and no carcasses. Estimated adult returns of spring Chinook salmon to Lookingglass Creek totaled 71 AD-clipped and 39 unmarked.

Coded wire tags (CWT) were recovered from 40 of the 45 AD-clipped fish; no data for snout collected on the spawning ground surveys was available. CWT showed 23 Rapid River stock (19 brood year (BY) 1998, 4 BY 1999) and 2 BY 2000 Catherine Creek captive broodstock progeny liberated into Lookingglass Creek on 24 September 2001. Fish straying into the Lookingglass Creek adult trap included 10 from Catherine Creek, 3 from the upper Grande Ronde River and 2 from the Lostine River. The 15 strays recovered had been reared at Lookingglass Hatchery and acclimated and released in natal streams. SAR for CWT code 92819 was 0.00019.

Approximately 5,822 natural-origin juveniles outmigrated from 28 June 2002 through 22 August 2003. Approximately 77% outmigrated from 28 June-30 September 2002. Modal FL of 414 fish PIT-tagged and released was 9 cm. Mean FL of fall, winter, and spring release groups were 96.0, 95.7, and 100.8 mm, respectively. Median arrival dates at Lower Granite Dam for the three groups were 15 April 2003, 12 April 2003, and 26 May 2003, respectively. Survival rates to Lower Granite Dam were 0.3624, 0.2566, and 0.1101, respectively.

An estimated 3,285 hatchery-origin juveniles outmigrated from 31 May 2002 through 16 1 June 2003. Modal FL of 349 fish PIT-tagged and released was 8 cm. Mean FL of PIT-tagged fish released was 99.1 mm. Median arrival date at Lower Granite Dam was 19 April 2003. Survival to Lower Granite Dam was 0.1768. The estimated outmigrants

totaled 19% of the original number released (17,569) into Lookingglass Creek on 28 May 2002.

A total of 428 natural-origin juvenile spring Chinook salmon were seined from 29 July-7 August 2002, PIT-tagged, and released. Mean FL of tagged fish was 85.2 mm. Median arrival timing to Lower Granite Dam was 11 April 2003 and survival to Lower Granite Dam was 0.2902.

Management of spring Chinook salmon in Lookingglass Creek is in a transition phase, as the Rapid River stock is being replaced with Catherine Creek stock. Juvenile survival and first-year adult returns of the first two hatchery releases of Catherine Creek stock suggest these fish will contribute little to adult returns.

1.2 Introduction

Detailed background information for this project for years prior to 2003 is contained in the 2002 and previous annual reports.

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 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 areas where spring Chinook salmon spawning takes place with any regularity.

1.4 Methods

1.4.1 Stream Flow and Temperature

We obtained and summarized Lookingglass Creek stream flow data collected in 2003 by the United States Geological Survey (USGS). Stream flows (CFS at 0.25-hour sample intervals) were recorded at an electronic gauging station located just below the floating weir sill near Lookingglass Hatchery (Figure 1). Stream water temperature data were obtained from four electronic recording devices operated by the Umatilla National Forest (UNF) and USGS. UNF temperature recorders were located in Lookingglass Creek between Summer Creek and Lost Creek, below the mouth of Eagle Creek, and in Mottet Creek about 1.6 mi upstream of the mouth. The USGS temperature recorder was located

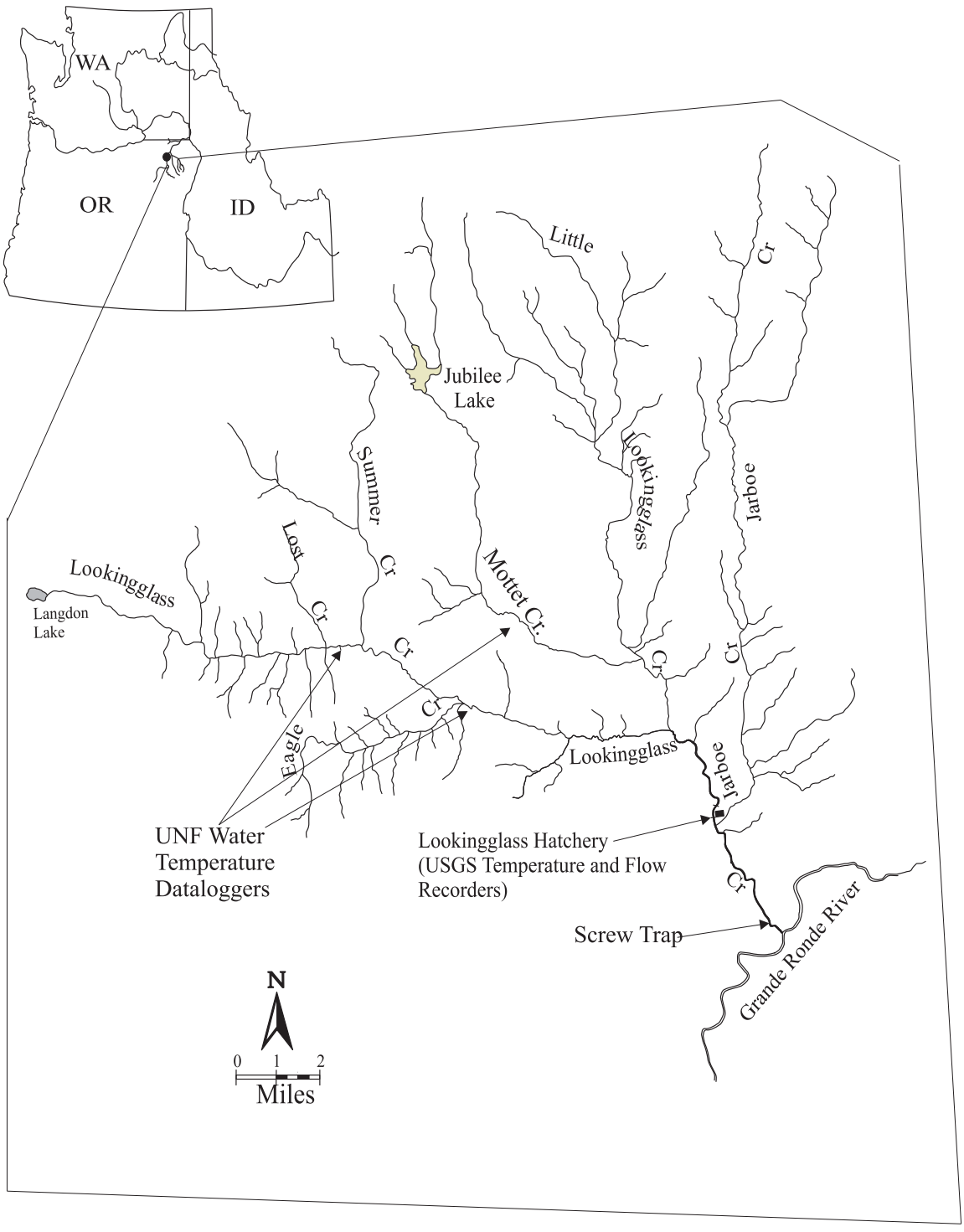

Figure 1. Map of the Lookingglass Creek basin showing the locations of major tributaries, temperature and flow recorders, screw trap and the Lookingglass Hatchery complex.

at the flow gauge near Lookingglass Hatchery. Temperatures were recorded every hour below Eagle Creek and in Mottet Creek and every 90 minutes at the site between Lost and Summer Creeks. Temperatures were taken every 15 minutes at the USGS site. Temperatures were summarized as daily minima, means, and maxima, and graphed.

1.4.2 Adult Spring Chinook Salmon

Adult spring Chinook salmon returning to Lookingglass Creek were diverted into a trap using a picket weir at the LH water intake. ODFW LH staff installed the trap on 6 March 2003 and operated it until 2 October 2003. CTUIR staff checked the trap three times a week, usually Monday-Wednesday-Friday, or more frequently if conditions warranted.

Returning adult spring Chinook salmon captured in the Lookingglass Hatchery trap in 2003 consisted of unmarked progeny of marked and unmarked fish spawning naturally (likely including some unmarked strays from other streams), and those hatchery-reared as juveniles. Brood year 1998 and 1999 releases were Rapid River stock; brood year 2000 and 2001 releases were Catherine Creek stock (Table 1).

Table 1. Hatchery-produced spring Chinook salmon released into Lookingglass Creek, 1999-2001.

BY	Release Date	No. Released	Mean weight (g)	Marks*
1998	6/24/1999	57,290	3.56	AD clips/CWT
1999	6/9/2000	23,819	6.5	AD clip/CWT
2000	9/24/2001	51,864	17.8	AD clip/CWT/PIT
2001	5/28/2002	17,539	7.0	AD clip/CWT

** AD = adipose, CWT = coded wire tag, PIT = passive integrated transponder tag*

All spring Chinook salmon captured in the trap were enumerated, examined for fin clips and other marks and tags, measured (nearest mm FL), sex and maturity status determined, and scale samples collected. All fish were euthanized and snouts taken to recover CWT. No fish were intentionally released above the hatchery weir for natural production in 2003. Week of capture was designated by the first day of the week (e.g. week of 1 January included 1-7 January). Age determinations were made using scales (Mosher 1969) or CWT data.

Some fish did not ascend to the adult trap and spawned in the 2.5 mi reach below Lookingglass Hatchery. Spawning ground surveys (Parker et al. 1995) were conducted during the spawning season from August-September 2003. Surveys were conducted below the trap (Unit 1, Burck 1993) about weekly after the first redd were observed to count redds and sample carcasses (Figure 2). Only one survey was completed above the weir since no fish were intentionally released above the weir, and we were confident no fish migrated above the weir.

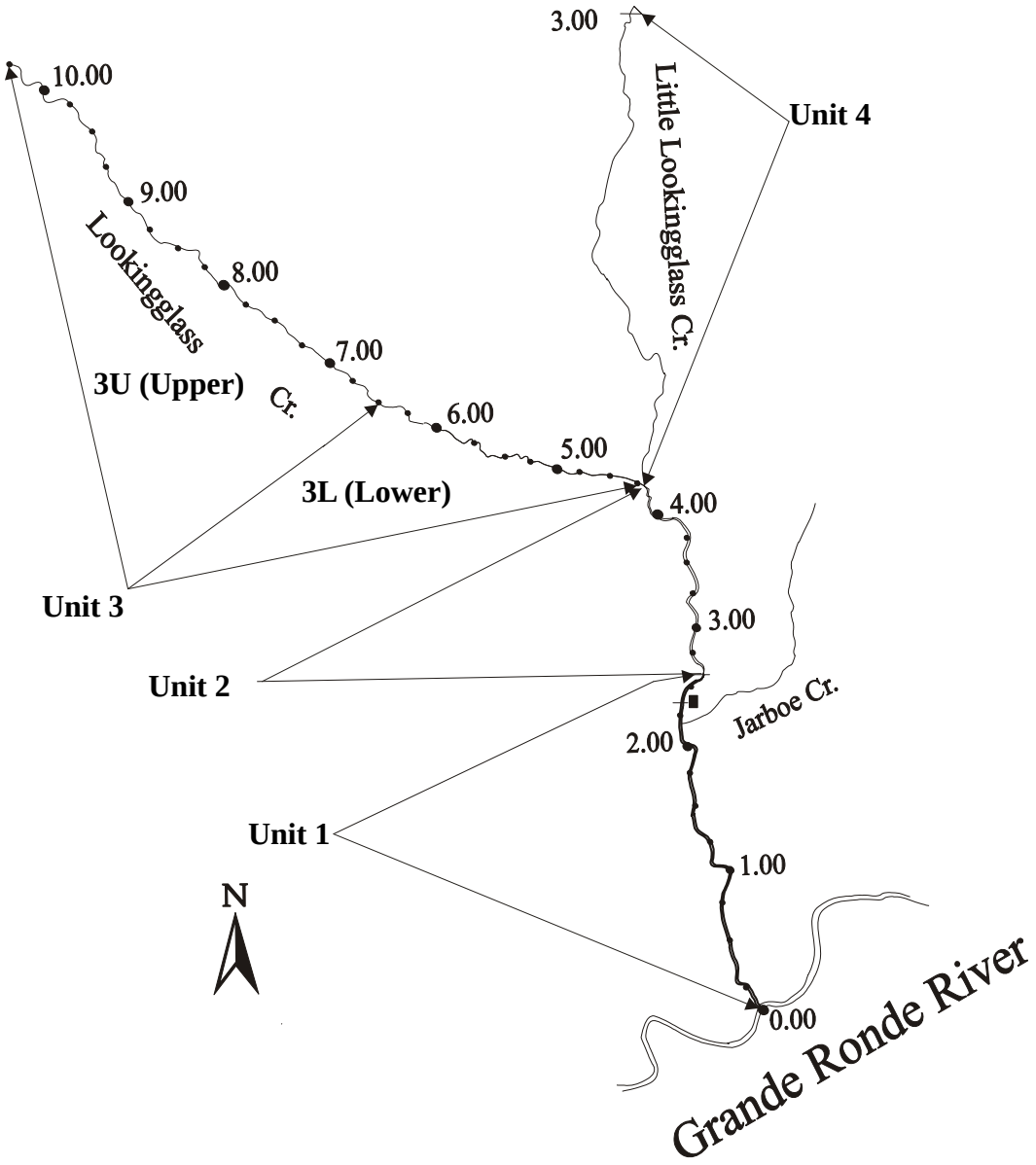

Figure 2. Spawning ground survey unit designations and river miles for Lookingglass Creek.

Only completed redds were counted (McLean and Lofy 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 AD-clipped carcasses for CWT recovery.

Snouts were sent to the ODFW CWT laboratory in Clackamas, OR for CWT recovery. Recovery data were obtained from the Regional Mark Processing Center database maintained by the Pacific States Marine Fisheries Commission (http://www.rmpc.org/). Smolt-to-adult (SAR) survival of brood year (BY) 1998 CWT fish released in June 1999 and recovered in 2001-2002-2003 was obtained from the Columbia Basin Research website maintained by the University of Washington at http://www.cbr.washington.edu/cwtSAR/. Methods for calculating SAR are described by Skalski and Townsend (2005).

Total spawning escapement (total returns to the stream) was obtained by adding the fish captured and euthanized at the LH trap to the estimated number spawning below the trap. The estimated escapement of unmarked fish below the LH weir was the product of the fraction of unmarked carcasses observed in the spawning ground surveys, the total number of redds, and the fish per redd value (3.26) reported by McLean et al. (1995). The estimated escapement of unmarked fish was separated into age groups using scale data for unmarked fish captured at the LH trap. Estimated escapement of AD-clipped fish below the LH trap was obtained in the same way as for unmarked fish. The estimate of AD-clipped fish was separated into coded wire tag status using the fractions observed in the trap catch. Tag status 1 (tag read OK) fish were allocated to the various tag codes also using the fractions observed in the LH adult trap catch. For a tag status of other than 1 (e.g. tag lost before read), forks lengths were used to allocate to the various age groups based on length at age data from CWT status 1 fish.

1.4.3 Juvenile Spring Chinook Salmon

We operated a 1.52 m diameter rotary screw trap (Roper and Scarnecchia 1996) at rm (river mile) 0.1 on Lookingglass Creek to collect outmigrating natural and hatchery-produced juvenile spring Chinook salmon. The screw trap was operated continuously during 2002 and 2003 except for brief periods during the spring freshet and if iced up in winter. The trap was 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 to the nearest mm FL, and weighed to the nearest 0.1 g. Those not already PIT-tagged were tagged using standard methods (PIT Tag Steering Committee 1999). Those not bearing a secondary mark (Alcian Blue tattoo just above the anal fin on the left side) received one prior to release in order to estimate trap efficiency. The secondary mark was used because some fish had been previously PIT-tagged but not tattooed, and we wanted to avoid multiple capture/recapture of PIT-tagged fish. All newly-tattooed fish were released about 100 ft above the screw trap; previously-tattooed fish were released 50 ft below the screw trap.

DARR 2.0 (Bjorkstedt 2005) was used to estimate the numbers of outmigrating natural and hatchery-origin spring Chinook juveniles. DARR 2.0 uses stratified mark-recapture data and pools strata with 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 separated into three groups based on marks or size. BY 2001 hatchery-origin presmolts (Catherine Creek captive broodstock progeny) reared under an accelerated growth regime at Irrigon Hatchery were released in Lookingglass Creek below the hatchery weir on 28 May 2002. These fish were adipose-clipped and coded-wire tagged prior to release into Lookingglass Creek, but not PIT-tagged. Some of these were caught in the screw trap, PIT-tagged and released. BY 2001 natural origin juveniles (primarily Rapid River stock progeny) constituted the great majority of unmarked outmigrants from June 2002 through August 2003. During January-June of 2003, naturally-produced (unmarked) BY 2002 juveniles were distinguished from BY 2001 naturally-produced juveniles by their much smaller size and lower abundance. BY 2002 naturally-produced juveniles were not PIT-tagged or used in estimates of trap efficiency. Production and performance of BY 2002 natural-origin spring Chinook salmon will be described in the 2004 annual report.

PIT-tagged natural-origin BY 2001 juvenile spring Chinook salmon were grouped by period to compare arrival timing, travel time, survival and capture probability to Lower Granite Dam by querying the PIT tag database maintained by the Pacific States Marine Fisheries Commission at http://www.ptagis.org/ and PitPro (Westhagen and Skalski 2006). Groups were categorized by initial arrival timing at the screw trap (Burck 1993). The fall group was PIT-tagged from 28 June-30 September 2002, the winter group from 1 October-31 December 2002, and the spring group from 1 January-22 August 2003. No seasonal groups were designated for BY 2001 hatchery-origin fish. A field group consisted of naturally-produced fish seined from various locations in Lookingglass Creek below the hatchery from on 29 July-7 August 2002, PIT-tagged, and released where collected. This group was used to compare to natural-origin fish captured and PIT-tagged by ODFW during a similar time period in Catherine Creek, the Lostine River and the Minam River by ODFW (Reischauer et al. 2003). A hatchery-origin group was also PIT-tagged and released in Lookingglass Creek during the same time period.

