Lower Snake River Compensation Plan
Confederated Tribes of the Umatilla Indian Reservation
Evaluation Studies for 1 January to 31 December 1996

Section I
Evaluation of Reestablishing Natural Production of Spring Chinook Salmon in Lookingglass Creek, Oregon, Using a Non-Endemic Hatchery Stock

Section II
Assistance Provided to LSRCP Cooperators and Other Projects

Michael L. M^{c}Lean and Peter T. Lofy
Fisheries Program, Department of Natural Resources
Confederated Tribes of the Umatilla Indian Reservation

P.O. Box 638   Pendleton, OR 97801
Administered by the United States Fish and Wildlife Service
and funded under the Lower Snake River Compensation Plan
CTUIR Project No. 63, Contract No. 14-48-0001-96523

September 1999

Table of Contents

List of Figures

List of Tables

List of Appendix Tables

SECTION I

Evaluation of Reestablishing Natural Production of Spring Chinook Salmon in Lookingglass Creek, Oregon, Using a Non-endemic Hatchery Stock

Abstract

One hundred five unmarked spring Chinook salmon returned to Lookingglass Hatchery between 27 May and 5 September 1996. We selected 50 fish from the 101 fish that returned by 26 August 1996 for release into Lookingglass Creek above a temporary weir at river mile 6.5, about 4 river miles above the hatchery. Intensive spawning ground surveys were conducted about 3 times a week beginning 26 August and ending 20 September to remove dead and dying adult spring Chinook salmon from the creek channel. Removal of fish was done to reduce the amount of pathogens being shed into the hatchery water supply. We observed a total of 24 redds above the temporary weir and recovered a total of 44 spring Chinook salmon (88%), all of which were from the release group. Surveys were also completed in the lower areas of Lookingglass Creek and Little Lookingglass Creek on 10, 13, and 16 September. During these surveys, an additional 7 redds and 3 carcasses were observed, all below the hatchery.

We collected data on the success of adult spring Chinook salmon natural spawning in Lookingglass Creek, as well as data on monthly growth, migration timing, and survival of juveniles to Lower Granite Dam. Movement of the 1994 cohort past the rotary screw trap in Lookingglass Creek peaked in October of 1995 with an estimated total of 7,793 juveniles passing the trap. The range of median monthly fork lengths of fish captured in the trap was 37 mm in March 1995 to 98 mm in April 1996. Four groups of fish were tagged, three at the screw trap from June to September 1995, October to December 1995, January to April 1996, and one group which was seined from Lookingglass Creek in September 1995 (field group). All four of the groups had median arrival dates at Lower Granite Dam within 3 days of each other from 14-17 April 1996. Groups tagged later at the trap had higher minimum survival rates: 17.9, 18.3, and 30.0%. The minimum survival rate for the field group was 16.9%. Minimum survival rates for months with at least 50 fish PIT-tagged (September 1995 through November 1995) ranged from 16.9 to 19.0%. The arrival timing at Lower Granite Dam of larger fish in the field group was significantly different from that of smaller fish with the median arrival dates being 8 April and 15 April respectively. Minimum survival rates among fish of 6 different fork length ranges from the field group were not different ($\alpha \leq 0.05$) from average survival for the entire group. The arrival timing of the 1993 cohort field group at the screw trap was significantly different than non-PIT-tagged fish, whereas the 1994 cohort did not differ from the non-PIT-tagged fish. There were no significant differences in fork length, weight, or condition factor of the 1992, 1993, or 1994 cohorts between detected and non-detected fish at Lower Granite Dam. The median arrival dates at Lower Granite Dam of the field groups from the1992, 1993, and 1994 cohorts, tended to be earlier than median arrival dates of natural populations from the Wenaha, Minam, Lostine, and upper Grande Ronde rivers, and Catherine Creek. The minimum survival rates

to Lower Granite Dam of field groups from the 1992, 1993, and 1994 cohorts were generally similar to minimum survival rates for other Grande Ronde River tributaries.

We released the 30,880 hatchery reared progeny of 8 returning unmarked female spring Chinook salmon from the 1995 cohort into the upper reaches of Lookingglass Creek on 25 July, 1996. This release was in lieu of releasing adults in 1995 because of pathological concerns at the hatchery. To determine if PIT-tagging affects survival or migration to the screw trap as well as Lower Granite Dam, a portion of the 1995 cohort (3,612) was divided into three different fork length groups; small, 55-59 mm; medium, 62-66 mm; and large, 69-72 mm; and were PIT-tagged and marked with Alcian blue dye. A control group of 3,638 fish from the same size groups were marked with dye only. Both treatments were divided equally and released into two areas of Lookingglass Creek (~river mile 10.25 and 7.00) and Little Lookingglass Creek (~river mile 2.75).

Introduction

The Grande Ronde River Basin historically supported large populations of fall and spring Chinook (*Oncorhynchus tshawytscha*), sockeye (*O. nerka*) and coho (*O. kisutch*) salmon and steelhead (*O. mykiss*) (Nehlsen et al. 1991). Dwindling Chinook salmon and steelhead populations and extirpation of coho and sockeye salmon in the Grande Ronde River Basin were, in part, a result of construction and operation of hydroelectric facilities, over fishing, and loss and degradation of critical spawning and rearing habitat in the Columbia and Snake River basins (Nehlsen et al. 1991). Anadromous salmonid stocks have declined in both the Grande Ronde River Basin (LSRCP Status Review Symposium 1998) and in the entire Snake River Basin (Nehlsen et al. 1991), many to the point of extinction.

Hatcheries were built in Oregon, Washington and Idaho under the Lower Snake River Compensation Plan (LSRCP) to compensate for losses of anadromous salmonids due to the construction and operation of the lower four Snake River dams. Lookingglass Hatchery on Lookingglass Creek, a tributary of the Grande Ronde River, was completed under the LSRCP in 1982 and has served as the main incubation and rearing site for the Chinook salmon programs for the Grande Ronde and Imnaha rivers in Oregon. Despite these hatchery programs, natural spring Chinook populations continued to decline, resulting in the National Marine Fisheries Service (NMFS) listing fall Chinook salmon as "endangered" and spring/summer Chinook salmon as "threatened" under the federal Endangered Species Act of 1973 on 22 April, 1992.

This study was designed to evaluate the potential for reestablishing spring Chinook natural production in Lookingglass Creek using Rapid River Hatchery stock (Lofy et al. 1994). The Confederated Tribes of the Umatilla Indian Reservation (CTUIR) and the Oregon Department of Fish and Wildlife (ODFW) developed it in consultation with the Nez Perce Tribe. Fishery managers believed that Lookingglass Creek was a good location to evaluate reintroduction of a non-endemic stock in the Grande Ronde River Basin. It was assumed that the relatively good quality habitat that was available in Lookingglass Creek would provide an adequate opportunity for success, and the existence of the weir provided the ability to easily control and enumerate adult escapement. There is also a database on the life history of the endemic spring Chinook salmon in Lookingglass Creek from 1964 to 1974 (Burck 1993; Burck 1964-1974) that would aid in the evaluation of the success of the Rapid River stock.

Until this study was initiated in 1992, no adult spring Chinook salmon captured at the Lookingglass Hatchery weir were placed upstream of the hatchery with the exception of a few fish released above the hatchery in 1989. The upstream migration has been almost completely blocked by a picket or floating weir located at the hatchery (Figure 1). Some fish escaped above the weir each year as evidenced by redd counts during spawning surveys (ODFW, unpublished data).

Since this study began in 1992, adults were placed above the Lookingglass Hatchery weir each year through 1994 (Lofy and McLean 1995a; Lofy and McLean 1995b; and McLean and Lofy 1995). In 1995 no adults were placed above the weir with increased concern about potential effects of supplementation with adult salmon after a disease outbreak at Lookingglass Hatchery in 1994 that affected the 1993 cohort that was being held at Lookingglass Hatchery (McLean and Lofy 1998).

Instead, CTUIR and co-managers proposed to use the progeny of unmarked spring Chinook salmon that returned to Lookingglass Hatchery in 1995 for supplementation as parr (i.e., artificial spawning/ incubation/ early rearing at Lookingglass Hatchery and release in 1996 for final rearing in Lookingglass Creek) (McLean and Lofy 1998).

With increased concern about pathogen load in the water taken into Lookingglass Hatchery, co-managers decided to release fewer adults above the weir in 1996 than the numbers released from 1992 to 1994. As a condition of the release of adults above the weir in 1996, CTUIR personnel made an increased effort to recover carcasses and remove them from the active stream channel. This was done to reduce the risk of pathogens shed by the adults into the water supply (Letter from William Stelle, NMFS, to Michael Spear, USFWS, 16 August, 1996).

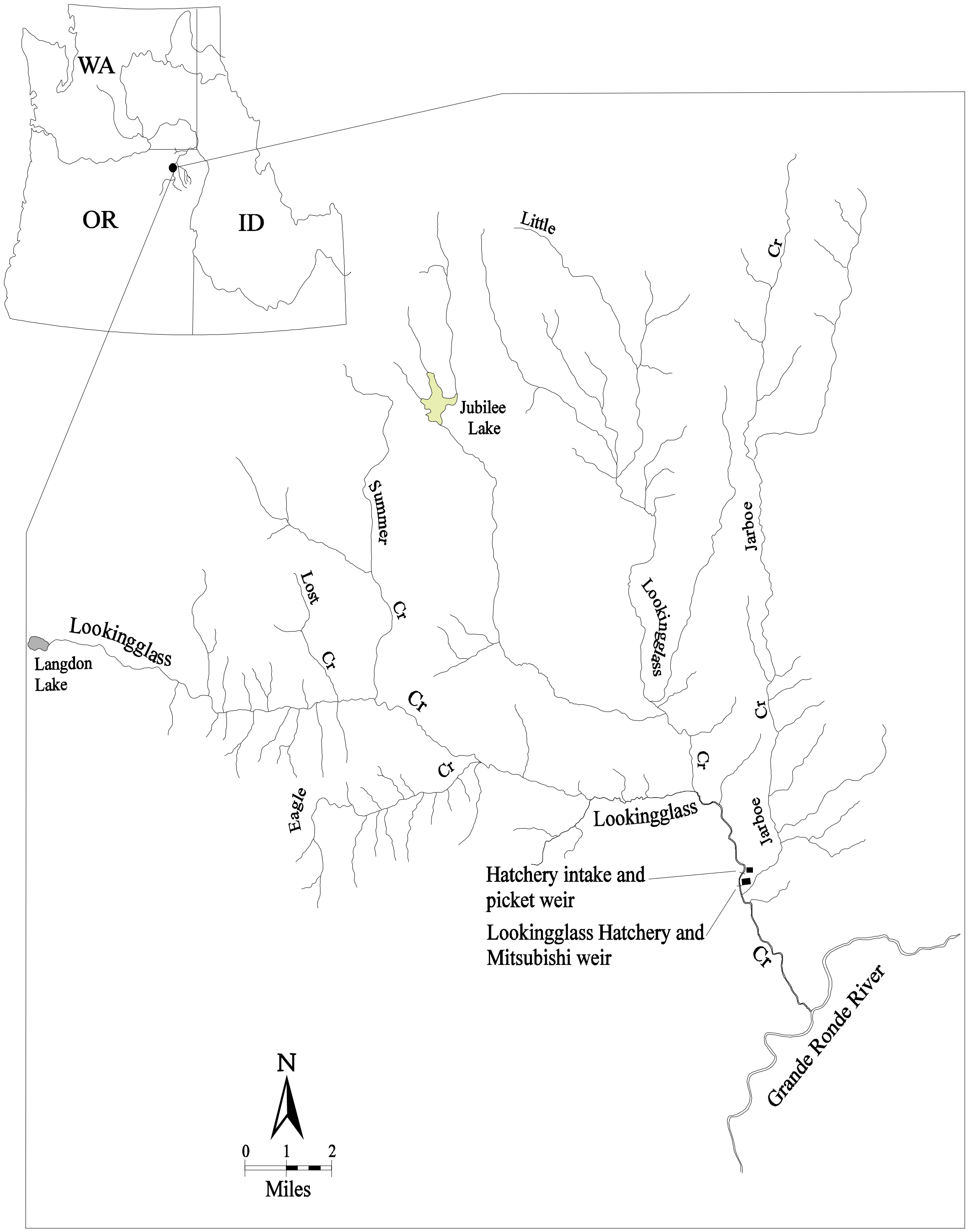

Figure 1. Map of the Lookingglass Creek basin showing the location of major tributaries and the Lookingglass Hatchery complex.

Study Area

The Lookingglass Creek basin is located in the Blue Mountains of northeast Oregon with the headwaters originating at an elevation of about 4,870-ft above sea level (Figure 1). Lookingglass Creek flows to the southeast approximately 15.5 river miles (rm) through the Umatilla National Forest then through private land where it enters the Grande Ronde River at approximately rm 85, at an elevation of about 2,355 ft above sea level. Lookingglass Creek has five major tributaries, Lost Creek (about rm 10.75), Summer Creek (about rm 10.25), Eagle Creek (about rm 8.25), Little Lookingglass Creek (just below rm 4.25), and Jarboe Creek (just below rm 2.25) (Figure 2). Lookingglass Creek and Little Lookingglass Creek (the largest tributary) are the only major portions of the basin where adult spring Chinook salmon spawning is likely to take place. During the previous study (Burck 1993) these two streams were divided into four geographic units for evaluation of spring Chinook salmon production (Figure 2). We used these same units and landmarks in our study, but we further divided unit 3 into upper and lower sections (Figure 2).

