Lower Snake River Compensation Plan
Confederated Tribes of the Umatilla Indian Reservation
Evaluation Studies for 1 January 2002 to 31 December 2002

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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

Stream flows in Lookingglass Creek were in the range of 50-70 CFS from January-March and mid-July through the end of the year in 2002. Peak flow occurred in mid-April (over 800 CFS), followed by smaller peaks in late May and early June (over 600 CFS). The highest daily mean water temperature (16.9^{o}C) at the site near Lookingglass Hatchery occurred on 29 July 2002.

We collected 63 spring Chinook salmon (*Oncorhynchus tshawytscha*) adults (22 unmarked, 27 AD-clipped, 14 ADRV-clipped) at the Lookingglass Hatchery water intake trap from 5 June-23 September 2002. A total of 59 fish were marked with opercle-punches, transported and released below the trap for harvest or to spawn naturally. No fish were intentionally passed above the trap. Twelve spawning ground surveys completed below the trap from 10 July-28 September 2002 yielded 18 completed redds and 28 carcasses. No redds, carcasses or live fish were observed during a survey above the trap on 6 September 2002. Estimated spawning escapement below the trap was 104 (95% confidence interval 64-179). Estimated spawning escapements by mark groups were 36 unmarked, 45 AD-clipped and 23 ADRV-clipped. Age composition was estimated at 10 age 3, 65 age 4, and 30 age 5. Smolt-to-adult ratio ranged from 0.00088-0.00188 for five groups of coded wire tagged BY 1997 hatchery-origin spring Chinook salmon released in 1999. Mean fork lengths of males were 507.6, 739.8 and 843.2 mm at ages 3, 4, and 5. Mean fork lengths of females were 723.9 and 818.0 mm at ages 4 and 5.

Naturally-produced brood year 2000 juvenile spring Chinook salmon outmigrants were sampled using a rotary screw trap 0.1 mi above the mouth of Lookingglass Creek. An estimated 21,168 (+/-2,082) naturally-produced juveniles outmigrated from 29 May 2001 through 24 June 2002. Capture probabilities ranged from 0.038-0.291. Approximately 77% outmigrated during late August-early October 2001. Fish collected in the screw trap, PIT-tagged and released were separated into three groups: fall group, 29 May-30 September 2001; winter group, 1 October-31 December 2001; and spring group, 1 January-24 June 2002. Mean FL for PIT-tagged fish from fall, winter, and spring groups were 86.5, 89.3, and 91.9 mm, respectively. Median arrival dates at Lower Granite Dam in 2002 for fish from the fall, winter, and spring groups were 15 April, 19 April, and 26 April, respectively. Harmonic mean travel times to Lower Granite Dam were 229, 176, and 68 d, respectively. Survival rates to Lower Granite Dam for fish from the fall, winter, and spring groups were 0.1609, 0.2968, and 0.5062, respectively.

Approximately 51,864 (including 499 PIT-tagged) hatchery-produced brood year 2000 juveniles (Catherine Creek stock, captive broodstock progeny) were released from Lookingglass Hatchery into Lookingglass Creek on 24 September 2001. Estimated outmigrants from 25 September 2001-22 April 2002 totaled 37,485 (+/- 3,803). Approximately 92% outmigrated during the period 25 September-15 October 2001. Trap

efficiency recapture probabilities ranged from 0.093-0.303. Untagged hatchery-origin outmigrants collected in the screw trap from 25 September 2001 through 22 April 2002 were PIT tagged. Mean FL for PIT-tagged fish from the 24 September 2001 release, winter (25 September-31 December 2001), and spring (1 January-22 April 2002) groups were 109.1, 112.4, and 115.5 mm, respectively. Median arrival dates at Lower Granite Dam in 2002 for fish from the three groups were 30 April, 3 May, and 3 May, respectively. Harmonic mean travel times to Lower Granite Dam were 213, 166, and 50 d, respectively. Survival rates to Lower Granite Dam for fish from the three groups were 0.0850, 0.1359, and 0.4603, respectively.

A "field" group of 528 naturally-produced brood year 2000 spring Chinook salmon was seined from several sites between the Lookingglass Hatchery weir and the mouth on 21 August 2001, PIT-tagged, and released. Mean FL was 83.4 mm and median arrival date at Lower Granite Dam was 20 April 2002. Harmonic mean travel time to Lower Granite Dam was 245 d, and survival to Lower Granite Dam was 0.1477. Fish from Lookingglass Creek were larger than those from Catherine Creek and the Lostine and Minam Rivers, median arrival time was earlier than the other three streams, and survival to Lower Granite Dam was higher than two of the other three streams.

Adult escapement and juvenile outmigrants were lower than past years, indicative of the transition from Rapid River stock to Catherine Creek stock. A comprehensive report should be completed for the years when the Rapid River stock was used. This should include comparisons, when appropriate, between data collected and summarized by Burck (1993) for the endemic stock.

1.2 Introduction

Many anadromous salmonid stocks in the Snake River Basin have declined to the point of extinction (Nehlsen et al. 1991). Principal factors in the declines of anadromous salmonid populations in the Pacific Northwest are construction and operation of hydroelectric facilities, overfishing, and the loss and degradation of critical spawning and rearing habitat in the Columbia and Snake River Basins (Nehlsen et al. 1991). The Grande Ronde River Basin once supported large populations of fall and spring Chinook sockeye (*O. nerka*), and coho (*O. kisutch*) salmon and summer steelhead (*O. mykiss*), but all have experienced severe declines in abundance or extirpation (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 anadromous salmonids resulting from construction and operation of the lowest four Snake River dams (Lower Granite, Lower Monumental, Little Goose, and Ice Harbor). Lookingglass Hatchery (LH) on Lookingglass Creek, tributary to the Grande Ronde River, was completed in 1982 and has been the main spring Chinook salmon hatchery for the Grande Ronde and Imnaha Rivers. But natural spring Chinook populations have continued to decline and resulted in the National Marine Fisheries Service (NMFS, recently renamed National Oceanic and Atmospheric Administration-Fisheries) listing Snake River spring/summer Chinook salmon as "threatened" under the federal Endangered Species Act on 22 April 1992.

After construction of Lookingglass Hatchery in 1982, managers attempted to maintain production of the native Lookingglass Creek stock by hatchery spawning. This failed, and the native stock became functionally extirpated. Wind River (Washington), Carson (Washington), and Rapid River (Idaho) fish, all non-endemic stocks, were used in succession beginning in the early 1980's, to reestablish natural production. Prior to 2002, studies under this project were designed to evaluate the use of Rapid River stock (Lofy et al. 1994). The Confederated Tribes of the Umatilla Indian Reservation (CTUIR) and the Oregon Department of Fish and Wildlife (ODFW) developed the study in consultation with the Nez Perce Tribe and U. S. Fish and Wildlife Service. Fishery managers believed that Lookingglass Creek was a good location to evaluate reintroduction of a non-endemic hatchery stock in the Grande Ronde River Basin. Managers assumed that the relatively good quality habitat available in Lookingglass Creek would provide an adequate opportunity for success, and the weir and trap at LH afforded control and enumeration of adult escapement. An existing database on the life history and production of the native (now extirpated) spring Chinook salmon in Lookingglass Creek from 1964 to 1974 (Burck 1993) provided reference to evaluate performance of the introduced stock. Monitoring and evaluation efforts under the current project included spawning ground surveys, rotary screw trapping (beginning in October 1993), monthly sampling to estimate seasonal growth of juveniles, and other activities.

Prior to 1992, no adult spring Chinook salmon captured at the LH weir were placed upstream of the hatchery with the exception of a few fish in 1989 (Lofy and McLean undated). The upstream migration of spring Chinook salmon has been blocked by either a picket or floating weir located at the hatchery. The picket weir has been effective at preventing upstream migration. However, redd counts during spawning surveys from 1982-1991 (ODFW, unpublished data) show some fish escaped above the weir each year.

From 1992 to 1994, adults were placed above the LH weir (Lofy and McLean 1995a,b: McLean and Lofy 1995). In the fall of 1994, an infectious hematopoietic necrosis epizootic at LH affected the 1993 cohort being reared at the hatchery. This incident caused increased concern about release of adult spring Chinook salmon above the hatchery weir causing increased in pathogens in the LH water supply. No release of adults above the LH weir occurred in 1995 (McLean and Lofy 1998). Instead, CTUIR and co-managers retained the adults for artificial propagation and used the progeny of unmarked spring Chinook salmon that returned to LH in 1995 for supplementation as parr (i.e., artificial spawning/ incubation/ early rearing at LH and release in 1996 as parr above the weir on Lookingglass Creek) (McLean and Lofy 1998, 1999).

Co-managers decided to release only 50 adults above the weir in 1996, compared to 100-300 fish released from 1992-1994 (McLean and Lofy 1999). As a condition of the release of adults above the weir in 1996, during the holding and spawning season, CTUIR staff attempted to recover carcasses and remove them from the active stream channel to reduce the number of carcasses in the water, presumably reducing the pathogen load in the water supply (W. Stelle, NMFS, 1996 letter to Michael Spear, USFWS; McLean and Lofy 1999). The other unmarked fish that were trapped at LH in 1996 (20 females and 21 males) were spawned at the hatchery. Their progeny were released as smolts from the hatchery at 42.1 fish-per-pound and 19.3 fish-per-pound in 1998 (McLean and Lofy

2000b). In 1997, all 77 returning unmarked fish trapped at LH were released above the weir while keeping the survey frequency for carcass recovery the same as in 1996 (McLean and Lofy 2000a).

Comanagers decided again in 1998 and 1999 to not intentionally release adult spring Chinook salmon above the LH weir due to the fear of increasing pathogens in the water supply. Returning spring Chinook salmon captured at the LH trap were retained at the hatchery in 1998 and 1999. These fish came from several sources: unmarked (most likely of natural parentage from Lookingglass Creek), AD-clipped jacks (returns from our 1995 cohort release of progeny of unmarked adult spring Chinook salmon), and ADRV-clipped fish (returns from LH releases not intercepted at Lower Granite Dam) (McLean and Lofy 2000b, 2001). All spring Chinook salmon captured at LH were transported to the CTUIR South Fork Walla Walla Facility (SFWW) due to higher priority for holding space being given to programs for endemic broodstock that are held at LH. The unmarked and AD-clipped jacks were spawned at SFWW and the eggs incubated at Irrigon Hatchery for incubation. After hatching and marking, these fish were released into Lookingglass Creek in July 1999. Gametes of the ADRV-clipped fish were taken at SFWW by the Nez Perce Tribe for the Rapid River stock program in Idaho.

No fish were intentionally passed above the weir and no redds were observed above the weir in 2000 (McLean et al. 2001). All spring Chinook salmon returning to Lookingglass Creek were allowed to spawn below the weir or be harvested in sport and tribal fisheries. The trap at LH was operated during the return and fish were enumerated and given an opercle punch to identify them as having been trapped. Fish were transported downstream 1 mile and released back to the stream for harvest opportunities.

While evaluation of the Rapid River stock was underway, NOAA-Fisheries directed comanagers to eliminate stocking with non-endemic fish. Comanagers decided to replace the Rapid River stock with an endemic stock from within the Grande Ronde River Basin (Catherine Creek). Catherine Creek stock brood year 2000 presmolts (captive brood progeny from the supplementation program, Boe et al. 2003) were released from LH into Lookingglass Creek 24 September 2001. At the close of 2001, comanagers were developing a comprehensive management plan for spring Chinook salmon in Catherine Creek, the upper Grande Ronde River, and Lookingglass Creek. A complete list of the annual reports generated by this study is in the Literature Cited section.

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 occurs consistently.

1.4 Methods

1.4.1 Stream Flow and Water Temperature

We obtained and summarized Lookingglass Creek stream flow data collected in 2002 by the United States Geological Survey (USGS). Stream flows in cubic feet per second (CFS) were recorded at 15 min intervals at an electronic gauging station just below the floating weir sill near Lookingglass Hatchery (Figure 1). Stream 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 with the flow gauge near Lookingglass Hatchery. Temperatures were recorded every hour below Eagle Creek and in Mottet Creek and every 90 min at the site between Lost and Summer Creeks. Temperatures were taken every 15 min at the USGS site. Temperature data were summarized as daily minima, means, and maxima.

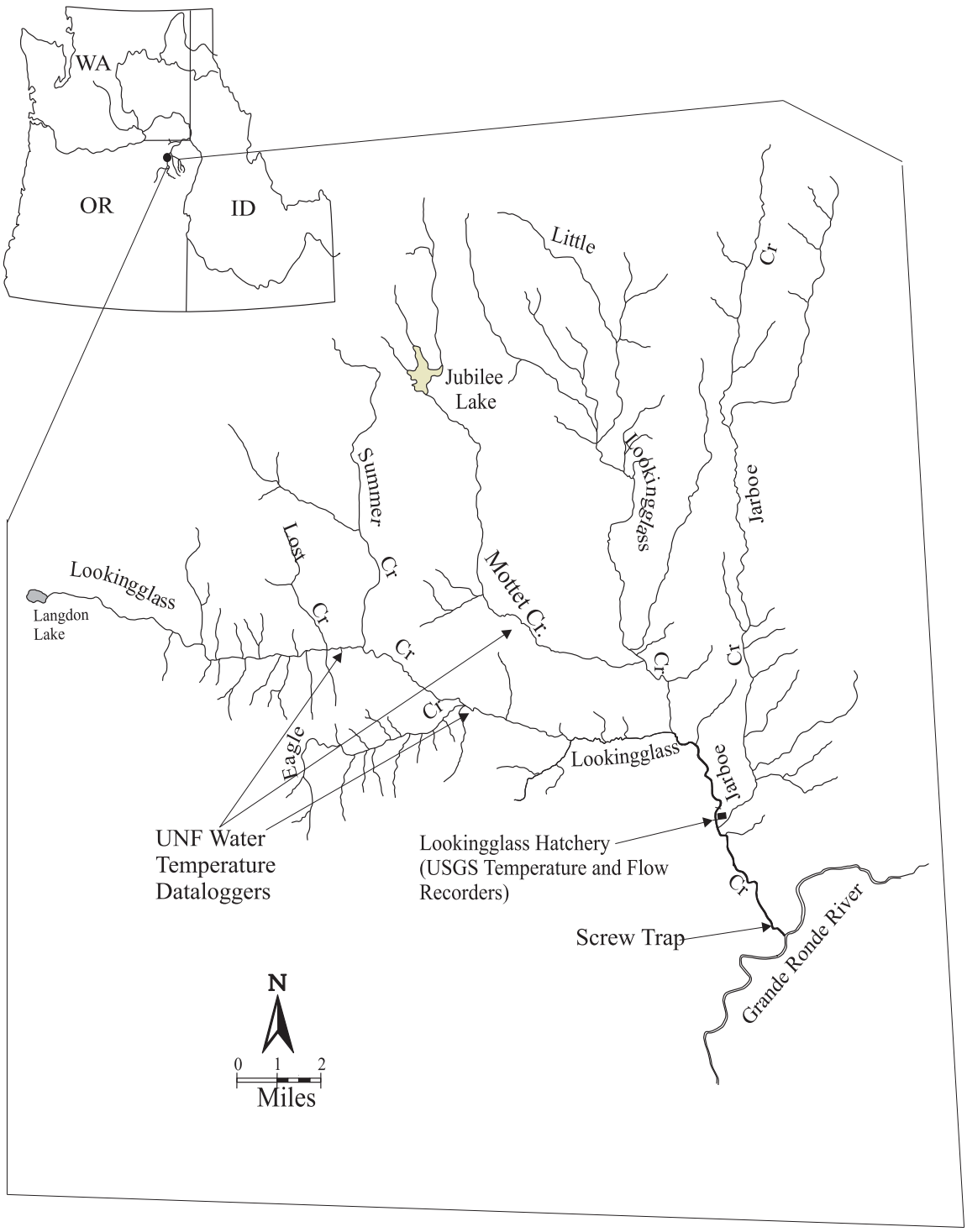

Figure 1. Map of the Lookingglass Creek basin showing the locations of major tributaries, temperature and flow recorders, screw trap and the Lookingglass Hatchery complex.

1.4.2 Adult Spring Chinook Salmon Returning to Spawn

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 22 March 2002 and maintained it until 23 September 2002. CTUIR staff removed and processed fish three times a week, usually Monday-Wednesday-Friday, or more frequently if needed.

Adult spring Chinook salmon returning to Lookingglass Creek in 2002 consisted of unmarked progeny of natural (unmarked) fish, hatchery-reared progeny of marked Rapid River stock fish released as smolts, and hatchery-reared progeny of unmarked parents released as presmolts (Table 1).

Table 1. Hatchery-produced spring Chinook salmon released into Lookingglass Creek, 1999-2000.

Brood Year	Release Date	No. Released	$\bar{X}$ weight (g)	Marks*
1997	4/1/1999	295,766	19.14-22.5	AD+RV clips/CWT
1998	6/24/1999	57,290	3.56	AD clip/CWT
1999	6/9/2000	23,819	6.5	AD clip/CWT

* *AD = adipose, RV = right ventral, CWT = coded wire 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, opercle punched for recapture information, and scale samples collected. Week of capture was designated by the first day of the week (e.g. week of 1 January included 1-7 January). During May and June 2002 when tribal and sport fisheries existed, all fish were transported and released about 1 mi below the trap. After the fisheries ended, any ADRV-clipped fish captured in the trap were euthanized. Age determinations were made using scales for unmarked fish (Mosher 1969). All fish were assumed to have spent 2 years rearing in freshwater; age 3 fish spent 1 year in the ocean, age 4 fish 2 years, and age 5 fish 3 years. All AD-clipped fish were assumed to be from the brood year 1998 and 1999 releases, and all AD-RV-clipped fish were assumed to be from the brood year 1997 release. All fish not removed at the trap were transported 1 mi downstream and released to spawn naturally in the 2.50 mi section below the hatchery trap or be available for harvest. No fish were intentionally released above the hatchery weir for natural production in 2002.