We monitored seasonal growth of natural- and hatchery-origin juvenile spring Chinook by obtaining fork lengths (mm) of 50 fish collected by seining at several locations in the 2.5 mi reach below the weir in June, July, August, and September.

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].

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. 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

A brief spike in Lookingglass Creek streamflow occurred from 26 January-7 February 2003 (Figure 3), due to a brief warm period and some precipitation. Streamflows began increasing again the week of 6 March 2003, and this period of elevated flows lasted until about 12 June 2003. After 12 June, flows diminished, reaching a stable level of about 50 CFS that lasted throughout most of the fall.

Maximum daily water temperature peaked at the USGS site in mid-July, at just under 20^{o}C (Figure 4). Maximum temperatures over 16^{o}C were recorded for about a two week period in late July at the springs site, but maximum temperatures during June through September were usually below 14^{o}C (Figure 5). Maximum temperatures never exceeded 12^{o}C at the site below the mouth of Eagle Creek (Figure 6). Maximum water temperatures at the Mottet Creek site were above 15^{o}C for July and early August (Figure 7).

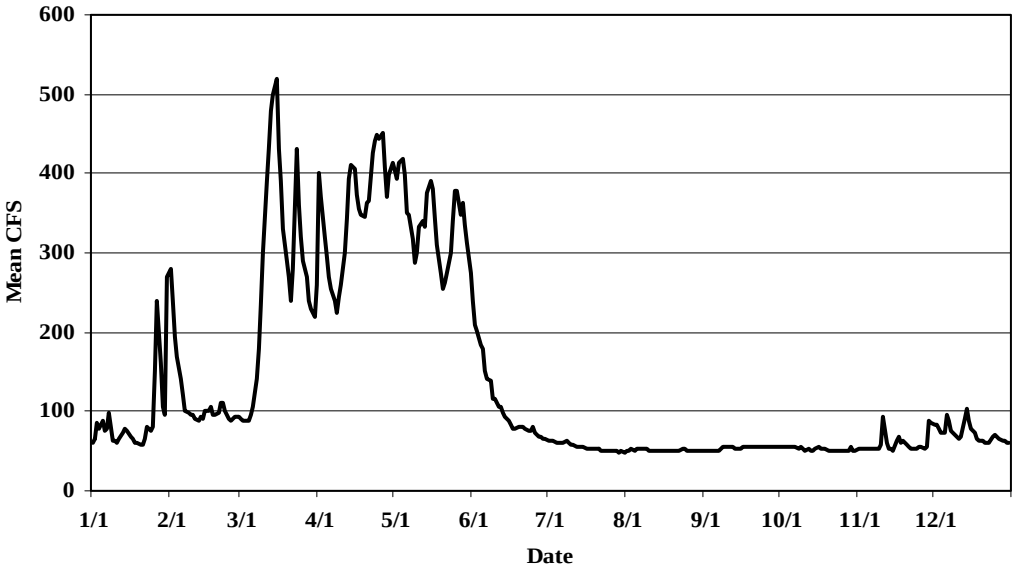

Figure 3. Mean daily streamflows in Lookingglass Creek at the USGS gauging station near Lookinglass Hatchery, 2003.

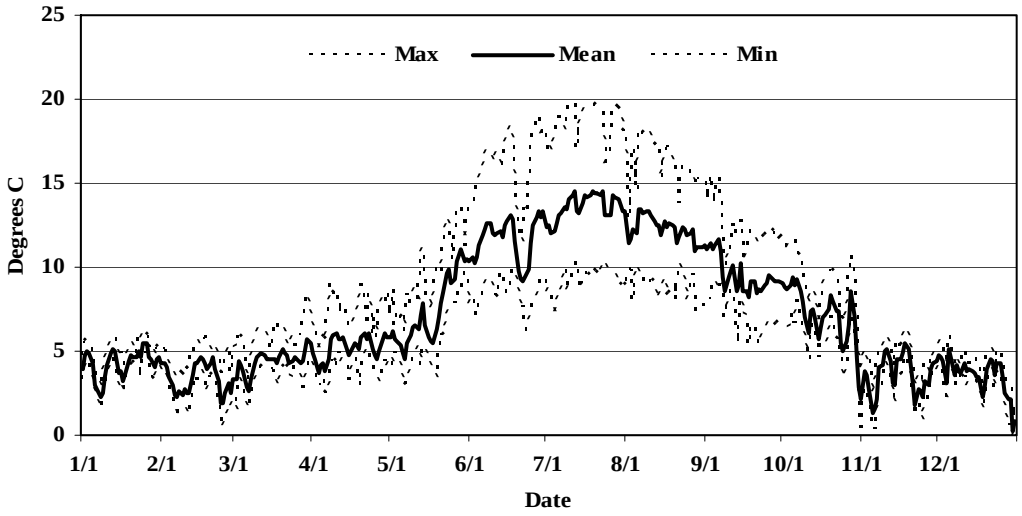

Figure 4. Water temperatures in Lookingglass Creek at the USGS gauging station near Lookingglass Hatchery, 2003.

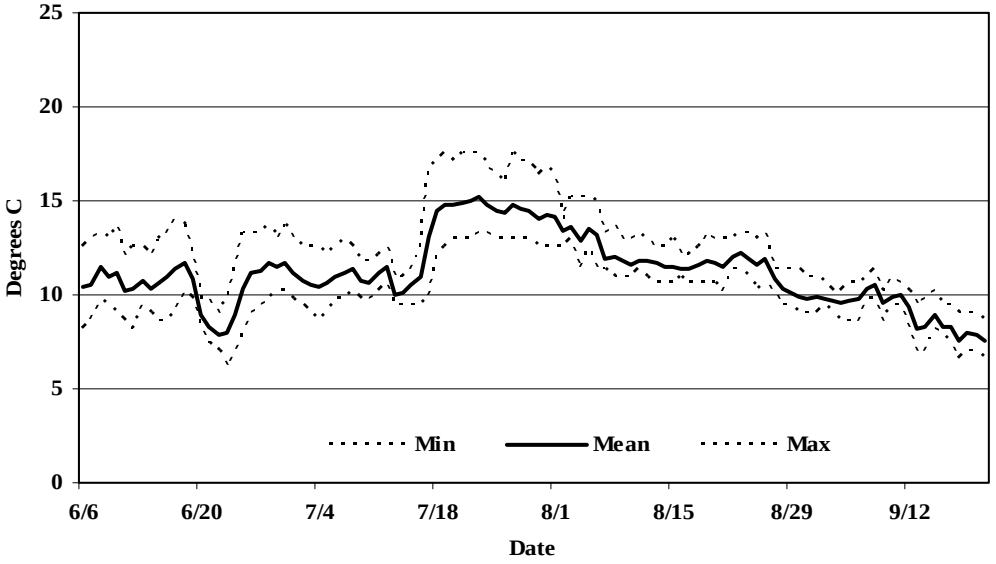

Figure 5. Water temperatures in Lookingglass Creek at the UNF site between Lost and Summer Creeks ("springs", rm 10.5), 2003.

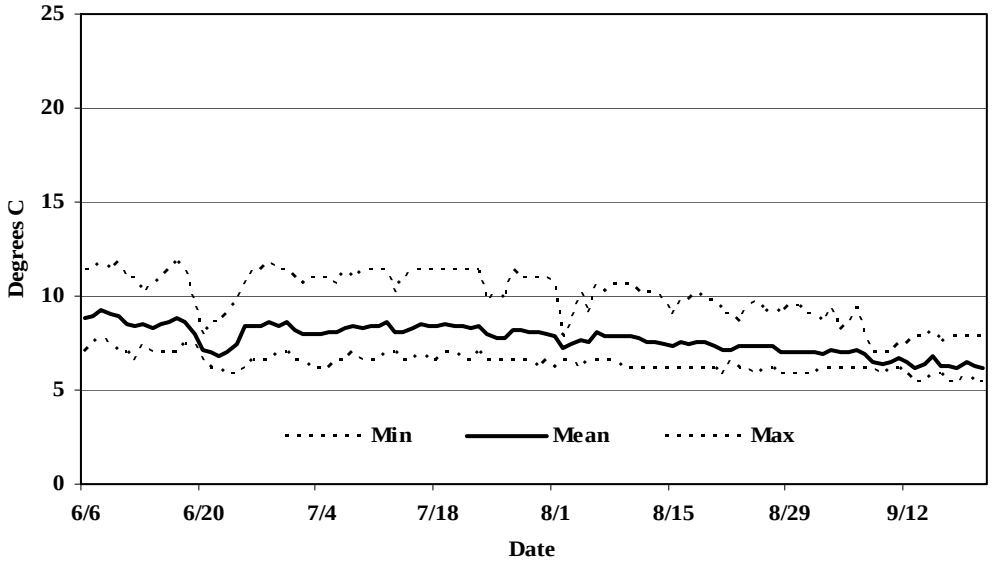

Figure 6. Water temperatures in Lookingglass Creek at the UNF station just below the mouth of Eagle Creek (rm 8.25), 2003.

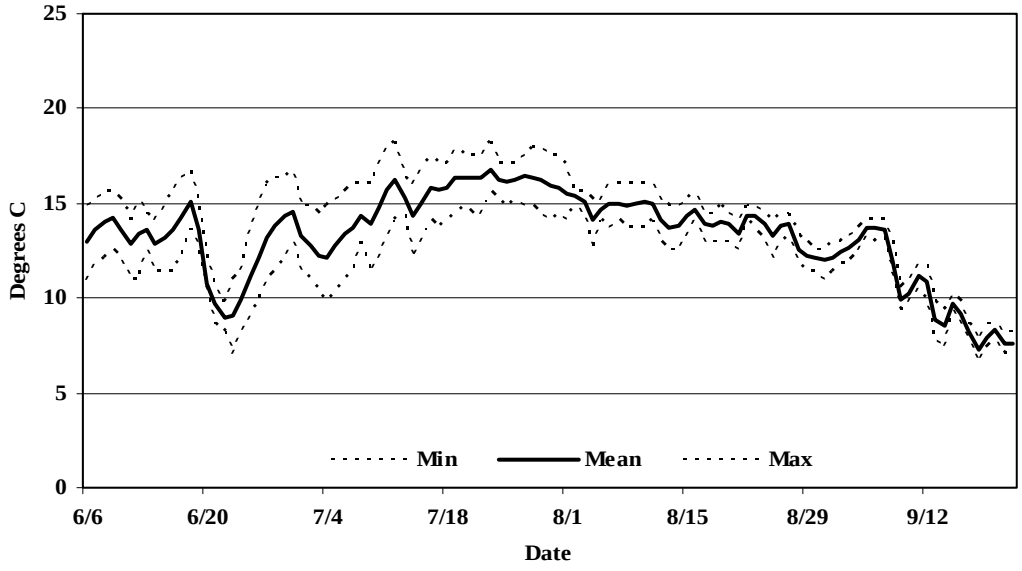

Figure 7. Water temperatures at the UNF gauging station in Mottet Creek, 2003.

1.5.2 Adult Spring Chinook Salmon

The adult trap at the Lookingglass Hatchery water intake was operated from 6 March-2 October 2003 and 77 spring Chinook salmon were collected. The first and last unmarked fish were collected on 21 May and 8 September, respectively. The first and last AD-clipped fish were collected on 23 May and 2 September, respectively. An unmarked 900 mm male was trapped on 28 May 2003 that had been radio-tagged in the spring of 2003

by the Idaho Cooperative Fishery Research Unit. An 885 mm unmarked female trapped on 28 May 2003 had been jaw-tagged by the Washington Department of Fish and Wildlife at Bonneville Dam on 18 April 2003. An 878 mm AD-clipped male trapped on 6 June 2003 had been PIT-tagged by ODFW at the Grande Ronde River scoop trap at rm 522.271.

Most AD-clipped and unmarked ages 4 and 5 adults were caught during the weeks of 21 May-18 June (Figure 8). Age 3 fish were caught beginning the week of 18 June. No fish were caught during the weeks of 30 July and 6 August.

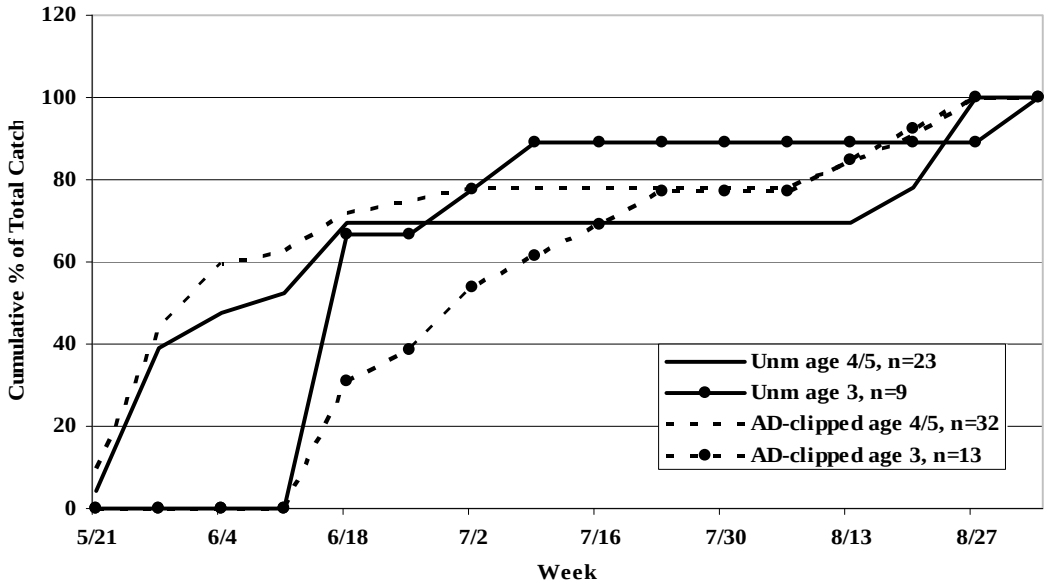

Figure 8. Cumulative % of total catch by week for marked (AD-clipped)) and unmarked adult spring Chinook salmon caught in the Lookingglass Hatchery adult trap, 2003.

The catch of unmarked fish showed three age classes present with age 4 fish most abundant (Table 2). AD-clipped fish also had three age classes present, and age 5 fish were most abundant. Age 3 males made up 28-29% of the catch of both unmarked and AD-clipped fish. Mean FL of unmarked males were greater than AD-clipped for ages 3 and 4. Length frequencies for both AD-clipped and unmarked fish showed three distinct age groupings (Figures 9, 10).

Table 2. Summary of FL data by age, sex, and mark for spring Chinook salmon trapped at the Lookingglass Hatchery adult trap and aged using scales or CWT data, 2003 (unique captures only).

Mark	Sex	Age	$\bar{X}$ FL	Range	SE	n
Unmarked	M	3	514.3	444-590	15.5	9
		4	744.0	695-795	16.4	6
		5	900.0			1
	F	3				0
		4	719.6	680-770	10.7	9
		5	875.0	795-915	14.4	7
AD-clipped	M	3	502.0	391-600	14.6	13
		4	712.2	645-850	36.0	5
		5	908.4	830-1000	18.9	9
	F	3				0
		4	730.0	705-771	10.1	6
		5	885.3	848-960	9.5	12

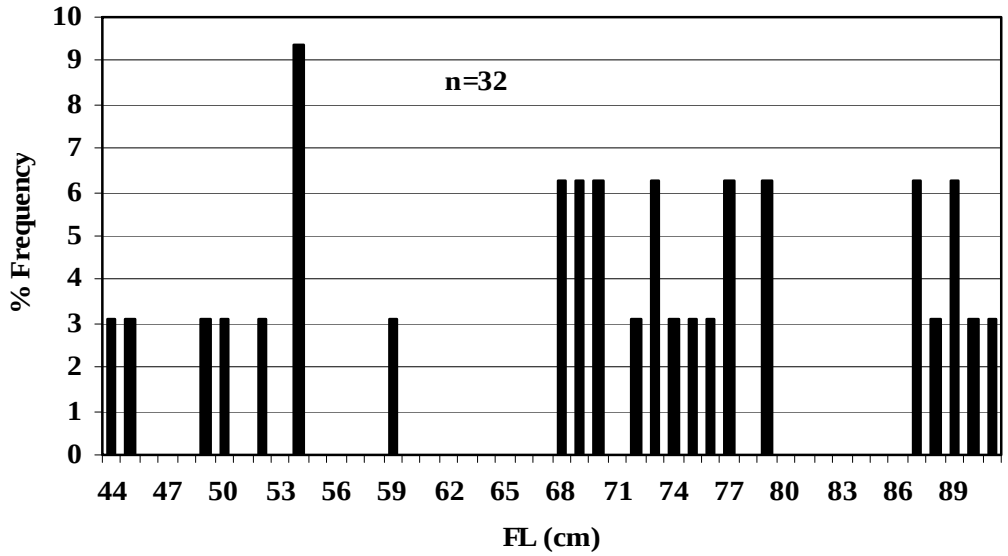

Figure 9. FL frequency distribution of unmarked spring Chinook salmon collected at the Lookingglass Creek adult trap, 2003.