Lookingglass Hatchery is located at rm 2.50. Channelization to the mouth of the stream is due to the access road to the hatchery. Some small scale logging (about 7,500 linear board feet)(personal communication, Oregon Department of Forestry, La Grande, Oregon) occurred on the upper hillsides of the private land from about rm 4.25 to rm 6.25 in 1996 (Figure 2).

Methods

Stream Flow and Temperature

We obtained and summarized stream flow data collected by the United States Geological Survey (USGS) for comparison to stream flows recorded in Lookingglass Creek from 1964 to 1971 (at about rm 2.50) (Burck 1993) (Figure 3). Mean daily stream flows (0.5-hour sample interval) in Lookingglass Creek for 1996 were estimated from an electronic stream gauging station located just below the Mitsubishi weir (Figure 2). The data were obtained from the USGS (personal communication, Jo Miller, USGS, Walla Walla District, WA, unpublished data) who maintained and operated the station. Maximum and minimum daily mean flows for each week of the year were reported here using methods described in M^{c}Lean and Lofy (1995).

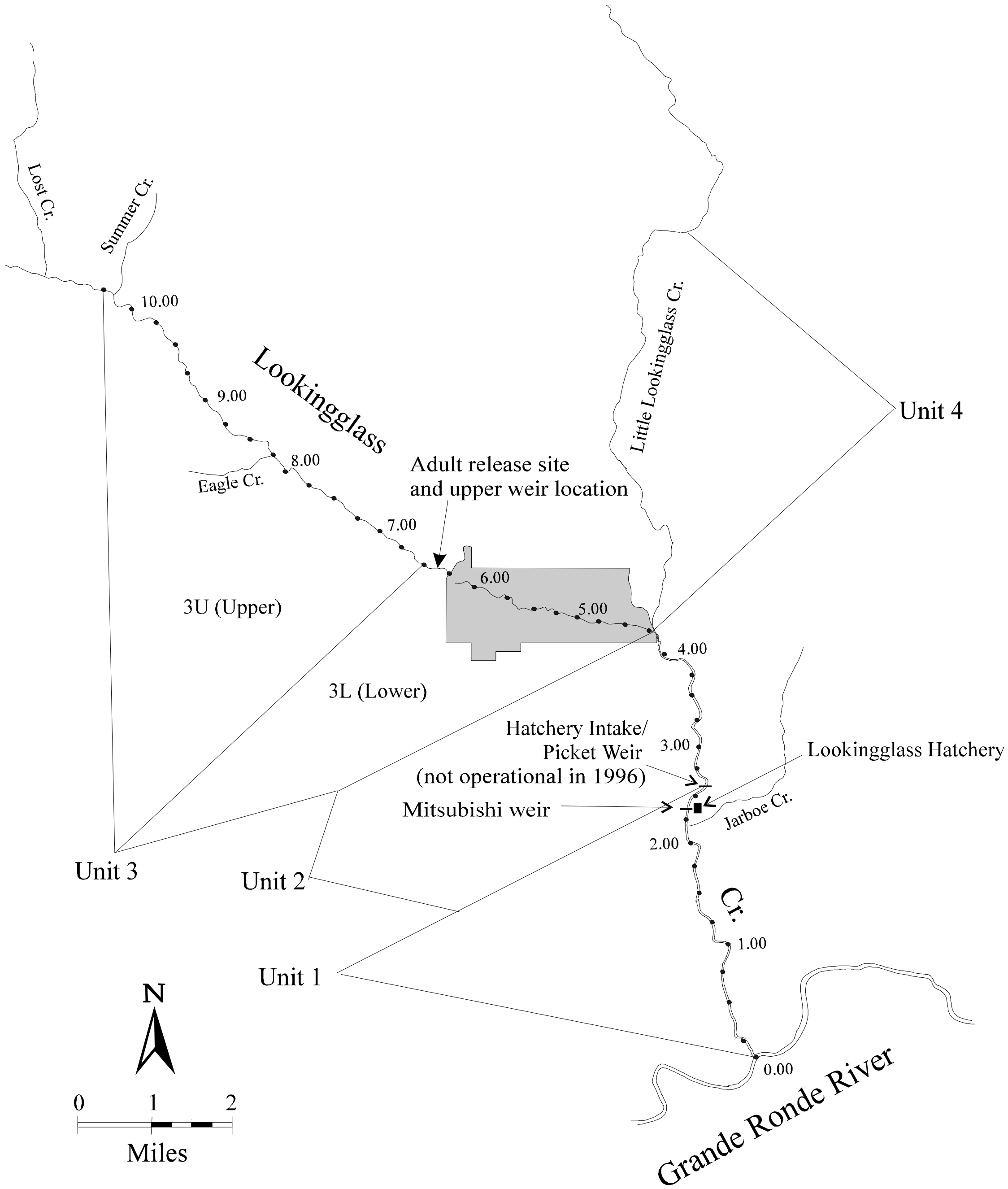

Figure 2. Unit Designations, adult spring Chinook salmon release site in 1996, and 0.25-river mile sections of Lookingglass Creek. The shaded area is the private property where access was restricted by the landowner to a single spawning ground survey conducted by CTUIR in 1996.

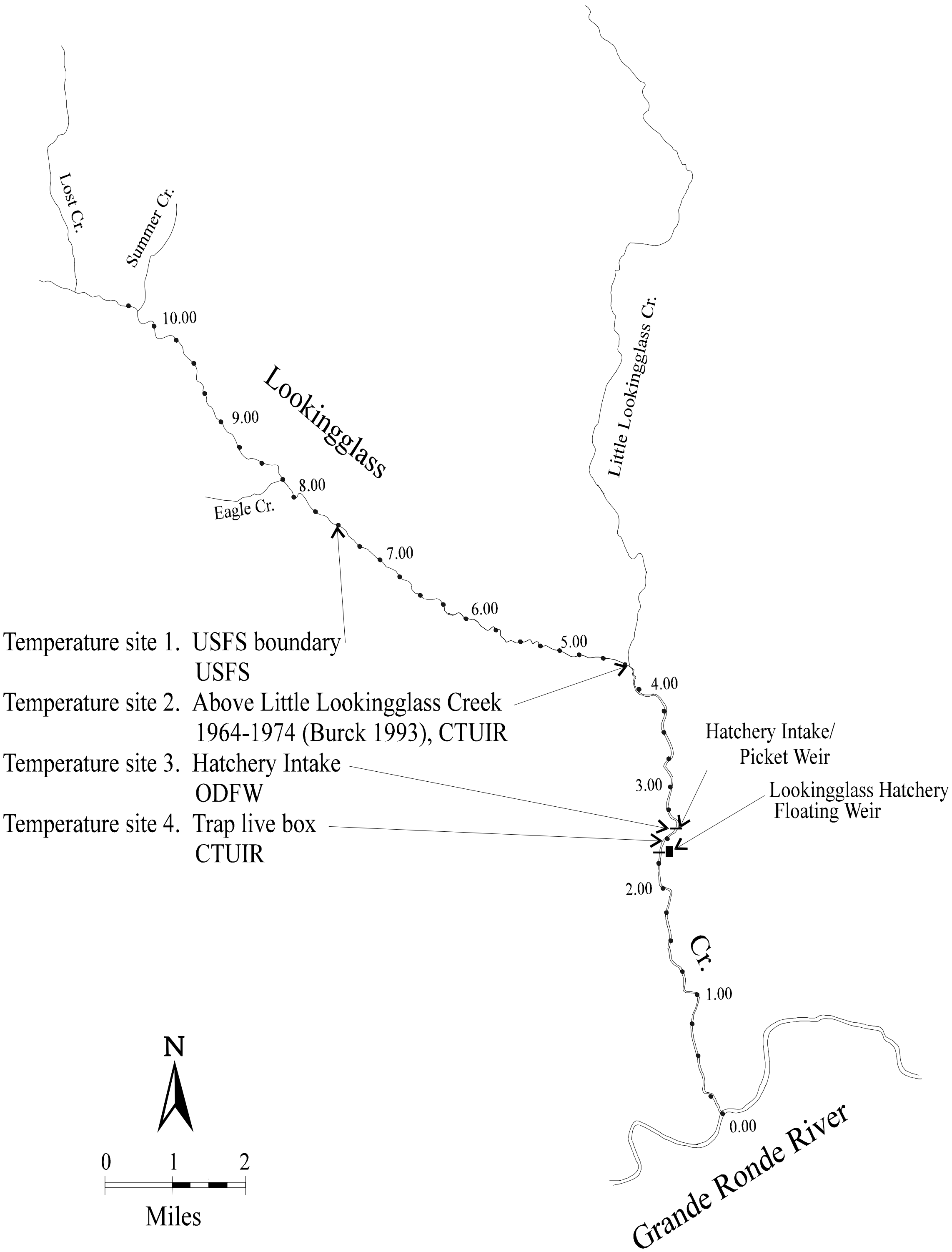

Figure 3. Location of temperature data recorders in Lookingglass Creek in 1996.

Stream temperature data were collected for comparison to stream temperatures recorded in Lookingglass Creek from 1964 to 1971 at rm 4.25 by Burck (1993) (Figure 3). The daily range of hourly stream temperatures for 1996 were obtained from summaries completed by the United States Forest Service (USFS) (personal communication, Scott Wallace, USFS, Walla Walla District, WA, unpublished data), ODFW (personal communication, Debbie Eddy, Portland, Hatchery Management Information System), and from two electronic thermographs (Ryan Tempmentor® 2000) operated by CTUIR. Stream temperature data collected in 1996 were recorded by the USFS near the downstream end of the Umatilla National Forest boundary (at about rm 7.50), by ODFW at the hatchery intake (at about rm 2.50), by CTUIR approximately 20 m above the mouth of Little Lookingglass (at about rm 4.25) and inside the livebox of our rotary screw trap (at about rm 2.50) (Figure 3). We summarized all hourly stream temperature data as a weekly range (McLean and Lofy 1995).

Adult Returns to Lookingglass Hatchery

In order to evaluate the relative success of our adult releases in 1992, 1993, and 1994 (Lofy and McLean 1995a, Lofy and McLean 1995b, and McLean and Lofy 1995) progeny per parent ratios were calculated using the unmarked adult spring Chinook salmon intercepted at Lookingglass Hatchery. The fish were enumerated, and then aged using scales to determine cohort origin.

Unmarked and marked adult spring Chinook salmon returning to the hatchery were enumerated by ODFW. Returning fish were diverted into the hatchery trap using a Mitsubishi weir. The trap was checked once a week for the duration of the return to Lookingglass Creek (until no spawning was observed in Lookingglass Creek below the hatchery). When the trap was checked, all fish were checked for fin clips, measured, tagged with colored spaghetti tags, and injected with antibiotics. The fish were then placed into the adult holding ponds until release above the weir or spawning.

Since none of the cohorts (1992-1994) were completed in 1996, progeny-per-parent ratios don't include 5-year-olds. The progeny-per-parent ratio was calculated using the number of unmarked adults that returned from the 1992 and 1993 cohorts divided by the estimated number of adults above the weir in 1992 and 1993.

Progeny-per-parent ratios of other Grande Ronde River basin tributaries were calculated for comparison to Lookingglass Creek. Since there are no actual counts (weirs) of adult returns to other Grande Ronde River basin tributaries, redd counts in each of these tributaries (ODFW, unpublished data) were multiplied by the average fish-per-redd estimate of 3.25 from 1992 to 1994 in Lookingglass Creek to obtain an estimate of adult escapement (Lofy and McLean 1995a, Lofy and McLean 1995b, and McLean and Lofy 1995). The average age structure from adults returning to Lookingglass Creek from 1971 to 1974 (Burck 1993) was applied to all natural populations calculate the cohort returns (8.93, 84.00, and 7.07% for 3,4, and 5-year-olds respectively). Carcass recoveries were not used because jacks and adult males are less likely to be recovered than females, which would bias the age, structure (Lofy and McLean 1995a, Lofy and McLean 1995b, and McLean and Lofy 1995)

Release of Adult Spring Chinook Salmon Above the Weir

We released 50 unmarked adult spring Chinook salmon above the Lookingglass Hatchery on 26 August 1996. The release group was comprised of the first 25 males and 25 females that were taken from the pond holding the unmarked adults that had returned to Lookingglass Hatchery since 27 May 1996. Unmarked adults did swim into the hatchery after the release date until 26 September 1996. The sex of the fish was estimated by hatchery personnel using the physical appearance of the fish at the time of release. The fish were measured (fork length, mm), weighed (kg), re-spaghetti-tagged if necessary, for primary identification, opercle punched for secondary identification and confirmation of estimated sex (1 punch for males and 2 for females); and had scale samples removed before being loaded into the truck for release. All of the fish released above the weir had been injected with erythromycin by ODFW hatchery personnel as they swam into the trap in order to lessen the effects of bacterial kidney disease (BKD). We also removed some caudal fin tissue using a paper hole punch for genetic analysis by the NMFS (see Genetic Monitoring).