Burck (1993) designated different stream reaches of Lookingglass Creek and Little Lookingglass Creek as spawning units (Figure 2). Spawning ground surveys using methods similar to those described by Parker et al. (1995) were conducted during the spawning season during August and September 2002. Surveys were conducted in Unit 1 (below the weir) every 3 to 5 days after the first redds were observed to count redds and sample carcasses. Only completed redds were counted (McLean and Lofy 1995) and flagged to eliminate double counting. Carcasses were enumerated and fork length, sex, marks, and percent spawned recorded. Tails were cut off to prevent double sampling. Snouts were taken from any AD or ADRV-clipped carcasses for CWT recovery. 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.

Snouts were dissected and CWT data obtained by the ODFW CWT laboratory in Clackamas, Oregon. 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) 1997 CWT fish released in April 1999 and recovered in 2000-2001-2002 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).

Some returning adults were not caught at the trap. The Chapman modification of the Petersen method was used to estimate adult escapement (Ricker 1975). The marked sample was the fish released below the weir with an opercle punch. The recapture sample was the carcasses recovered on the spawning ground surveys. Appendix II of Ricker (1975) was used to calculate confidence intervals for the escapement estimate. The mark and age composition of the weir catch was used to obtain mark and age totals for escapement. Tag status and CWT code data from snouts recovered were used to obtain the total numbers for different tag status and CWT codes.

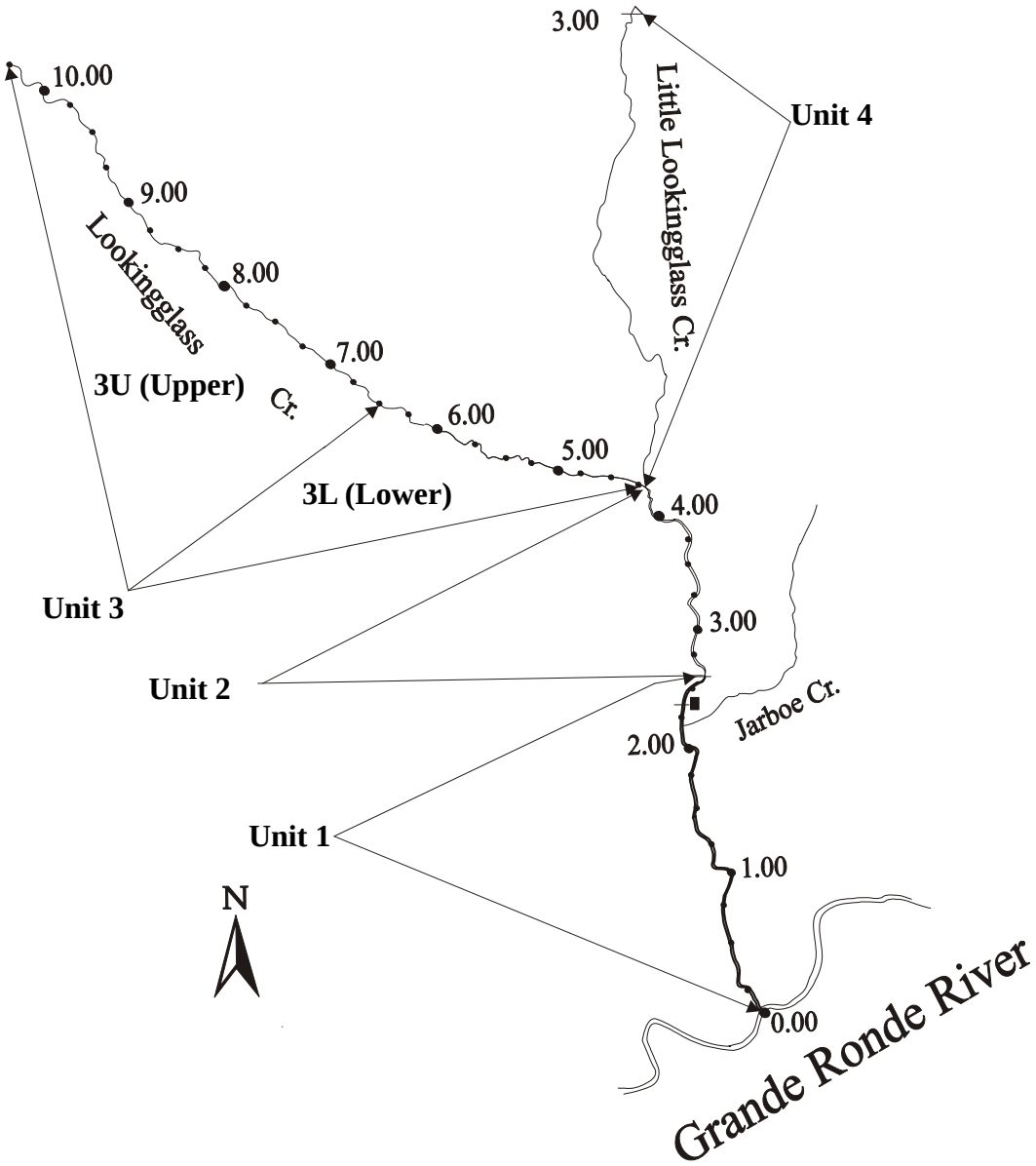

Figure 2. Spawning ground survey unit designations and river miles for Lookingglass Creek.

1.4.3 Outmigrating 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 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 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 similar capture probabilities. We used the one trap and no prior pooling of strata options.

Juvenile spring Chinook collected at the screw trap could be separated into four groups based on marks or size. During January-June of 2002, naturally-produced (unmarked) BY 2001 juveniles were distinguished from BY 2000 naturally-produced juveniles by their much smaller size and lower abundance. BY 2001 naturally-produced juveniles were not PIT-tagged or used in estimates of trap efficiency. BY 2000 hatchery-origin juveniles were Catherine Creek stock captive brood progeny released as subyearlings from Lookingglass Hatchery into Lookingglass Creek on 24 September 2001. All fish of this group were adipose-clipped and coded-wire tagged; and 499 were also PIT-tagged. BY 2001 hatchery-origin presmolts (Catherine Creek captive broodstock progeny) reared under an accelerated growth regime at Irrigon Hatchery were released at several sites 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. We used data collected by McLean et al. (2002) during calendar year 2001 to describe life history of BY 2000 natural- and hatchery-origin spring Chinook salmon. Production and performance of BY 2001 hatchery and natural-origin spring Chinook salmon will be described in the 2003 annual report.

PIT-tagged natural-origin BY 2000 juvenile spring Chinook salmon were grouped by tagging date when estimating arrival timing, travel time, and survival to and capture probability at Lower Granite Dam. We queried the PIT tag database maintained by the Pacific States Marine Fisheries Commission at http://www.ptagis.org/ and used PitPro (Westhagen and Skalski 2006) to make these estimates. Groups were categorized by initial arrival timing at the screw trap (Burck 1993). The fall group was PIT-tagged from 30 June-30 September 2001, the winter group from 1 October-31 December 2001, and the spring group from 1 January-30 June 2002. For hatchery-origin brood year 2000 fish, the winter group was from 24 September 2001-31 December 2001, and the spring group from 1 January-30 June 2002. A fourth group (field) consisted of naturally-produced fish seined from various locations below the LH weir on 21 August 2001, 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).

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 LH 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]. Median arrival timing at Lower Granite Dam for each group was the date that 50% of the expanded detections had occurred.

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 recapture (*.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 Water Temperature

Lookingglass Creek stream flows were usually in the range of approximately 50-70 CFS during January-March 2002 (Figure 3). Flows of 150-160 CFS during this period were brief and probably due to rainfall. Spring snowmelt produced flows that remained above 100 CFS from 22 March through 2 July. Peak flow of 859 CFS was recorded on 14 April. High flows from 30 April-7 May made the USGS flow gauge and temperature recorder inoperable. Flows dropped to below 100 CFS after 2 July and remained in the range of 50-60 CFS from 18 July through the end of 2002.

The highest mean daily water temperature of 16.9^{o}C at the USGS site near Lookingglass Hatchery occurred on 29 July 2002 (Figure 4) and the maximum temperature of 19.2 ^{o}C was recorded the same day. Maximum temperatures of 15.6-17.2 ^{o}C were recorded at the "springs" site from 10-30 July (Figure 5). Maximum temperatures of 12.2-12.8 ^{o}C were recorded from 26 June-13 July below the mouth of Eagle Creek (Figure 6), and 17.2-21.1 ^{o}C were recorded at the Mottet Creek site from 10-26 July (Figure 7).

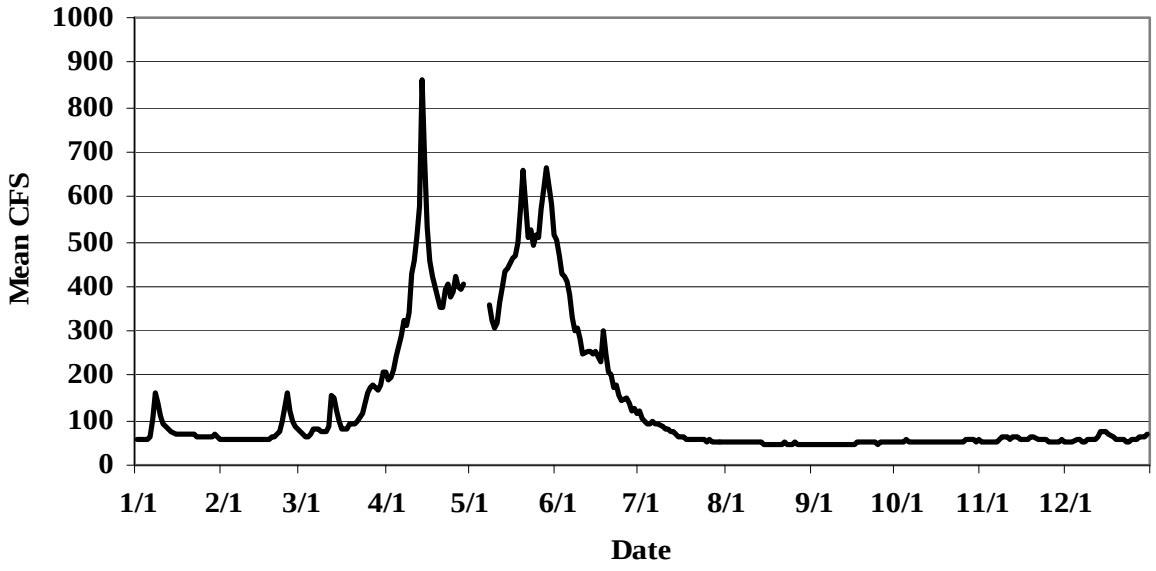

Figure 3. Mean daily streamflows at the United States Geological Survey gauging station in Lookingglass Creek near Lookingglass Hatchery, 2002.

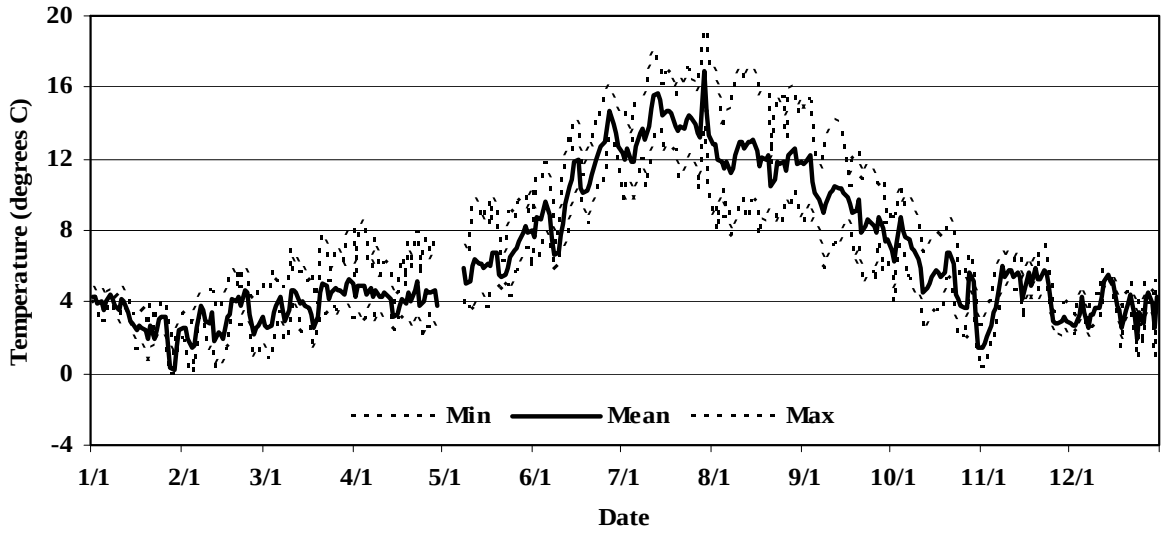

Figure 4. Water temperatures in Lookingglass Creek at the United States Geological Survey gauging station near Lookingglass Hatchery, 2002.

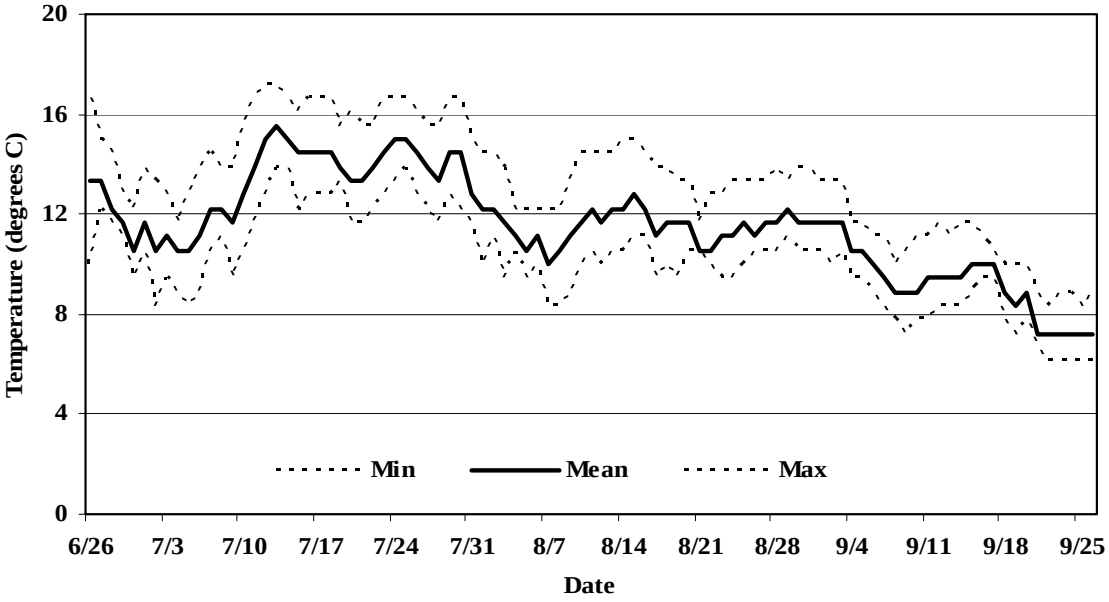

Figure 5. Water temperatures in Lookingglass Creek at the Umatilla National Forest site between Lost and Summer Creeks ("springs" site), 2002.

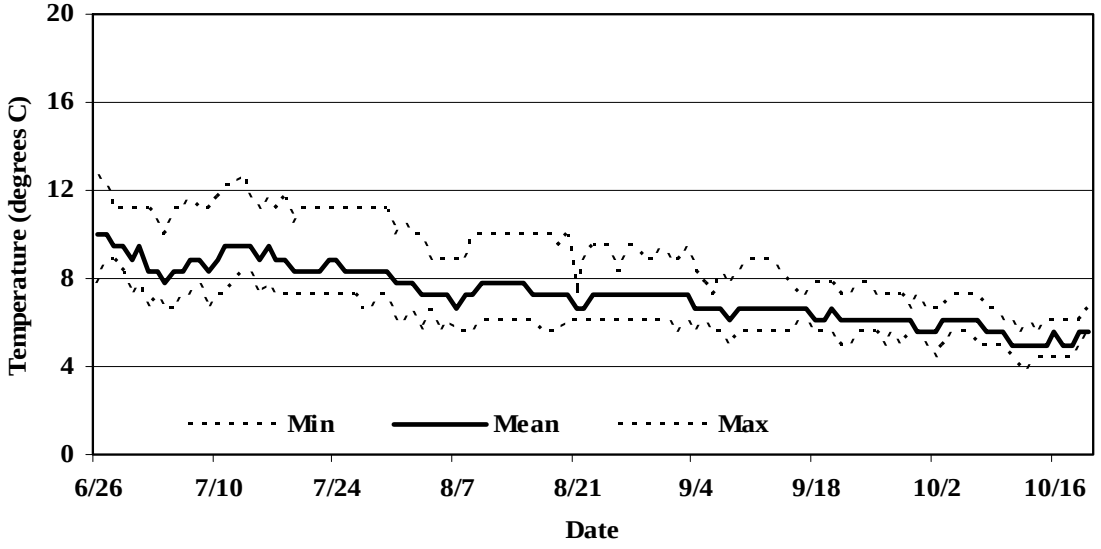

Figure 6. Water temperatures in Lookingglass Creek at the Umatilla National Forest site just below the mouth of Eagle Creek, 2002.