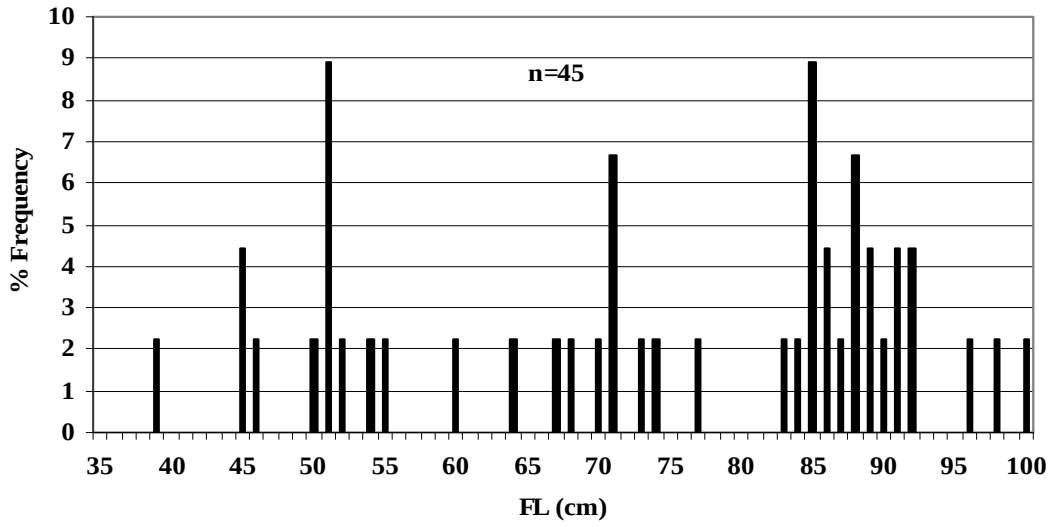

Figure 10. FL frequency distribution of AD-clipped spring Chinook salmon collected at the Lookingglass Creek adult trap, 2003.

We conducted one spawning ground survey of Units 2,3U, 3L, and 4 (sections above the weir) on 5 September 2003 and did not observe any redds or carcasses. We surveyed Unit 1 (below the weir) 6 times from 28 August-22 September 2003 and observed 10 completed redds and 10 carcasses. The 10 carcasses included 7 AD-clipped, 2 unmarked, and 1 fish for which mark status was undetermined. Estimated total returns to the stream were 71 AD-clipped fish and 39 unmarked (Table 3).

Table 3. Estimated returns of adult spring Chinook salmon to Lookingglass Creek by age and mark, 2003.

Mark	n	Fraction	Age	Weir Catch	Fraction	Estimated Spawners	Returns to stream[b]
AD-clip	45	0.584	3	13	0.289	8	21
			4	11	0.244	6	17
			5	21	0.467	12	33
			All	45		26[a]	71
Unmarked	32	0.416	3	9	0.281	2	11
			4	15	0.469	3	18
			5	8	0.25	2	10
			All	32		7[a]	39

[a] *estimated redds below weir x 3.26 fish=33 fish (McLean et al. 1995)*
[b] *weir catch plus estimated spawners below weir*

No CWT data were available for the 7 snouts recovered on the spawning ground surveys. Snouts recovered from adults caught at the LH adult trap in included 40 tag status 1 (tag read OK), 4 tag status 2 (no tag), and 1 tag status 3 (tag lost before read). CWTs recovered from AD-clipped fish (Table 4) revealed 23 Rapid River-stock fish liberated as smolts or presmolts (19 BY 1998, 4 BY 1999). Two BY 2000 Catherine Creek captive broodstock progeny liberated on 24 September 2001 were recovered. Strays into the Lookingglass Creek adult trap included 10 from Catherine Creek (5 BY 1999, 5 BY 2000), 3 from the upper Grande Ronde River (BY 2000), and 2 from the Lostine River. All 15 strays were captive broodstock progeny, spawned at Bonneville Hatchery, reared at Lookingglass Hatchery, and acclimated and released in the stream of parental origin. SAR for tag code 92819 was 0.00019 (SE 0.000064). In-basin strays made up 17.7% of the total returns for CWT code 92819 (Lostine River, Catherine Creek Trap) and out-of-basin strays 5.8% (Round Butte Trap, Salmon River) (Table 5). Mean FL of males were greater than females at ages 4 and 5 for recoveries of CWT code 92819 (Table 6).

The expanded total of AD-clipped spawners from Table 3 was partitioned into tag codes using information from the 45 fish collected at the Lookingglass Hatchery adult trap (we assumed the tag status 3 fish was tag code 92819). Using those fractions, the numbers of AD-clipped spawners by tag code were 92819 (11.55), 93114 (2.10), 93438 (1.15), 93434 (1.15), and 70149 (1.15). Expanded numbers for tag codes 93109, 93110, 93111, 93112, 93113, 93421, 93426, 93432, 93435, 93436, and 93440 were all 0.59. The expanded number of AD-clipped spawners without a CWT was 2.10. Summing the Lookingglass Hatchery adult trap recoveries of tag code 92819 and the estimated spawners with tag code 92819 gives a total of 31.55.

Table 4. CWT data for AD-clipped spring Chinook salmon carcasses collected from Lookingglass Creek or the Lookingglass Hatchery adult trap, 2003

BY	Release Date	Sex	FL (mm)	CWT Code	Stock	Rel Loc
1998	6/24/1999	F	858	92819	RR	LKGCR
1998	6/24/1999	M	900	92819	RR	LKGCR
1998	6/24/1999	F	848	92819	RR	LKGCR
1998	6/24/1999	F	865	92819	RR	LKGCR
1998	6/24/1999	M	1000	92819	RR	LKGCR
1998	6/24/1999	M	850	92819	RR	LKGCR
1998	6/24/1999	F	890	92819	RR	LKGCR
1998	6/24/1999	M	925	92819	RR	LKGCR
1998	6/24/1999	F	882	92819	RR	LKGCR
1998	6/24/1999	M	878	92819	RR	LKGCR
1998	6/24/1999	F	850	92819	RR	LKGCR
1998	6/24/1999	F	880	92819	RR	LKGCR
1998	6/24/1999	F	918	92819	RR	LKGCR
1998	6/24/1999	F	960	92819	RR	LKGCR
1998	6/24/1999	M	883	92819	RR	LKGCR
1998	6/24/1999	F	891	92819	RR	LKGCR
1998	6/24/1999	M	983	92819	RR	LKGCR
1998	6/24/1999	M	512	92819	RR	LKGCR
1998	6/24/1999	M	927	92819	RR	LKGCR
1999	4/16/2001	F	711	93109	CC	CCACC
1999	4/16/2001	F	705	93110	CC	CCACC
1999	4/16/2001	M	850	93111	CC	CCACC
1999	4/16/2001	F	715	93112	CC	CCACC
1999	4/16/2001	F	743	93113	CC	CCACC
1999	6/9/2000	M	681	93114	RR	LKGCR
1999	6/9/2000	M	675	93114	RR	LKGCR
1999	6/9/2000	F	771	93114	RR	LKGCR
1999	6/9/2000	M	710	93114	RR	LKGCR
2000	4/5/2002	M	450	70149	UGR	UGRACC
2000	4/5/2002	M	500	70149	UGR	UGRACC
2000	4/14/2002	M	544	93421	LOS	LOSACC
2000	4/14/2002	M	552	93426	LOS	LOSACC
2000	4/15/2002	F	917	93432	CC	CCACC
2000	9/24/2001	M	510	93434	CC	LOOH
2000	9/24/2001	M	455	93434	CC	LOOH
2000	4/15/2002	M	510	93435	CC	CCACC
2000	4/15/2002	M	600	93436	CC	CCACC
2000	4/15/2002	M	391	93438	CC	CCACC
2000	4/15/2002	M	467	93438	CC	CCACC
2000	4/15/2002	M	525	93440	UGR	UGRACC

Table 5. Summary of CWT data for hatchery-origin BY 1999 (tag code 92819) spring Chinook salmon released into Lookingglass Creek in June 2000.

RY	Recapture Location Name	Estimated Number	% of RY Total
2002	Bonneville Ceremonial	1.02	10.7
	Columbia River Net[a]	2.06	21.5
	Lostine River	2.16	22.6
	Lookingglass Creek	4.32	45.2
RY 2002 Total		9.56	
2003	Round Butte Trap	1	4.0
	Salmon River[b]	1.01	4.0
	Catherine Creek Trap	4	15.8
	Lookingglass Hatchery	18	71.3
	Lookingglass Creek Trap	1.25	4.9
RY 2003 Total		25.26	

[a] *Zone 2*
[b] *recovered 11/9/2004*

Table 6. FL (mm) at recovery of CW-tagged BY 1998 (tag code 92819) hatchery-origin spring Chinook salmon released from Lookingglass Hatchery into Lookingglass Creek in June 2000.

RY	Sex	$\bar{X}$	SE	Min	Max	n
2002	M	789.0	41.0	748	830	2
	F	725.8	28.7	650	825	6
	Both	741.6	24.6	650	830	8
2003	M	912.1	15.1	850	1000	10
	F	873.7	10.5	785	960	14
	Both	889.7	9.4	785	1000	24

1.5.3 Juvenile Spring Chinook Salmon

1.5.3.1 Brood Year 2001

Trap operation was effective from 28 June-31 December 2002 with only a few (2-3) days lost to freezeup in November, and little trouble from mink. In 2003, we had over 100 mortalities from mink, and we killed two mink in traps within the live box. High flows and debris loads caused ineffective weir operation for a good part of March 2003. The trap was removed from operation during 30 July-17 August 2003. Trap catches immediately preceding and after this period were very low, similar to past years.

1.5.3.1.1 Natural Production

The estimated total number of hatchery-origin outmigrants was 5,822 +/-1,179 (Table 7). DARR 2.0 reduced the initial number of strata from 4 to 3. Outmigrants were collected from 28 June 2002 through 22 August 2003. The total catch included 14 mortalities and the total marked and released for trap efficiency included 43 recaptures of the field group that was marked and released in late July and early August of 2002. Field group fish used for trap efficiency constituted 8 of the 52 recaptures (15%). Days elapsed between mark/release and recapture of fish used for trap efficiency were usually 1-4 d (94%), but ranged up to 102 d Most outmigration occurred during 28 June-30 September 2002 (77%). Outmigrants per redd for the 2001 cohort was 68 (5,731/86).

Table 7. Naturally-produced juvenile spring Chinook salmon from the 2001 cohort captured in the Lookingglass Creek rotary screw trap, releases and recaptures from trap efficiency tests, estimated number of outmigrants and SE, MY 2003.

Dates	u	m	r	Cp	N	SE
6/28/02-9/30/02	265	241	15	0.059	4,471	1,160
10/2/02-11/20/02	107	106	22	0.208	516	96
1/28/03-8/22/03	115	109	15	0.138	836	199
	487	456	52		5,822	1,179

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$^{0.5}$)

Most fish PIT-tagged and released were in the 8-10 cm FL categories (Figure 11). The mean FL of the different seasonal groups (fall, winter, spring) varied by only 5.1 mm (Table 8). Mean K was the same for fall and winter groups, but increased by 0.07 for the spring group.

Median arrival dates at Lower Granite Dam varied by only 3 d between the fall and winter groups, but the spring group was almost 6 weeks later (Table 9). Harmonic mean travel times varied by about 29 d between the fall and winter groups (Table 10). Survival was lower the later the tag group (Table 11).

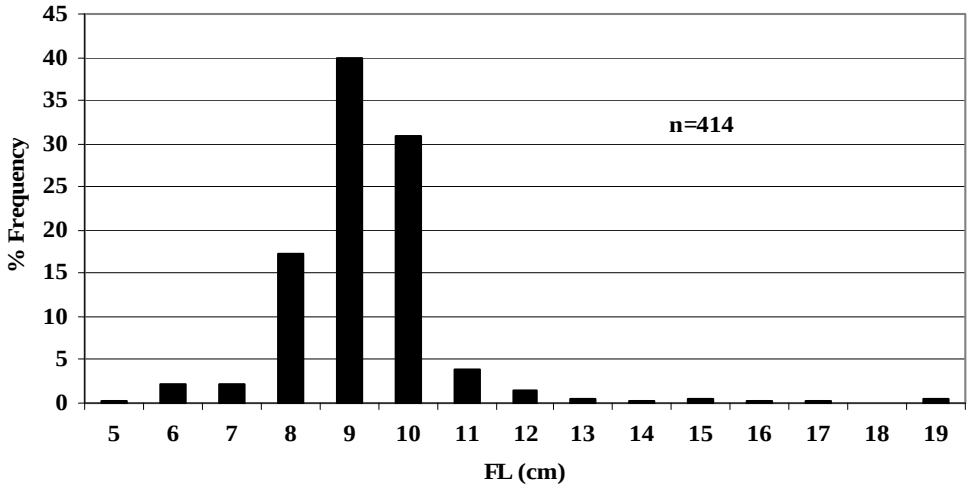

Figure 11. FL frequency of BY 2001 naturally-produced spring Chinook salmon caught in the Lookingglass Creek screw trap, PIT-tagged/released, MY 2003.

Table 8. FL, weight and K factor summaries for natural-origin BY 2001 spring Chinook salmon collected in the Lookingglass Creek screw trap, PIT-tagged/released, MY 2003.

		Parameter		
Group	Statistic	FL	Wgt	K
Fall	Mean	96.0	10.2	1.10
	SD	12.8	5.8	0.10
	SE	0.8	0.4	0.007
	Min	62	36.3	0.75
	Max	191	67.4	1.64
	n	229	223	223
Winter	Mean	95.7	9.8	1.10
	SD	9.1	2.8	0.13
	SE	1.0	0.3	0.015
	Min	67	5	0.82
	Max	118	18.8	1.76
	n	76	75	75
Spring	Mean	100.8	13.0	1.17
	SD	18.3	9.8	0.15
	SE	1.8	0.9	0.014
	Min	58	2.8	0.79
	Max	193	85.2	1.64
	n	109	109	109

Table 9. Migration timing summary for naturally-produced BY 2001 spring Chinook salmon caught in the Lookingglass Creek screw trap, PIT-tagged/released, MY 2003.

Group	n	Median Tagging date	Median Arrival Date at Lower Granite Dam	Actual Detections	Expanded Detections
Fall	229	9/23/2002	4/15/2003	27	43
Winter	76	10/9/2002	4/12/2003	7	13
Spring	109	6/30/2003	5/26/2003	6	8

Table 10. Travel time (TT) in days to Lower Granite Dam summary for naturally-produced BY 2001 spring Chinook salmon caught in the Lookingglass Creek screw trap, PIT-tagged/released, MY 2003.

Group	n	Harmonic $\bar{X}$ TT	SE
Fall	27	208.431	4.600
Winter	7	179.225	7.852
Spring	6	13.305	4.729

Table 11. Survival to and capture probabilities at Lower Granite Dam for naturally-produced BY 2001 spring Chinook salmon caught in the Lookingglass Creek screw trap, PIT-tagged/released, MY 2003.

Group	n	Survival	SE	Capture Probability	SE
Fall	229	0.3624	0.0797	0.3253	0.0833
Winter	76	0.2566	0.0664	0.3590	0.1245
Spring	109	0.1101	0.0540	0.5000	0.2500

1.5.3.1.2 Hatchery Production

The estimated total number of hatchery-origin outmigrants was 3,285 +/-487 (Table 7). The trap was moved to shallow water for 28 and 29 May 2002 and was not fishing. The total catch included 10 mortalities and the total marked and released for trap efficiency included 16 recaptures of the field group that was marked and released in late July and early August of 2002. Only 1 field group fish was in the 42 trap efficiency recaptures (2%). Days elapsed between mark/release and recapture of fish used for trap efficiency were usually 1-4 d (93%), but ranged up to 210 d. Most outmigration occurred during 23 August-30 September 2002 (48%). The outmigrant estimate from the screw trap was about 19% of the total released into Lookingglass Creek on 31 May 2002.

Most hatchery-origin fish PIT-tagged and released were in the 8-11 cm FL groups (Figure 12). Due to the low number of hatchery-origin fish captured, data were summarized for the whole group, rather than splitting into fall, winter, and spring groups. Mean Fl at PIT-tagging was similar to the natural-origin fish (Table 13). The 239 PIT-tagged fish used in Tables 14-16 were fish tagged and released after the tagging data for the last detection at Lower Granite Dam in 2002.

Table 12. Hatchery-reared juvenile spring Chinook salmon from the 2001 cohort captured in the Lookingglass Creek rotary screw trap, releases and recaptures from trap efficiency tests, estimated outmigrants and SE, MY 2003.

Dates	u	m	r	Cp	N	SE
5/31/02-6/17/02	131	126	16	0.132	992	279
7/1/02-7/17/02	43	43	5	0.112	383	196
8/23/02-10/30/02	158	150	15	0.1	1,580	385
1/1/03-6/16/03	45	44	6	0.136	330	124
	377	363	42		3,285	487

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$^{0.5}$)

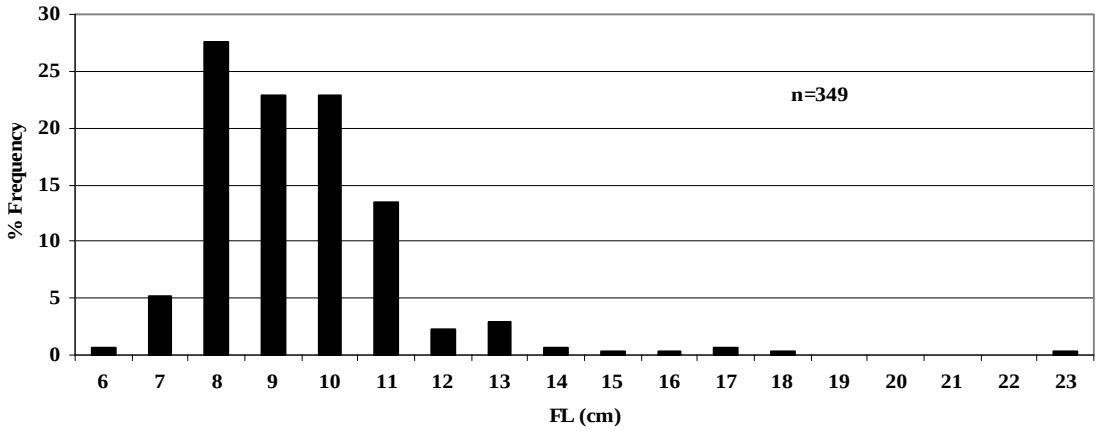

Figure 12. FL frequency of BY 2001 hatchery-produced spring Chinook salmon caught in the Lookingglass Creek screw trap, PIT-tagged, and released, MY 2003.