The release site for the unmarked spring Chinook salmon was moved upstream from past years (Lofy and McLean 1995a; Lofy and McLean 1995b; and McLean and Lofy 1995), to just below rm 6.5 (Figure 2). This move occurred because a land owner on Lookingglass Creek would not allow us access to his property which contains about 2 miles of spawning areas available to spring Chinook salmon and the old release site (Figure 2). The site was chosen because it was just above the restricted area (Figure 2), and it was the only site above the restricted area that is accessible by vehicle. We did not release the fish below the restricted area because we did not want fish from the release group spawning in the restricted area since we had restricted access to count redds or recover any carcasses.

In order to prevent downstream movement into the restricted area or into the hatchery intake, we installed a wire fence as an upper weir across the stream just below rm 6.5 five days before release of the fish. The upper weir was constructed from fence posts pounded in the river channel with 2" mesh wire fence stretched across them in an upstream “V” configuration. There was a 4" opening between fence posts in the middle of the channel so any fish that escaped above the hatchery weir could pass the weir going upstream while the small opening would reduce the probability of fish going downstream. This weir was kept in the creek until one week after no adult spring Chinook salmon were observed above it.

Spawning Ground Surveys

In order to decrease the risk of disease transmission from spawned adults to the juvenile spring Chinook salmon being reared at Lookingglass Hatchery, we conducted spawning ground surveys above the release site (Unit 3U, Figure 2) three days a week to count completed redds and remove adult spring Chinook that had completed spawning from the active stream channel as soon as possible.

Fish were removed from the river channel when a carcass was recovered, when females were removed with a gaff off of completed redds, and when males were weak enough to be either captured by hand or easily gaffed. Determination of whether or not a fish should be gaffed and killed was made by visual inspection of the females (flaccid abdomen and tail condition), length of time female had been observed on a redd, swimming ability of males (easily approached and captured by hand), and if there are excess males (most of the females had finished spawning).

The first spawning survey was conducted in the lower 0.75 rm of Unit 3U (Figure 2) the day after the release to determine if fish were needed to replace transport mortality. All remaining surveys were usually conducted on Monday, Wednesday, and Friday until no live fish were observed or believed to be alive. During each survey, only completed new redds were flagged and counted using methods described in M^{c}Lean and Lofy (1995).

Additional surveys were conducted in Units 1, 2, 3L, and 4 (Figure 2) to complete the ODFW spring Chinook spawning ground index counts for Lookingglass Creek, as well as recover more carcasses and document all spring Chinook salmon that returned to Lookingglass Creek that were never counted at the hatchery.

Sampling Adult Chinook Salmon Carcasses for Pathogens

Kidney tissues were taken from adult spring Chinook salmon recovered during spawning ground surveys in 1996 to document levels of bacterial infection in fish spawning in the natural environment. The kidney tissues removed from spring Chinook salmon were kept on ice until the tissue could be transferred to a freezer. Whole carcasses taken from Lookingglass Creek were frozen as soon as possible. The kidney tissue was analyzed by ODFW fish health, La Grande OR, for the level of *Renibacterium salmoninarum* (bacterial kidney disease), and presence of aeromonad/ pseudomonad bacteria (general septicemia), *Flexibacter psychrophilus* (coldwater disease), and *Yersinia ruckeri* (enteric redmouth disease). The whole carcasses were also sampled for *Ceratomyxa shasta* infection. The data provided by ODFW are summarized in this report.

Genetic Monitoring

As part of an ongoing genetic monitoring program, the NMFS requested that we collect tissue samples from unmarked adult spring Chinook that returned to Lookingglass Hatchery. The eye, heart, liver, and muscle tissues were taken from all unmarked fish that were spawned at the hatchery for allozyme analysis. After the tissue samples were collected, they were immediately placed on ice and transported to La Grande for storage in a freezer at -80^{o}C within six hrs. The caudal fin tissue was taken from all unmarked fish that returned to the hatchery or were recovered on spawning ground surveys. To obtain the fin sample, a hole punch was used to remove a portion of the caudal fin. These samples were placed in small vials of 95% ethanol for storage. Genetic samples, collected in 1996 to be used for allozyme analysis, that were kept in the -80^{o}C freezer were lost when the freezer broke and the samples thawed. The tissues were still sent to Dr. Robin Waples of the NMFS laboratory in Seattle, WA, for mitochondrial DNA analyses that can be done with any tissue.

We also collected whole specimens of juvenile spring Chinook salmon from the 1994 cohort while PIT-tagging in the field during the fall of 1995. The collected fish were kept on ice until transfer into the -80^{o}C freezer within 3 hours. Our juvenile samples were sent to Dr. Robin Waples before the freezer broke.

Population Estimates and Timing Past the Rotary Screw Trap for the 1994 Cohort

To evaluate the spawning success of adults released above the weir in 1994, we operated a rotary screw trap from 1 January 1995 (M^{c}Lean and Lofy 1998) to 31 December 1996. We used the screw trap to estimate the timing to the trap and total number of fish moving past the trap site on Lookingglass Creek. From January 1995 to September 1995, we also captured fish from the 1993 cohort (M^{c}Lean and Lofy 1998); however, differences in fork length ranges made it possible to differentiate the two cohorts. We operated the screw trap in three different locations on Lookingglass Creek while trapping the 1994 cohort (Figure 4). From 1 January 1995 to 28 July 1995 the trap was located at Site 1, from 29 July 1995 to 27 November 1995 the trap was located a Site 2, and from 7 December 1996 to present, the trap was located at Site 3 (Figure 4). We stopped trapping of the 1994 cohort on 1 May 1996 at Site 3 (Flume Hole, Figure 4) because only five fish were captured during April. We resumed trapping on 26 July 1996 at Site 2 (Figure 4) using a Fyke Net trap just before a hatchery release of the 30,880 juveniles from the 1995 brood was made above the weir (see Experimental Release of 1995 Cohort). We used the Fyke Net trap because there was not enough flow at Site 3 to operate the screw trap. We began operating the screw trap at Site 3 on 3 August 1996 after modifications were made to increase the flow into the screw trap.
Most of the juvenile spring Chinook salmon captured in our rotary screw trap were measured (fork length (mm)), weighed (g) and enumerated similar to McLean and Lofy (1998). At times fish would be counted only, because they may have an injury, there may have been too many in the trap to measure them all, or in the case of small fry, they may have been eaten by other fish while in the bucket. Only lengths from fish captured on or around the 20th of each month were used in calculating the median fork length and 95% confidence interval (M^{c}Lean and Lofy 1998). For comparison purposes the trapping periods we designated were summarized for the endemic spring Chinook salmon juveniles from the 1965 to 1969 cohorts (Burck 1964-1974; M^{c}Lean and Lofy 1998). We expanded the number of fish captured each month using trap efficiency estimates. All months were totaled for the population estimate moving past the trap. We used PIT tags as marks for estimating the trapping efficiency of the 1994 cohort in order to track individual fish and increase our sample size of PIT-tagged fish. Every healthy juvenile spring Chinook captured at the trap that was at least 60 mm (Prentice et al. 1990) was tagged and released for trap efficiency estimation. We also released all PIT-tagged field recaptures (see PIT-Tagging of the 1994 Cohort) for trap efficiency estimation. Because we were not always able to differentiate between the field PIT-tagged fish recaptured in the trap and the recaptured fish used to estimate the trap efficiency we used a secondary mark of Alcian blue dye applied with a battery operated tattoo pen on the caudal peduncle. The secondary mark was used because we did not want to release the recaptured trap efficiency fish again for trap efficiency. To calculate the variance around the estimate of total migration and the monthly

numbers trapped for the 1994 cohort, we used a bootstrap method described in McLean and Lofy (1998).

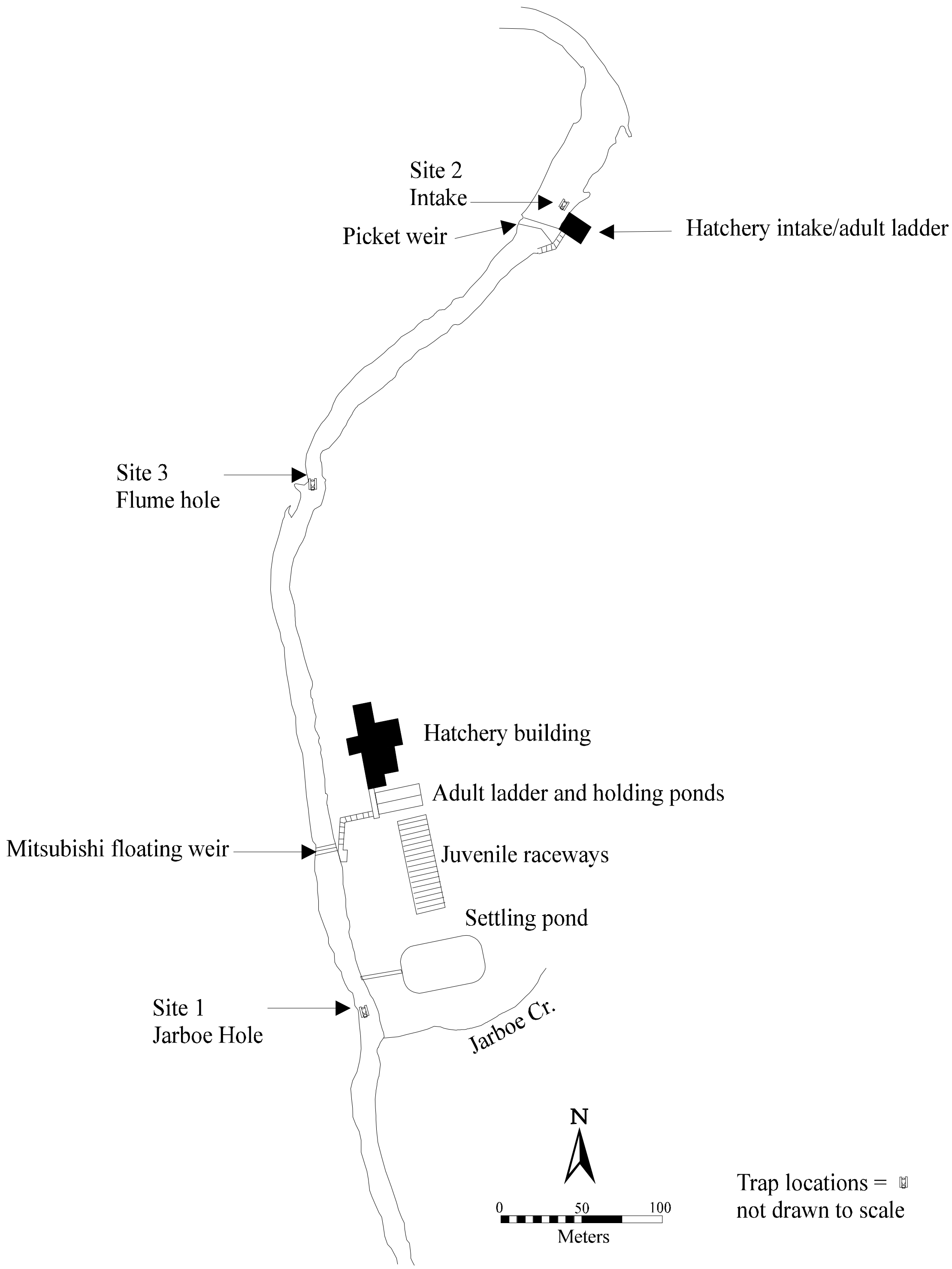

Figure 4. Locations of the rotary screw trap while trapping the 1994.

We conducted trap efficiency releases near the left and right stream bank to determine if bank of release affected recapture at the trap. These releases were made during testing of assumptions for trap efficiency estimation described in M^{c}Lean and Lofy (1998). We tried to release equal numbers of fish from each bank when fish were released. A Chi-square test (α 0.05, df = 1) was used to test for significant difference in recapture rate between the banks of release.

PIT-Tagging of the 1994 Cohort

Four groups of juvenile spring Chinook salmon from the 1994 cohort from Lookingglass Creek were PIT-tagged to determine arrival timing at, and the minimum survival rate to Lower Granite Dam. The first group was comprised of juveniles that were seined from rearing habitat above the trap (field group) from 19 through 21 September 1995. The remaining three groups from Lookingglass Creek were juveniles captured in the screw trap throughout the migration of the 1994 cohort. The groups were derived from their initial arrival timing at the screw trap. The fall group was PIT-tagged from 3 June 1995, when the fish began to reach at least 60 mm (Prentice et al. 1990), to 30 September 1995. The winter group was tagged from 1 October 1995 to 31 December 1995. The spring group was tagged from 1 January 1996 until the last non-precocial juvenile was captured in 1996 (1 July) (McLean and Lofy 1998). All of the fish were tagged using methods described in M^{c}Lean and Lofy (1998). All of the fish from the field group were held for 24 hours after tagging in liveboxes to determine delayed mortality. Some of the fish tagged at the screw trap were also held overnight in liveboxes to determine delayed mortality.