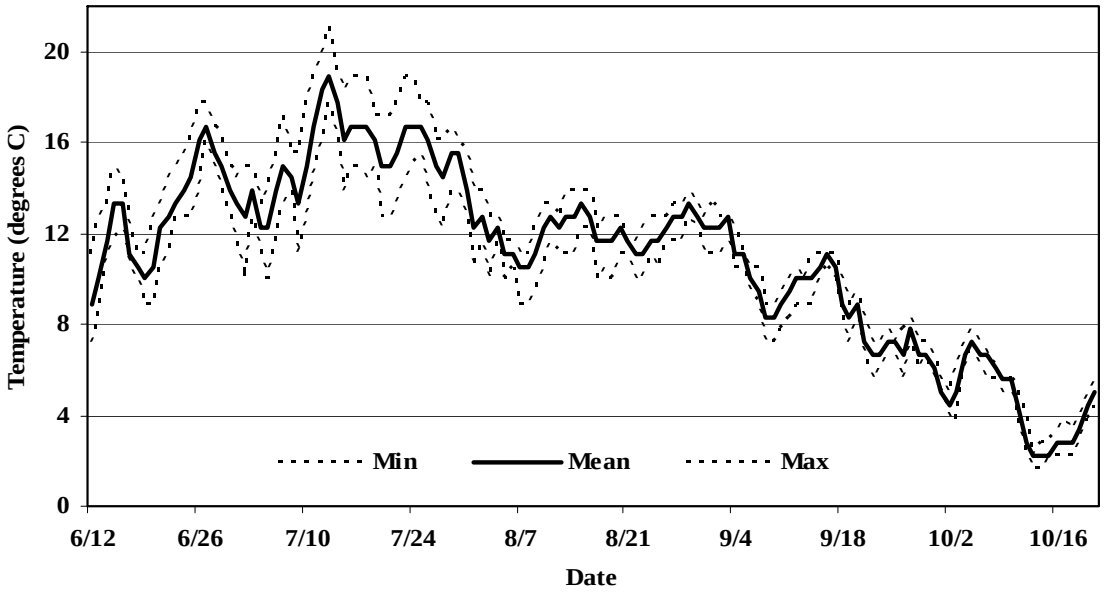

Figure 7. Water temperatures at the Umatilla National Forest site in Mottet Creek, 2002.

1.5.2 Adult Spring Chinook Salmon Returning to Spawn

The adult trap at the Lookingglass Hatchery water intake was operated from 22 March to 23 September 2002 and 63 adult spring Chinook salmon (first-time captures) were caught. The first unmarked, AD-clipped, and ADRV-clipped fish were trapped on 5 June 2002. The last unmarked fish was caught on 30 August, the last AD-clipped on 23 September, and the last ADRV-clipped on 21 August. One AD-clipped OP-punched fish was recaptured on 15 July 2002. There were 15 additional recaptures of previously OP-punched AD-clipped fish; 14 occurred from 21 August-23 September 2002. Substantial numbers of recaptures occurred 3 June, 24 June, 15 July, and 26 August 2002. Eight unmarked fish were recaptured from 23 August-1 September 2002. No ADRV-clipped fish were recaptured, 3 were euthanized, and 1 was a trap mortality. Totals of OP-punched fish released below the weir included 22 unmarked, 14 AD-clipped, and 10 ADRV-clipped.

Most fish were caught early or late in the trapping period; none were caught from mid-July to mid-August (Figure 8). Cumulative percentages of the catch for each of the three mark groups ranged from 64-68 the week of 2 July and 85-93 the week of 20 August.

The trap catch was dominated by ages 4 and 5 fish and most fish were AD or ADRV-clipped (Table 2). Most unmarked and AD-clipped fish were in the 65-80 cm FL groups (Figures 9-10). Most ADRV-clipped fish were >80 cm (Figure 11).

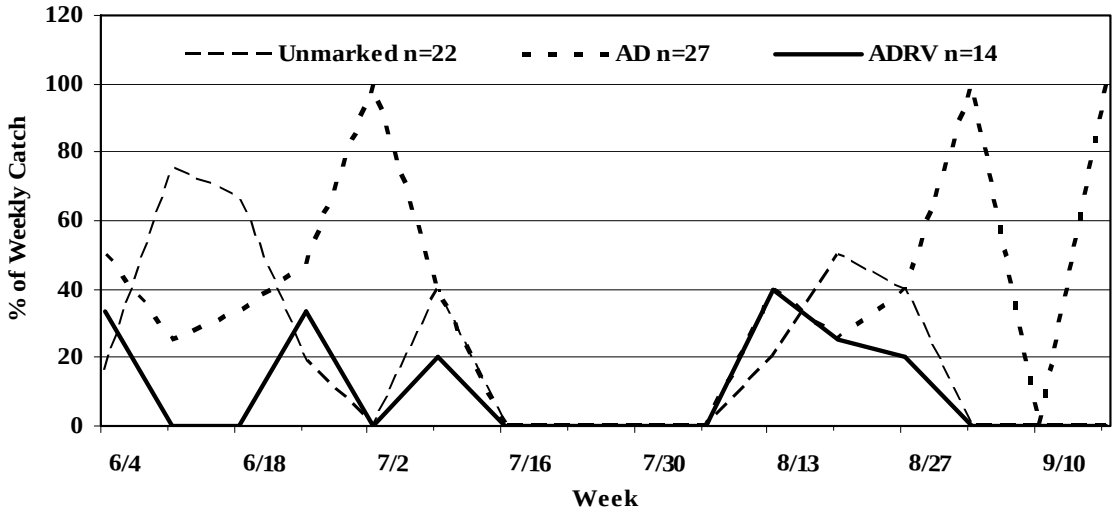

Figure 8. Catches of marked (ADRV, AD) and unmarked adult spring Chinook salmon as percentages of the total weekly catch (unique captures only) in the Lookingglass Hatchery adult trap, 2002.

Table 2. FL (mm) by age and sex for spring Chinook salmon caught in the Lookingglass Hatchery adult trap and aged using scales, 2002 (unique captures only).

Mark	Sex	Age	$\bar{X}$ FL	Min-Max	SE	n
Unmarked	M	3	546.7	457-638	52.3	3
		4	722.4	671-793	15.2	7
		5	913.0	910-916	3.0	2
	F	3				0
		4	756.9	664-831	18.3	8
		5	867.0	867		2
AD	M	3	540.0	467-593	37.7	3
		4	760.0	705-891	14.4	13
	F	3				0
		4	744.0	675-843	16.6	11
ADRV	M	5	844.6	730-918	22.6	7
ADRV	F	5	801.3	737-875	20.9	7

Figure 9. FL frequency distribution of unmarked spring Chinook salmon caught in the Lookingglass Creek adult trap, 2002.

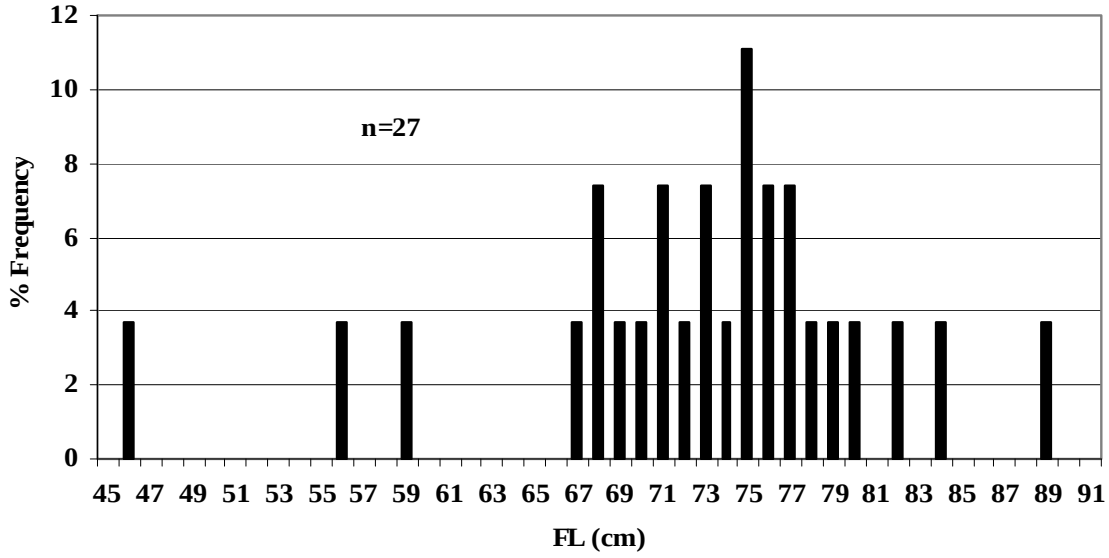

Figure 10. FL frequency distribution of AD-clipped spring Chinook salmon caught in the Lookingglass Creek adult trap, 2002.

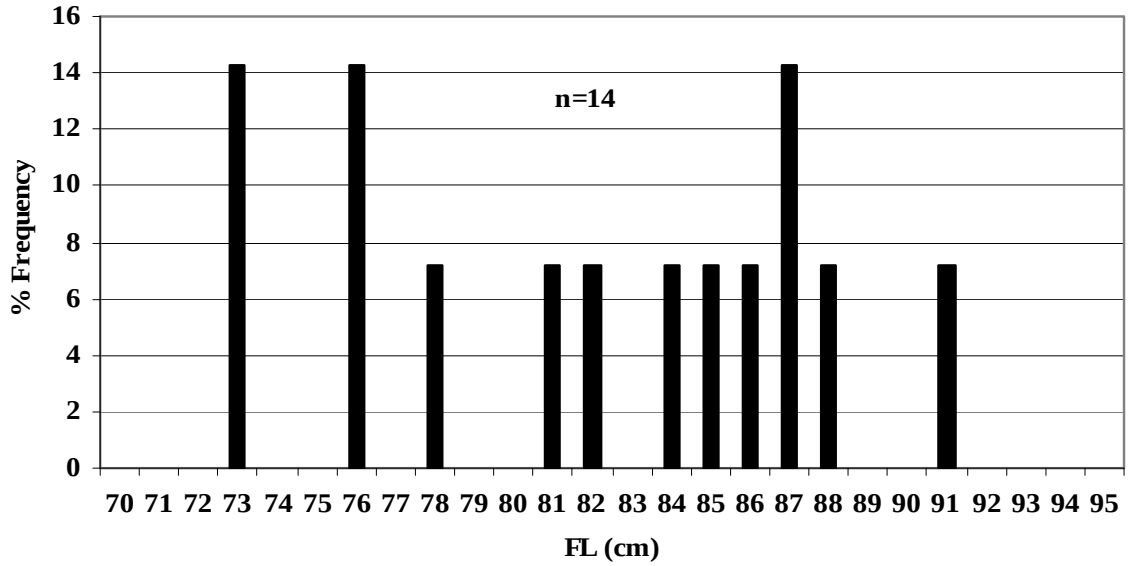

Figure 11. FL frequency distribution of ADRV-clipped spring Chinook salmon caught in the Lookingglass Creek adult trap, 2002.

A spawning ground survey of Units 2, 4, 3U, and 3L (sections above the weir) on 6 September 2002 yielded no redds, live fish, or carcasses. We surveyed Unit 1 (below the weir) 12 times from 10 July-28 September 2002 and observed 18 completed redds. The first completed redd was observed on 15 August 2002. The largest number of new redds

(8) was observed on 28 August 2002. We recovered 28 carcasses, of which mark (OP punch) status could be accurately determined for 26. Fourteen of the 26 carcasses had been OP punched and released from the trap. Carcasses ranged from 640-910 mm FL; 17 were 640-790 mm and 8 from 804-910 mm. Eighteen were females, nine male, and one unknown.

Estimated escapement using all fish released below the weir for the marked sample was 104 fish (95% confidence interval, 64-179). If only fish > 638 mm FL were used in the marked sample (the smallest carcass recovered was 640 mm FL), the estimate was 94 (95% confidence interval, 57-161. Using the estimate of 104 and the percentages by mark group observed in the weir catch, the estimated numbers of unmarked, AD-clipped, and ADRV-clipped fish in the escapement were 36, 45, and 23, respectively. Table 3 shows the approximate age composition by mark group.

Table 3. Estimated spawning escapement of spring Chinook salmon by mark and age, Lookingglass Creek, 2002.

Mark Group	Estimated Escapement	Age	Fraction At Age At Weir	Estimated Number
Unmarked	36	3	0.1364	5
		4	0.6818	25
		5	0.1818	7
AD-clipped	45	3	0.1111	5
		4	0.8889	40
ADRV-clipped	23	5	1.0000	23

Snouts from 11 AD-clipped fish were submitted for CWT recovery. Codes from 4 different groups were recovered (Table 4). No CWT were present in 3 snouts. The estimated (expanded) number of AD- or ADRV-clipped fish without CWTs was 22. The estimated (expanded) numbers of fish by CWT code were 70148 (7), 92621 (7), 92819 (30), and 92820 (15).

Table 4. CWT data for AD- or ADRV-clipped spring Chinook salmon carcasses collected from Lookingglass Creek or the Lookingglass Hatchery adult trap, 2002.

BY	Release Date	Sex	FL (mm)	CWT Code
1997	4/1/1999	F	740	70148
1997	4/1/1999	M	895	92621
1998	6/24/1999	M	748	92819
1998	6/24/1999	F	650	92819
1998	6/24/1999	F	680	92819
1998	6/24/1999	F	670	92819
1998	4/1/2000	F	715	92820*
1998	4/1/2000	F	720	92820*

* *Acclimated and released from Catherine Creek acclimation facility*

BY 1997 fish with CWT released in Lookingglass Creek in 1999 were most abundant in the Lookingglass Creek sport fishery, with 322 taken as 4 year olds in 2001 (Table 5). The number taken from the Lookingglass Creek sport fishery was 41% of the total recoveries for all three run years. Net or sport fisheries in the mainstem Columbia River accounted for 33% of the 4-year old harvest (run year (RY) 2001) and 89% of the 5-year olds (RY 2002). The estimate of total recoveries of CW-tagged fish across all three run years was 782.54. Out-of-basin strays were 2% of the total CWT recoveries. Smolt-to-adult survival rates for tag codes 92620-92622 (0.00161-0.00188) were higher than for tag codes 70148 and 70749 (0.00088-0.00104) (Figure 12). The numbers released for each code ranged from 49,967-63,786. Mean FL of CW-tagged males was greater than for females at ages 4 and 5 (Table 6).

Table 5. Summary of CWT data for hatchery-origin BY 1997 (tag codes 70148, 70149, 92620, 92621, and 92622) spring Chinook salmon released into Lookingglass Creek in 1999 (from PFMFC RMIS database).

RY	Recapture Location Name	Estimated Number	% of RY Total
2000	Bonneville Ceremonial	2.1	2.7
	Lower Granite Trap	57.57	75.1
	Imnaha Spawn	1	1.3
	Lookingglass Creek	6	7.8
	Lookingglass Hatchery	10.03	13.1
RY 2000 Total		76.7	
2001	Young's Bay Net	2.65	0.4
	Bonneville Pool Net	1.7	0.3
	Bonneville Pool–Umatilla	6.12	1.0
	Pelton Dam Trap	1.01	0.2
	Sherar's Falls Sport Fish	2.51	0.4
	Columbia R. Sport Fish OR[a]	90.71	14.1
	Columbia R. Sport Fish WA[b]	63.73	9.9
	Columbia River Net[c]	15.41	2.4
	Dalles Pool Net	10.96	1.7
	John Day Pool Net	18.22	2.8
	Imnaha Trap	1.02	0.2
	Minam River	3	0.5
	Wenaha River	1	0.2
	Lostine River	1	0.2
	Lostine River Trap	1	0.2
	Lookingglass Creek	1	0.2
	Lookingglass Creek Sport	322	50.2
	Lookingglass Hatchery	98.98	15.4
RY 2001 Total		642.02	
2002	Bonneville Pool Net	5.1	8.0
	Bonneville Pool–Umatilla	2.04	3.2
	Columbia R. Sport Fish OR	5.8	9.1
	Columbia R. Sport Fish WA	5.7	8.9
	Columbia River Net	37.89	59.4
	Snake River Mainstem	4.05	6.3
	Lostine River	1.08	1.7
	Lookingglass Creek	2.16	3.4
RY 2002 Total		63.82	

[a] *all or some of Sections 1,2,4,5,10*

[b] *all or some of Sections 1,4,5*

[c] *all or some of Zones 1,2,3*

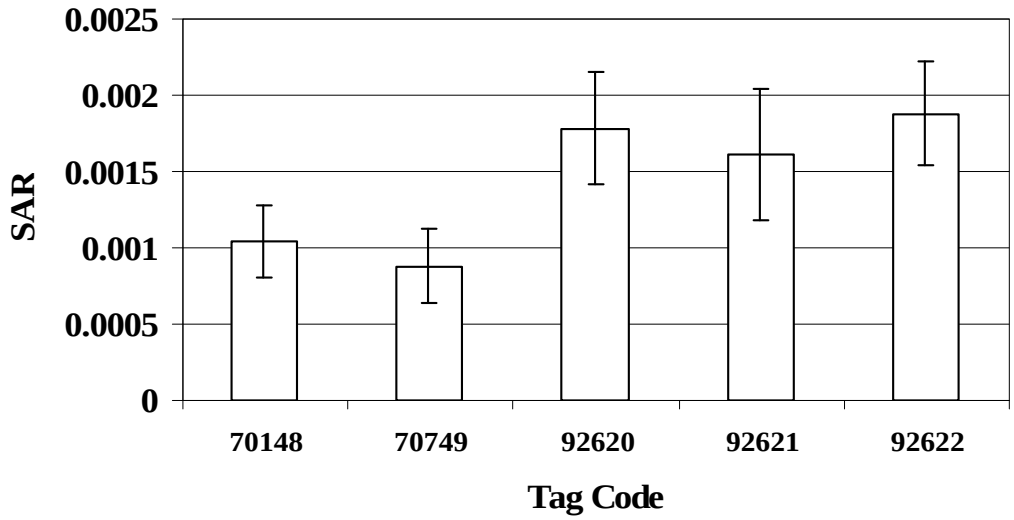

Figure 12. SAR and SE by CWT code for hatchery-origin spring Chinook salmon smolts released from Lookingglass Hatchery into Lookingglass Creek in April 1999 and recovered during 2000-2001-2002.