Table 13. Length, weight and K factor summary for hatchery-origin BY 2001 spring Chinook salmon collected in the Lookingglass Creek screw trap, PIT-tagged/released, 2002-2003.

	Parameter		
Statistic	FL	Wgt	K
Mean	99.1	13.6	1.12
SD	18.0	11.3	0.14
SE	1.0	0.7	0.008
Min	67	4.5	0.67
Max	235	147.6	1.80
n	349	270	270

Table 14. Migration timing summary for hatchery-origin BY 2001 spring Chinook salmon caught in the Lookingglass Creek screw trap, PIT-tagged/released, 2002-2003.

n	Median Tagging date	Median Arrival Date at Lower Granite Dam	Actual Detections	Expanded Detections
239	9/25/2002	4/19/2003	13	26

Table 15. Travel time (TT) in days to Lower Granite Dam summary for hatchery-origin BY 2001 spring Chinook salmon caught in the Lookingglass Creek screw trap, PIT-tagged/released, 2002-2003.

n	Harmonic $\bar{X}$ TT	SE
13	84.025	20.760

Table 16. Survival to and capture probabilities at Lower Granite Dam for hatchery-origin BY 2001 spring Chinook salmon caught in the Lookingglass Creek screw trap, PIT-tagged/released, 2002-2003.

n	Survival	SE	Capture Probability	SE
239	0.1768	0.0406	0.3077	0.0905

1.5.3.1.3 Field Groups

Mean FL of 424 (4 fish were not measured) PIT-tagged BY 2000 natural-origin spring Chinook salmon collected by seining from 29 July-7 August 2002, PIT-tagged and released in Lookingglass Creek was 85.2 mm (Table 17). Fish from Lookingglass Creek were larger than fish from the three other streams.

Arrival timing at Lower Granite Dam for Lookingglass Creek fish was at least a month earlier than for the other three streams (Table 18). Harmonic mean travel time to Lower Granite Dam was lowest for Lookingglass Creek (Table 19). Survival rate to Lower Granite Dam for Lookingglass Creek fish was almost double that for the Lostine River and about four times the values for Catherine Creek and the Minam River (Table 20). Recaptures in the screw trap indicated that most of the Lookingglass Creek field group outmigrated during August-October 2001 (Figure 13).

Table 17. FL (mm), weight (g), and K factor summary for naturally-produced BY 2001 spring Chinook salmon collected by seining (field groups) from Lookingglass Creek, the Lostine River, Catherine Creek, and the Minam River, 2002.

Stream	Collection Dates	Parameter	$\bar{X}$	SE	n
Lookingglass Creek	7/29-8/7	FL	85.2	0.4	426
		Weight	8.0	0.1	425
		K	1.28	0.01	424
Catherine Creek	7/29-8/1	FL	67.6	0.3	505
		Weight	3.9	0.1	496
		K	1.23	0.01	495
Lostine River	8/13-8/15	FL	69.6	0.4	509
		Weight	4.4	0.1	406
		K	1.18	0.01	406
Minam River	8/20-8/21	FL	66.7	0.2	999
		Weight	3.4	0.1	691
		K	1.08	0.004	691

Table 18. Migration timing summary for naturally-produced BY 2001 spring Chinook salmon (field groups) collected by seining from Lookingglass Creek, the Lostine River, Catherine Creek, and the Minam River, PIT-tagged/released, 2002.

Stream	n	Median Arrival Date at Lower Granite Dam	Actual Detections	Expanded Detections
Lookingglass Creek	428	4/11/2003	83	120
Catherine Creek	506	5/11/2003	18	32
Lostine River	509	5/7/2003	22	41
Minam River	1,000	5/13/2003	23	45

Table 19. Travel time (TT) in days to Lower Granite Dam summary for naturally-produced BY 2001 spring Chinook salmon (field groups) collected by seining from Lookingglass Creek, the Lostine River, Catherine Creek, and the Minam River, PIT-tagged/released, 2002.

Stream	n	Harmonic $\bar{X}$ TT	SE
Lookingglass Creek	83	254.941	1.574
Catherine Creek	18	286.709	4.074
Lostine River	22	263.606	3.482
Minam River	23	260.601	3.250

Table 20. Survival to and capture probabilities at Lower Granite Dam for naturally-produced BY 2001 spring Chinook salmon (field groups) collected by seining from Lookingglass Creek, the Lostine River, Catherine Creek, and the Minam River, PIT-tagged/released, 2002.

Stream	n	Survival	SE	Capture Probability	SE
Lookingglass Creek	428	0.2902	0.0356	0.3865	0.0575
Catherine Creek	506	0.0744	0.0132	0.4516	0.0894
Lostine River	509	0.1582	0.0304	0.2609	0.0647
Minam River	1,000	0.0613	0.0106	0.3750	0.0765

Mean FL of the hatchery-origin field group was about 15 mm greater than for the natural-origin group (Table 21). Migration timing and travel time to Lower Granite Dam differed by 3-5 d (Tables 22-23). Survival for the natural-origin group was almost double that of the hatchery-origin group (Table 24). Recaptures of the natural-origin field group in the Lookingglass Creek screw trap ranged from 21 August-16 October 2002, with almost half occurring on 9 October (Figure 13). Hatchery-origin field group recaptures totaled 16 from 23 August 2002-14 March 2003, with 6 occurring on 9 October 2002.

Table 21. FL (mm), weight (g) and K factor comparison by rearing type for BY 2001 spring Chinook salmon collected by seining (field groups) from Lookingglass Creek, 2002.

		Rearing Type	
Parameter	Statistic	Natural	Hatchery
FL (mm)	$\bar{X}$	85.2	101.1
	SE	0.4	0.5
	n	426	259
Wgt (g)	$\bar{X}$	8.0	12.9
	SE	0.1	0.2
	n	425	257
K	$\bar{X}$	1.28	1.23
	SE	0.01	0.01
	n	424	256

Table 22. Migration timing comparison by rearing type for BY 2001 spring Chinook salmon (field groups) collected by seining from Lookingglass Creek, PIT-tagged/ released, 2002.

Rearing Type	n	Median Arrival Date at Lower Granite Dam	Actual Detections	Expanded Detections
Natural	428	4/11/2003	83	120
Hatchery	260	4/14/2003	16	30

Table 23. Travel time (TT) in days to Lower Granite Dam comparison by rearing type for BY 2001 spring Chinook salmon (field groups) collected by seining from Lookingglass Creek, PIT-tagged/released, 2002.

Rearing Type	n	Harmonic $\bar{X}$ TT	SE
Natural	83	254.941	1.574
Hatchery	16	259.440	3.843

Table 24. Survival to and capture probabilities at Lower Granite Dam comparison by rearing type for BY 2001 spring Chinook salmon (field groups) collected by seining from Lookingglass Creek, PIT-tagged/released, 2002.

Rearing Type	n	Survival	SE	Capture Probability	SE
Natural	428	0.2902	0.0356	0.3865	0.0575
Hatchery	260	0.1538	0.0310	0.4000	0.0955

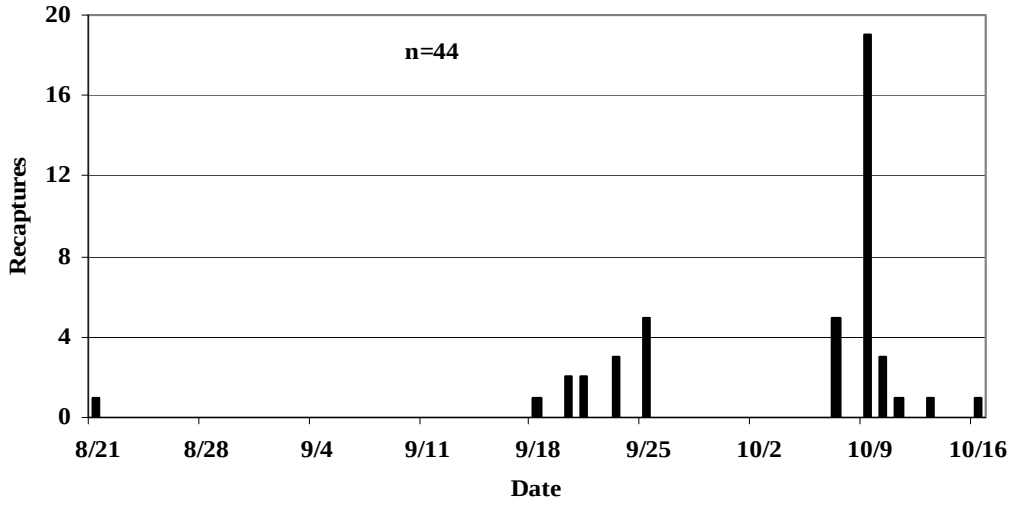

Figure 13. Recaptures by date of natural-origin BY 2001 spring Chinook salmon field group from Lookingglass Creek, 2002.

1.5.3.2 Brood Year 2002

We collected 10 spring Chinook salmon about 25 mm long in the screw trap on 19 April 2003.

Mean FL of natural-origin spring Chinook salmon collected by seining below the weir increased by about 10 mm per month (Figure 14).

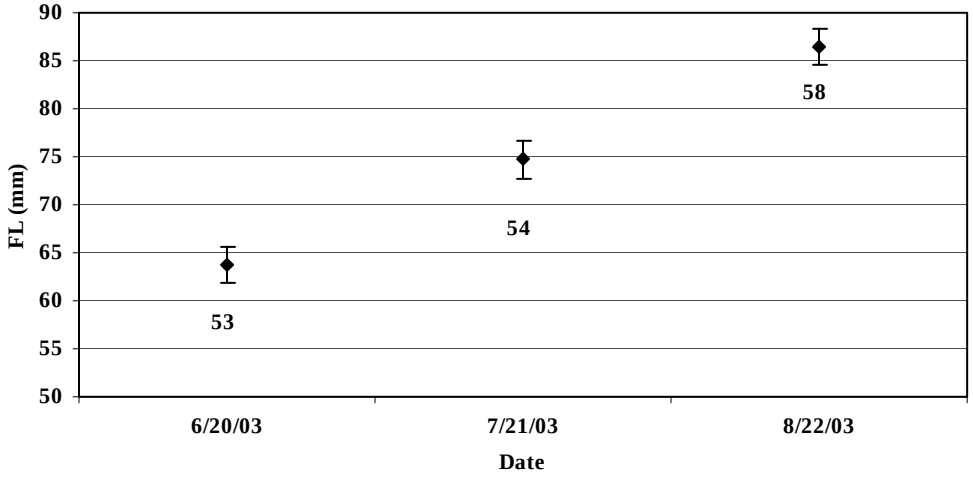

Figure 14. Mean FL +/-SE for natural-origin spring Chinook salmon seined from Lookingglass Creek during 2003 (sample sizes below data points).

1.6 Discussion

Water temperatures at the various sampling stations in Lookingglass Creek and tributaries in 2003 showed similarities in pattern to previous years. Daily means were generally less than the standard of 15.6^{o}C suggested by McCullough (1999). Daily maxima approached or exceeded 20^{o}C for brief periods in July and August at the two sites below the hatchery weir and Mottet Creek. In the reaches of Lookingglass Creek above the hatchery, and Little Lookingglass Creek, where historically most spring Chinook spawning and rearing has occurred, inflow from springs is significant, and with the generally good shading from steep canyons and riparian vegetation, provides a beneficial temperature regime for salmonid populations.

Stream flows in 2003 showed a typical pattern of spring freshet followed by rapid decline to low levels throughout most of the summer and fall. The spring freshet was less intense and more prolonged than in most years, and contributed to effective trapping conditions for adults. Observations during summer field work indicated none of the major tributaries (Little Lookingglass Creek, Mottet Creek, Eagle Creek, Jarboe Creek, Summer Creek) ceased flow during the summer.

Management of Lookingglass Creek spring Chinook salmon is in a transition phase as the Rapid River stock is no longer used, having been replaced with Catherine Creek stock. Adult escapement and juvenile outmigration of unmarked fish (Rapid River progeny) were both reduced in 2003 compared to previous years. Returning adult fish were removed from the stream in 2003 to minimize the effects on Catherine Creek stock fish used for reestablishment of a viable spring Chinook population.

Outmigrant survival of the 24 September 2001 release group of hatchery-reared fish to Lower Granite Dam was poor was poor compared to spring releases. Few returned as age 3 fish in 2003, and few will likely return at ages 4 or 5.

There was a discrepancy between the 2003 estimated returns for tag code 92819 obtained from the RMIS database and calculated from the Lookingglass Hatchery trap catch and estimated spawners below the weir. This may have resulted from no snout data for carcasses below the weir being reported. The SAR estimate is therefore an underestimate.

Some of the 28 May 2002 release group of hatchery-reared juveniles outmigrated immediately after release, but it is unknown how many. The high flows and debris made proper operation of the trap impossible for the first couple of days after the release. Some stayed in the stream and outmigrated in the fall of 2002 or spring of 2003. The accelerated growth regime at Irrigon Hatchery and early release date may have contributed to poor survival and a low estimate of outmigrants. The low number released and possibly low survival during outmigration in the hydropower system suggest that this hatchery release group will also contribute little in the way of adult returns.

The stray rate into Lookingglass Creek of fish acclimated and released in Catherine Creek and the Lostine and upper Grande Ronde Rivers may present a problem. A stray rate of 5-10% is considered acceptable (McElhaney et al. 2000). But good data on hatchery, natural, or wild stray rates for spring Chinook salmon are rare (Quinn 2004). In Lookingglass Creek, a higher stray rate for hatchery-origin fish from other streams in the basing would be expected, since fish are reared for several months in Lookingglass Creek water.

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

2.1 Abstract

We collected 164 unmarked (wild) adult summer steelhead at the Lookingglass Hatchery trap during 10 March-2 June 2003, including 102 females and 62 males. Scale age composition of 55 males was estimated at 65% 1-salt and 35% 2-salt. Age composition of 94 females was 22% 1-salt and 78% 2-salt.

A total of 106 redds were observed during spawning ground surveys covering 73.1 mi in the Lookingglass Creek watershed from 25 March-17 June 2003. Most redds were observed in Lookingglass Creek between Little Lookingglass Creek and Summer Creek and the lower 3.0 mi of Little Lookingglass Creek.

An estimated 45,050 (+/-5,699) outmigrants left Lookingglass Creek during 2003. The highest numbers left between March-June and September-November. Capture probabilities ranged from 0.032-0.19.

Mean FL for 457 fish PIT-tagged and released from 17 June 2002-27 December 2002 was 147.2 mm, median arrival date at Lower Granite Dam was 18 May 2003, and survival to Lower Granite Dam was 0.4311. Mean FL for 824 fish PIT-tagged and released from 28 January 2003-9 June 2003 was 147.0 mm, median arrival date at Lower Granite Dam was 26 May 2003, and survival to Lower Granite Dam was 0.4599.

A total of 221 pools across 8 pool types were snorkeled in Lookingglass Creek, Little Lookingglass Creek, and Mottet Creek from 14 July-19 August 2003. Mean densities (fish/100m^2) of unidentified salmonids < 70 mm FL were highest in Section 2 (immediately above the Lookingglass Hatchery weir) and lowest in Section 1 (below the Lookingglass Hatchery weir). Mean densities of *O. mykiss* 70-100 mm were 8-15 fold higher in Section 5 (Mottet Creek) compared to the other sections. Mean densities of *O. mykiss* 100-150 mm and 150-200 mm were highest in Section 2, and for *O. mykiss* > 200 mm, highest in Sections 3U and 3L (upstream of Lookingglass Hatchery weir). Highest densities of unidentified salmonids <70 mm were in alcove pools and densities of *O. mykiss* 70-100 mm were similar in alcove and cascade/plunge pools. *O. mykiss* 100-150 mm and *O. mykiss* 150-200 mm had highest densities in pocket water pools. *O. mykiss* > 200 mm were found at roughly the same densities in scour and debris pools.

The number of adult summer steelhead caught in 2003 was lower than in 2002 but above the mean observed during 1969-1974. Migration timing, sex ratio, and age composition were similar to past years. The estimate of outmigrating juveniles in 2003 was also lower than in 2002, slightly higher than in 2001 and about 5 times the average observed from 1969-1974. Densities of juveniles obtained by snorkeling were highly variable within and between pool types.

2.2 Introduction

Many anadromous salmonid stocks in the Snake River Basin have declined to the point of extinction, principally due to construction and operation of hydroelectric facilities, overfishing, and the loss and degradation of critical spawning and rearing habitat (Nehlsen et al. 1991). 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 for similar reasons (U. S. Army Engineer District 1975, 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 consumptive recreational harvest was reopened in 1986 (Flesher et al. 2004). Despite these harvest-driven hatchery programs, 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. Burck recorded the number of summer steelhead adults returning to Lookingglass Creek from 1965-1974 (unpublished data, summarized by McLean and Lofy 2001). 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* in the Grande Ronde River Basin was described by Van Dyke et al. (2001) and Reischauer et al. (2003). 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.

2.3 Methods

2.3.1 Adult Summer Steelhead Returns

2.3.1.1 Intake Trap

A picket weir diverted returning fish into a trap near the Lookingglass Hatchery water intake. All adult summer steelhead captured were enumerated, anesthetized in MS222, checked for fin clips and other marks or tags, measured (nearest mm FL), 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. Criteria for annuli were 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 fish were euthanized and removed from the stream. Wild (unmarked) fish were transported about 0.5 mi upstream and released.