Weekly Arrival Timing at Lower Granite Dam

To describe weekly arrival timing of the four groups of PIT-tagged fish from Lookingglass Creek as well as PIT-tagged fish from other natural populations in the Grande Ronde River basin (Walters et al. 1994; Sankovich et al. 1995 and 1996), the daily detections of these groups at Lower Granite Dam were downloaded from the Columbia River Basin PIT Tag Information System (PTAGIS). The daily detections were then expanded for spill using a daily expansion factor [(Powerhouse Flow + Spillway Flow) / Powerhouse Flow] calculated from data provided by the United States Corp of Engineers (USACE) River Information. The expanded daily detections (rounded to the nearest 0.1 fish) were then summed each week and rounded to the nearest whole number. Arrival timing at Lower Granite Dam for each group was graphed using the expanded weekly detections as a percentage of the total expanded number of fish for that group.

We used a Kruskal-Wallis one-way ANOVA to test for differences among the arrival distributions of the four groups of Lookingglass Creek fish (α 0.05). The same test was used to detect differences between the Lookingglass Creek field group and other natural populations in the Grande Ronde River basin (α 0.05). We followed each test with a multiple comparison suggested by Dunn (1964, cited by Daniel 1990) if a significant difference among groups was detected to determine which of the Lookingglass Creek groups differed from the other, or which Grande Ronde River basin natural populations differed from the Lookingglass Creek field group (α 0.20).

In order to determine if the size of the juvenile Chinook salmon at the time of tagging affected arrival timing of fish that were detected at Lower Granite Dam, unexpanded detections at Lower Granite Dam from the Lookingglass Creek field group were divided into two size categories. Fish shorter than or equal to the median fork length at tagging were included in the "small fish" group. Fish longer than the median fork length comprised the "large fish" group. A Kolmogorov-Smirnov two sample test (Wilkinson 1996) was then used to compare arrival distributions of the groups of small and large fish (α 0.05).

Minimum Survival Rate to Lower Granite Dam

To determine the minimum survival rates to Lower Granite Dam of juvenile outmigrants from Lookingglass Creek as well as outmigrants from other Grande Ronde River, the total unique detections at all Snake and Columbia River dams were used. Survival rates for each month of tagging at the Lookingglass Creek trap were calculated to determine if a trend in survival was evident over time. Survival rates were calculated for groups of fish tagged each month by dividing the total number of unique detections by the total number of the juveniles tagged during that month. Confidence intervals (95%) for total detection percentages were calculated using methods described in Ott and Mendenhall (1985) to determine differences between groups based on the overlap of these intervals. Only the upper bound of the confidence interval was used for determining overlap, because the point estimate was an actual observed minimum.

Chi-square goodness of fit analysis was used with the field group to determine if minimum survival rates to Lower Granite Dam differed among fish of different fork lengths at tagging (α 0.05). Fish from the field group were categorized into 5-mm intervals except at the extremes of the fork length distribution, where intervals were combined to increase the expected detections to at least five (Thorndike 1982). The overall cumulative detection rate was used to calculate the expected number of detections for each size interval. The intervals used for the 1994 cohort were 63-82, 83-87, 88-92, 93-97, 98-102, and 103-107 mm.

Effects of Tagging on Fish Movement Past the Rotary Screw Trap

In order to determine whether PIT-tagging influenced migration timing out of Lookingglass Creek, we described the migration timing past the trap of both tagged and non-tagged fish after PIT-tagging commenced. We expanded PIT tag recaptures and non-PIT-tagged captures at the trap for each cohort based on the trap efficiency estimates during the period the fish were captured (M^{c}Lean and Lofy 1998) (see Population Estimates And Timing Past The Rotary Screw Trap For The 1994 Cohort). We described arrival timing for each group by graphing the expanded trap captures for each month as a percentage of the estimated total number of fish captured from that group after the first day of PIT-tagging. A Kruskal-Wallis one-way ANOVA (Wilkinson 1992) was then used to compare arrival distributions by trapping period for the field group and the untagged fish within each cohort (α 0.05).

Fork Length, Weight, and Condition Factor of Detected vs. Non-detected Fish

The field groups from the 1992, 1993, and 1994 cohorts were used to determine if fish that were detected at Columbia and Snake River dams differed in size (fork length or weight) or condition factor at the time of tagging from those that were not detected. We used a Kolmogorov-Smirnov two-sample test within cohorts, to compare the fork length, weight, and condition factor of fish from the field group that were detected at any of the Columbia and Snake River dams to the fish that were not detected (α 0.05).

Comparison of Arrival Timing and Survival Rates to Lower Granite Dam Between Lookingglass Creek and Other Grande Ronde River Tributaries and Lookingglass Hatchery

In order to compare arrival timing at and minimum survival rates to Lower Granite Dam, we made comparisons between the Lookingglass Creek field groups from the 1992, 1993 and 1994 cohorts and the same cohorts from natural populations of juvenile spring Chinook salmon in the Upper Grande Ronde, Minam, Lostine, and Wenaha rivers, and Catherine Creek, and the Rapid River stock spring Chinook salmon from Lookingglass Hatchery. The natural populations from other Grande Ronde River tributaries were PIT-tagged by ODFW during the same general time, August to September, as the Lookingglass Creek field group (Walters et al. 1994; Sankovich et al. 1995 and 1996). The Rapid River stock was tagged in the February immediately before release in April.

Weekly Arrival Timing at Lower Granite Dam

The arrival timing at Lower Granite Dam for each group of fish within a cohort was calculated in the same manner described earlier (see PIT-Tagging of the 1994 Cohort, *Weekly Arrival Timing at Lower Granite Dam*). We used a Kruskal-Wallis one-way ANOVA to test for differences among the arrival distributions of the tributaries within a cohort (α 0.05). If a significant difference among tributaries was detected, we followed with a multiple comparison, suggested by Dunn (1964, cited by Daniel 1990) using Lookingglass Creek field group against each of the other tributaries for each cohort (α 0.20). We illustrated arrival timing by week at Lower Granite Dam for each tributary for the 1992 to 1994 cohorts by graphing weekly detections as a percentage of the expanded total number of fish detected.

Minimum Survival Rate to Lower Granite Dam

Unexpanded total unique detections at all Snake and Columbia River dams were used to calculate a minimum survival rate to Lower Granite Dam for each tributary within a cohort. The minimum survival rate and the upper end of the ninety-five percent confidence intervals to Lower Granite Dam were calculated for each tributary (see PIT-Tagging of the 1994 Cohort, Minimum Survival Rate to Lower Granite Dam). Differences between Lookingglass Creek and the other Grande Ronde River tributaries were based on the overlap of these intervals. Only the upper bound of the confidence interval was used for determining overlap, because the point estimate was an actual observed minimum.

Release of Juvenile Spring Chinook Salmon from the 1995 Cohort

Co-managers decided not to release adult spring Chinook salmon above the hatchery weir in 1995. This issue arose out of concern about the potential for increasing disease transmission to juvenile Chinook salmon rearing at Lookingglass Hatchery. All unmarked spring Chinook salmon trapped at Lookingglass Hatchery were retained for hatchery production. CTUIR and ODFW proposed to use the progeny of unmarked females that returned to Lookingglass Hatchery for supplementation and release them as subyearlings in Lookingglass Creek, in accord with the outcome of dispute resolution to continue the Rapid River stock program for the 1995 cohort.

The eggs from each of eight unmarked Rapid River stock females were placed in individual egg trays. The females were spawned with the first marked or unmarked males that were ripe during handling. Eggs from the first unmarked female that was spawned at the hatchery were not included among those progeny that were eventually released for supplementation. Since the hatchery water chillers were not in operation during the first spawn date, the rate of development for these eggs was too far advanced from eggs of unmarked females spawned later. Additional eggs, to make up for the early female, were taken from marked females that were spawned with at least one unmarked male on the date when the largest number of unmarked females were spawned. With an estimated 4,375 eggs per female (personal communication, Bob Lund, ODFW, Lookingglass Hatchery), 35,000 eggs were allocated for supplementation.

CTUIR requested that the size and growth rate of the 1995 cohort mimic that of naturally produced fish from Lookingglass Creek as much as possible. In order to accomplish this, we provided hatchery personnel with monthly fork length data from the naturally produced juveniles of the 1993 and 1994 cohorts from Lookingglass Creek (McLean and Lofy 1998) as a target. After hatching, the fish in the troughs were weighed and fork lengths were recorded once a month (twice a month as the release date drew near) to give hatchery personnel the data needed to adjust growth rates to match the naturally reared fish in Lookingglass Creek. The fish were transferred to outside raceways during the last week of April and the first week in May 1996. The fish were coded-wire-tagged (CWT) and their adipose fins were removed on 26 June 1996 to identify them as hatchery fish. All other progeny of Rapid River stock held at Lookingglass Hatchery were marked with CWT and the adipose and right pelvic fins were removed.

We released 30,880 juvenile spring Chinook salmon (raceways 8-13) into Lookingglass and Little Lookingglass creeks on 25 July 1996. Two release sites were in Lookingglass Creek, around rm 7.25 (9,006 fish, raceways 10 and 13) and rm 10.25 (11,825 fish, raceways 9 and 12) (Figure 2). The third release sites were in Little Lookingglass Creek around rm 2.75 (6,888 fish, raceway 8) and rm 3.50 (2,769 fish, raceway 11). Because of the inaccessibility of the two sites in Lookingglass Creek, the fish were released using a helicopter. A truck was used to transport the fish to the release sites on Little Lookingglass Creek.

PIT-Tagging Effects on Survival and Migration Timing

Incidental data from PIT-tagging juvenile spring Chinook salmon in the Grande Ronde River has suggested that length at tagging may be related to the probability of detection at Snake and Columbia river dams. For the past 3 years, ODFW and CTUIR have PIT-tagged juvenile Chinook salmon in six Grande Ronde River tributaries during the late summer/early fall before the expected seaward migration in the spring. Minimum survival rates of small juvenile Chinook salmon (less than 60 mm FL) that were near the smallest size suggested for tagging salmonids (55 mm FL, Prentice et al. 1990), have had lower cumulative detection rates than juveniles 60 mm or greater (M. Keefe, ODFW, personal communication). However, the lower end of the fork length distribution had too few fish in the appropriate size range to adequately detect statistically significant differences in survival rates. To determine if there are differences in weekly arrival timing at and survival to the screw trap and Lower Granite Dam between fish of different size categories, we marked a portion of the 1995 cohort hatchery-reared Rapid River stock juvenile spring Chinook salmon between 54 and 74 mm FL with PIT tags and Alcian Blue dye. To determine if there is a difference between PIT-tagged and non-PIT-tagged survival to the screw trap on Lookingglass Creek, we added a control group with only dye.

We marked 3,612 fish with PIT tags and Alcian Blue dye and 3,638 fish with dye only, from the hatchery-reared 1995 cohort Rapid River stock juvenile spring Chinook salmon (see Release of Juvenile Spring Chinook Salmon From The 1995 Cohort). On the dates of tagging (15-19 July, 1996) the fish were netted from the raceways, lightly anaesthetized with (40-60 mg/l) of MS-222 (tricaine methanesulfonate), and sorted by fork length into one of 15 containers, with each container representing a fork length. To check the accuracy and precision of the fork length measurements used in the experiment, 50 fish were measured by three samplers to obtain an inter-sampler variance estimate. The fork lengths used were 1-mm increments from 55 to 59 mm (small), 62 to 66 mm (medium), and 69 to73 mm (large). We did not use the 2-mm intervals between each group focus the tagging on a more definite size category. Fish that were not within a targeted length category were returned to an empty raceway. Fish were taken from the individual containers and were either dyed (control group), or dyed and PIT-tagged (experimental group). The experimental group was PIT-tagged, the PIT tag was scanned, the fish weighed, and data entered into a computer file. The fork length of the fish was hand entered using the length on the individual container from which it came. The experimental group was then marked with Alcian Blue dye [60mg/l] using a Panjet® injector (Hart and Pitcher 1969) on the skin of the fish dorsal of the insertion of the left pelvic fin.

The fish were dyed in this area to keep the Panjet away from the PIT-tagging wound. The sample sizes for the experimental group of PIT-tagged fish were 1,199, 1,190, and 1,223 for the small, medium, and large categories respectively. The control group was treated in the same manner with the exception of the PIT-tagging process (length only). Fish in the control group were dyed in three separate areas of the skin on the body representing the three size groups. Fish from the small category were marked on the left side of the fish posterior to the tip of the left pectoral fin. The fish from the medium category were marked on the right side of the fish posterior to the tip of the right pectoral fin. The fish from the large category were marked on the right side of the fish dorsal of the insertion of the right pelvic fin. The sample sizes for the control group were 1,214, 1,197, and 1,227 for the small, medium, and large categories, respectively.

When the 1995 cohort migration is complete in 1997 we will report arrival timing of both PIT-tagged and non-PIT-tagged fish from 3 size groups at the screw trap on Lookingglass Creek, and the 3 size groups of PIT-tagged fish at Lower Granite Dam. We will also report survival rate to the screw trap and Lower Granite Dam.

Results/Discussion

Stream Flow and Temperature

Increasing and fluctuating flows began in Lookingglass Creek in February 1996, and continued until the week of 27 May (Figure 5). Weekly maximum flows ranged from 2 to 53 m^3/s with two major peaks occurring on 11 February and 29 April (Figure 5). Flow then decreased dramatically to a summer low of about 2 m^3/s after the week of 20 May (Figure 5). Flow started increasing again after the week of 28 October with an increase in flow occurring the week of 23 December to 9 m^3/s by the end of the 1996 (Figure 5). This was a similar pattern to historical flows and generally within the historical range observed.