Table 6. FL (mm) at recovery of CW-tagged BY 1997 (tag codes 70148, 70149, 92620, 92621, and 92622) hatchery-origin spring Chinook salmon released from Lookingglass Hatchery into Lookingglass Creek in April 1999.

RY	Sex	$\bar{X}$ FL	SE	Min	Max	n
2000	M	507.6	4.7	450	610	67
2000	F					0
2001	M	739.8	3.7	590	870	146
2001	F	723.9	2.5	595	830	187
2001	Combined*	729.6	1.9	590	870	475
2002	M	843.2	15.8	810	895	5
2002	F	818.0	14.7	740	900	11
2002	Combined*	825.7	10.9	740	900	19

1.5.3 Outmigrating Juvenile Spring Chinook Salmon

1.5.3.1 Brood Year 2000 Natural-origin

The screw trap was operated nearly continuously from 29 May 2001 through 31 December 2002. Approximately 230 fish too small to be PIT-tagged were caught from 28 March-1 June 2001. FL of 25 of these fish ranged from 32-44 mm. High flows and debris prevented operation from 10-17 April 2002. For 1 or 2 day periods in January, February, March, and April of 2002, logs jammed into the cone prevented it from turning. The trap iced up for 2 days each in November and December. The trap was functioning, but probably not very effectively during a period of high flow for 3 days around 1 May 2002 and 14 days from 17-31 May 2002. Since few fish were caught immediately before

and after these periods, no attempt was made to adjust the catches. Mink predation occurred sporadically despite leg hold traps, and other devices. The outmigrant estimate was 21,168+/- 2,082 (Table 7). Peak outmigration was during late August-early October (approximately 77% of the total). In Table 6, "m" includes recaptures of fish from the field group used to estimate trap efficiency.

Table 7. Naturally-produced BY 2000 juvenile spring Chinook salmon caught in the Lookingglass Creek screw trap, releases and recaptures from trap efficiency tests, estimated outmigrants and standard errors, Lookingglass Creek, MY 2002.

Dates	u	m	r	Cp	N	SE
5/29-8/15*	115	111	20	0.288	399	304
8/16-8/31	777	503	56	0.113	6,885	1,000
9/1-9/15	525	225	22	0.089	5,868	1,456
9/16-9/31	135	92	13	0.131	1,027	294
10/1-10/15	528	281	58	0.219	2,414	437
10/16-10/31	253	224	61	0.267	947	142
11/1-11/15	68	68	19	0.291	234	52
11/16-11/30	112	100	21	0.21	533	101
12/1-6/24*	109	105	4	0.038	2,861	1,402
	2,622	1,709	274		21,168	2,082

**Pooled time periods*

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$^{0.5}$)

Mean FL increased and mean K factor decreased the later the tagging group (Table 8). Modal FL group was 8 cm (Figure 13).

Median arrival date at Lower Granite Dam became progressively later, the later the tagging group, but the difference was only 11 d between the fall and spring tag groups (Table 9). Travel times to Lower Granite Dam were about 68-229 d (Table 10). Survival rates increased substantially the later the tag group (Table 11). Capture probabilities were similar for the fall and winter tag groups and lower than for the spring group.

Table 8. FL (mm), weight (g), and K factor summary for naturally-produced BY 2000 spring Chinook salmon caught in the Lookingglass Creek screw trap, PIT-tagged and released, MY 2002.

		Parameter		
Group	Statistic	FL	Wgt	K
Fall	Mean	86.5	7.9	1.19
	SD	8.6	2.2	0.07
	SE	0.3	0.1	0.003
	Min	52	1.7	1.00
	Max	115	20.3	1.60
	n	859	858	858
Winter	Mean	89.3	7.9	1.10
	SD	7.3	2.0	0.08
	SE	0.3	0.1	0.003
	Min	67	3.5	0.81
	Max	116	17.6	1.48
	n	648	647	647
Spring	Mean	91.9	8.4	1.06
	SD	10.4	2.6	0.16
	SE	1.0	0.3	0.02
	Min	64	2.5	0.61
	Max	132	16.2	2.17
	n	103	102	102

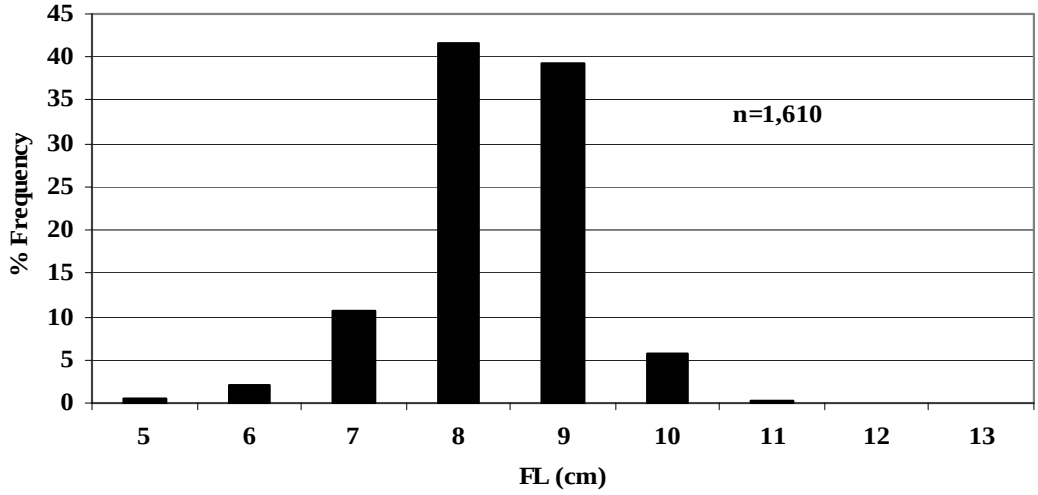

Figure 13. FL (cm) frequency distribution for naturally-produced BY 2000 spring Chinook salmon caught in the Lookingglass Creek screw trap, PIT-tagged and released, MY 2002.

Table 9. Migration timing summary for naturally-produced BY 2000 spring Chinook salmon caught in the Lookingglass Creek screw trap, PIT-tagged and released, MY 2002.

Group	Number PIT-tagged	Median Tagging date	Median Arrival Date at Lower Granite Dam	Actual Detections	Expanded Detections
Fall	859	8/24/2001	4/15/2002	28	49
Winter	648	10/24/2001	4/19/2002	41	76
Spring	104	1/11/2002	4/26/2002	16	30

Table 10. Travel time (TT) in days to Lower Granite Dam summary for naturally-produced BY 2000 spring Chinook salmon caught in the Lookingglass Creek screw trap, PIT-tagged and released, MY 2002.

Group	n	Harmonic $\bar{X}$ TT	SE
Fall	859	229.369	3.414
Winter	648	175.872	3.908
Spring	104	68.013	13.488

Table 11. Survival to and capture probabilities at Lower Granite Dam for naturally-produced BY 2000 spring Chinook salmon caught in the Lookingglass Creek screw trap, PIT-tagged, and released, MY 2002.

Group	n	Survival	SE	Capture Probability	SE
Fall	859	0.1609	0.0207	0.2026	0.0400
Winter	648	0.2968	0.0481	0.2080	0.0428
Spring	104	0.5062	0.1038	0.3068	0.0845

1.5.3.2 Brood Year 2000 Hatchery-origin

A total of 51,864 (including 499 PIT-tagged) hatchery-origin BY 2000 spring Chinook salmon (Catherine Creek stock, captive brood progeny) were released from Lookingglass Hatchery into Lookingglass Creek on 24 September 2001. The outmigrant estimate was 37,485 (+/- SE 3,803) (Table 11), or 72 % of the total released. Most (92%) fish left Lookingglass Creek from 25 September-15 October 2001. In Table 12, "m" includes recaptures of fish from the field group used to estimate trap efficiency.

Mean FL increased and mean K factor decreased the later the tagging group (Table 13). Modal FL group was 11 cm (Figure 14). PIT-tagged hatchery-origin BY 2000 spring Chinook salmon were first detected at Lower Granite Dam on 3 April 2002, with the last fish detected 22 April 2002. Median arrival dates of all three groups varied by only 3 days (Table 14). Travel times to Lower Granite Dam were about 50-213 d (Table 15). Survival to Lower Granite Dam increased the later the tag group (Table 16).

Table 12. Hatchery-origin BY 2000 spring Chinook salmon captured in the Lookingglass Creek screw trap, trap efficiency releases and recaptures, estimated outmigrants, and standard errors, Lookingglass Creek, MY 2002.

Dates	u	m	r	Cp	N	SE
9/25-9/30	5,830	167	47	0.284	20,527	3,913
10/1-10/15	3,856	315	86	0.276	13,966	1,526
10/16-10/31	57	56	14	0.246	232	76
11/1-11/15	50	50	13	0.26	192	44
11/16-12/31	75	75	8	0.107	703	234
1/1-2/28	43	43	10	0.303	142	110
3/1-3/15	215	212	40	0.189	1,129	158
3/16-4/22	55	54	5	0.093	594	252
	10,179	972	223		37,485	3,803

u=newly caught, unmarked fish (includes fish not marked and released above the trap)
m=newly marked and released below 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$^{0.5}$)

Table 13. FL (mm), weight (g), and K factor summary for hatchery-produced BY 2000 PIT-tagged spring Chinook salmon released from Lookingglass Hatchery or captured in the Lookingglass Creek screw trap, MY 2002.

		Parameter		
Group	Statistic	FL	Wgt	K
24 Sept 2001	Mean	109.1	17.8	1.36
	SD	6.0	3.2	0.09
	SE	0.3	0.1	0.004
	Min	79	6.6	1.04
	Max	125	30.3	1.75
	n	499	499	499
Winter	Mean	112.4	18.0	1.24
	SD	8.8	5.4	0.10
	SE	0.3	0.2	0.004
	Min	93	8.9	0.84
	Max	159	56.2	1.58
	n	645	644	644
Spring	Mean	115.5	17.6	1.10
	SD	11.6	6.9	0.10
	SE	0.7	0.4	0.006
	Min	69	3.9	0.85
	Max	193	77.4	1.38
	n	295	292	292

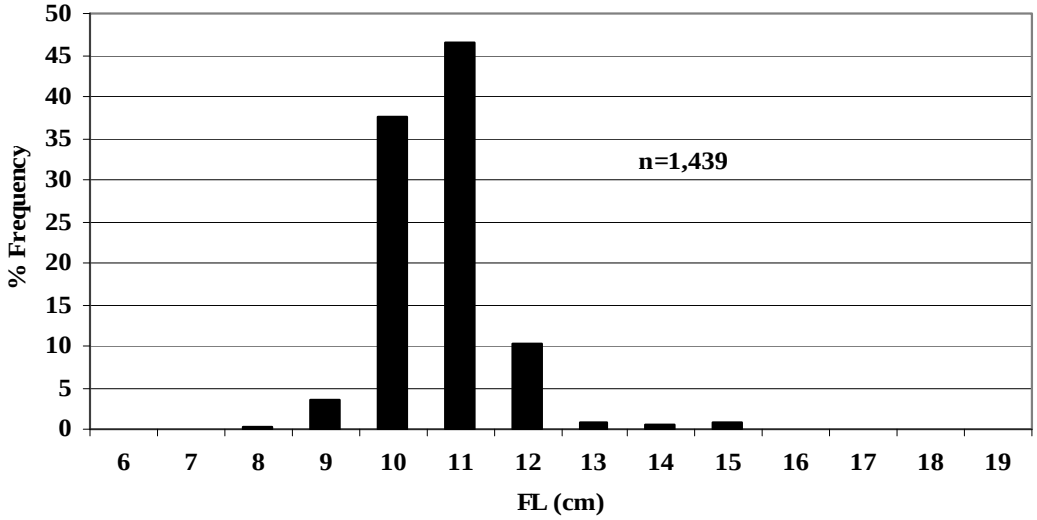

Figure 14. FL (cm) frequency distribution for hatchery-produced BY 2000 spring Chinook salmon released from LH,, and fish caught in the Lookingglass Creek screw trap, PIT-tagged and released, MY 2002.

Table 14. Migration timing summary for hatchery-produced BY 2000 spring Chinook salmon released from Lookingglass Hatchery on 24 September 2001 or captured in the Lookingglass Creek screw trap, PIT-tagged and released, MY 2002.

Group	n	Median Tagging date	Median Arrival Date at Lower Granite Dam	Actual Detections	Expanded Detections
24 Sept 2001	499	[a]	4/30/2002	9	20
Winter	645	10/8/2001	5/3/2002	23	48
Spring	310	3/4/2002	5/3/2002	40	82

a *All fish in this group tagged and released on 9/24/2001*

Table 15. Travel time (TT) in days to Lower Granite Dam summary for hatchery-produced BY 2000 spring Chinook salmon released from Lookingglass Hatchery on 24 September 2001 or captured in the Lookingglass Creek screw trap, PIT-tagged and released, MY 2002.

Group	n	Harmonic $\bar{X}$ TT	SE
24 Sep 2001	499	213.049	5.091
Winter	645	165.654	7.746
Spring	310	50.202	2.304

Table 16. Survival to and capture probabilities at Lower Granite Dam for hatchery-produced BY 2000 spring Chinook salmon released from Lookingglass Hatchery on 24 September 2001 or captured in the Lookingglass Creek screw trap, PIT-tagged and released, MY 2002.

Group	n	Survival	SE	Capture Probability	SE
24 Sep 2001	499	0.0850	0.0184	0.2121	0.0712
Winter	645	0.1359	0.0210	0.2623	0.0563
Spring	310	0.4603	0.0456	0.2733	0.0429

1.5.3.3 Brood Year 2001 Natural-origin

Approximately 20 BY 2001 natural-origin spring Chinook salmon were collected in the screw trap during March and April 2002. These fish were in the 30-40 mm size groups, too small to be PIT-tagged. The performance of this cohort will be described in the 2003 annual report.

1.5.3.4 Brood Year 2001 Hatchery-origin

A total of 17,539 BY 2001 spring Chinook salmon (Catherine Creek stock, captive broodstock progeny), reared at Irrigon Fish Hatchery were released at three sites in Lookingglass Creek between the adult trap and the screw trap on 28 May 2002. Mean FL was 84.2 mm (Table 17). All fish had coded wire tags and adipose clips. Some of these fish emigrated from Lookingglass Creek immediately after release. Performance of this group of fish will be described in the 2003 annual report.

Table 17. FL (mm), weight (g), and K factor summary for hatchery-produced BY 2001 spring Chinook salmon (Catherine Creek stock, captive brood progeny) released in Lookingglass Creek on 28 May 2002.

	Parameter		
Statistic	FL	Wgt	K
Mean	84.2	7.0	1.18
SD	5.0	1.3	0.12
SE	0.3	0.2	0.02
Min	62	4.7	0.87
Max	99	10.8	1.64
n	313	50	50

**Sampled at Irrigon Hatchery on 24 May 2002 (ODFW, unpublished data)*

1.5.3.4.1 Monthly Sampling

Naturally-produced BY 2000 spring Chinook salmon were collected by seining at several locations below Lookingglass Hatchery on 22 June, 26 July, 21 August, and 24 September 2001. Collections of naturally-produced BY 2001 fish in 2002 were made at several locations below the weir on 18 July, 20 August, and 24 September 2002. Mean

FL increased from 67.4-91.0 mm in 2001 and 79.1-100.2 mm in 2002 (Table 18). Mean FL of BY 2001 hatchery-origin fish (from 28 May 2002 release) increased from 94.6-112.2 mm during 2002.

Table 18. Growth of natural- and hatchery-origin juvenile spring Chinook salmon collected by seining from Lookingglass Creek, 2001 and 2002.

Origin	Brood Year	Date	$\bar{X}$ FL	Min-Max	SE	n
Natural	2000	22 June 2001	67.4	46-90	1.4	53
		26 July 2001	79.6	58-93	1.2	53
		21 August 2001	83.4	62-104	0.3	528
		24 September 2001	91.0	73-99	0.7	51
	2001	18 July 2002	79.1	52-95	1.1	60
		20 August 2002	89.5	74-103	0.8	60
		24 September 2002	100.2	88-120	0.7	60
Hatchery	2001	18 July 2002	94.6	83-115	1.5	34
		20 August 2002	101.9	85-114	0.8	60
		24 September 2002	112.2	90-120	0.8	60

1.5.3.4.2 Field Group Comparison

Mean FL of 528 PIT-tagged BY 2000 natural-origin spring Chinook salmon collected by seining on 21 August 2001, PIT-tagged and released in Lookingglass Creek was 83.4 mm (Table 19). Fish from Lookingglass Creek were larger than fish from the three other streams. Modal FL (cm) groups for Lookingglass Creek, Catherine Creek, the Lostine River, and the Minam River were 8, 6, 8, and 6, respectively.