2.3.1.2 Spawning Ground Surveys

Known or suspected spawning areas in Lookingglass Creek and tributaries were surveyed by walking downstream on foot during March-June 2003 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*

2.3.2.1 Screw trap

We operated a 1.52 m diameter rotary screw trap (Roper and Scarnecchia 1996) at rm 0.1 on Lookingglass Creek to collect outmigrating juvenile *O. mykiss*. The screw trap was operated continuously during 2003 except for brief periods during the spring freshet. The trap was usually checked 3 times/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 (nearest mm FL), and weighed (nearest 0.1 g). First-time captures of fish >50 mm FL, in good condition (no injuries or obvious disease) were PIT-tagged using standard methods (PIT Tag Steering Committee 1999). All newly-tagged fish were released about 100 ft above the screw trap; recaptures were released 50 ft 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. DARR 2.0 also estimates outmigrants by unpooled strata using the capture probabilities from the pooled strata. We used the one trap and no prior pooling of strata options.

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, "late 2002" and "early 2003". The date of PIT-tagging (in 2002) for the last detection in the hydrosystem in 2002 was used as the separation point for the late 2002 group. All fish PIT-tagged after that date were placed in the late 2002 group. Similarly, the date of PIT-tagging (in 2003) for the last detection in the hydrosystem in 2003 was used as the separation date for the "early 2003" group.

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 to 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. Observation sites used, 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). Lower Granite Dam was used as the last recapture site.

2.3.2.2 Snorkeling

We snorkeled (Thurow 1994) pool habitats during July and August 2003 and made visual counts of *O. mykiss* in Lookingglass Creek and tributaries. Starting points for sampling areas were designated using the EMAP protocol (Stevens and Olsen 2003). Sites sampled were restricted to the mainstem Lookingglass Creek, Little Lookingglass Creek, and Mottet Creek with deep enough water to effectively snorkel.

We used a Garmin GPS 76 global positioning unit to locate the starting point for a section. The first ten pools upstream of the starting point were snorkeled and all salmonids counted. As we approached a pool, the general size of the pool was discussed to determine sampling boundaries. One person snorkeled and another recorded data. The snorkeler entered the stream downstream of the pool and slowly moved upstream counting salmonids within the predetermined pool boundaries. Fish observed were recorded in five size categories: Unidentified salmonids < 70mm (most likely age-1 or

age-0 *O. mykiss*), *O. mykiss* 70-100 mm, *O. mykiss* 100-150 mm, *O. mykiss* 150-200 mm and *O. mykiss* >200 mm. Spring Chinook salmon, bull trout (*Salvelinus confluentus*) and mountain whitefish (*Prosopium williamsonii*) were recorded without size. Pool type (Armantrout 1998), width (W, nearest 0.1 m), length (L, nearest 0.1 m), and depth (D, nearest 0.1 m) were recorded upon completion of snorkeling each pool. Snorkelers underwent familiarization with sizes and species of fish encountered prior to the start of sampling. Actual fish counts per pool (n) were expanded to the density of fish/100m^2 [n/(L*W)*100].

2.3.3 Habitat

The Internet, Pierce Library at Eastern Oregon University Library, and local offices of ODFW were search to locate anadromous fish habitat information for Lookingglass Creek.

2.4 Results

2.4.1 Adult Summer Steelhead Returns

2.4.1.1 Intake Trap

The weir and trap were installed on 4 March 2003 and trapping began on 6 March 2003. The first adult summer steelhead was captured on 10 March 2003 and the peak catch was during the week of 9 April (Figure 1). We captured 164 unmarked adult summer steelhead. Catches of males and females fluctuated similarly and females dominated the catch (Figure 2). Females comprised 62% of the total catch. Modal FL group for males was 63 cm (Figure 3) and for females was 71 cm (Figure 4). Small numbers of fish < 50 cm of both sexes were collected. Age composition of 55 males was 65% 1-salt and 35% 2-salt, and for females, 22% 1-salt and 78% 2-salt (Table 1). One-salt females were slightly longer than 1-salt males, but the reverse occurred for 2-salt fish.

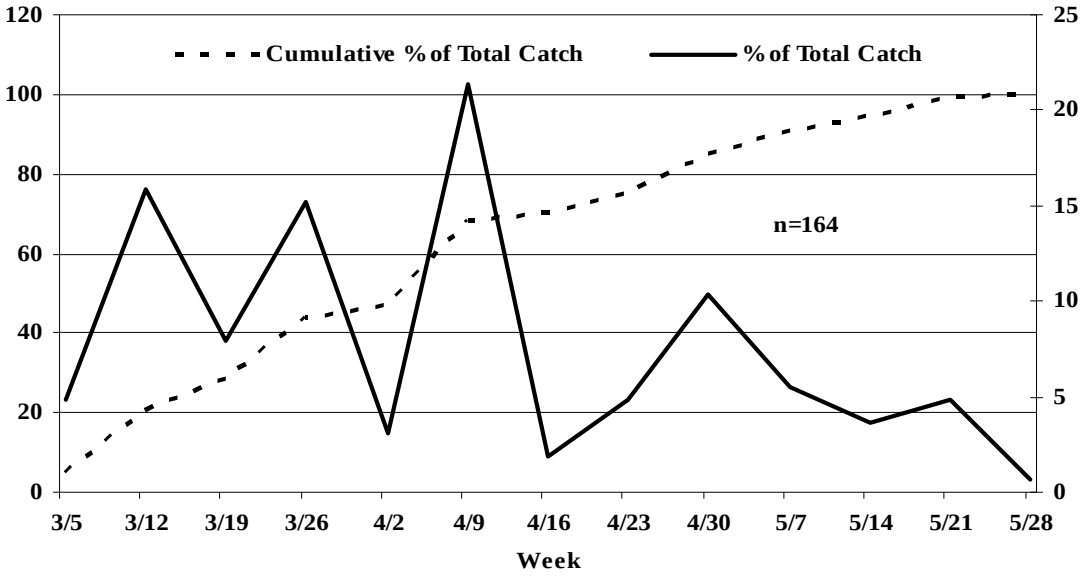

Figure 1. Percent of total catch and cumulative percent distribution by week for adult summer steelhead at the Lookingglass Hatchery trap, 2003.

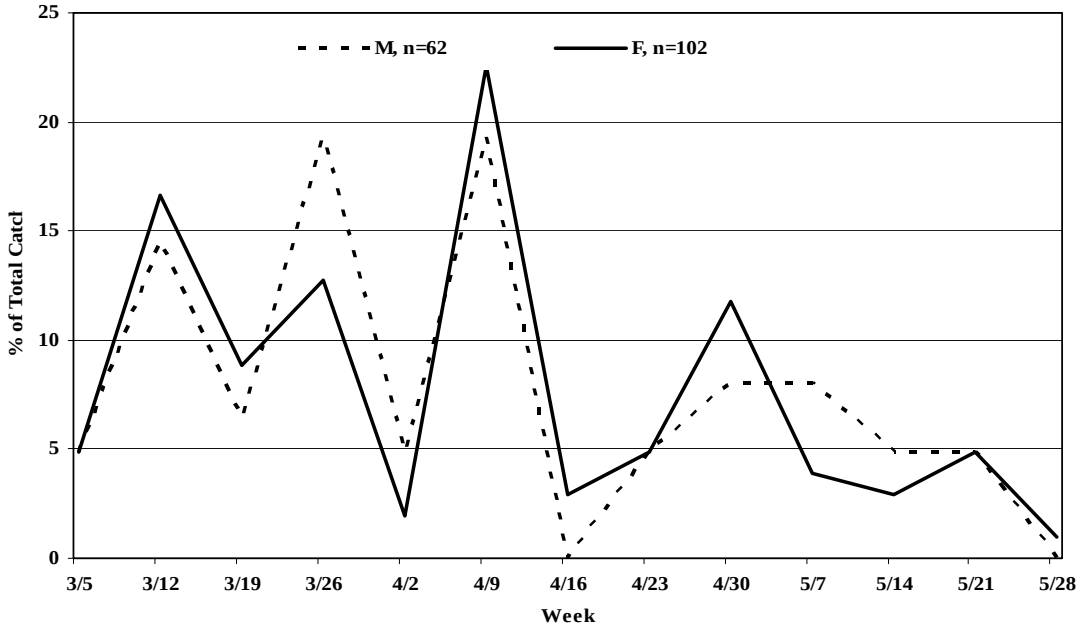

Figure 2. Percentages of total catch by week for adult male (M) and female (F) summer steelhead at the Lookingglass Hatchery trap, 2003.

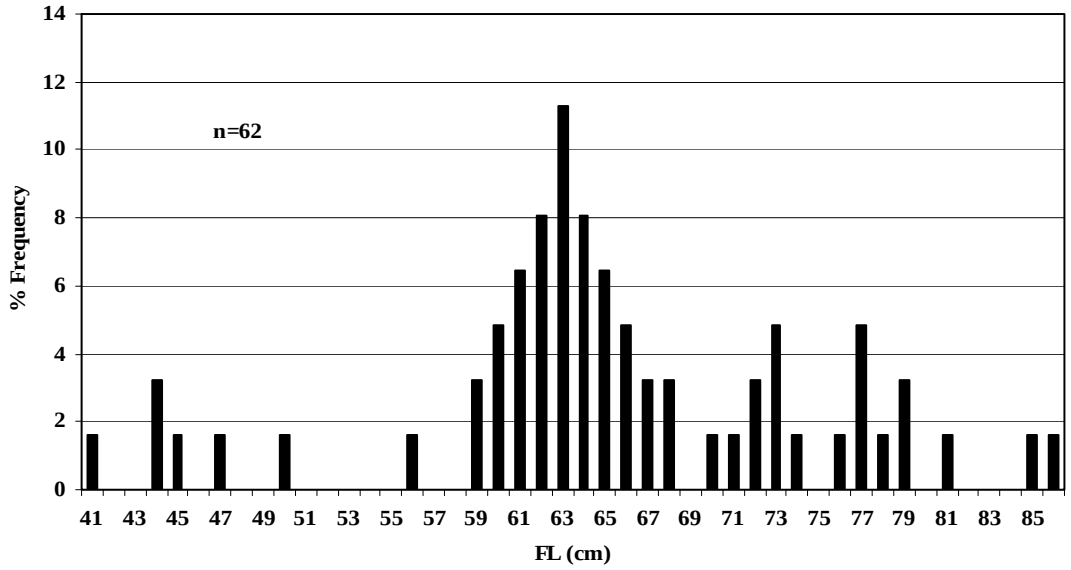

Figure 3. FL frequency of adult male summer steelhead collected at the Lookingglass Hatchery trap, 2003.

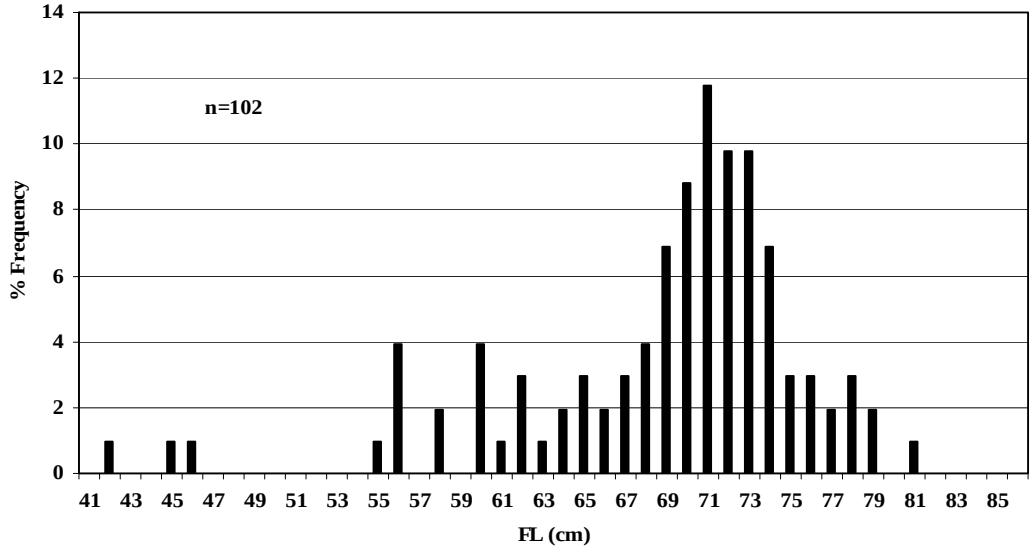

Figure 4. FL frequency of adult female summer steelhead collected at the Lookingglass Hatchery trap, 2003.

A Floy-tagged ("Wind River 011534 WDFW") 610 mm male was collected on 12 May 2003 that had been tagged and released at Bonneville Dam on 25 March 2003. We collected tissue samples from all 164 unmarked adult summer steelhead trapped in 2003.

Table 1. FL (mm) summary for summer steelhead caught in the Lookingglass Creek trap and aged using scales, 2003.

Sex	Age	$\bar{X}$ FL	SE	Min-Max	n
Male		654.7	12.3	410-868	55
	1-salt	610.4	11.5	410-704	36
	2-salt	738.6	15.4	627-868	19
Female		697.6	6.4	450-810	94
	1-salt	620.0	15.0	450-755	21
	2-salt	719.9	4.4	560-810	73

2.4.1.2 Spawning Ground Surveys

A total of 73.1 mi of stream, including reaches walked more than once, were covered in 31 spawning ground surveys in the Lookingglass Creek watershed from 25 March–17 June 2003. Sections of streams surveyed at least once totaled 11.5 mi in mainstem Lookingglass Creek, 3.5 mi in Little Lookingglass Creek, and 9.5 mi in Mottet, Eagle, Summer, and Swamp Creeks. Surveying the upper reaches of Lookingglass Creek required long hikes up and down steep hillsides. During March and April, roads used to reach trailheads were often blocked by snow at the higher elevations. High flows during March and April often obscured plunge pools and riffles. Water clarity was good to excellent on most surveys during May and June even though streams ran near bankfull until the end of May. Little Lookingglass Creek had the poorest water clarity of the reaches surveyed; it decreased while walking in the stream. Permission to enter private land near the lower end of Little Lookingglass and Mottet Creeks was not granted until 22 May 2003, towards the end of the spawning season.

A total of 106 redds were located, producing values of 1.04 redds/female and 4.33 redds/mi. Lookingglass Creek and Little Lookingglass Creek were the major spawning areas (Table 2). Lookingglass Creek between UNF Road 62 bridge and Summer Creek had the highest number of redds, followed by Little Lookingglass Creek. Gradients in Mottet, Summer, and Swamp Creeks were generally too high to provide suitable spawning habitat. The highest numbers of redds were observed the weeks of 5 May (16) and 1 June (38).

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

Stream*	Reach	Section**	Miles	Surveys	Redds
LKG	Spout Springs to Summer Creek	3U	3.0	1	4
LKG	Above Lost Creek to Summer Creek	3U	1.5	1	2
LKG	Summer Creek to Eagle Creek	3U	2.7	2	8
LKG	Summer Creek to UNF footbridge	3U	2.0	1	5
LKG	Luger Springs to UNF footbridge	3U	1.8	1	4
LKG	UNF footbridge to LLKG mouth	3U,3L	4.9	5	39
LKG	Upstream to Luger Springs	3U	1.5	1	3
LKG	UNF #62 bridge to intake	2	1.6	2	9
LLKG	UNF #3607 to UNF boundary	4	2.9	1	1
LLKG	Cascades to UNF #62 culvert	4	2.5	3	14
LLKG	Cascades to private property	4	2	1	9
LLKG	Above UNF to private property	4	1.4	1	4
LLKG	UNF #62 culvert to Mottet Creek	4	0.4	1	1
MOT	Upstr to UNF #63 culvert		2.0	2	0
MOT	UNF #63 culvert to UNF boundary		1.5	3	0
MOT	UNF boundary to mouth		1.5	1	1
EAG	Mouth upstr		1.5	2	2
SUM	Mouth upstr		2.5	1	0
SWA	Mouth upstr		0.5	1	0
Totals				31	106

**LKG=Lookingglass Creek mainstem, LLKG=Little Lookingglass Creek, MOT=Mottet Creek, EAG=Eagle Creek, SWA=Swamp Creek, SUM=Summer Creek, UNF=Umatilla National Forest*
*** after Burck (1993) and McLean et al. (2001)*

2.4.2 Juvenile *O. mykiss*

2.4.2.1 Screw trap

We collected 2,216 *O. mykiss* during 2003 (first time captures), including 1,741 that were PIT-tagged and released, 105 tagging and trapping mortalities, and 366 fish not PIT-tagged. There were 120 recaptures of fish tagged and released in 2003. One fish that had been tagged and released in 2002 was recaptured in 2003.

The estimate of outmigrants was 45,050 +/-5,699 (Table 3). Most fish left the stream during March-early May 2003 or 1 September-31 October 2003 (Figure 5). The original data set included 21 two-week time periods (early and late for each month), with three exceptions, only early January and August were used and late December. DARR 2.0 pooled strata to result in five capture probabilities ranging from 0.02-0.19. Most recaptures (95%) were made within 5 d of release, but ranged up to 217 d. Recaptures in the screw trap were mostly in the 10-19 cm size groups (92% of the recaptures).The total outmigrant estimate decreased slightly (42,411+/-5,241) using only fish ≥80 mm FL.

Table 3. *O. mykiss* captured in the Lookingglass Creek screw trap, releases and recaptures from trap efficiency tests, outmigrant estimates and standard errors, 2003.