Water temperature peaked at all sites in Lookingglass Creek for 1996 around late-July (15.4°C to 19.4°C) (Figure 5). This was the same period for the peaks in maximum water temperature observed from 1964 to 1971 (Figure 5). Maximum temperatures at site 3 in 1996 were similar to maximum temperatures observed among all years from site 2 from 1964 to 1971 (Figure 5). The minimum water temperatures for all sites in 1996 were very similar to one another, generally falling within the minimums observed from 1964 to 1971 (Figure 5). Maximum temperatures in 1996 at the hatchery intake (19.4°C) and at the trap live box (18.9°C) were somewhat higher than those from locations upstream in 1996 (Figure 5).

Adult Return to Lookingglass Hatchery

There were 3 three-year-old, 101 four-year-old, and one five-year-old unmarked adult spring Chinook salmon that returned to Lookingglass Hatchery in 1996 (Table 1). Figure 6 shows the run timing for the marked and unmarked adult spring Chinook salmon that swam into Lookingglass Hatchery.

The Lookingglass Creek progeny-to-parent ratio for the portion of the 1992 cohort that was complete in 1996 with three and four-year-old fish was 0.50 with the Grande Ronde River tributaries ranging from 0.28 to 0.79 (Table 2). The ratio for the 1993 cohort three-year-old fish was 0.01 with the Grande Ronde River tributaries ranging from 0.02 to 0.11 (Table 2).

The returns of three and four-year-old spring Chinook salmon to Lookingglass Hatchery are more than likely production from our releases of adult spring Chinook salmon above the weir in 1992 and 1993 (Lofy and McLean 1995a, McLean and Lofy 1995). It is possible that the unmarked fish returning to Lookingglass Creek are not from natural production in Lookingglass Creek but from other sources. Strays from other Grande Ronde River tributaries could be another source of unmarked adult spring Chinook salmon returning to the

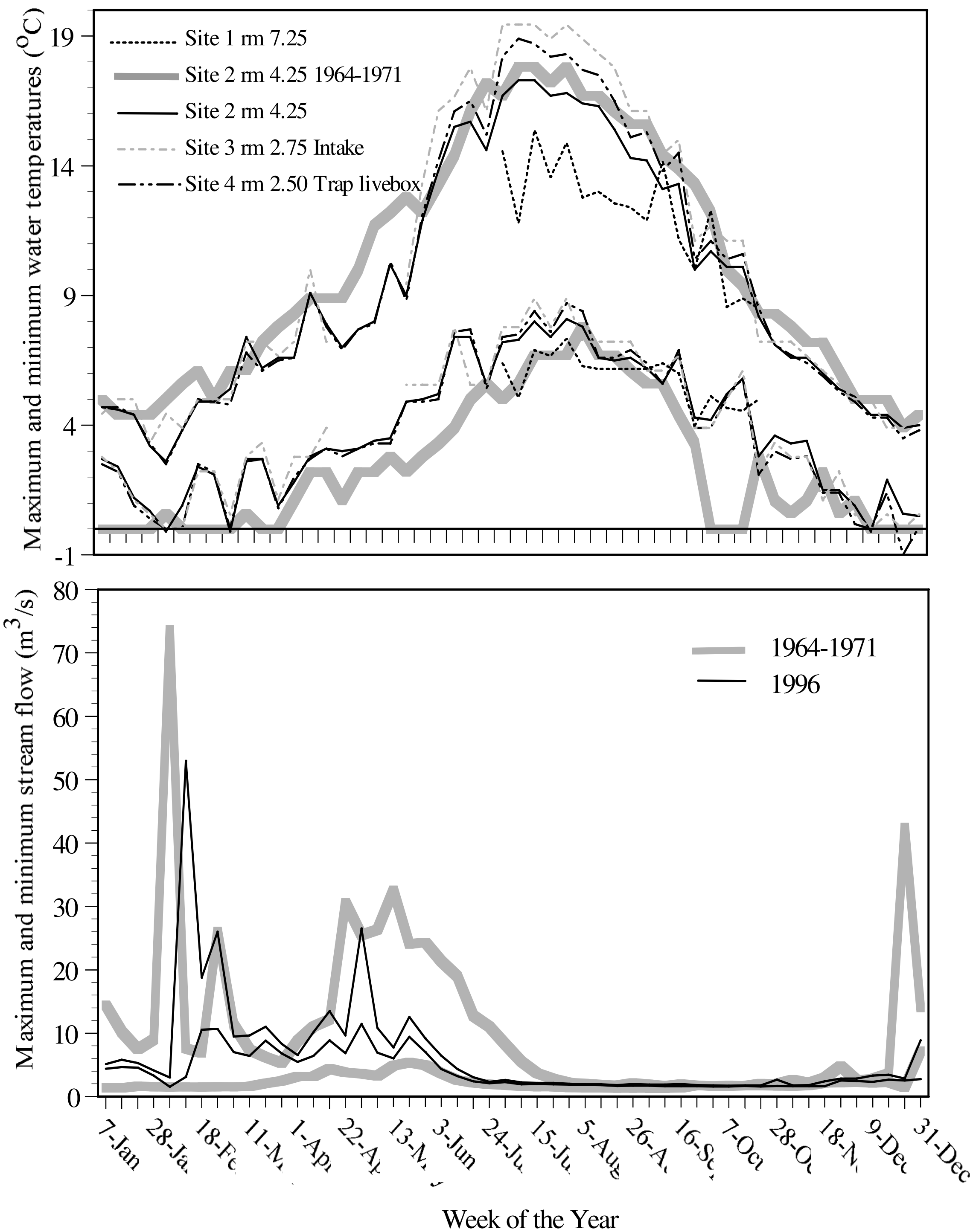

Figure 5. Historical and 1996 ranges of weekly stream temperature and flow in Lookingglass Creek. Week of the year is represented by the last day of the week. Data was provided by the USFS unpublished, Burck 1993, ODFW HMIS unpublished, and USGS unpublished.

Table 1. Disposition, age, sex, and fork length information from unmarked spring Chinook salmon that returned to Lookingglass Creek Hatchery in 1996.

		Males[a]			Females[a]		
			Fork length (mm)			Fork length (mm)	
Disposition[b]	Age[c]	N	Range	Median	N	Range	Median
Passed	3	1	663	--	0	--	--
Passed	4	24	620-852	760	25	683-774	727
Passed	5	0	--	--	0	--	--
Spawned	3	1	586	--	0	--	--
Spawned	4	20	705-900	756	20	671-773	730
Spawned	5	0	--	--	0	--	--
Mortality	3	1	480	--	0	--	--
Mortality	4	6	682-810	764	6	693-820	720
Mortality	5	1	900	--	0	--	--

[a] *The sex of the dead or spawned fish was determined by internal inspection. The sex of the passed fish was judged by hatchery personnel using the physical appearance of the fish on 26 August.*

[b] *Disposition of the fish, Passed = placed above the upper weir, Spawned = artificially spawned at the hatchery, Mortality = died while at Lookingglass Hatchery.*

[c] *Age of the fish was determined by ODFW using scale reading.*

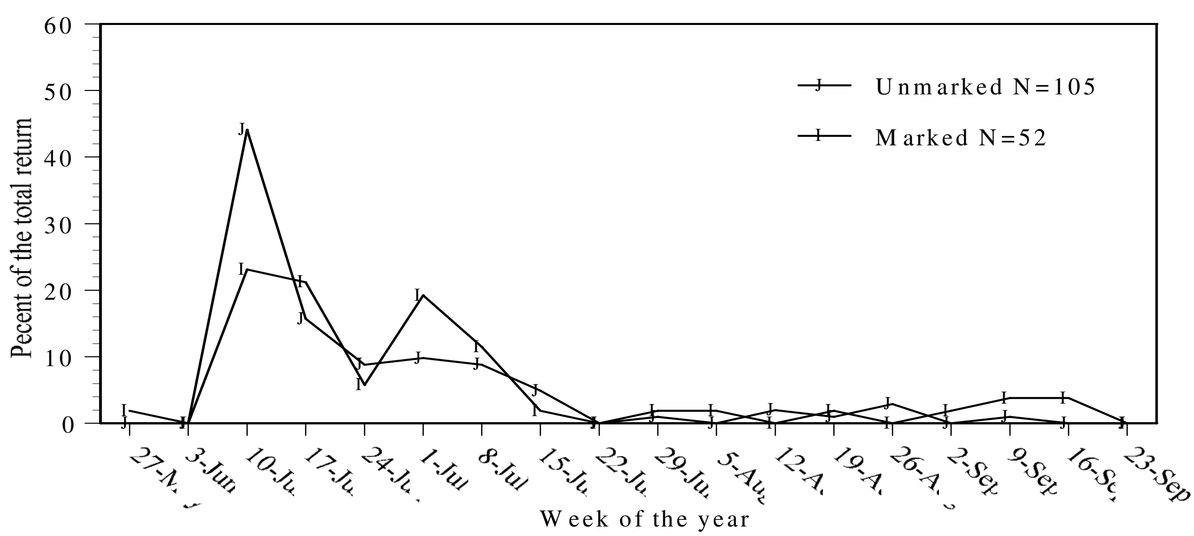

Figure 6. Arrival timing at the Lookingglass Hatchery adult trap of marked and unmarked spring Chinook salmon in 1996. N= total number of swim-ins to the hatchery.

Table 2. Progeny-per-parent ratios for the 1992 and 1993 cohort spring Chinook salmon returning in 1995 and 1996 to Lookingglass Creek and other Grande Ronde River tributaries.

Cohort, Location	Expanded[a] redd count	Parent Population	Returning progeny by age 3	4	5	Progeny-per-Parent
1992,						
Lookingglass Ck.	49	220	9	101		0.50
Wenaha R.	205	668	10	353		0.54
Minam R.	112	365	7	282		0.79
Lostine R.	44	77	3	74		0.54
Catherine Ck.	54	175	4	45		0.28
Grande Ronde R.	119	387	2	196		0.51
1993,						
Lookingglass Ck.	132	297	3			0.01
Wenaha R.	108	352	38			0.11
Minam R.	167	543	30			0.06
Lostine R.	105	344	8			0.02
Catherine Ck.	87	283	5			0.02
Grande Ronde R.	103	336	21			0.06

[a] *The expanded redd count was developed by ODFW Research, La Grande (M. Keefe, ODFW, Personal communication). The expansion is based on the redd distribution observed on the surveys covering all spawning areas and the subsequent increase in redd counts in the areas surveyed multiple times throughout the spawning season. The increase is then expanded across the total spawning area using the distribution of redds on the extensive surveys. The parent population was derived using the 1992 to 1994 average fish-per-redd estimate from Lookingglass Creek of 3.25(Lofy and M^cLean 1995a, Lofy and M^cLean 1995b, and M^cLean and Lofy 1995). The returning progeny age structure was derived from the average age of returning adults to Lookingglass Creek from 1971 to 1974 (Burck 1993). The percent age composition by return year was 8,93, 84.00, and 7.07% for 3, 4, and 5-year-olds respectively.*

Lookingglass Creek basin. Since we could not mark (fin clip, PIT tag, CWT) every fish leaving Lookingglass Creek as we have no way of being certain where the unmarked fish originated. The fact that high numbers of unmarked fish in Lookingglass Creek are a result of straying from other basins would suggest that Lookingglass Creek fish probably stray at the same rate into other Grande Ronde River tributaries making the total return to each basin the same. Another possible source of the unmarked fish returning to Lookingglass Creek could be Lookingglass Hatchery releases that were not fin clipped. Pre-release sampling of the Rapid River stock released from Lookingglass Hatchery conducted by ODFW suggest this is unlikely. The 1992 and 1993 cohorts, released from Lookingglass Hatchery, were 100% marked with either an adipose (AD) or right pelvic (RV) fin clip or a combination of the two (ADRV) (Table 3).

Release of Adult Spring Chinook Salmon Above the Weir

We selected 25 males and 25 females from the unmarked adult spring Chinook salmon that returned to Lookingglass Hatchery by 26 August, for release above the weir (Table 1, Appendix Table A-2). There were no five-year-olds, and only 1 three-year-old in the group released above the weir (Table 1, Appendix Table A-2). The median fork lengths for the 4-year-old males and females in the release group were 760 and 727 mm respectively, while the median fork lengths of the four-year-old males and females spawned at the hatchery were 756 and 730 mm respectively (Table 1). Hatchery personnel were 100% accurate at estimating the sex of the fish at release for the fish recovered on the spawning grounds (See **Spawning Ground Surveys**).

Spawning Ground Surveys

Between 30 August and 16 September 1996, 24 completed redds were observed above the upper weir (Unit 3U) and 7 completed redds were observed below Lookingglass Hatchery in Unit 1 (Appendix Tables A-3, A-4) (Figure 2). There were no redds observed in units 4, 3L, or 2 (Appendix Table, A-4) (Figure 2). No dead fish were recovered during a survey of the lower 0.75 rm of Unit 3U on 27 August, the day after the release. A peak count of 14 new redds in Unit 3U occurred on 30 August, just four days after the 26 August release of the 50 spring Chinook salmon above the upper weir (Figure 7).