Arrival timing at Lower Granite Dam was similar between the Lostine River and Lookingglass Creek and from 12-16 d earlier than for Catherine Creek and the Minam River (Table 20). Mean travel time to Lower Granite Dam was lowest for Lookingglass Creek (Table 21). Survival rates to Lower Granite Dam were similar for Lookingglass Creek and the Lostine River, and higher than for Catherine Creek and the Minam River (Table 22). Recaptures in the screw trap indicated that most of the Lookingglass Creek field group outmigrated during August-October 2001 (Figure 15).

Table 19. FL (mm) , weight (g) and K factor summary for naturally-produced BY 2000 spring Chinook salmon collected by seining (field groups) from Lookingglass Creek, Lostine River, Catherine Creek and the Minam River, 2001.

Stream	Collection Dates	$\bar{X}$ FL	SE	n	$\bar{X}$ Wgt	SE	n	$\bar{X}$ K	SE	n
Lookingglass Creek	21 August	83.4	0.3	528	6.8	0.1	527	1.14	0.003	527
Catherine Creek	30 Jul-2 Aug	68.5	0.2	501	4.2	0.1	458	1.26	0.007	458
Lostine River	6-9 August	73.2	0.5	501	5.3	0.1	499	1.26	0.004	499
Minam River	Aug 20-Aug 23	63.7	0.2	993	3.0	0.03	932	1.11	0.004	932

Table 20. Migration timing summary for naturally-produced BY 2000 spring Chinook salmon (field groups) collected by seining from Lookingglass Creek, Lostine River, Catherine Creek and the Minam River, PIT-tagged and released, 2001.

Stream	n	Median Arrival Date at Lower Granite Dam	Actual Detections	Expanded Detections
Lookingglass Creek	528	4/20/2002	15	26
Catherine Creek	501	5/6/2002	17	35
Lostine River	501	4/21/2002	23	44
Minam River	996	5/3/2002	30	62

Table 21. Travel time (TT) in days to Lower Granite Dam summary for naturally-produced BY 2000 spring Chinook salmon (field groups) collected by seining from Lookingglass Creek, Lostine River, Catherine Creek and the Minam River, PIT-tagged and released, 2001.

Stream	n	Harmonic $\bar{X}$ TT	SE
Lookingglass Creek	528	245.391	2.454
Catherine Creek	501	277.602	3.121
Lostine River	501	259.429	3.133
Minam River	996	255.293	2.467

Table 22. Survival to and capture probabilities at Lower Granite Dam for naturally-produced BY 2000 spring Chinook salmon (field groups) collected by seining from Lookingglass Creek, Lostine River, Catherine Creek and the Minam River, PIT-tagged and released, 2001.

Stream	n	Survival	SE	Capture Probability	SE
Lookingglass Creek	528	0.1477	0.0275	0.1923	0.0535
Catherine Creek	501	0.1092	0.0185	0.3095	0.0713
Lostine River	501	0.1544	0.0219	0.2973	0.0593
Minam River	996	0.0944	0.0114	0.3190	0.0529

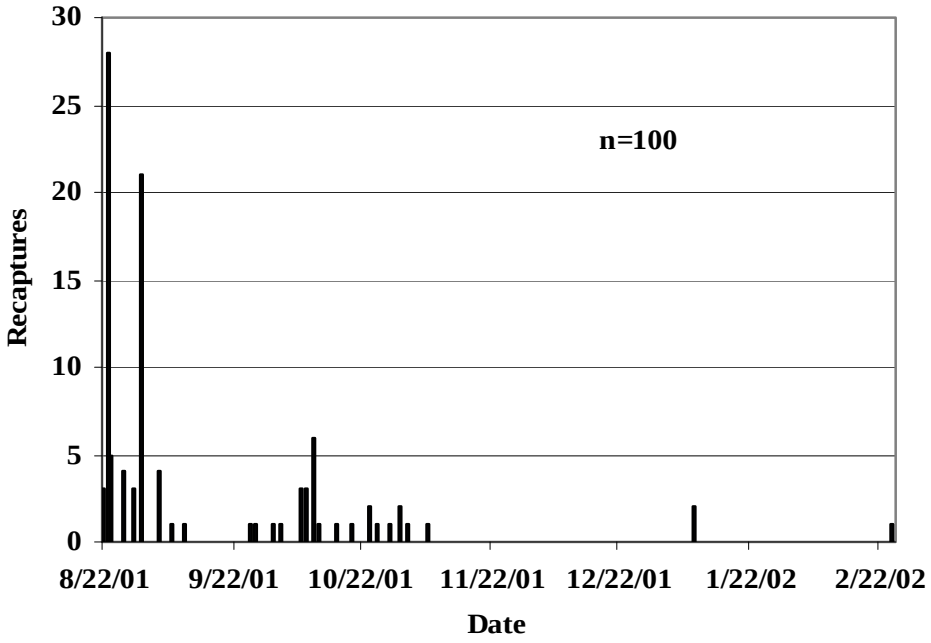

Figure 15. Screw trap recaptures during 2001-2002 of natural-origin spring Chinook salmon PIT-tagged and released in Lookingglass Creek on 21 August 2001 (field group).

1.6 Discussion

Water temperatures at the USGS gauging station during 2002 showed a pattern similar to previous years. Maximum temperatures approached 20°C for only a brief period in early August. Maximum temperatures at the sites between Lost Creek and Summer Creek and near the mouth of Eagle Creek remained below 18°C during the warmest months of the summer. Maximum water temperatures in Mottet Creek exceeded 20°C for a brief period in early July, probably due to the combination of low flow and less shading than many areas of Lookingglass Creek.

Spring flows are primarily driven by snow melt at higher elevations in the watershed. Low flows are sustained in late summer, fall and winter by springs and rainfall. Stream flows in 2002 showed a typical pattern of spring freshet followed by rapid decline to low levels throughout most of the summer and fall. Observations during field work indicated none of the major tributaries (Little Lookingglass Creek, Mottet Creek, Eagle Creek, Jarboe Creek, Summer Creek) ceased flow during the summer.

The 63 trapped adult spring Chinook salmon returning to Lookingglass Creek and 18 redds observed were lower than many past years, reflecting both the phasing out of the Rapid River stock used for reintroduction, as well as low SAR for two of the five CWT groups of hatchery fish released in 1999. In contrast, the count of spring Chinook salmon (hatchery and natural) at Lower Granite Dam in 2002 was more than double the 10-year average (DeHart 2003). Adult escapement in 2002 for three other tributaries in the subbasin ranged from 71-884, and redd counts from six other tributaries ranged from 14

to 211 (ODFW, unpublished data).

Carcass recoveries in 2002 included two hatchery-origin fish released from the Catherine Creek acclimation facility. Water quality conditions in other tributaries in the subbasin may influence the number of unmarked strays spawning in Lookingglass Creek, since the spring-fed nature of the stream allows for relatively consistent water volume and cool water temperatures.

An unknown number of fish were harvested by tribal fishers in 2002 as a creel survey was not conducted. Few were harvested in a limited sport fishery (ODFW, unpublished data). Accurate estimation of the numbers of adult spring Chinook returning to spawn in Lookingglass Creek in was impossible, since an unknown number of fish migrated into the stream without being trapped and marked. Accurate estimation of returning adults spawning below the hatchery weir will depend on our ability to account for fish harvest and untrapped escapement.

Survival of the various PIT tag groups of BY 2000 spring Chinook salmon released in Lookingglass Creek showed a pattern commonly observed in other streams in the basin, i.e. higher survival for fish PIT-tagged and released closer to the outmigration time). Median arrival dates at Lower Granite Dam were 9-20 d earlier for the 4 groups of naturally-produced spring Chinook from Lookingglass Creek than for the overall median of age 1 Chinook (DeHart 2003). Median arrival dates for hatchery-origin spring Chinook from Lookingglass Creek were only 2-5 d earlier.

Production of BY 2000 natural-origin spring Chinook salmon from Lookingglass Creek came from 86 redds (246 smolts/redd). Data from Burck (1993) for the native Lookingglass Creek stock showed smolts/redd ranging from 230-493 (mean =346).

The estimated number of outmigrating hatchery–origin BY 2000 spring Chinook from 24 September 2001-22 April 2002 was 72% of the estimated total released. While most fish left the stream soon after release from Lookingglass Hatchery, some died from the stress of forceout, and some remained in the stream, experiencing some degree of mortality over the winter and spring.

Fish leaving tributary streams in the fall have a greater exposure to predators if they move to larger water and hold there until spring. Water quality (temperature, flow) in the Snake and Columbia Rivers was extremely poor during the summer of 2001 (DeHart 2002). These conditions persisted into the fall of 2001, and probably affected survival. Spring rather than fall release of hatchery-origin spring Chinook salmon juveniles is the normal practice to afford better survival.

A comprehensive report should be completed covering the years when the Rapid River stock was used to reintroduce spring Chinook salmon into Lookingglass Creek. This should include comparisons, when appropriate, between data collected and summarized by Burck (1993) for the endemic stock.

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1.8 Acknowledgements

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2 SECTION II. *Oncorhynchus mykiss* Investigations in Lookingglass Creek and Other Grande Ronde River Tributaries

2.1 Abstract

We collected 258 wild (104 males, 154 females) and 3 hatchery (AD-clipped) adult summer steelhead (*Oncorhynchus mykiss*) at the Lookingglass Hatchery water intake trap from 23 March-12 June 2002. Scale age composition of males was 79% 1-salt and 21%

2-salt. Age composition of females was 62% 1 salt and 38% 2 salt.

We obtained and preserved 79 genetics samples from juvenile *O. mykiss* sampled from Lookingglass Creek. We estimated 67,275 (+/-25,364) outmigrants left Lookingglass Creek during 2002. Capture probabilities ranged from 0.01-0.136. Modal length groups were 15 cm (April), 14 cm (Sept-Oct), 9 cm (July), and 8 cm (June).

Mean FL, weight, and K factor for 1,072 fish PIT-tagged and released from 6/12/2001-12/31/2001 (late 2001 group) were 130.6 mm, 29.2 g, and 1.04, respectively. Median arrival date at Lower Granite Dam was 6 May 2002. Harmonic mean travel time to Lower Granite Dam was 201 d. Survival to Lower Granite Dam was 0.1825. FL (cm) distributions of fish PIT-tagged and released and subsequently detected in the hydropower system were similar.

Mean FL, weight, and K factor for 461 fish PIT-tagged and released from 1/1/2002-6/13/2002 (early 2002 group) were 134.7 mm, 30.9 g, and 1.04, respectively. Median arrival date at Lower Granite Dam was 3 May 2002. Harmonic mean travel time to Lower Granite Dam was 16 d. Survival to Lower Granite Dam was 0.3688. The FL (cm) distribution of fish PIT-tagged and released was shifted more towards smaller fish than those subsequently detected in the hydropower system.

The number of summer steelhead adults trapped in 2002 was considerably higher than previous years. The estimated number of outmigrating juvenile *O. mykiss* was 1.7 times the estimate for 2001. In several aspects of both adult and juvenile life history, the Lookingglass Creek population was similar to others in the Snake River basin.

2.2 Introduction

Many anadromous salmonid stocks in the Snake River Basin have declined to the point of extinction (Nehlsen et al. 1991). Principal factors in the declines of anadromous salmonid populations are construction and operation of hydroelectric facilities, overfishing, and the loss and degradation of critical spawning and rearing habitat in the Columbia and Snake River basins (Nehlsen et al. 1991). Similar conditions exist in the Grande Ronde River Basin (U. S. Army Engineer District 1975). 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 (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 lowest four Snake River dams. 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. Harvest augmentation in the Grande Ronde River using (non-endemic) Wallowa Hatchery stock has occurred since the early 1980's and consumptive recreational harvest was reopened in 1986 (Flesher et al. 2004). Comanagers discontinued off-station releases of Wallowa Hatchery stock summer steelhead into Catherine Creek in 1998 and the upper Grande

Ronde River in 1999. This followed a recommendation by NMFS after evidence of high stray rates appeared.

Few data exist on adult return numbers and the genetic structure of adult summer steelhead that return to tributaries of the Grande Ronde River Basin. High spring flows make maintaining weirs in streams to capture adult steelhead very difficult. Burck (unpublished data, summarized by McLean et al. 2001) tabulated the number of summer steelhead adults returning to Lookingglass Creek from 1965-1974. Adult trap counts at the LH weir have been compiled since 1997, although trap installation dates have varied. The Lookingglass Creek summer steelhead population is significant because it appears to be doing well in relatively undisturbed habitat with little influence from hatchery fish.

Some studies have described life history of juvenile *O. mykiss* in the Grande Ronde River Basin (e.g. Van Dyke et al. 2001, Reischauer et al. 2003). We have captured juvenile *O. mykiss* in the screw trap since trapping began in October 1993; we began PIT-tagging juvenile *O. mykiss* during the spring of 1999 to investigate their migration timing and survival through the Columbia River hydrosystem.

2.3 Methods

2.3.1 Adult Summer Steelhead Returns

The LH adult trap is usually installed to capture adult spring Chinook salmon. In 2002 the trap and weir were installed earlier than normal in order to collect adult summer steelhead passing the weir site. A picket weir diverted returning fish into the 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), sexed, and opercle punched for identification. Age determinations were made using scales (Mosher 1969). Week of capture was designated by the first day of the week (e.g. week of 1 January included 1-7 January). Any AD-clipped fish were euthanized and removed from the stream. Wild (unmarked) fish were transported about 0.5 mi upstream and released. Tissues removed (opercle punches) were preserved in either 70% isopropanol or 95% ethanol and archived at the La Grande office for future analysis.

Adult steelhead count information for Lower Granite Dam was obtained from Columbia River DART (Data Access in Real Time, http://www.cqs.washington.edu/dart/dart.html).

2.3.2 Genetic Monitoring (Juveniles)

Comanagers saw the need for genetics data to properly manage summer steelhead in northeast Oregon. They planned collections for Grande Ronde and Imnaha River basin juvenile *O. mykiss* populations during 1999-2002. Basins were divided into 17 different units with one major tributary in each unit selected for sample collection (Figures 1, 2). The NPT collected samples from the Imnaha River basin and ODFW and CTUIR cooperatively sampled the Grande Ronde River basin. Up to 100 samples were collected

from each tributary during mid-July. We directed our sampling towards smaller fish, < 100 mm (age 0+), to ensure that most of the juveniles were progeny of adult *O. mykiss* spawning the previous spring. We used a Smith-Root electro-fisher (smooth or continuous DC, 400-600 volts) to collect fish. Fish were anaesthetized with a 40-60 mg/l dose of MS-222 (tricaine methanesulfonate). A 1-2 mm diameter section of caudal or anal fin was removed using scissors and placed in a vial of 95% ethanol for storage. Fish were measured (mm, FL), allowed to recover in fresh water, and released near the area of capture. We attempted to sample a large portion of the rearing habitat available to the juvenile *O. mykiss* within each tributary. Some tributaries could not be sampled because of dewatering or inaccessibility. We selected sampling areas that were currently accessible and would remain so in the future (e.g. road crossings on federal land). Depending on the length of the stream that was accessible, we also tried to distribute the sample sites evenly along the stream (every 1.0 or 0.5 miles).

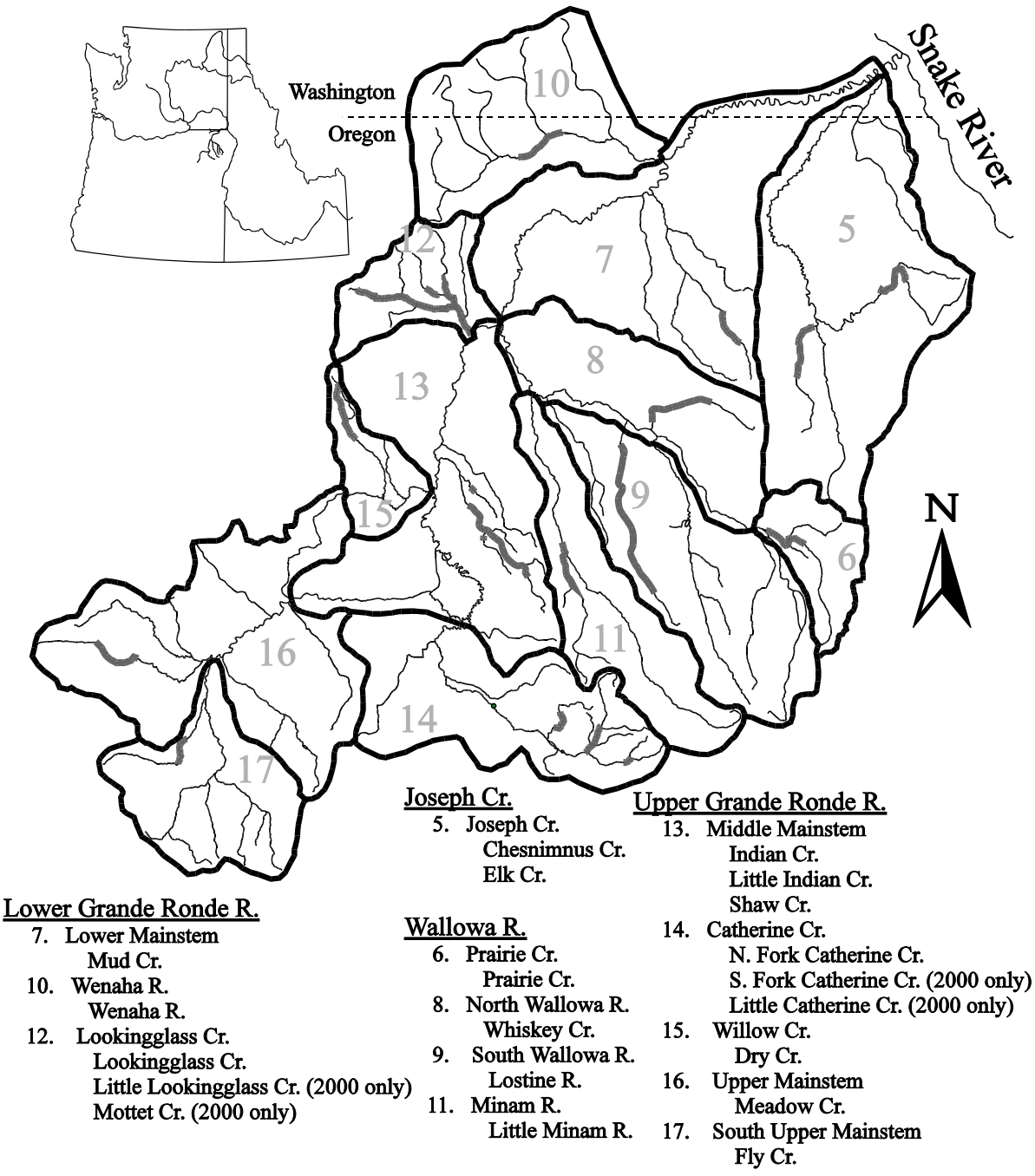

Figure 1. Map of the Grande Ronde River basin showing the 13 management units. Shaded areas on tributaries within each management unit indicates the juvenile *O. mykiss* sample area range.