Dates	u	m	r	C_p	N	SE
1/28-2/28	74	59	7	0.119	624	220
3/1-5/15	568	542	18	0.032	17,934	4,281
5/16-8/31	427	400	21	0.051	8,362	2,053
9/1-10/31	763	470	23	0.047	16,118	3,356
11/1-12/4	383	268	51	0.19	2,013	250
					45,050	5,699

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$^{0.5}$)

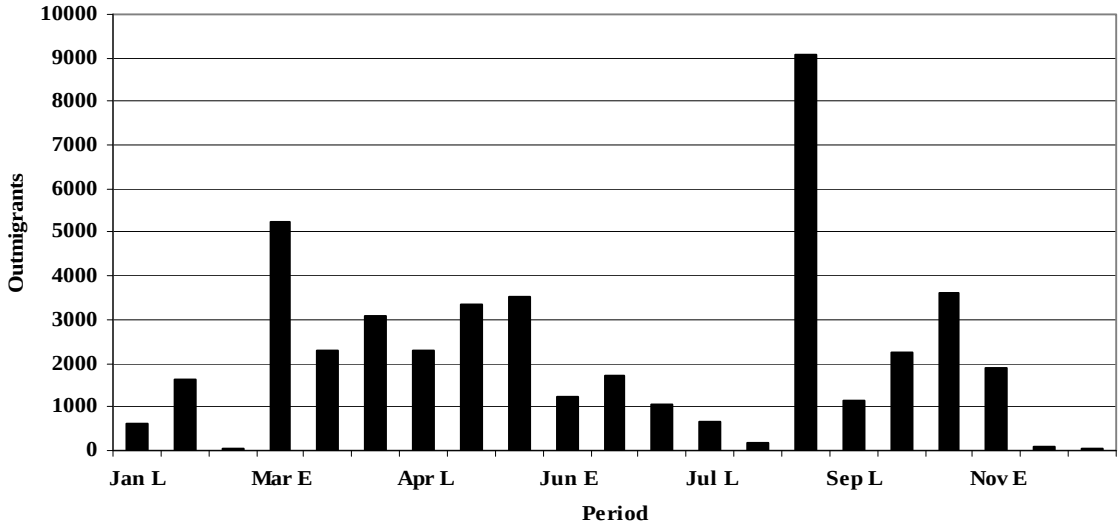

Figure 5. Estimated *O. mykiss* outmigrants by month, Lookingglass Creek, 2003.

Mean FL and weights were highest during March-May and September-November (Figures 6, 7). Mean K factor was highest in June and was slightly higher for the months of January-May than August-December (Figure 8). Most fish > 190 mm were caught during March-May and September-November. Fish < 110 mm were caught during all months but mostly during May-July and November.

The highest numbers of fish PIT-tagged and released were during March-June and September-November 2003 (Figure 9). Mean FL of fish in the late 2002 and early 2003 groups were similar (Tables 5, 6). Median arrival date for the late 2002 group was 8 d earlier than the early 2003 group (Table 7). Harmonic mean travel times were about 223 and 12 d, respectively, for the late 2002 and early 2003 groups (Table 8). Survival for the early 2003 group was slightly higher than for the late 2002 group (Table 9). FL (cm) at

PIT-tagging frequencies of fish released and detected in the hydropower system were roughly similar for the late 2002 group (Figure 10). Large disparities in the 15-17 cm and 6-11 cm groups were observed for the early 2003 group (Figure 11).

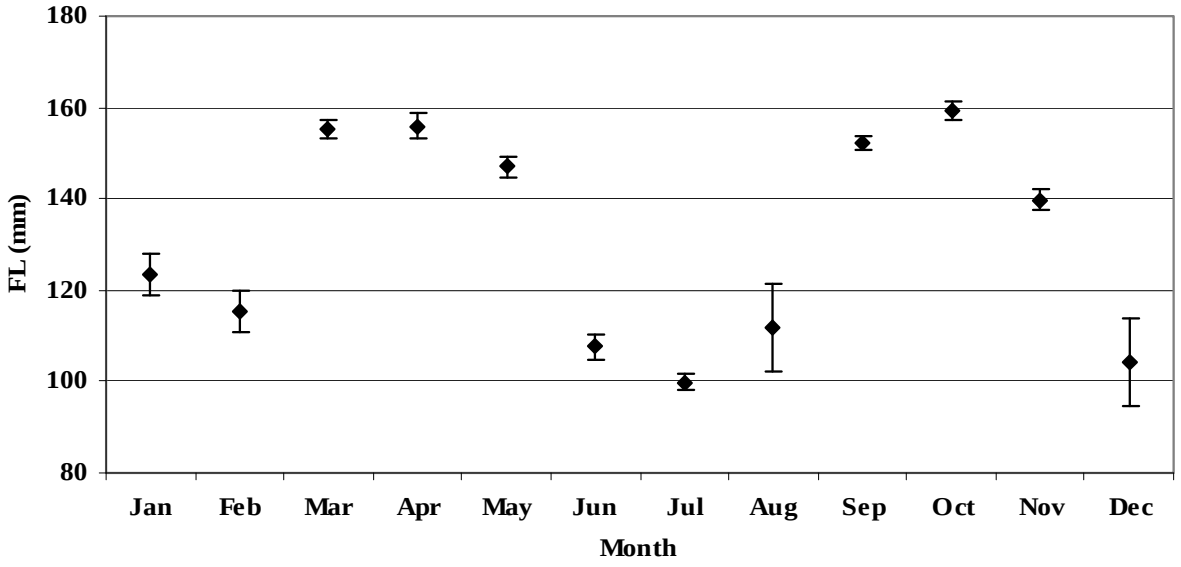

Figure 6. Mean FL by month with SE for *O. mykiss* captured in the Lookingglass Creek rotary screw trap, 2003.

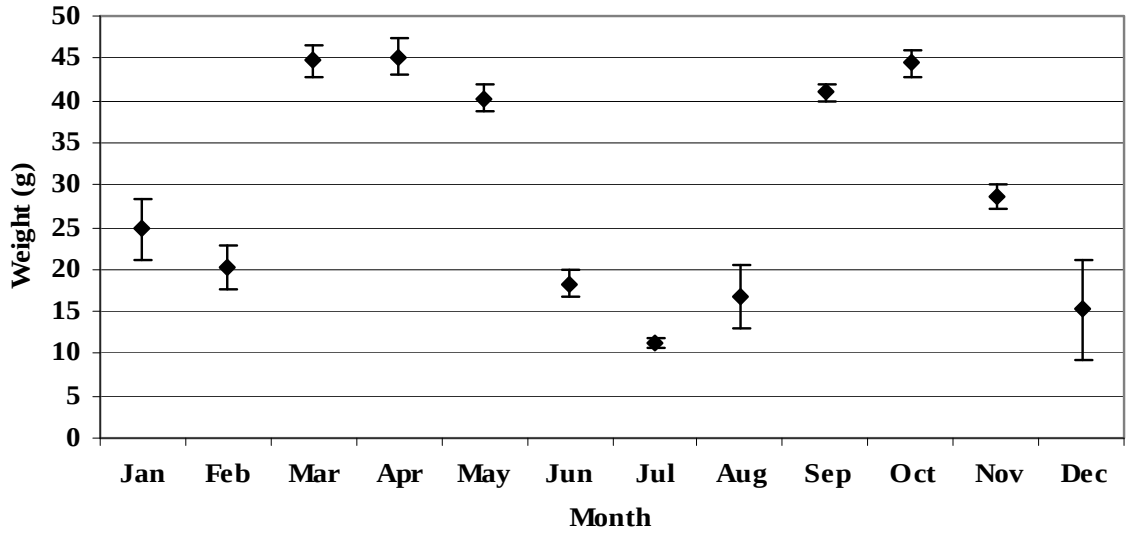

Figure 7. Mean weight by month with SE for *O. mykiss* captured in the Lookingglass Creek rotary screw trap, 2003.

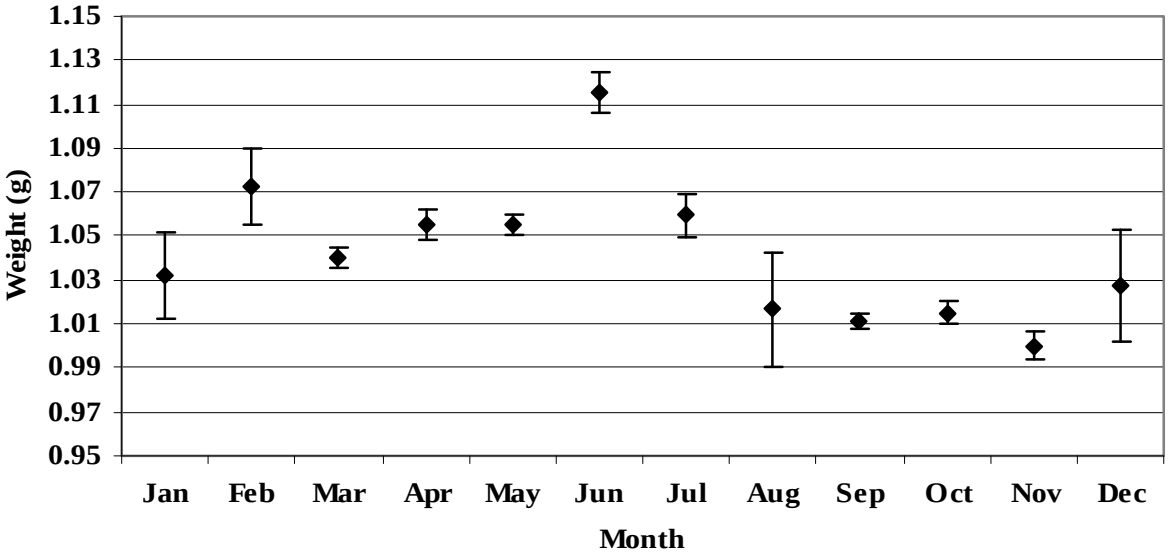

Figure 8. Mean K by month with SE for *O. mykiss* captured in the Lookingglass Creek rotary screw trap, 2003.

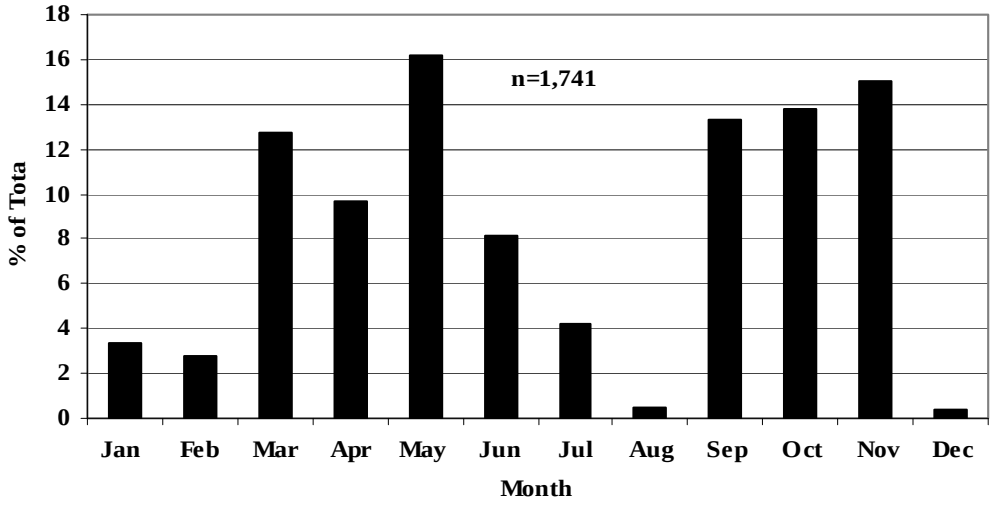

Figure 9. Percentages of *O. mykiss* PIT-tagged and released in Lookingglass Creek by month, 2002.

Table 5. FL (mm), weight (g), and K factor summary for *O. mykiss* caught in the Lookingglass Creek screw trap, PIT-tagged and released, late 2002 group (6/17/02-12/27/02).

	Parameter		
Statistic	FL	Wgt	K
Mean	147.2	38.9	1.04
SD	37.4	29.7	0.10
SE	1.8	1.4	0.005
Min	66	4.1	0.70
Max	305	302.8	1.50
n	457	443	443

Table 6. FL (mm), weight (g), and K factor summary for *O. mykiss* caught in the Lookingglass Creek screw trap, PIT-tagged and released, early 2003 group (1/28/03-6/9/03).

	Parameter		
Statistic	FL	Wgt	K
Mean	147.0	39.8	1.05
SD	37.8	27.5	0.08
SE	1.3	1.0	0.003
Min	63	2.4	0.78
Max	287	236.4	1.46
n	823	810	809

Table 7. Migration timing summary for *O. mykiss* outmigrants caught in the Lookingglass Creek screw trap, PIT-tagged and released, 2002-2003.

Tagging Group	n	Median Tagging Date	Median Arrival Date at Lower Granite Dam	Actual Detections	Expanded Detections
Late 2002	457	10/7/02	5/18/03	33	59
Early 2003	824	4/13/03	5/26/03	152	255

Table 8. Travel time (TT) in days to Lower Granite Dam summary for *O. mykiss* outmigrants caught in the Lookingglass Creek screw trap, PIT-tagged and released, 2002-2003

Tagging Period	n	Harmonic $\bar{X}$ TT	SE
Late 2002	33	223.335	6.038
Early 2003	152	11.742	0.948

Table 9. Survival to Lower Granite Dam and capture probabilities for *O. mykiss* outmigrants caught in the Lookingglass Creek screw trap, PIT-tagged and released, 2002-2003.

Tagging Period	n	Survival	SE	Capture Probability	SE
Late 2002	457	0.4311	0.1873	0.1675	0.0770
Early 2003	824	0.4599	0.0283	0.4011	0.0318

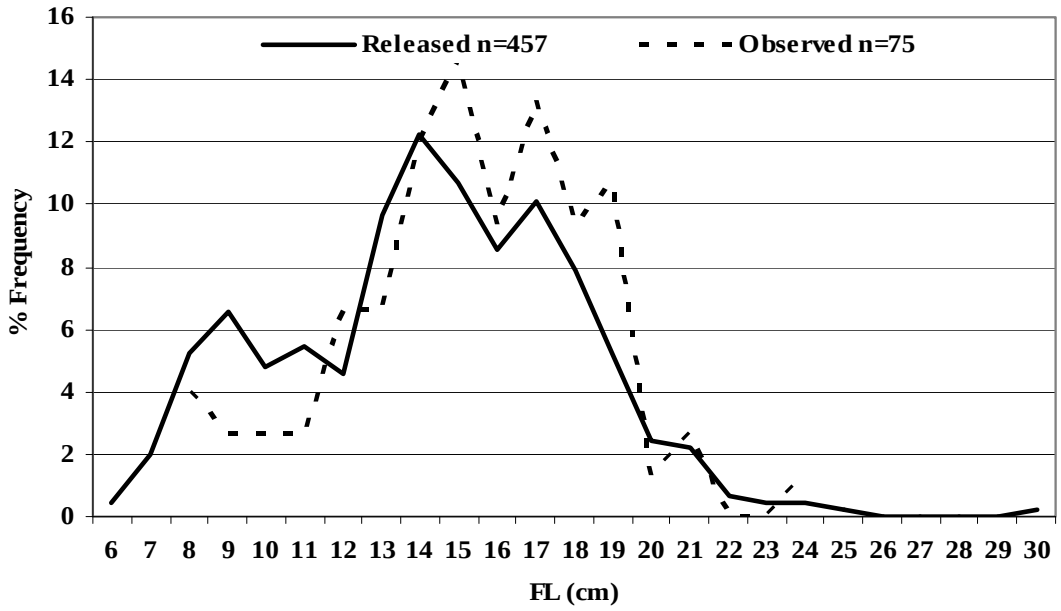

Figure 10. Percentages of *O. mykiss* PIT-tagged and released in Lookingglass Creek, late 2002 group, and unique detections by FL group during 2003.

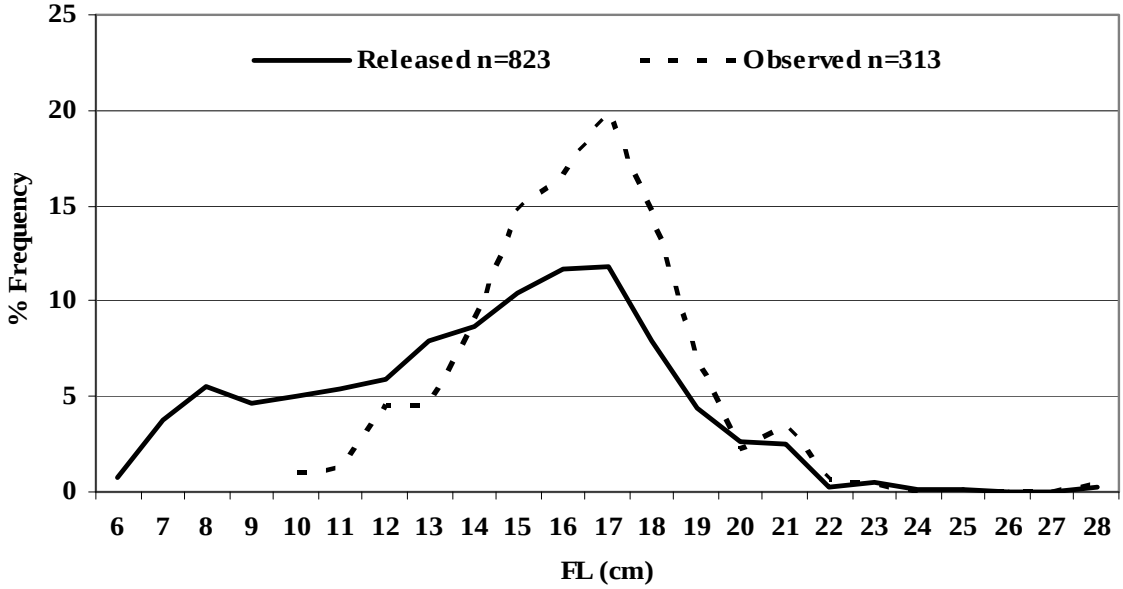

Figure 11. Percentages of *O. mykiss* PIT-tagged and released in Lookingglass Creek, early 2003 group, and unique detections by FL group during 2003.