We recovered 44 (88%) spring Chinook salmon from the release group during our surveys of Unit 3U (Appendix Table A-3) with the peak number of fish recovered on 9 September (Figure 7). We did not recover any fish in Unit 3U that were not tagged (not handled at the hatchery). We recovered only 3 fish during our surveys of units 4, 3L, 2, and 1 (Appendix Table A-4). None of these three fish were from the release group and all were recovered in Unit 1, below the Mitsubishi weir (Appendix Table A-4). Of the 44 marked recoveries only 17 had retained the spaghetti tag (38.6%), but all were identifiable as fish we released by the opercle punches. The sex of these fish, which was estimated at the time of tagging and verified by the data associated with spaghetti tags and opercle punches of recovered fish, was 100% accurate.

Table 3. Release, return, and fin clip quality data for the Rapid River stock spring Chinook salmon released at Lookingglass Hatchery.

	Juvenile release				Number of returning adults							
	Number	Pre-release fin clip[a]			ADRV			AD or RV			Survival (%)	
Cohort[a]	released	ADRV	AD or RV	None	3	4	5	3	4	5	ADRV	AD or RV
1992	849,273	830,968	18,305	0	34	578		0	1		0.074	0.005
1993	658,230	645,413	12,817	0	29			1			0.004	0.008

[a] *Release numbers and finclip quality are from ODFW prerelease sampling (ODFW Research, La Grande, unpublished). Most adult spring Chinook salmon from the 1992 and 1993 cohorts that were marked with an ADRV fin clip were collected at Lower Granite Dam and trucked to Lookingglass Hatchery. Some ADRV marked fish did swim into Lookingglass Hatchery because the dam was not 100% effective at collecting all the fish passing the dam. All AD only and RV only marked fish swam into the hatchery because these fish would not have been recognized as Rapid River stock released from Lookingglass Hatchery at Lower Granite Dam.*

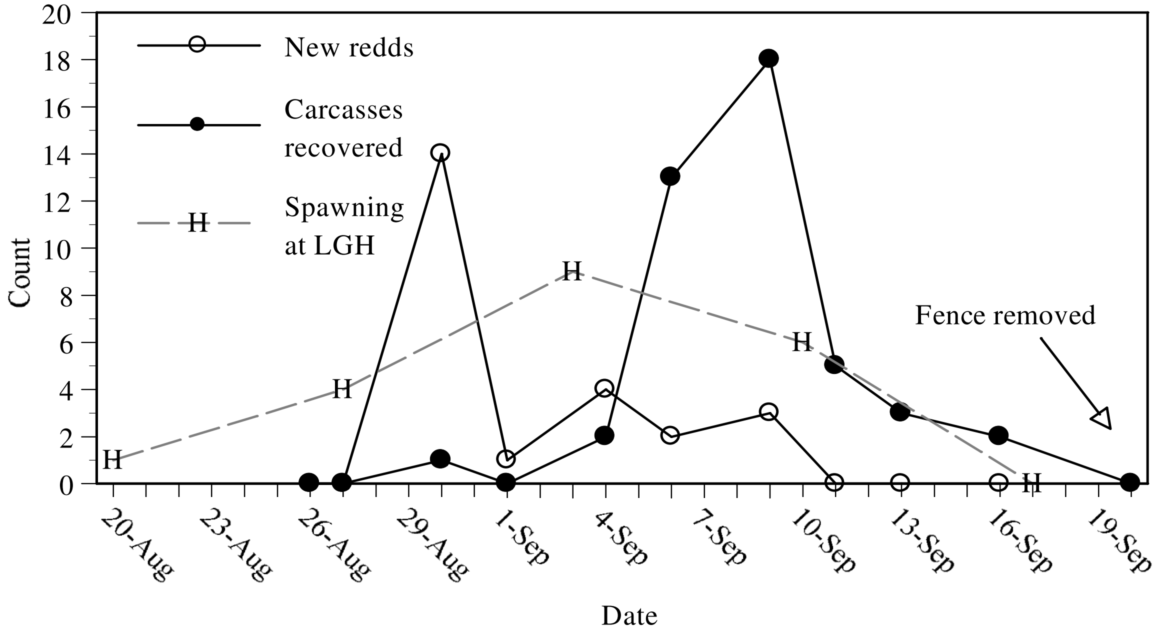

Figure 7. Completed new redds and recovery of unmarked spring Chinook salmon adults released in Unit 3U of Lookingglass Creek and spawn timing of unmarked female salmon at Lookingglass Hatchery in 1996.

The higher rate of recovery than previous years in Unit 3U (Lofy and M^{c}Lean 1995, Lofy and M^{c}Lean 1995a, and M^{c}Lean and Lofy 1995) is most likely a result of the high frequency of surveys conducted in Unit 3U (Appendix Table A-3). Another factor that may have influenced the high recovery rate is the late release of the fish above the upper weir, which decreased the amount of time the fish were actually in the natural environment and the time available to predators and scavengers (e.g., bears, cougars, bobcats, coyotes, and raccoons).

Sampling Adult Chinook Salmon for Pathogens

Personnel from ODFW Fish Pathology laboratory were provided with 44 Chinook salmon kidney samples and 3 whole carcasses recovered during spawning ground surveys in 1996 (Appendix Tables A-3, A-4). Of the 47 kidney samples collected from Lookingglass Creek, only 1 of the fish had high levels, 5 had moderate levels, and 41 had low levels of infection of *Renibacterium salmoninarum* by enzyme-linked immunosorbent assay (ELISA) which causes bacterial kidney disease (BKD) (Appendix Table A-5). Only the carcasses that were collected whole could be sampled for *Ceratomyxa shasta* (ceratomyxosis). Of the 3 samples taken, 1 had low, and 1 had high infection levels (spores were present), and the third was negative (no spores were present) (Appendix Table A-5). Bacteria cultures were grown from all 47 Chinook salmon sampled in 1996. Aeromonad-pseudomonad bacteria (general septicemia) dominated 22 of the cultures, 19 were negative for any bacteria in the culture, 4were dominated by *Flexibacter psychrophilus* (cold water disease), and 2 were dominated by *Yersinia ruckeri* (enteric redmouth disease) (Appendix Table A-5). In past years of pathology reports (Lofy and McLean 1995a 1995b, McLean and Lofy 1995 and 1999) pathologists have not documented the absence of bacteria in cultures from carcasses recovered above the weir on Lookingglass Creek as in 1996. Possible explanations for this may be that in 1996, the sample size was higher than in past years, and many of the samples collected were from living fish (gaffed).

Genetic Monitoring

We collected 88 fin samples from the unmarked fish released above the weir and spawned in the hatchery for genetic analysis by the NMFS genetic monitoring program in 1996. The results from genetic analysis by NMFS have not been provided to us.

Population Estimates and Timing Past the Rotary Screw Trap for the 1994 Cohort

We captured 1,337 juvenile spring Chinook salmon from the 1994 cohort in the rotary screw trap. The first fry from the 1994 cohort was captured 16 January 1995 (Appendix Table A-1). We stopped trapping of the 1994 cohort on 30 April 1996 (Appendix Table A-1). Median monthly fork length of fish captured in the trap ranged from 37 mm for the month of March, 1995, to 98 mm for the month of April, 1996 (Figure 8). We estimated that the total population passing the rotary screw trap in Lookingglass Creek during the smolt migration for the 1994 cohort was 7,983 juveniles (Table 4).

Most of the juveniles from the 1994 cohort migrated past the trap before 1 December as sub-yearlings (Figure 9). Peak migration past the trap for the 1994 cohort occurred during the October trapping period (Figure 9).

We released 405 juvenile spring Chinook salmon from the 1994 cohort on the right bank and 419 on the left bank from 28 September to 2 November 1995. We recaptured 71 (17.5%) of the fish that were released on the right bank and 88 (21.0%) of the fish that were released on the left bank. There was no significant difference in recapture rate at the trap between banks of release (χ^2=3.841, P=0.21, df=1).

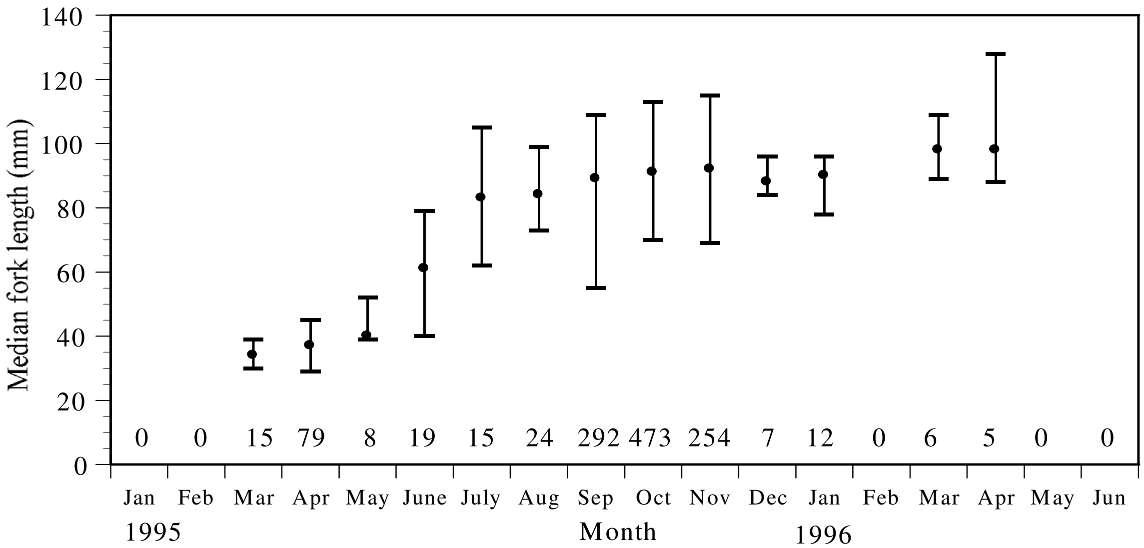

Figure 8. Monthly median and range of fork lengths from 1994 cohort juvenile spring Chinook salmon captured in the rotary screw trap on Lookingglass Creek in 1995 and 1996. Sample size is shown above the month.

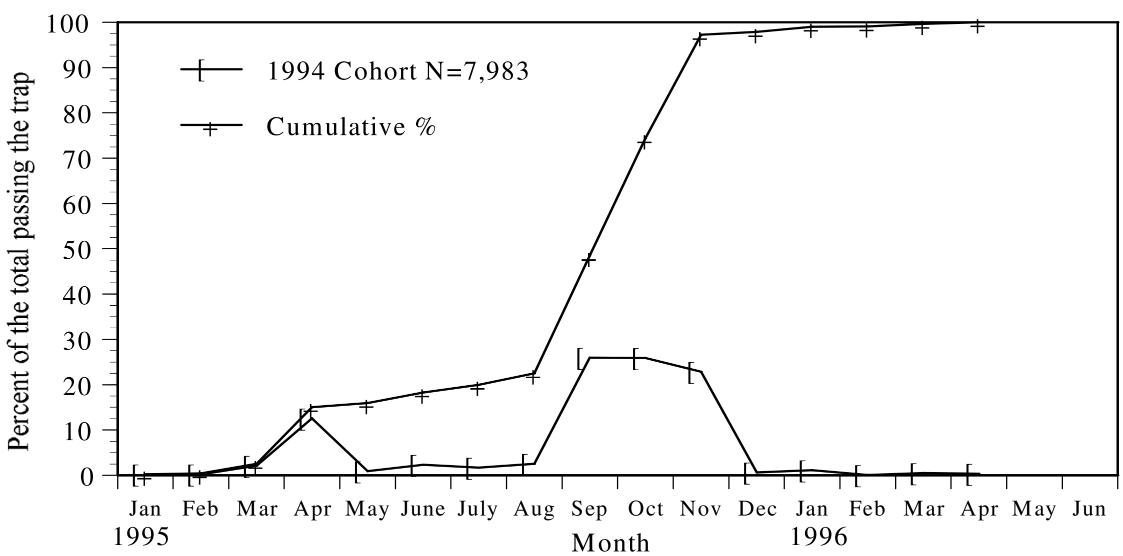

Figure 9. Percent of the total expanded numbers of 1994 cohort juvenile spring Chinook salmon passing the rotary screw trap site on Lookingglass Creek in 1995 and 1996. The total population is an estimated number.

Table 4. Juvenile spring Chinook salmon from the 1994 cohort captured in a rotary screw trap, releases and recaptures from trap efficiency tests, and the estimated number of migrants from Lookingglass Creek during 1995 and 1996. Also shown is the number of redds and adults that spawned this cohort.