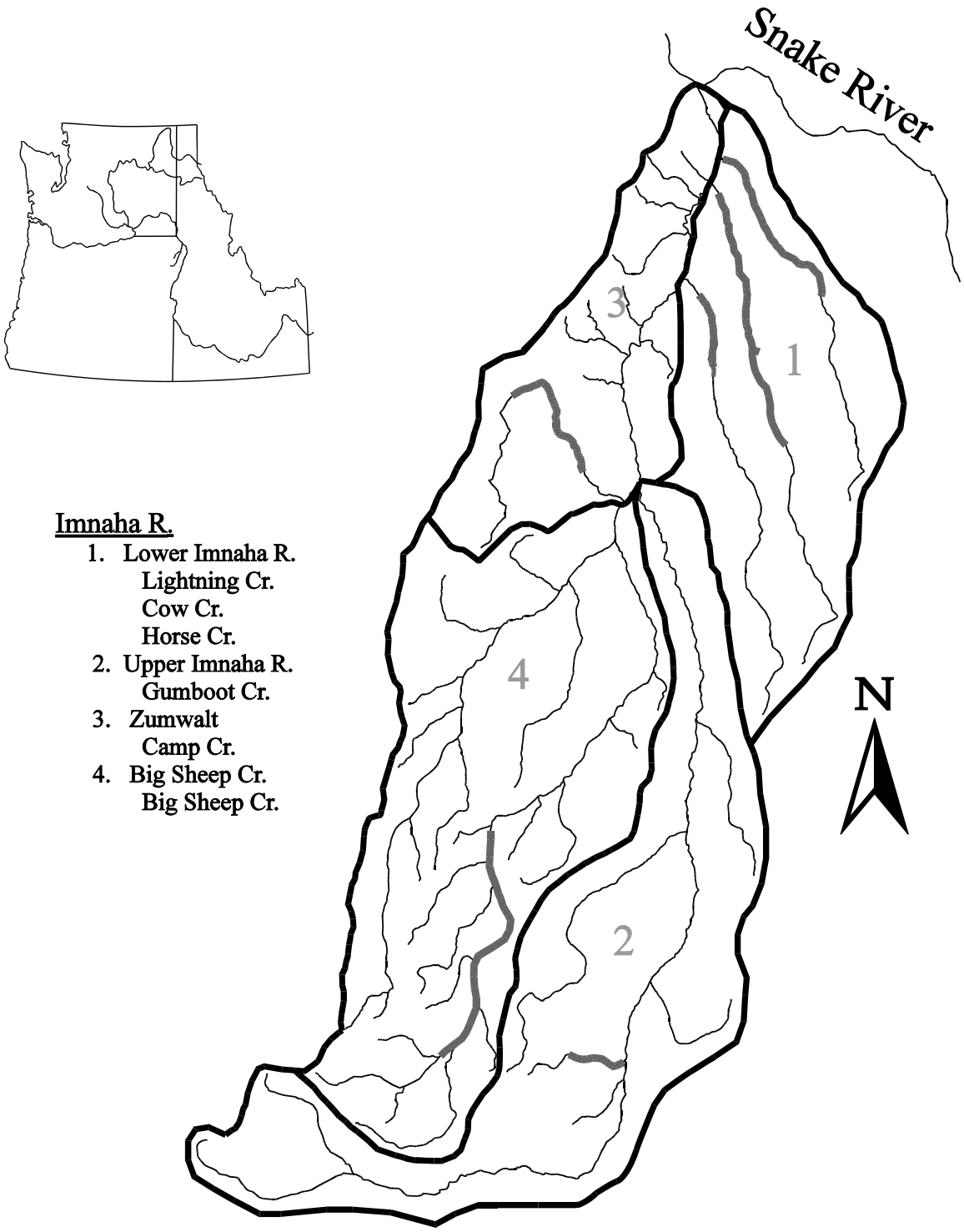

Figure 2. Map of the Imnaha River basin showing the 4 management units. Shaded areas on tributaries within each management unit indicates the juvenile *O. mykiss* sample area range.

2.3.3 Outmigrant Sampling

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 2002 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 to the nearest mm FL, and weighed to the nearest 0.1 g). Fish >50 mm FL, in good condition (no injuries or obvious disease) and not recaptures 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 stratified mark-recapture data and pools strata if necessary to derive capture probabilities for a given time period. We used the one trap and no prior pooling of strata options.

O. mykiss juveniles leave 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 and are not detected at Lower Granite Dam until the following spring. Spring outmigrants move directly downstream and are detected soon after at Lower Granite Dam. For comparisons of FL, weight, K factor, arrival timing, travel time, and survival, outmigrants were placed into two groups "late 2001" and "early 2002". We used data collected by McLean and Seeger (2001) during calendar year 2001 to describe the late 2001 group of outmigrants. The date of PIT-tagging (in 2001) for the last detection in the hydrosystem in 2001 was used as the separation point for the late 2001 group; all fish PIT-tagged after that date were placed in the late 2001 group. Similarly, the date of PIT-tagging (in 2002) for the last detection in the hydrosystem in 2002 was used as the separation date for the early 2002 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/ and using PitPro software (Westhagen and Skalski 2006). When using PitPro, we excluded the *.rcp file, and used observation sites, in downstream order, of 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 to estimate survival.

Daily PIT tag detections at Lower Granite Dam 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]. Distributions of arrival timing at Lower Granite Dam for each group were made using the expanded daily detections as a percentage of the total expanded number of fish for that group.

2.4 Results

2.4.1 Adult Summer Steelhead Returns

The weir and trap were installed on 21 March 2002. The first adult summer steelhead was captured on 23 March 2002 and the last on 12 June 2002 (Figure 3). The trap was closed from 13-16 April 2002 due to high flows. We captured 258 unmarked (wild) and 3 AD-clipped (hatchery-origin) summer steelhead. After the week of 2 April, females made up at least 50% of the catch. Overall, females comprised 59.7% of the total catch. Males ranged from 406-774 mm, and the length frequency distribution suggested bimodality (Figure 4). Females ranged from 535-814 mm, and the length frequency distribution was more clearly bimodal, with peaks at 61 and 70 cm (Figure 5). One female was not measured. Previously punched fish (fish that had been released upstream, then dropped back over the weir and were attempting to reascend) were caught from 19 April-4 June 2002 and totaled 41 (26 males, 15 females).

We collected scales from all 258 unmarked fish. We were able to age 85 of 104 males (81.7%) and 127 of 154 females (82.5%). The age composition of males was 79% 1-salt and 21% 2-salt. Age composition of females was 62% 1-salt and 38% 2-salt. Mean FL by sex for both age groups differed by less than 1 mm (Table 1).

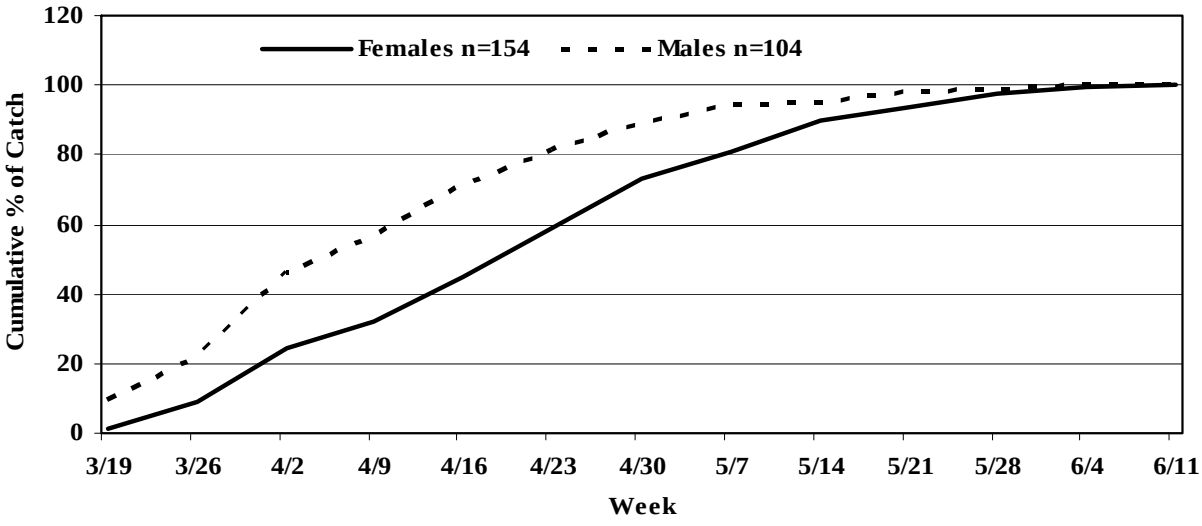

Figure 3. Cumulative percentages of total catch by week for male and female summer steelhead at the Lookingglass Hatchery trap, 2002.

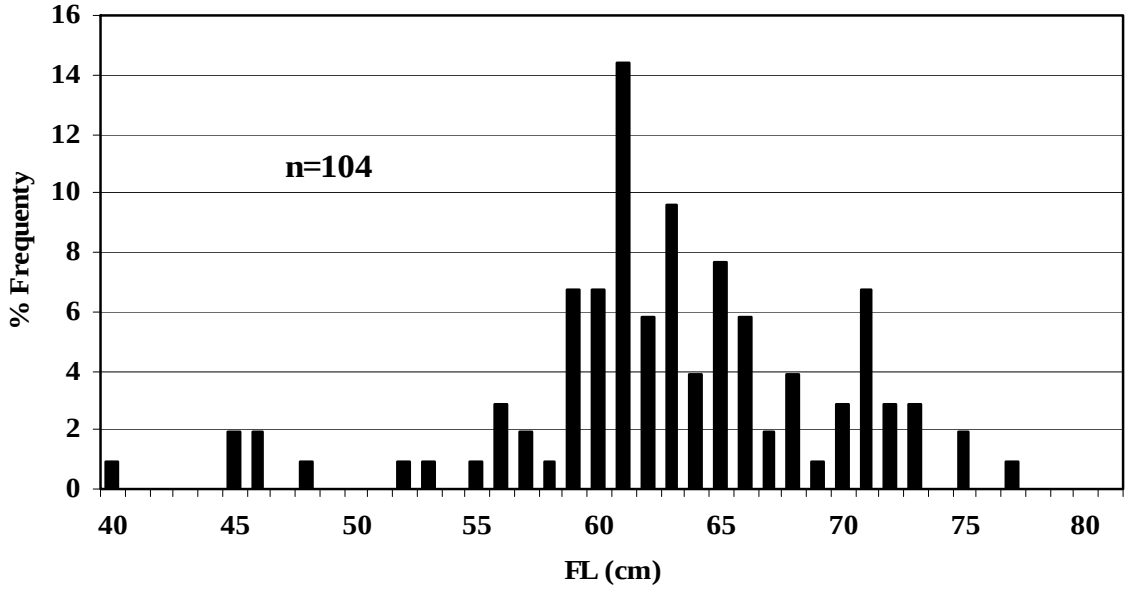

Figure 4. FL frequency of male summer steelhead caught in the Lookingglass Hatchery trap, 2002.

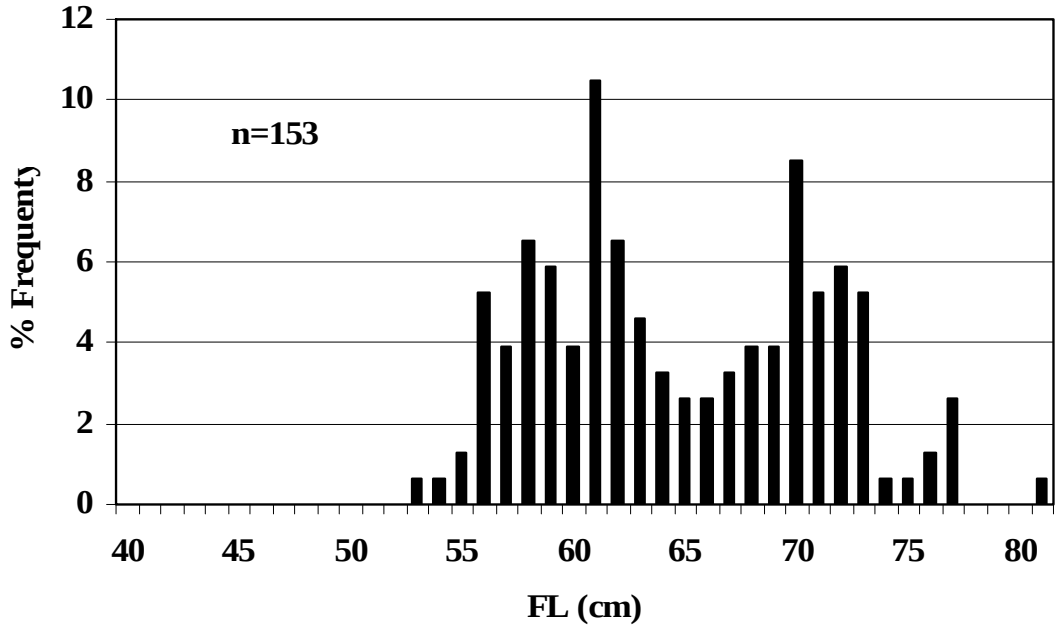

Figure 5. FL frequency of female summer steelhead caught in the Lookingglass Hatchery trap, 2002 (one fish was not measured).

We collected tissue samples from all 258 unmarked adult summer steelhead trapped in 2002. Tissues were immediately placed in vials with 2 ml of 90% ethanol. Tissues are being retained at our research office in La Grande, Oregon for future analysis.

Table 1. FL (mm) summary for summer steelhead caught in the Lookingglass Hathcery trap and aged using scales, 2002.

Sex	Age	$\bar{X}$ FL	SD	SE	Min-Max	n
Male						
	1-salt	613.4	60.4	7.4	406-736	67
	2-salt	717.8	28.4	6.7	656-814	18
Female						
	1-salt	613.4	39.9	4.5	535-723	79
	2-salt	716.9	31.4	4.5	661-814	48

2.4.2 Genetics Monitoring (Juveniles)

Co-managers in 2002 sampled 69-97 juvenile *O. mykiss* from the sample streams in each proposed management unit of the Grande Ronde and Imnaha River basins. Samples were collected from 23 July-26 August 2002 with most collected the first 2 weeks of August. Size range of the fish collected was 21-87 mm FL; median FL ranged from 33-57 mm (Table 2).

Table 2. Management unit, stream, FL (mm) data and collection dates for tissue sampling of juvenile *O. mykiss*, 2002.

		FL (mm)			
Management Unit[a]	Stream	N[b]	Range	Median	Collection Dates
Grande Ronde R.					
5	Chesnimnus Cr.[c]	97	27 - 54	38	25-Jul
5	Elk Cr.[c]	92	36 - 87	44	26-Jul
6	Prairie Cr.	80(79)	33 - 75	57	9-Aug
7	Mud Cr.	69	39 - 69	50	1-Aug
8	Whiskey Cr.	79	38 - 69	53	2-Aug
9	Lostine R.	77(76)	26 - 67	42	15,19,21-Aug
10	Wenaha R.	80	27 - 63	41	20-Aug
11	Little Minam R.	80	27 - 72	35	13-Aug
12	Lookingglass Cr.	79	27 - 64	37	7-Aug
13	Indian Cr.	76	27 - 57	38	5-Aug
14	Catherine Cr.	80	21 - 65	46	26-Aug
15	Dry Cr.	79	24 - 53	41	6-Aug
16	Meadow Cr.	80	23 - 45	57	7-Aug
17	Fly Cr.	77	32 - 69	50	6-Aug
Imnaha R.[c]					
1	Lightning Cr.	95	26 - 63	38	31-Jul, 1-Aug
1	Horse Cr.	97	28 - 58	44	31-Jul
1	Cow Cr.	79	30 - 62	50	8-Aug
2	Gumboot Cr.	91	25 - 49	33	24-Jul
3	Camp Cr.	72	34 - 69	57	23-Jul
4	Big Sheep Cr.	74	33 - 75	50	30-Jul, 16-Aug

[a] *The map units are from Figures 1 and 2.*

[b] *N is number of fish collected; numbers of fish measured is the same, except for those in parentheses.*

[c] *Nez Perce Tribe staff sampled Imnaha River tributaries and Chesnimus Creek and Elk Creek from map unit 5 in the Grande Ronde Basin.*

2.4.3 Outmigrant Sampling

The total estimate of *O. mykiss* outmigrants was 67,275 (+/- 25,364) (Table 3). DARR 2.0 reduced the original 12 time periods to 3. The small number of recaptures limited the number of separate capture probabilities (trap efficiencies) used to estimate outmigrants and also resulted in broad confidence limits. Seven recaptures were not used to estimate capture probabilities: Two were fish tagged and released in the Lostine River earlier in 2002, and five were recaptures of fish tagged and released in 2001. Recaptures ranged from 85-232 mm; 22 of 30 (73%) were 119-184 mm. All but 2 of 30 recaptures were caught 4 days or less after release. The estimate was 59,125 (+/- 22,123) if only fish ≥ 80 mm FL were used

Table 3. *O. mykiss* captured in the Lookingglass Creek screw trap, trap efficiency releases and recaptures, estimated outmigrants, and standard errors, Lookingglass Creek, 2002.