2.4.2.2 Snorkeling

We completed snorkel surveys from 14 July-19 August 2003. We sampled 221 pools across 8 pool types in three streams, Lookingglass Creek, Little Lookingglass Creek and Mottet Creek (Table 10). We counted 3,112 *O. mykiss*, 247 spring Chinook salmon, 69 bull trout, and 32 mountain whitefish. Fish counts were made in 34 pools unclassified by type (all but one in Mottet Creek, Table 11). Water temperatures ranged from 10.2^{o}C to 14.0^{o}C and streamflows varied from 50-55 CFS during snorkeling. Visibility was generally excellent.

Table 10. Numbers of pools snorkeled by type in Lookingglass Creek and tributaries, 2003.

Pool Type*	n	Resulting from
Scout (SC)	54	Flow deflection against obstruction
Pocket Water (PW)	49	Scour or eddy behind large boulder
Cascade/Plunge (CASCPL)	48	Water falling over an obstruction and scouring
Debris (DEB)	14	Channel obstruction, usually woody debris
Lateral Scout (LSC)	9	Current directed laterally to one side of stream
Eddy (EDDY)	5	Strong eddy currents on margin or off main channel
Alcove (ALC)	4	Deeper area along shoreline
Dammed/Beaver (DAM)	4	Impounded water from beaver dam or other blockage

* *after Armantrout (1998)*

Table 11. Fish counts for unclassified pools in Little Lookingglass Creek and Mottet Creek, 2003.

	Stream	
	Little Lookingglass Creek	Mottet Creek
Pools Sampled	1	33
Area (m^2) Sampled	7.7	24.8
O. mykiss		
<70 mm	2	3
70-100 mm	3	85
100-150 mm	1	25
150-200 mm	0	11
>200 mm	0	1
Bull trout	0	2

Three of the five size classes of *O. mykiss* appeared to have slightly higher densities in Unit 2 (immediately above the hatchery weir) compared to Unit 1 (unit below) (Table 12). Densities of *O. mykiss* 70-100 mm in Unit 5 (Mottet Creek) were about 10 times higher than other units in Lookingglass and Little Lookingglass Creeks.

Table 12. Mean densities (fish/100m^2) and SE of unidentified salmonids <70 mm and *O. mykiss* by size group and stream unit in Lookingglass Creek, Little Lookingglass Creek, and Mottet Creek, 2003.

	Size Group									
	<70 mm		70-100 mm		100-150 mm		150-200 mm		>200mm	
Unit	Mean	SE	Mean	SE	Mean	SE	Mean	SE	Mean	SE
1	30.87	5.70	14.72	3.03	43.04	5.61	29.52	5.30	7.21	2.32
2	82.17	21.54	24.91	6.51	68.22	13.03	41.05	11.08	10.57	3.61
3U, 3L	20.38	4.74	28.31	7.23	17.90	2.12	14.07	2.10	13.30	1.88
4	38.95	7.79	24.08	4.08	19.27	3.16	15.38	2.40	7.60	1.61
5**	5.87	4.24	214.05	44.40	29.14	10.39	9.49	5.22	1.11	1.11

* *in units 2-5,most were probably O. mykiss* ** *Mottet Creek*

Unidentified salmonids <70 mm (upstream of Lookingglass Hatchery, these were presumed to be mostly *O. mykiss*) had highest densities in alcove pools (Figure 12). *O. mykiss* 70-100 mm had highest densities in cascade/plunge and alcove pools and lowest densities in debris pools (Figure 13). Densities of 100-150 and 150-200 mm *O. mykiss* were highest in pocket water pools (Figures 14, 15). *O. mykiss* > 200 mm densities were 12-14 fish/100 m^2 in scour, debris, and lateral scour pools (Figure 16).

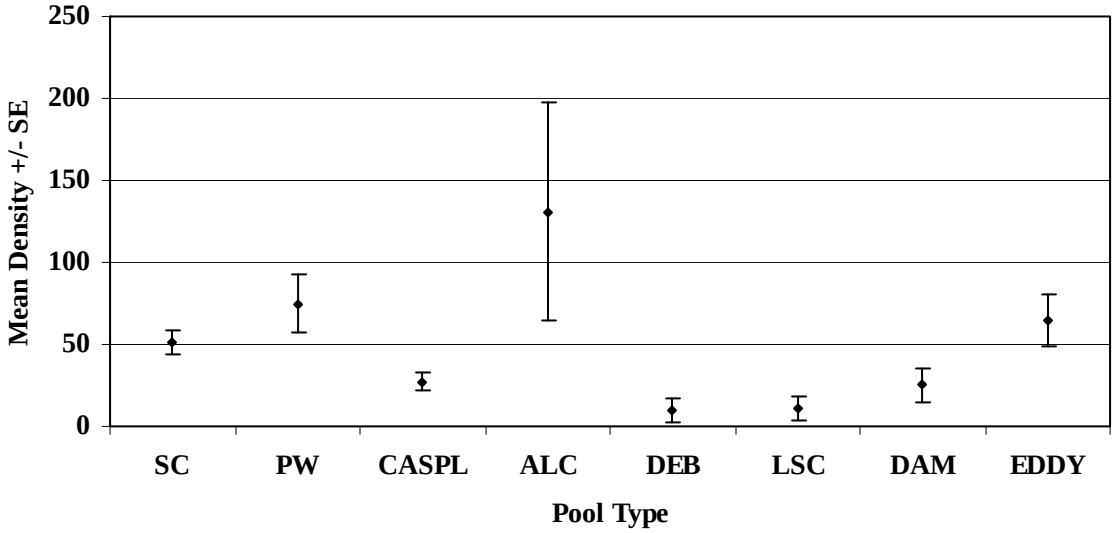

Figure 12. Mean densities (fish/100m^2) +/- SE of age 0 (< 70 mm) salmonids observed by snorkeling in Lookingglass Creek and Little Lookingglass Creek, 2003.

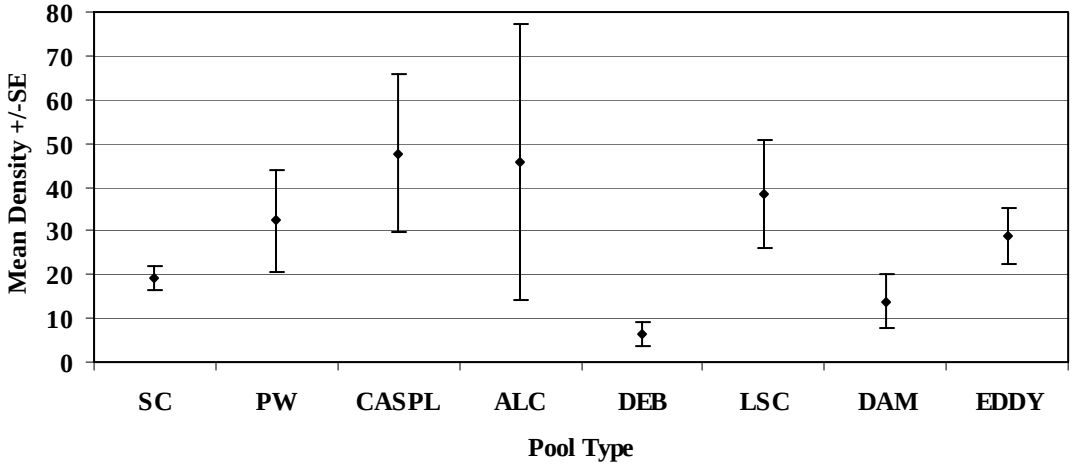

Figure 13. Mean densities (fish/100m^2) +/- SE of *O. mykiss* 70-100 mm observed by snorkeling in Lookingglass Creek and Little Lookingglass Creek, 2003.

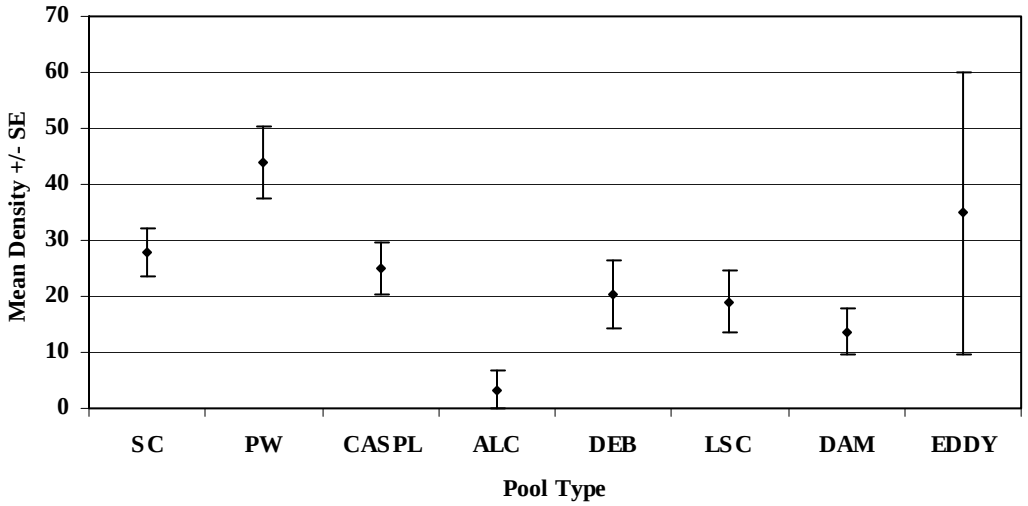

Figure 14. Mean densities (fish/100m^2) +/- SE of *O. mykiss* 100-150 mm observed by snorkeling in Lookingglass Creek and Little Lookingglass Creek, 2003.

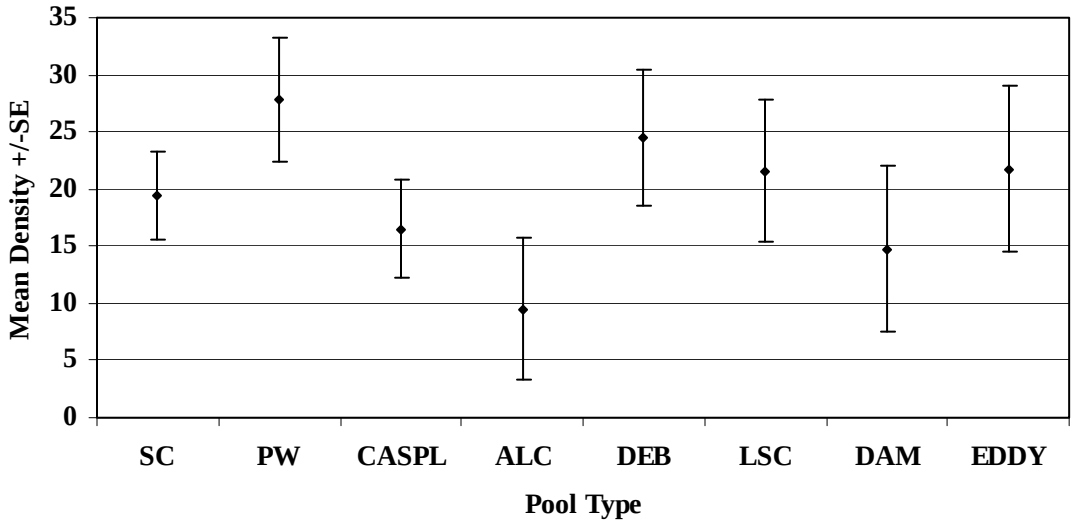

Figure 15. Mean densities (fish/100m^2) +/- SE of *O. mykiss* 150-200 mm observed by snorkeling in Lookingglass Creek and Little Lookingglass Creek, 2003.

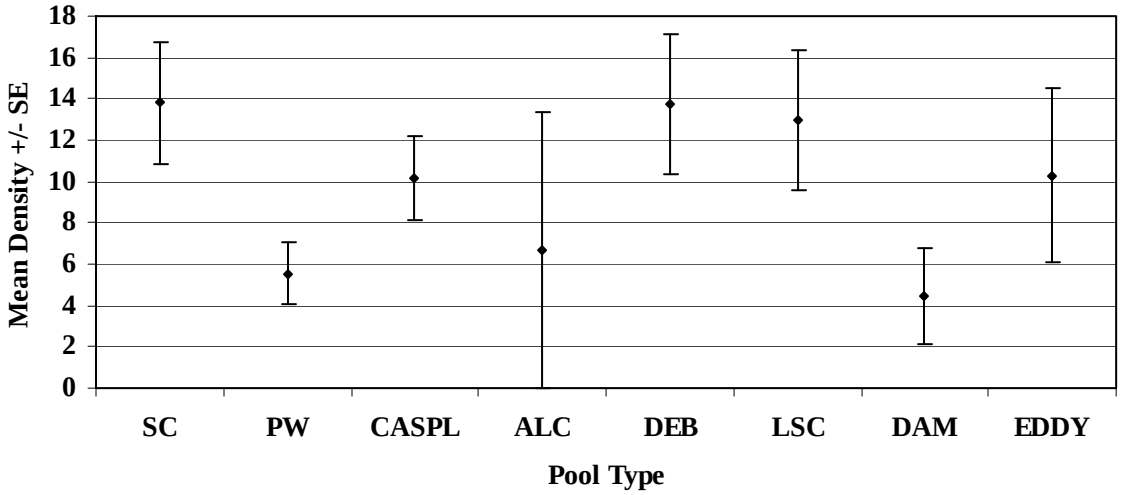

Figure 16. Mean densities (fish/100m^2) +/- SE of *O. mykiss* >200 mm observed by snorkeling in Lookingglass Creek and Little Lookingglass Creek, 2003.

Bull trout were found in 7 of 8 pool types and had highest densities in debris pools (Figure 17). Juvenile spring Chinook salmon were only found below the hatchery weir, and were most abundant in alcove pools (Figure 18). Mountain whitefish were too abundant to count below the hatchery weir but rarely seen above.

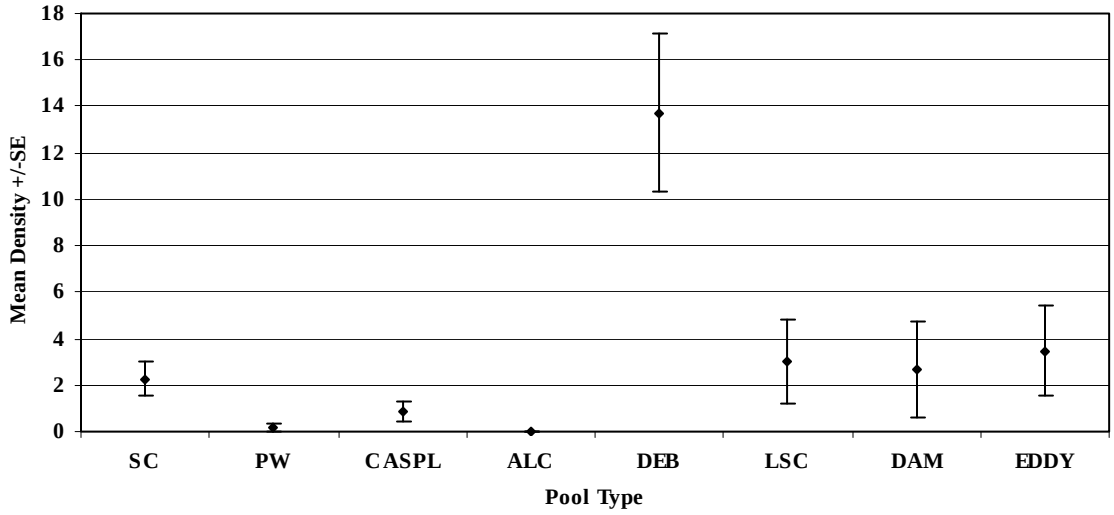

Figure 17. Mean densities (fish/100m^2) +/- SE of bull trout observed by snorkeling in Lookingglass Creek and Little Lookingglass Creek, 2003.

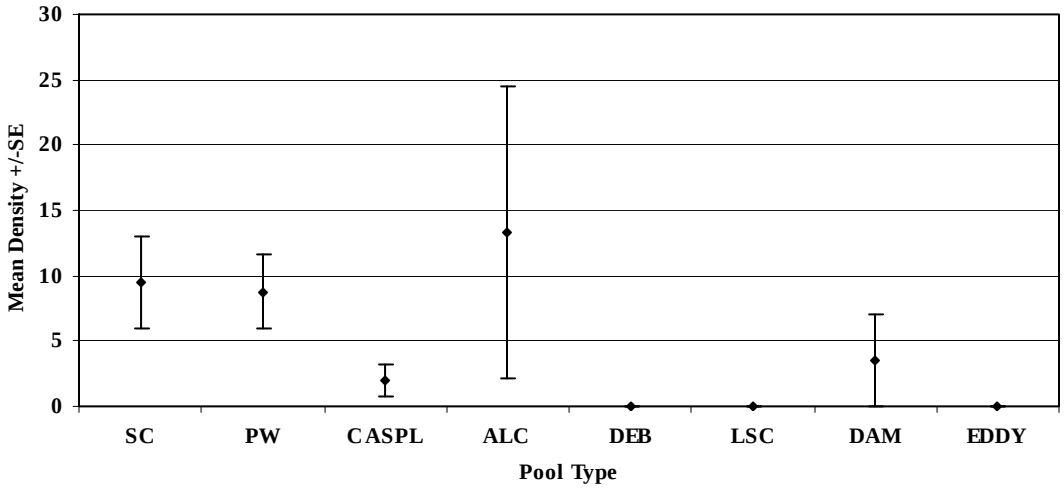

Figure 18. Mean densities (fish/100m^2) +/- SE of juvenile spring Chinook salmon observed by snorkeling in Lookingglass Creek below Lookingglass Hatchery, 2003.