Month	Total trapped	Trap efficiency release	Trap efficiency recapture	% Trap efficiency[a]	Population Estimate	±95%CI
Jan	2	0	0	11.90	17	47
Feb	2	0	0	11.90	17	47
Mar	20	0	0	11.90	168	295
Apr	119	0	0	11.90	1,000	1,607
May	9	0	0	11.90	76	137
Jun	22	3	1	11.90	185	320
Jul	16	12	0	11.90	134	224
Aug	24	27	4	11.90	202	346
Sep	353	176	30	17.05	2,071	798
Oct	482	468	109	23.29	2,070	386
Nov	257	262	38	14.08	1,825	613
Dec	7	7	1	14.08	50	39
Jan	13	5	0	14.08	92	56
Feb	1	0	0	14.08	7	13
Mar	6	4	1	14.08	43	35
Apr	4	6	0	14.08	28	28
	1,337				7,985	4,991

Estimated # of redds above the weir in 1994 was: 40
Estimated # of female spring Chinook salmon above the weir in 1994 was: 62
Estimated # of male spring Chinook salmon above the weir in 1994 was: 59

[a] *Because the trap efficiency release was less than 25 fish for the months of Jan-Jul 1995 and Dec 1995-Apr 1996, the releases for Jan-Aug 1995 and Nov 1995-Apr 1996 were combined to make one trap efficiency estimate that was used for individual months.. The trap efficiency release was sometimes greater than the total trapped because the release dates may have spanned months.*

PIT-Tagging of the 1994 Cohort

We PIT-tagged a total of 268 juveniles from the fall group, 655 juveniles from the winter group, and 20 juveniles from the spring group for the 1994 cohort at the screw trap (Table 5). We saw no delayed mortality at the trap when fish were held at least overnight before release. From the 1,098 juveniles tagged from the field group (Table 5), we saw no delayed mortality during the 24-hour retention in liveboxes.

Table 5. PIT-tagging information for juvenile spring Chinook salmon from the 1994 cohort captured in the field and at the rotary screw trap on Lookingglass Creek in 1995 and 1996.

Group	Number PIT-Tagged	Median date of PIT-tagging	Median arrival date at Lower Granite Dam	Number Detected	Expanded Detections
Field	1,098	22 September 1995	17 April 1996	70	134
Fall (trap)	268	25 September 1995	15 April 1996	11	22
Winter (trap)	655	26 October 1995	14 April 1996	45	90
Spring (trap)	20	19 February 1996	16 April 1996	4	6

Weekly Arrival Timing at Lower Granite Dam

Juvenile Chinook salmon from the 1994 cohort first arrived at Lower Granite Dam the week of 1 April, with the last fish arriving the week of 20 May (Figure 10). There were no significant differences between the arrival timing of any of the four groups PIT-tagged in Lookingglass Creek ($P=0.57$).

The arrival timing of the large fish group (>88mm) was significantly different than the arrival timing of the small fish group (≤ 88mm) for the 1994 cohort field group PIT-tagged in Lookingglass Creek ($P=0.00$) (Figure 11). The median length at tagging for the fish that were detected was 88 mm with sample sizes of 39 for the small group and 31 for the large group.

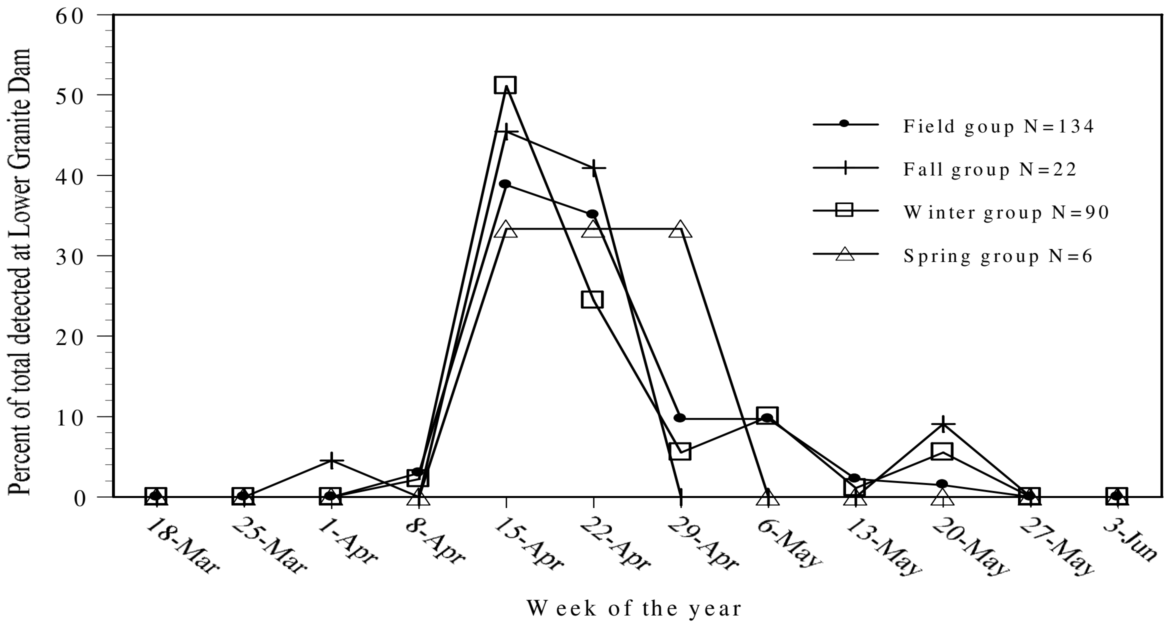

Figure 10. Arrival timing by week at Lower Granite Dam in 1996 of four groups of 1994 cohort juvenile spring Chinook salmon PIT-tagged from Lookingglass Creek. Expanded detections (N) are graphed. Actual observations are in parentheses. Week of the year is represented by the last date in the week.

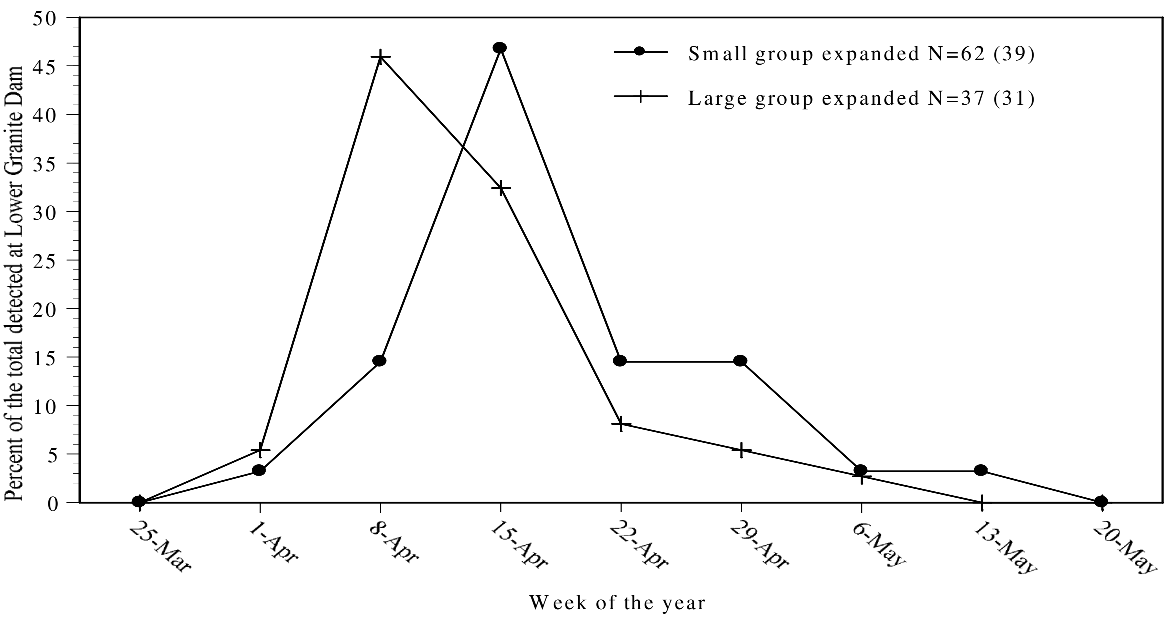

Figure 11. Arrival timing by week at Lower Granite Dam in 1996 for groups of small (fork length < 88 mm) and large (fork length ≥ 88 mm) fish from the field group of 1994 cohort juvenile spring Chinook salmon in Lookingglass Creek. Expanded detections (N) are graphed. Actual observations are in parentheses. Week of the year is represented by the last date in the week.

Minimum Survival Rate to Lower Granite Dam

Minimum survival rates of PIT-tagged juvenile spring Chinook salmon from the 1994 cohort for the field, fall, winter, and spring groups were 16.9, 17.9, 18.3, and 30.0%, respectively. There was no significant difference in detection rates between the field, fall, winter or spring groups based on the 95% confidence intervals (Figure 12). Survival indices of the 1994 cohort captured at the trap by month for the months in which more than 50 tagged fish were released (September to November), ranged from 16.9 to 19.0% (Figure 12). Minimum survival rates among 6 different size categories of fish from the 1994 cohort field group in Lookingglass Creek were not significantly different (χ^2=3.50, P=0.62, df=5) (Figure 13).

Migration Timing of the Field Group Past the Rotary Screw Trap

The field groups of PIT-tagged fish for both the 1993 and 1994 cohorts peaked in movement past the trap in September, the same month they were tagged (Figure 14). The peak in movement past the trap for the non-PIT-tagged fish after the first date of PIT-tagging for both the 1993 and 1994 cohorts was in October (Figure 14). There was a only a significant difference in the migration timing past the trap between the PIT-tagged and non-PIT-tagged fish of the 1993 cohort (P=0.00).

The earlier peak migration for PIT-tagged fish may have been induced by the activities associated with PIT-tagging (capture, anesthetization, and tagging). The earlier migration may place the fish in a less suitable environment until migration to the ocean, possibly lowering growth rates and survival. The earlier movement may also increase predation on the fish as they move to new areas to continue rearing. More data needs to be collected to determine if PIT-tagging, and the handling of the fish associated with PIT-tagging, is the reason these fish migrated earlier and how to decrease the detrimental effects of tagging on fish.

Fork Length, Weight, and Condition Factor of Detected vs. Non-Detected Fish

There were no differences in fork length or weight between detected and non-detected juvenile spring Chinook salmon from Lookingglass Creek that were PIT-tagged in the field within the 1992, 1993, or 1994 cohorts (Table 6).

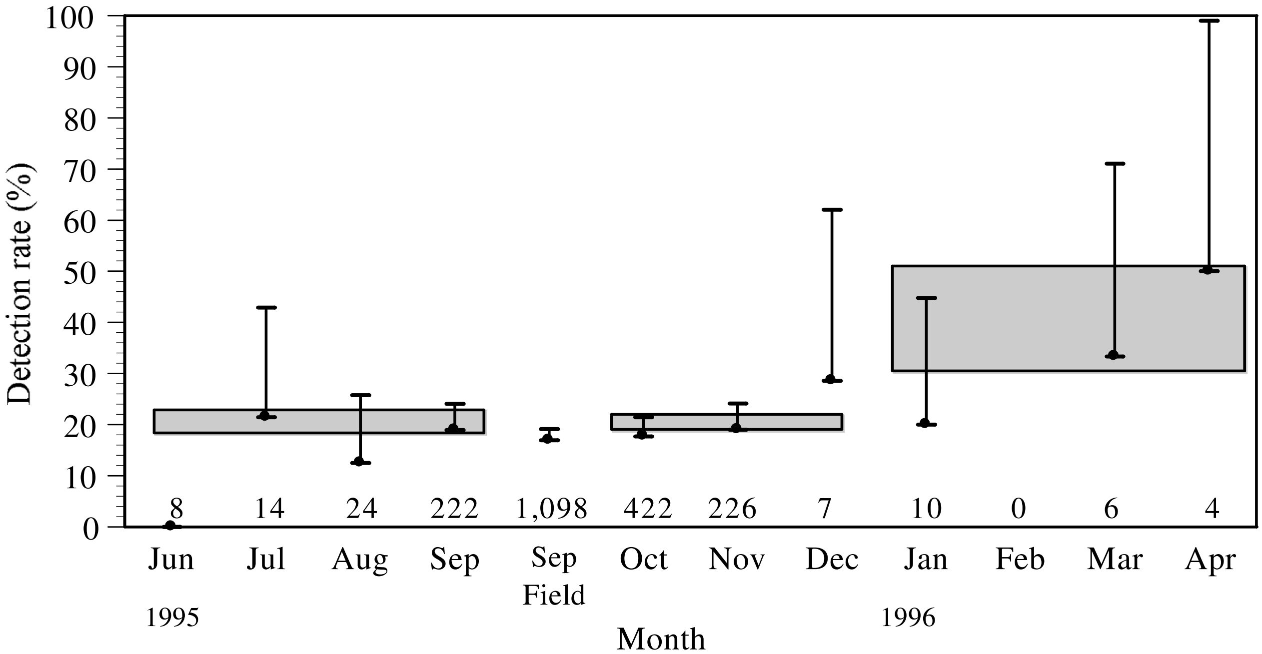

Figure 12. Total unique detection rates with upper ninety-five percent confidence intervals (bars) for 1994 cohort juvenile spring Chinook salmon tagged at the trap or during seining (field) in Lookingglass Creek and detected at Snake or Columbia River dams. The shaded boxes represent detection rate with upper ninety-five percent confidence intervals when fish for an entire group are combined. Number tagged is above each month.