Period	u	m	r	Cp	N	SE
1/1-2/28*	71	59	8	0.136	524	171
3/1-9/30*	642	599	7	0.01	62,281	25,357
10/1-12/31*	264	254	15	0.059	4,470	1, 118
Totals	977	912	30		67,275	25,364

**Pooled time periods*

u=newly caught, unmarked fish (includes fish not marked and released above the trap)

m=newly marked and released below the trap (includes a few fish inadvertently released below the trap)

Cp=capture probability (trap efficiency)

N=outmigration estimate

SE=standard error(variance$^{0.5}$)

The model FL group of fish caught in April was 15 cm, and 14 cm in Sept-Oct (Figure 6). Modal FL groups of fish caught during June (8 cm) and July (9 cm) were much smaller (Figure 7). Mean FL, weight and K factor for first-time captures showed considerable variation (Table 4). Data summarized in Figures 6 and 7 and Table 4 excludes mortalities and recaptures.

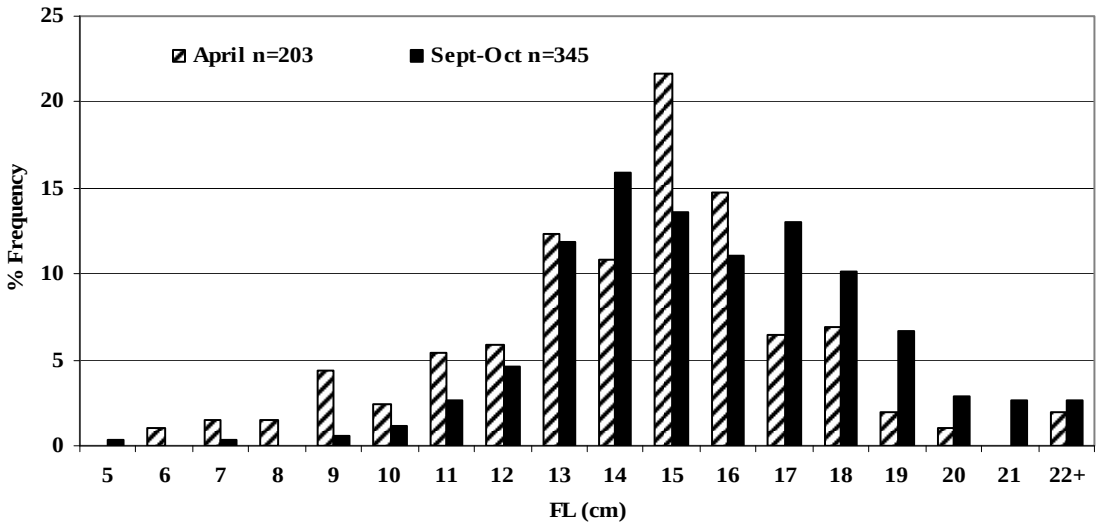

Figure 6. Percent frequency by FL group of *O. mykiss* caught in the Lookingglass Creek screw trap during April and September-October 2002.

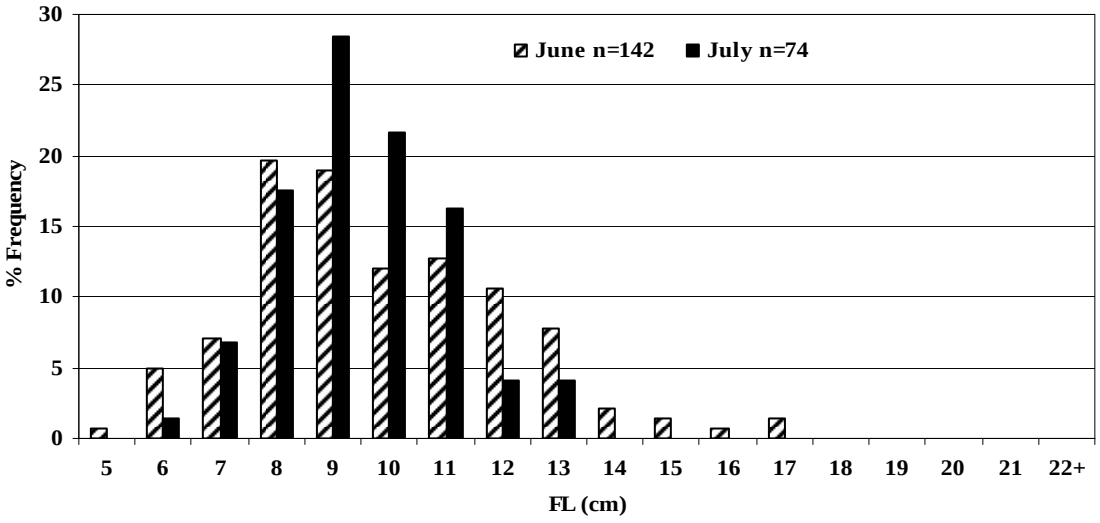

Figure 7. Percent frequency by FL group of *O. mykiss* caught in the Lookingglass Creek screw trap during June and July, 2002.

Table 4. FL (mm), weight (g), and K factor summary by week for *O. mykiss* caught in the Lookingglass Creek screw trap, 2002.

	Month										
Statistic	January	February	March	April	May	June	July	September	October	November	December
$\bar{X}$ FL	116.3	146.1	147.6	148.3	123.6	103.3	99.1	163.4	160.4	179.0	190.3
SD	50.8	40.5	37.0	30.7	42.0	22.9	14.7	25.8	30.1	31.1	21.6
SE	9.0	6.9	5.2	2.1	6.2	1.9	1.7	2.6	1.9	22.0	8.8
Min	45	57	76	68	64	53	66	78	54	157	164
Max	270	250	236	262	234	177	136	217	305	201	219
n	32	34	50	203	46	142	74	95	250	2	6
$\bar{X}$ Wgt	26.7	38.1	39.4	36.3	23.9	14.3	11.0	47.3	46.8	59.5	76.6
SD	35.8	37.1	30.8	23.2	21.9	9.4	4.8	21.4	31.3	21.8	20.3
SE	6.4	6.3	4.3	1.5	3.5	0.8	0.6	2.2	2.0	15.4	7.9
Min	1.0	2.8	5.0	3.3	2.2	3.2	4.3	4.7	2.1	44.1	59.9
Max	162.2	174.9	132.7	189.2	112.1	55.3	27.2	105	302.8	74.9	105.9
n	31	33	50	203	44	137	74	90	250	2	4
$\bar{X}$ K	1.11	1.01	1.04	1.00	0.98	1.17	1. 09	1.00	1.02	1.03	1.08
SD	0.26	0.13	0.07	0.11	0.20	0.24	0.17	0.07	0.16	0.15	0.06
SE	0.05	0.02	0.01	0.01	0.03	0.02	0.02	0.01	0.01	0.11	0.02
Min	0.82	0.86	0.92	0.75	0.39	0.47	0.48	0.77	0.57	0.92	1.01
Max	1.91	1.51	1.21	2.02	1.55	2.10	1.50	1.17	3.16	1.14	1.16
n	31	33	50	203	44	137	74	90	250	2	4

The highest numbers of fish were tagged in April and October (Figure 8). Mean FL, weight, and K factor varied only slightly between the late 2001 and early 2002 tag groups (Table 5, 6). Median tagging dates were 10/11/2001 (late 2001 group) and 4/8/2002 (early 2002 group). Median arrival timing at Lower Granite Dam differed by only 3 d between the two groups (Table 7). Harmonic mean travel times to Lower Granite Dam differed by 185 d (Table 8). Survival to Lower Granite Dam for the early 2002 group was about double that of the late 2001 group (Table 9). The size frequencies of fish tagged and later detected in the hydropower system were roughly similar for the late 2001 group (Figure 9), but detections were skewed towards larger fish for the early 2002 group (Figure 10).

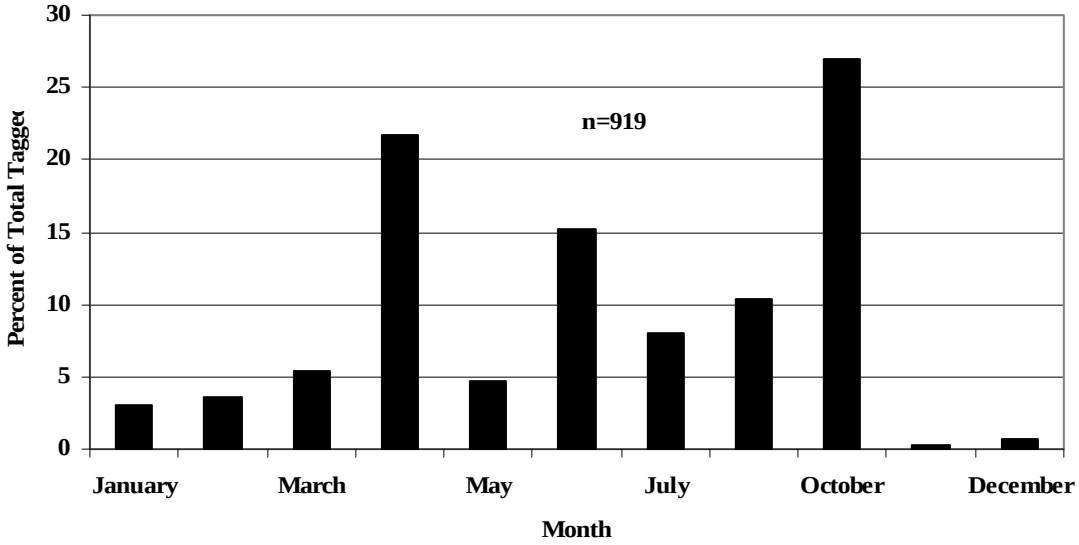

Figure 8. Percentages of *O. mykiss* PIT-tagged and released in Lookingglass Creek by month, 2002.

Table 5. FL (mm), weight (g), and K factor summary for *O. mykiss* caught in the Lookingglass Creek screw trap, PIT-tagged, and released, fall 2001.

	Parameter		
Statistic	FL	Wgt	K
Mean	130.6	29.2	1.04
SD	37.5	28.3	0.09
SE	1.1	0.9	0.003
Min	48	1.7	0.81
Max	326	374.7	1.63
n	1,072	1,071	1,071

Table 6. FL (mm), weight (g), and K factor summary for *O. mykiss* caught in the Lookingglass Creek screw trap, PIT-tagged, and released, spring 2002.

	Parameter		
Statistic	FL	Wgt	K
Mean	134.7	30.9	1.04
SD	37.6	25.9	0.15
SE	1.8	1.2	0.007
Min	53	2.2	0.61
Max	270	189.2	2.10
n	458	438	438

Table 7. Migration timing summary for *O. mykiss* outmigrants caught in the Lookingglass Creek screw trap, PIT-tagged and released, 2001-2002.

Tagging Period	n	Median Arrival Date at Lower Granite Dam	Actual Detections	Expanded Detections
6/12/2001-12/31-2001	1,072	5/6/2002	69	119
1/1/2002-6/13/2002	461	5/3/2002	50	95

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, 2001-2002

Tagging Period	n	Harmonic $\bar{X}$ TT	SE
6/12/2001-12/31-2001	1,072	200.807	5.091
1/1/2002-6/13/2002	461	15.564	1.901

Table 9. Survival to and capture probabilities at Lower Granite Dam for *O. mykiss* outmigrants caught in the Lookingglass Creek screw trap, PIT-tagged and released, 2001-2002.

Tagging Period	n	Survival	SE	Capture Probability	SE
6/12/2001-12/31-2001	1,072	0.1825	0.0164	0.3527	0.0406
1/1/2002-6/13/2002	461	0.3688	0.0438	0.2941	0.0460

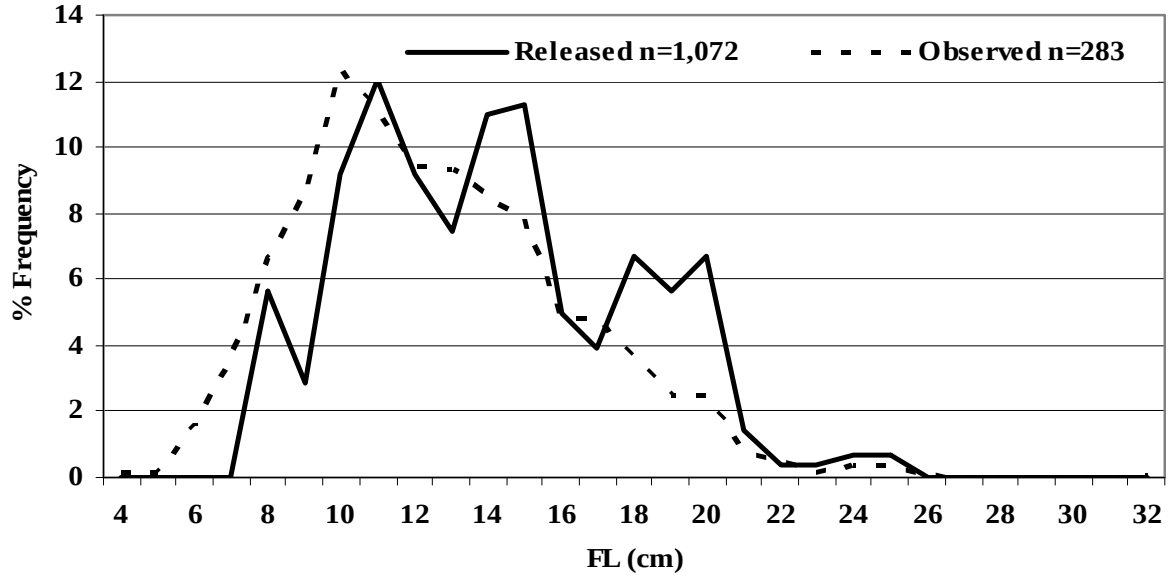

Figure 9. Percentages of *O. mykiss* PIT-tagged and released in Lookingglass Creek from 6/12/2001-12/31/2001 and observations in the hydropower system by FL (cm) group during 2002.

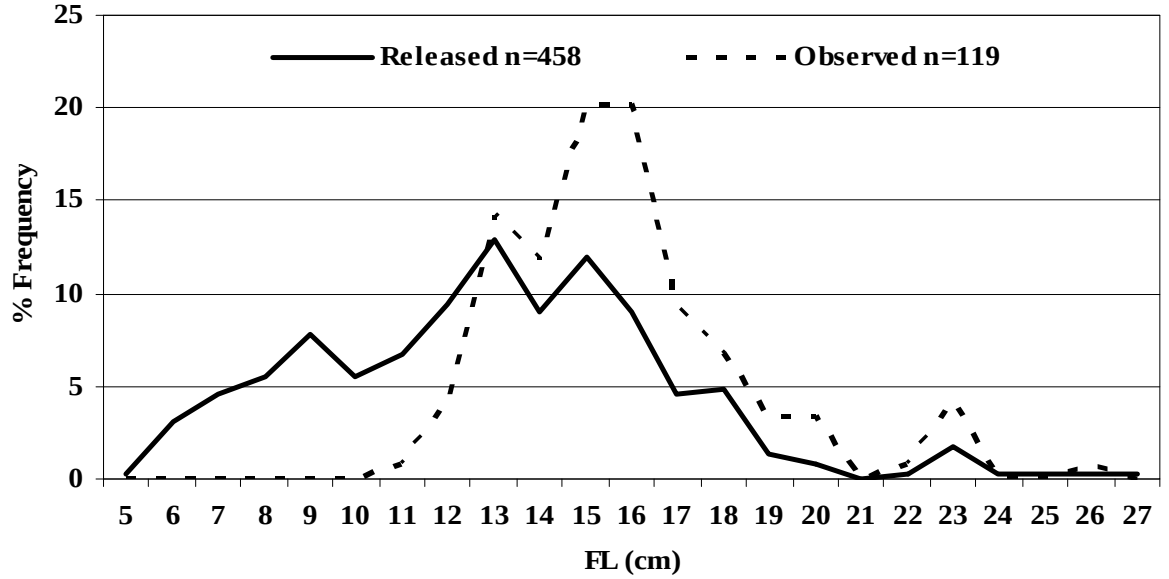

Figure 10. Percentages of *O. mykiss* PIT-tagged and released in Lookingglass Creek from 1/1/2002-6/13/2002 and observations in the hydropower system by FL (cm) group during 2002.