2.4.3 Habitat

Burck (1993) described methods and survey results for 15.5 mi of Lookingglass and Little Lookingglass Creeks completed in 1965 and 1966. ODFW surveyed the lower 7.4 mi of Lookingglass Creek and 2.8 mi of Little Lookingglass Creek in 1991. These data are available in GIS format at:

http//:oregonstate.edu/Dept/ODFW/freshwater/inventory/basinwid.html

The Umatilla National Forest -Walla Walla Ranger District completed a habitat survey of Lookingglass Creek and tributaries within the Umatilla National Forest during 18-27 August 1992 using U. S. Forest Service Region 6 Stream Survey Method 6.0. Published copies are available by contacting Dave Crabtree, Umatilla National Forest, 1415 West Rose Street, Walla Walla, WA 99362, (phone) 509-522-6042, (email) dmcrabtree@fs.fed.us. Thompson and Haas (1960) described habitats in Lookingglass Creek and other streams in the Grande Ronde Basin. Streamflow information for Lookingglass Creek dating from 1982 is available online at:

http://nwis.waterdata.usgs.gov/or/nwis/discharge

and entering station number 13324300. Realtime Lookingglass Creek water temperature and flow information for the most recent 31 d is available at

http//:waterdata.usgs.gov/or/nwis/uv?dd_cd=01&format=gif&period=7&site_no=13324300

The Umatilla National Forest has collected water temperature information for Lookingglass Creek and tributaries in recent years. These data are available from

Darlene Robison, Umatilla National Forest, 2517 S. W. Hailey Avenue, Pendleton, OR 97801, (phone) 541-278-6471, (email) drobison@fs.fed.us.

2.5 Discussion

The number of wild adult summer steelhead collected in 2003 was higher than in 2002. Trap catches the last three years suggest escapement has been higher compared to the 1970's, but the low number of years sampled and variations in start date of trapping and trap efficiency complicate any comparisons. As more data on summer steelhead escapement in the region become available in the near future, more insight will be gained into population trends of adult summer steelhead.

Summer steelhead from the Grande Ronde River usually enter freshwater during August through October, with some moving in the following spring. Movement into the smaller tributaries occurs in the spring (Howell et al. 1985). Unpublished data collected by Burck from 1964-1974 showed peak arrivals of summer steelhead during May or June (Howell et al. 1985). Lookingglass Creek trap catches in 2003 were highest during April and were lowest in May.

Adult summer steelhead catches from Lookingglass Creek in 2002 were dominated by 1-salt fish and the sex ratio was skewed toward females. Catches from Catherine Creek and the upper Grande Ronde River showed the same characteristics (Boe et al. 2005). Snake River summer steelhead are usually dominated by 1-salt fish (IDFG 1994 cited in Busby et al. 1996).

The estimated number of juvenile *O. mykiss* outmigrants in 2003 was slightly higher than the estimate of 39,052 in 2001 (McLean et al. 2002) but lower than the 2002 estimate (Boe et al. 2007). Outmigrants fluctuated from 6,907-11,863 from 1965-1969 (Mullarkey 1971). Outmigrant estimates ranged from 4,167-22,310 for Catherine Creek, the upper Grande Ronde River, and the Lostine River during migration years 1997-19990 (Van Dyke et al. 2001). Peak migration periods during 2003 in Lookingglass Creek occurred in the spring and fall, similar to results from McLean et al. (2002), Boe et al. (2005), Van Dyke et al. (2001), and Reischauer et al. (2003).

Capture probabilities (analogous to trap efficiencies) in 2003 ranged from 0.021-0.19, higher than in 2002, and similar to those reported by the values of 0.0189-0.1435 for 2001 reported by McLean et al. (2002). Trap efficiencies ranging from 0.041-0.507 by period were reported for Catherine Creek, the Lostine River, and the upper Grande Ronde River by Van Dyke et al. (2001) and Reischauer et al. (2003).

There did not appear to be any major differences in densities of *O. mykiss* of various size groups between the different units sampled, with the exception of a high density of fish 100-150 mm in Mottet Creek (Unit 5), but estimates were highly variable, both within and between units.

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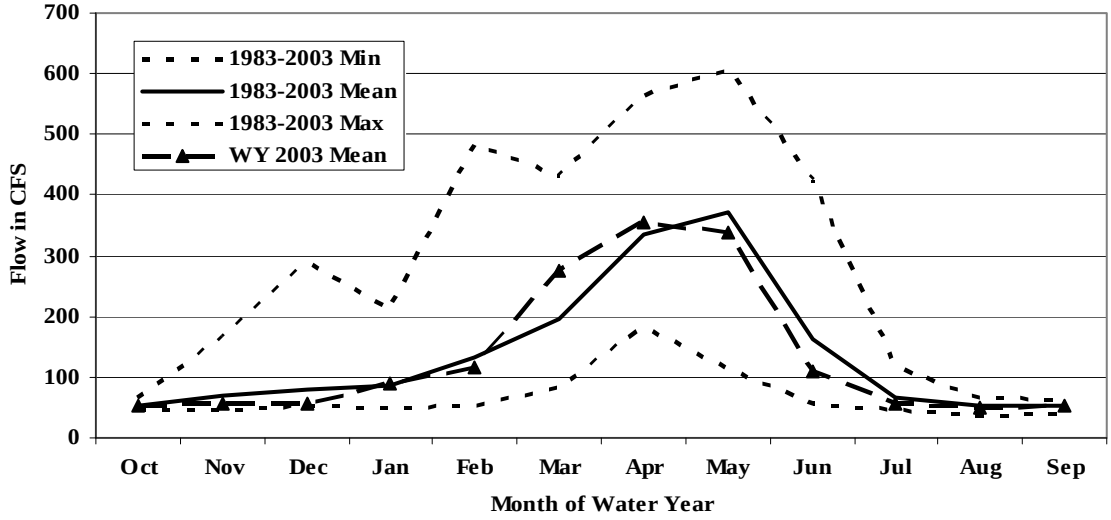
3 SECTION III. ASSISTANCE PROVIDED TO LSRCP COOPERATORS AND OTHER PROJECTS

We provided assistance to ODFW in 2003 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 ODFW personnel who have been collecting data on bull trout (*Salvelinus confluentus*) in the Grande Ronde River basin by collecting fork length, weight, and PIT tag data from bull trout captured in the screw trap and adult trap. We PIT-tagged and released first-time captures of bull trout from the screw trap and adult trap. We assisted the conventional adult spring Chinook salmon broodstock collection project in the Grande Ronde River and Catherine Creek in 2003 with weir building and trap checking.

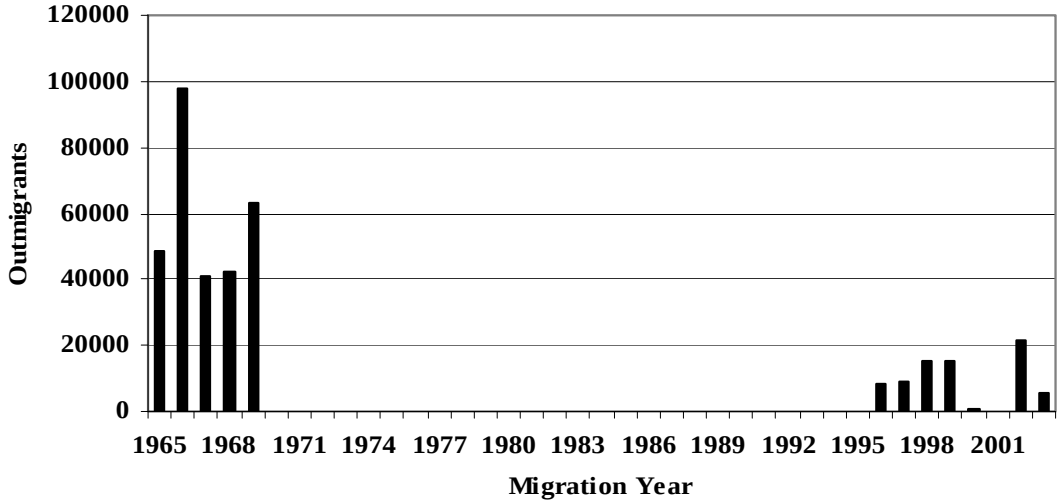
4 ACKNOWLEDGMENTS

Thanks to Dan Herrig, Margaret Anderson, and Tammy Froscher (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, Michelle Thompson, Julie Burke, and Celeste Reeves (CTUIR) provided technical and administrative support. Mike McLean, Ryan Seeger and Laurie Hewitt provided advice and trap assistance. 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 Darline Robison (United States Forest Service) provided stream flow and water temperature data. Lookingglass Hatchery (ODFW) staff provided assistance in handling fish, use of hatchery facilities and equipment, and kept an eye on the screw trap for us.

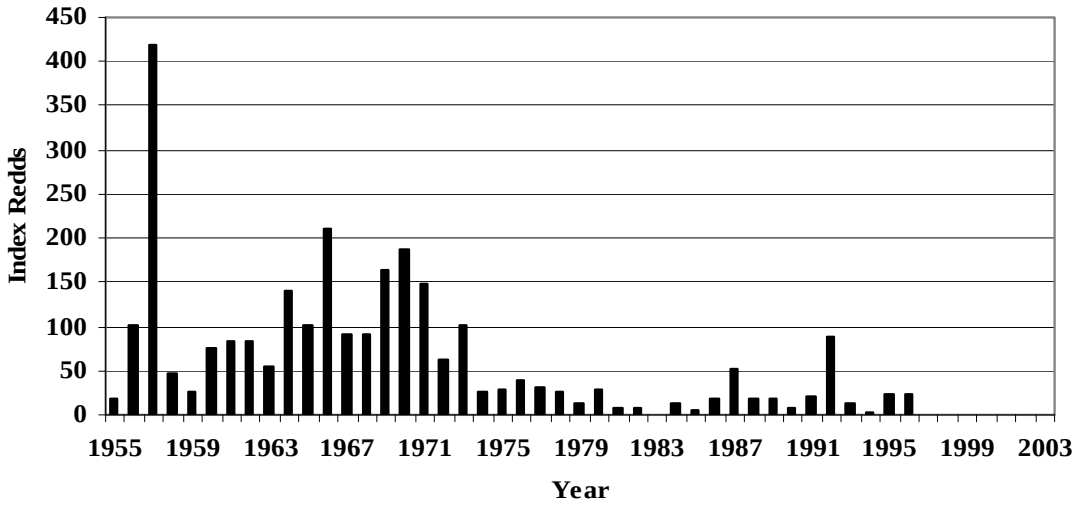
5 APPENDIX FIGURES



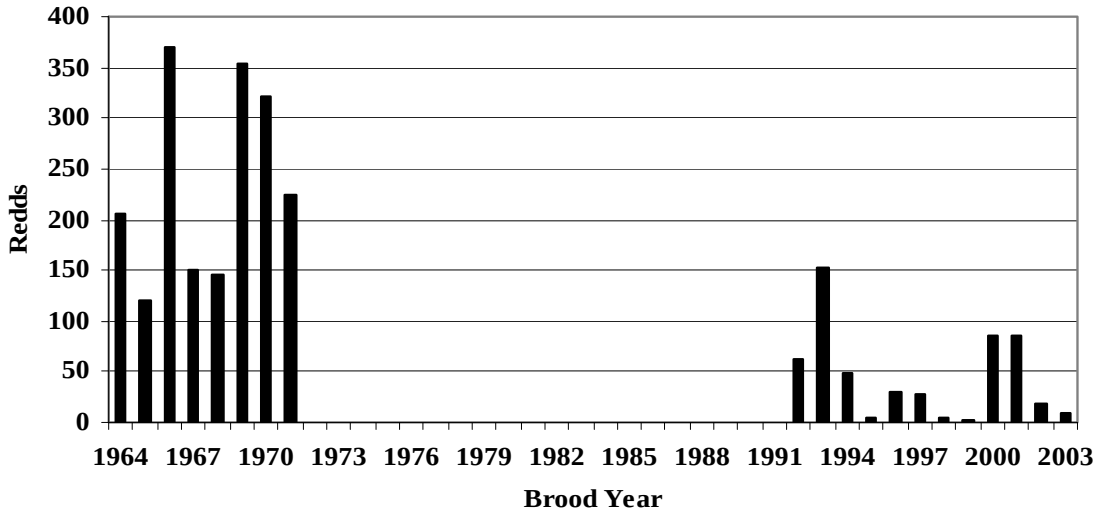
Appendix Figure 1. Historical streamflows for Lookingglass Creek for water years 1983-2003 (water year is from 1 October to following 10 September).



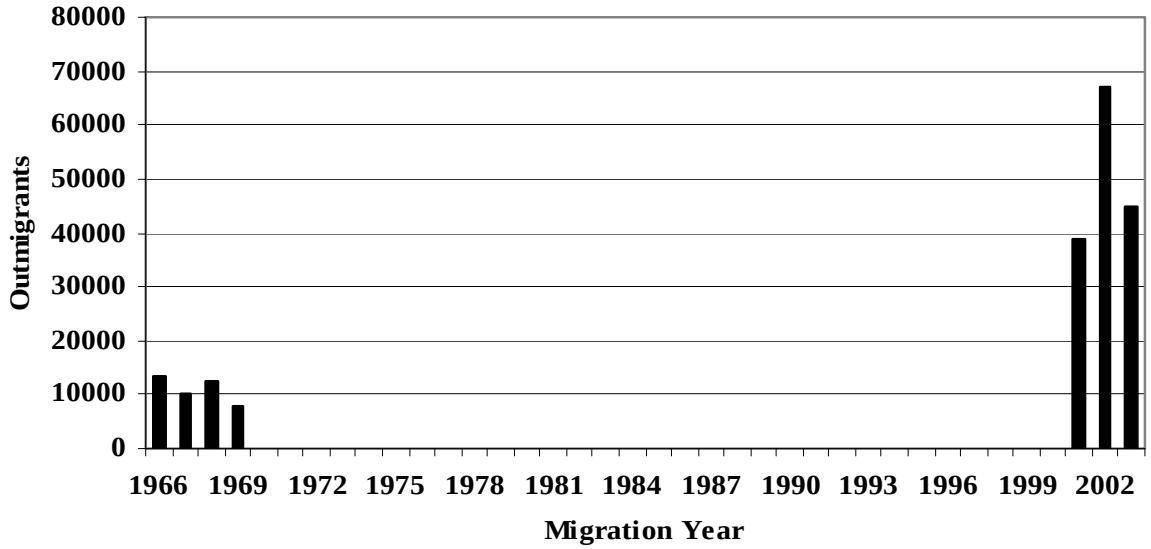
Appendix Figure 2. Historical (natural) juvenile spring Chinook salmon outmigration production from Lookingglass Creek, 1965-2003. (*Note: Trapping until November 2000 was at about rm 2.3, after November 2000 at rm 0.1*).



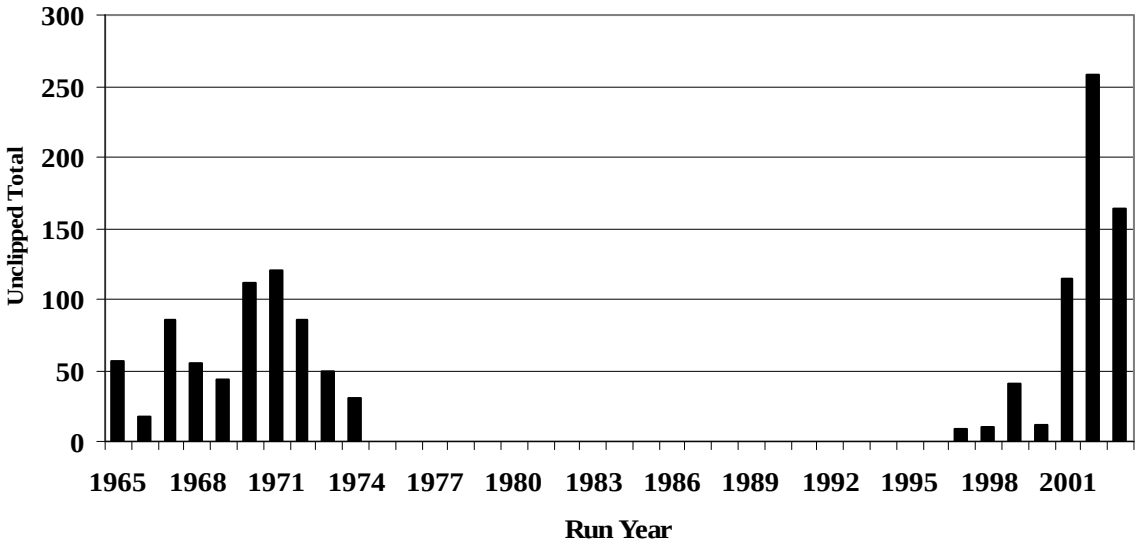
Appendix Figure 3. Redd counts for Lookingglass Creek spring Chinook salmon in the index area from Summer Creek to Little Lookingglass Creek, 1955-2003 (data from Tranquilli et al. 2004).



Appendix Figure 4. Total redd counts for Lookingglass Creek spring Chinook salmon, 1964-2003 (including data from Burck 1993).



Appendix Figure 5. Juvenile *O. mykiss* outmigrants from Lookingglass Creek, migration years 1966-2003. (*Note: Trapping until November 2000 was at about rm 2.3, after November 2000 at rm 0.1*).



Appendix Figure 6. Lookingglass Hatchery trap catches of unmarked (wild) summer steelhead adults, 1965-2003.