2.5 Discussion

A substantial increase in returns of adult summer steelhead escapement to Lookingglass Creek appears to have occurred over the last 10-15 years. The number of adult summer steelhead collected in 2002 was more than double the highest previous total from 15 years of data. Trap catches were 120 in 1971 (McLean et al. 2001) and 114 in 2001 (McLean et al. 2002). The start date of trapping has varied and for two years was unknown, so catches in years with longer trapping periods may have been higher. A substantial increase in wild (unmarked) summer steelhead has also occurred at Lower Granite Dam. The number counted in 2001 was 47,716, compared to a range of 7,630-11,965 from 1993-1999 (http://www.cbr.washington.edu/dart/river.html accessed July 2004). The count went up to 20,587 in 2000.

Most returning Grande Ronde River summer steelhead enter freshwater during August through October, with some the following spring. Movement into the smaller tributaries occurs in the spring (Howell et al. 1985). Unpublished data for the years 1964-1974 collected by Burck (unpublished) showed peak arrivals of summer steelhead during May or June. Fish were collected the weeks of 8 April-27 May during 2001, but the trap was not opened until 6 April; some fish probably moved past the trap before installation. Arrival timing at the Catherine Creek trap in 2002 was similar to that of Lookingglass Creek, but arrivals at the upper Grande Ronde River trap began about a month later (McLean et al. 2003). The upper Grande Ronde River trap was not installed until 22 April 2002 and probably missed part of the run.

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 (McLean et al. 2003). Adult Snake River summer steelhead are usually 1-salt fish (IDFG 1994 cited in Busby et al. 1996).

The raw catches of juvenile *O. mykiss* varied from 485-2,620 from 1994-2001 (McLean et al. 2001). The expanded estimate of juvenile *O. mykiss* outmigrants in 2002, was 1.7 times the 2001 estimate reported by McLean et al. (2002), although the confidence limits for the 2002 estimate were broad. Mullarkey (1971) reported annual outmigrants of 6,907-11,863 (mean 9,756) from Lookingglass Creek. Outmigrant estimates ranged from 4,167-22,310 for Catherine Creek, the upper Grande Ronde River, and the Lostine River during migration years 1997-1999 (Van Dyke et al. 2001). Peak migration periods for Lookingglass Creek occurred in the spring and fall, similar to results from McLean et al. (2002), Van Dyke et al. (2001), and Reischauer et al. (2003).

Capture probabilities (analogous to trap efficiencies) were somewhat lower than previously reported for Lookingglass Creek and other streams. McLean et al. (2002) reported trap efficiencies of 0.0189-0.1435 in 2001 and the overall trap efficiency (total recaptures/total marks released) was 0.083. Trap efficiencies ranging from 0.041-0.507 were reported for Catherine Creek, the Lostine River, and the upper Grande Ronde River (Van Dyke et al. 2001, Reischauer et al. 2003). Mean trap efficiency for steelhead in the Tucannon River was 12.87% (Cheng and Gallinat 2004).

The size distributions observed in 2002 were similar to those previously reported for Lookingglass Creek (McLean et al. 2001, McLean et al. 2002), and indicated the presence of several age groups of outmigrants. Outmigrants during January-June > approximately 120 mm FL were probably outmigrating to the ocean; smaller fish remained to rear above Lower Granite Dam, in the Lower Grande Ronde, or other areas for at least another year in fresh water. Spring 2002 outmigrants probably headed rapidly to the sea. Fall 2002 outmigrants probably moved downstream to overwinter in the Grande Ronde River or further downstream. Some fraction of the larger fish (> 225 mm FL) probably remained in fresh water to mature as resident rainbow trout. Most juvenile steelhead spend two to three years in freshwater before migrating to the ocean (Burgner et al. 1992). Fall outmigrants from the Lostine River, Catherine Creek and the upper Grande Ronde River usually showed two distinct modes, corresponding to age 0+ and 1+ fish (Van Dyke et al. 2001).

Median arrival dates at Lower Granite Dam in 2002 for the late 2001 and early 2002 tag groups were 6-9 d earlier than the overall median arrival date for steelhead smolts (DeHart 2003). Survival to Lower Granite Dam for late 2001 and early 2002 tag groups were both considerably lower than the range of rates reported for wild steelhead outmigrants from the Imnaha River (0.7584-0.8987) during the spring of 2002 (DeHart 2003). Distance from the Imnaha River trap to Lower Granite Dam is approximately 88 mi, compared to 146 mi for the Lookingglass Creek trap.

The recapture of two juvenile *O. mykiss* in the fall of 2002 in Lookingglass Creek that had been PIT-tagged and released earlier in 2002 at the Lostine River trap was noteworthy. Apparently some movement of juveniles occurs between streams.

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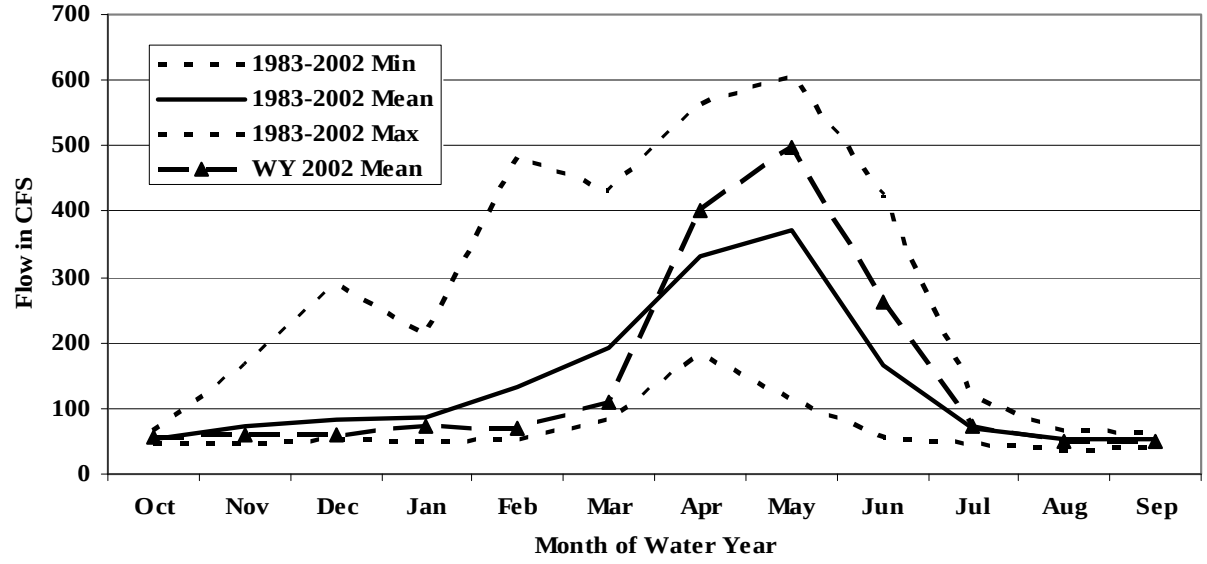
3 SECTION III. Assistance Provided to LSRCP Cooperators and Other Projects

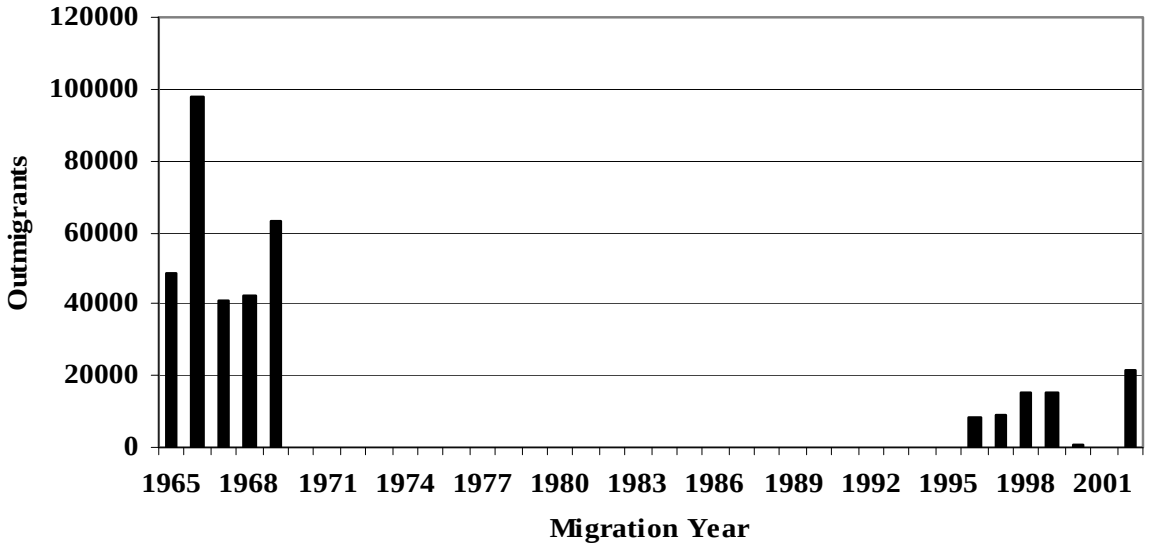
We provided assistance to ODFW in 2002 for ongoing hatchery evaluation research. Project personnel completed extensive spawning ground surveys for spring Chinook salmon in the Grande Ronde and Imnaha River basins. We provided assistance in pre-release sampling of spring Chinook salmon at LH. In addition, project personnel provided assistance in sampling adult spring Chinook salmon at Oregon LSRCP facilities and helped with the release of juvenile spring Chinook salmon 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. 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. We PIT-tagged and released bull trout captured in our rotary screw trap.

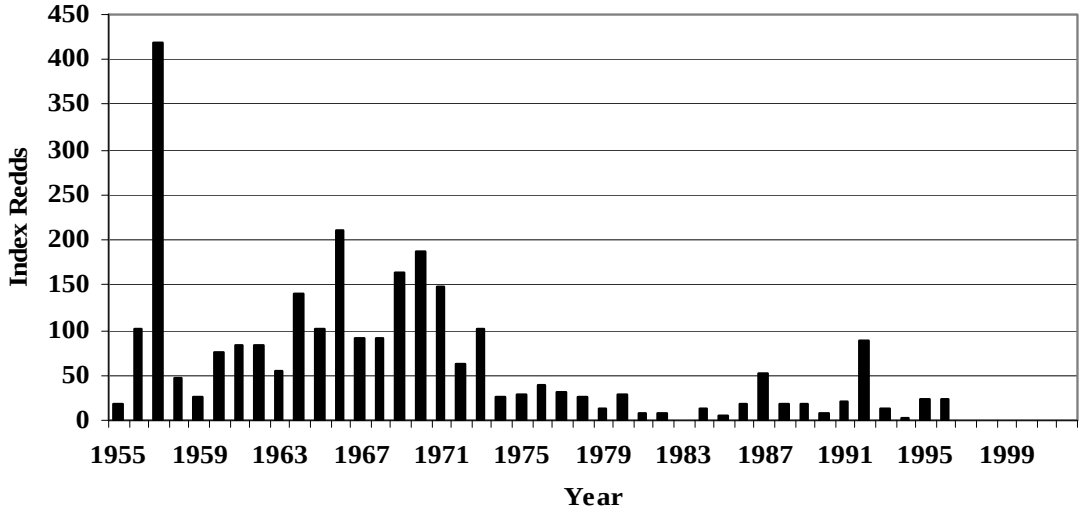
4 APPENDIX FIGURES



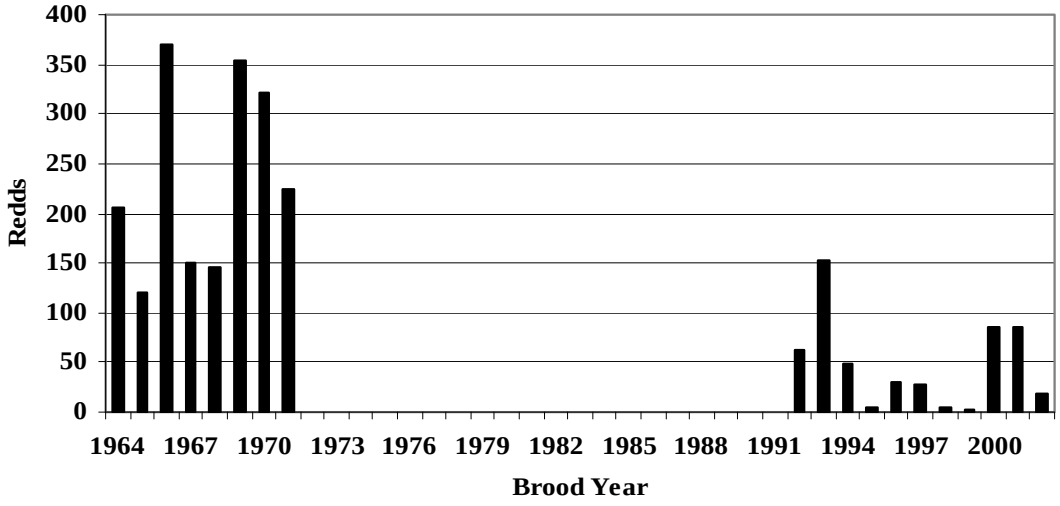
Appendix Figure 1. Historical streamflows for Lookingglass Creek for water years 1983-2002 (water year is from 1October to following 10 September).



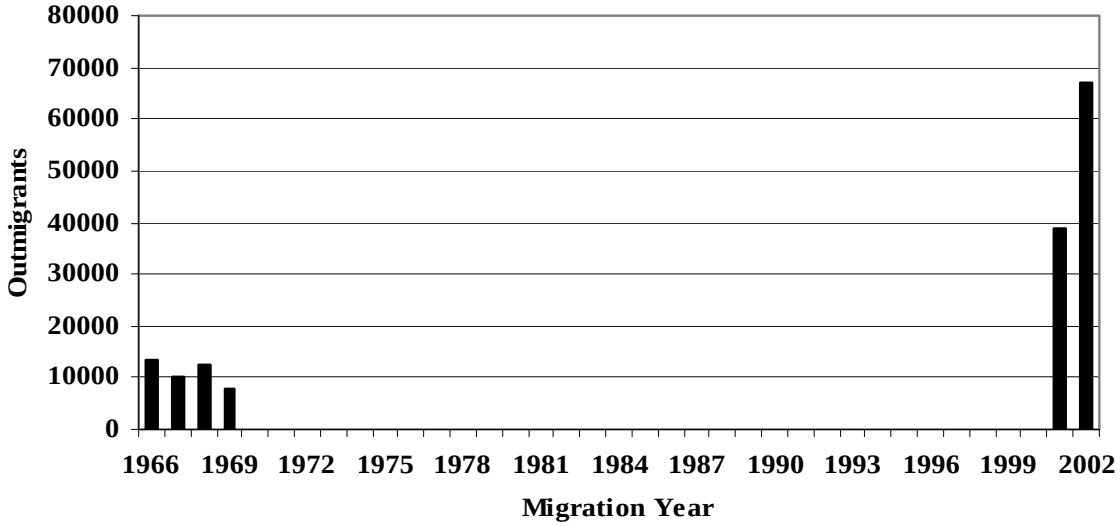
Appendix FIgure 2. Historical (natural) juvenile spring Chinook salmon outmigration production from Lookingglass Creek, 1965-2002. (*Note: Trapping until November 2000 was at about rm 2.3, after November 2000 at rm 0.1*).



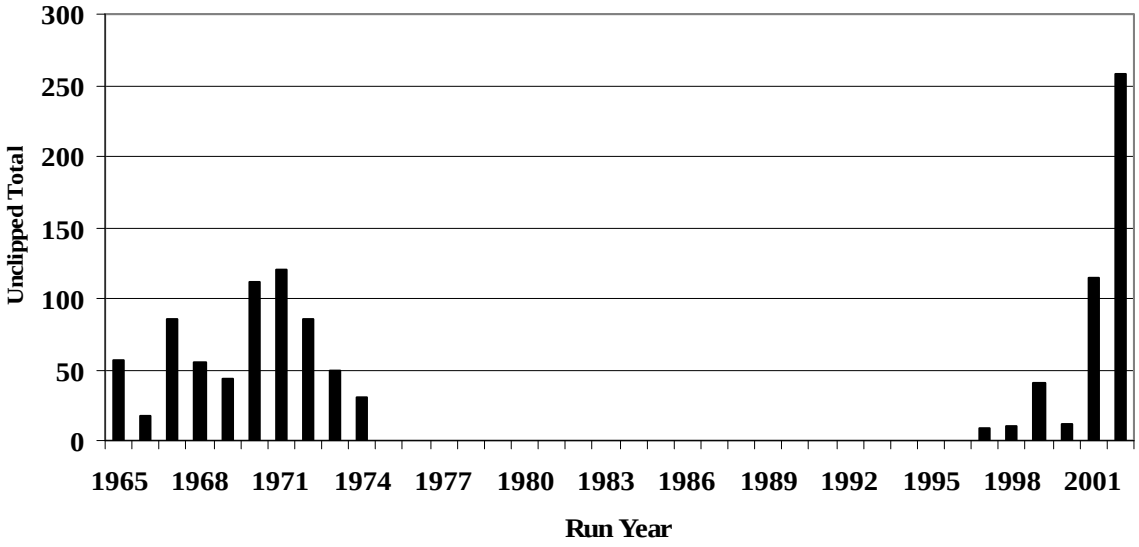
Appendix Figure 3. Redd counts for Lookingglass Creek spring Chinook salmon in the index area from Summer Creek to Little Lookingglass Creek, 1955-2002 (data from Tranquilli et al. 2004).



Appendix Figure 4. Total redd counts for Lookingglass Creek spring Chinook salmon, 1964-2002 (including data from Burck 1993).



Appendix Figure 5. Juvenile *O. mykiss* outmigrants from Lookingglass Creek, 1966-2002. (*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, 1965-2002.