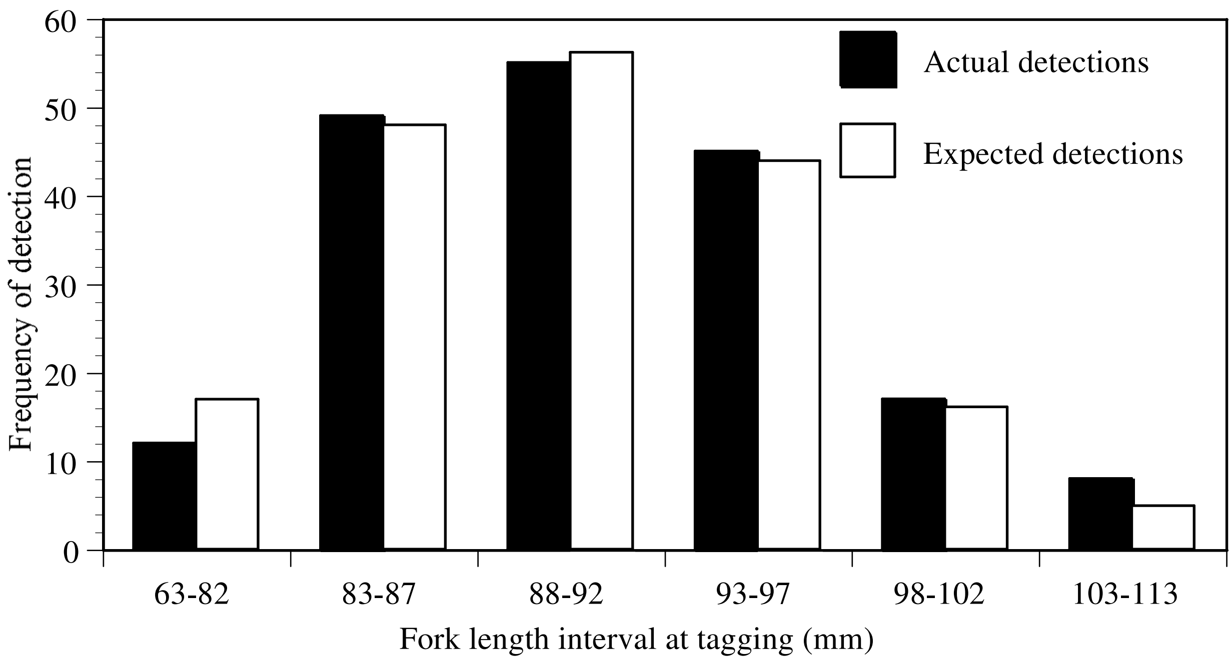

Figure 13. Comparison of actual and expected unique PIT tag detections at Snake or Columbia River dams by fork length interval of 1994 cohort juvenile spring Chinook salmon seined from Lookingglass Creek. The field group PIT-tagged in 1995 was used for this comparison.

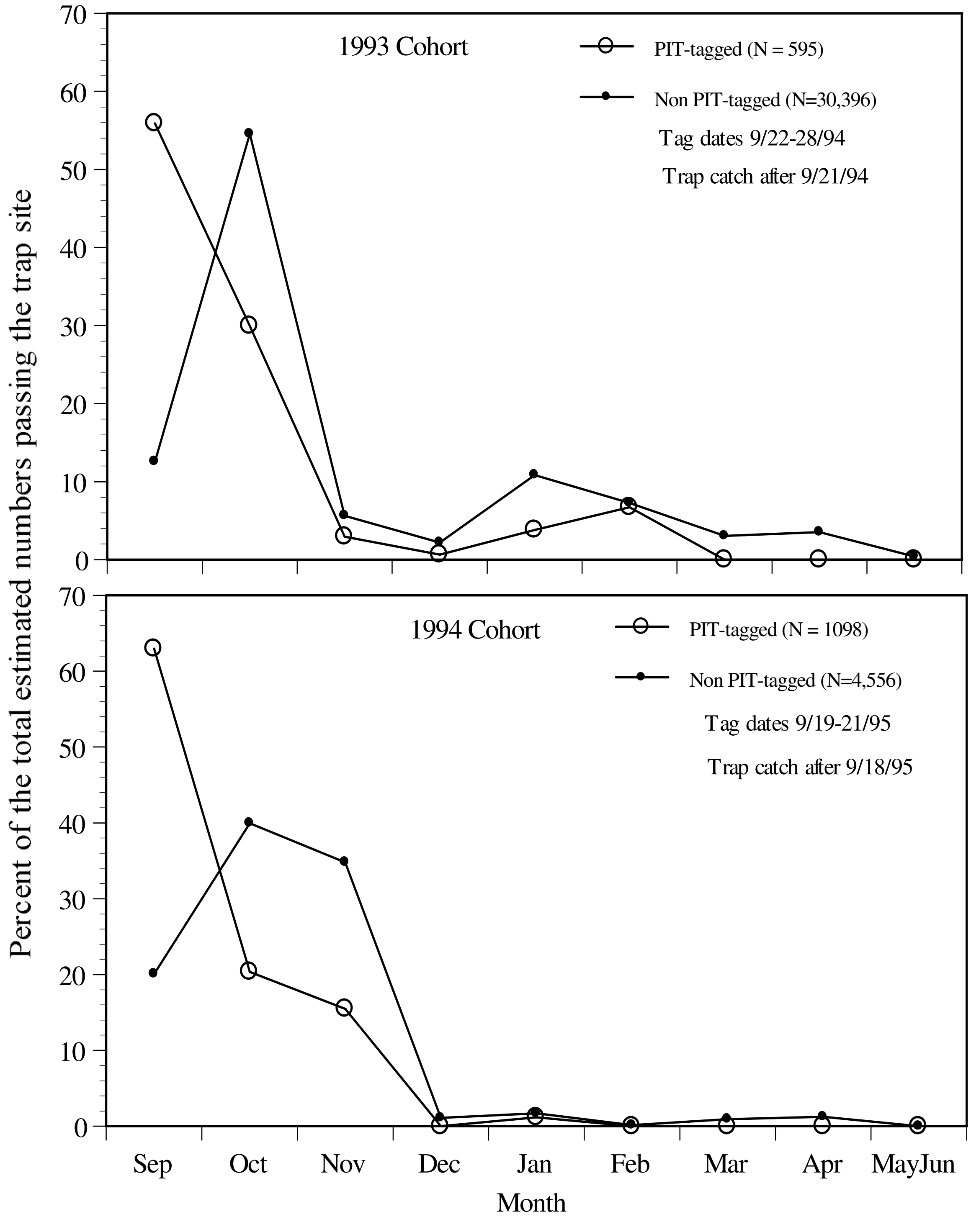

Figure 14. Arrival timing at the rotary screw trap in Lookingglass Creek of PIT-tagged and non-PIT-tagged juvenile spring Chinook salmon after commencing PIT-tagging the field group. N represents the total numbers of fish trapped (expanded for trap efficiency).

Table 6. Weight, fork length, and condition factor at PIT-tagging of juvenile spring Chinook salmon from the Lookingglass Creek field group that were detected at Snake or Columbia River dams versus those that were not detected.

Cohort,	Fork length(mm)				Weight (g)				Condition Factor			
	Min	Max	Mean	P	Min	Max	Mean	P	Min	Max	Mean	P
1992,												
Detected(N=176)	66	101	84.89		3.5	12.0	7.21		0.82	1.77	1.18	
Not detected(N=830)	65	108	83.29	0.17	2.9	14.0	7.06	0.33	0.70	1.82	1.20	0.05
1993,												
Detected(N=123)	69	105	83.33		3.5	13.5	6.79		0.70	1.69	1.15	
Not detected(N=852)	59	112	82.26	0.28	2.2	16.5	6.40	0.11	0.80	1.84	1.12	0.90
1994,												
Detected(N=185)	78	113	90.57		5.1	16.5	8.41		0.89	1.43	1.12	
Not Detected(N=909)	65	112	90.04	0.84	3.4	16.5	8.27	1.00	0.70	1.58	1.12	0.82

Comparison of Lookingglass Creek Field Groups to Other Grande Ronde River Tributaries

Weekly Arrival Timing at Lower Granite Dam

The arrival timing of PIT-tagged juvenile spring Chinook salmon at Lower Granite Dam for all of the Grande Ronde River tributaries and the Rapid River stock (from Lookingglass Hatchery) were significantly different from that of Lookingglass Creek for the 1992, 1993, and 1994 cohorts (Figures 15-20).

The median arrival dates for Lookingglass Creek were not different from that of the Grande Ronde River tributaries and the Rapid River stock 4 times (Figures 15-20) (Table 7). The Lookingglass Creek median weekly arrival was 1 week earlier 5 times, 2 weeks earlier 4 times, 4 weeks earlier 3 times, and 6 weeks earlier once (Figures 15-20) (Table 7). The juveniles from tributaries that had rearing areas that are the farthest from Lower Granite Dam, (i.e., Grande Ronde and Lostine rivers, and Catherine Creek) usually had the later median weekly arrival time (Figures 15-20) (Table 7).

Minimum Survival Rate to Lower Granite Dam

The survival of the field group from Lookingglass Creek for the 1992, 1993, and 1994 cohorts was not significantly different from most of the other groups from the Grande Ronde River tributaries (Table 8). The Wenaha, Minam, and upper Grande Ronde rivers had significantly different survival rates from the Lookingglass Creek group for the 1992 cohort (Table 8). The Lostine River had a significantly different survival rate than the Lookingglass Creek group for the 1993 cohort (Table 8). No significant differences in survival rates were seen for the 1994 cohort.

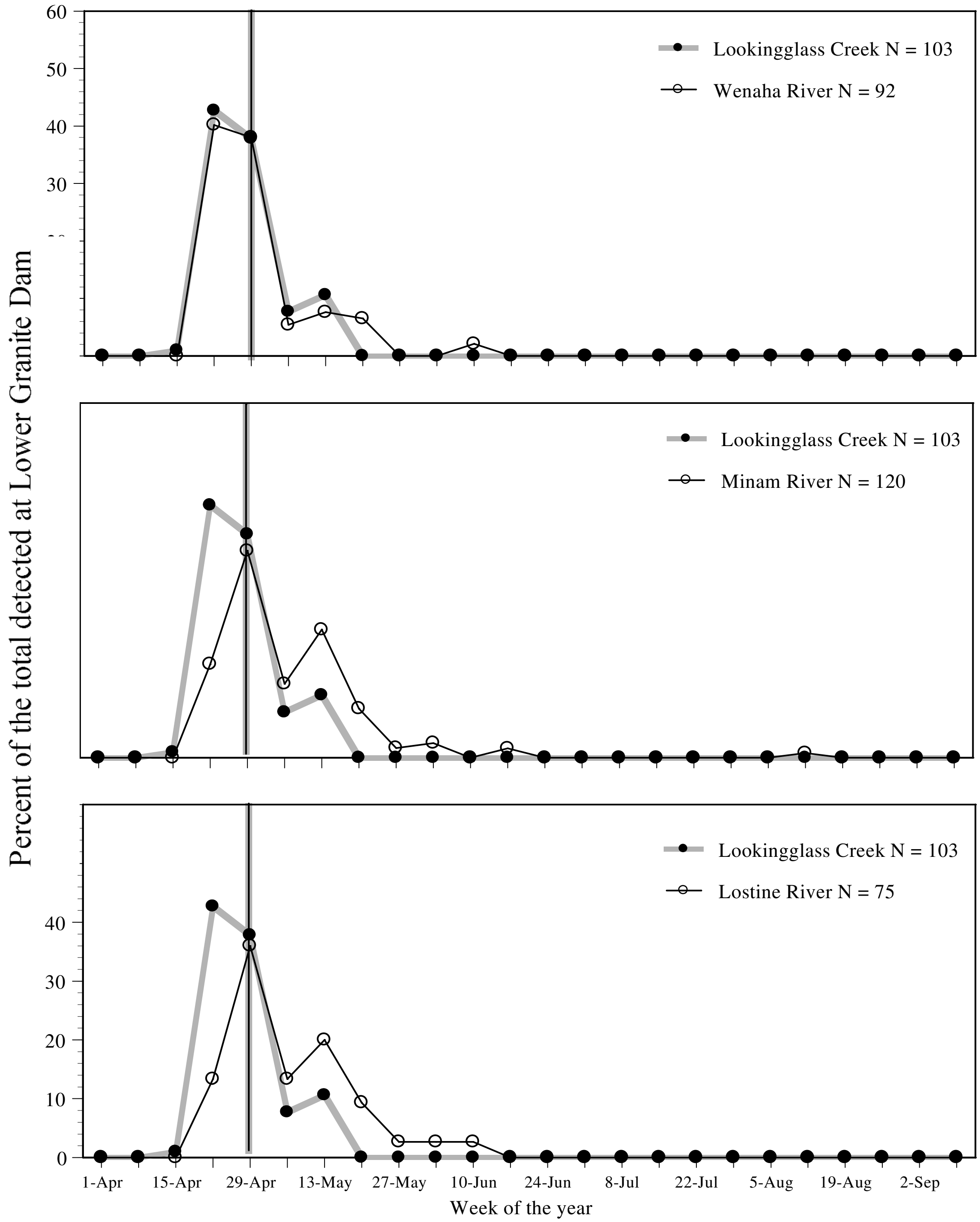

Figure 15. Arrival timing at Lower Granite Dam in 1994 of PIT-tagged juvenile spring Chinook salmon from the 1992 cohort that were tagged in 1993 from Lookingglass Creek and the Wenaha, Minam, and Lostine rivers. The vertical bars indicate the week of median arrival (when at least 50% of the fish had been detected) at the dam. N values reflect expanded detections for spill at Lower Granite Dam.

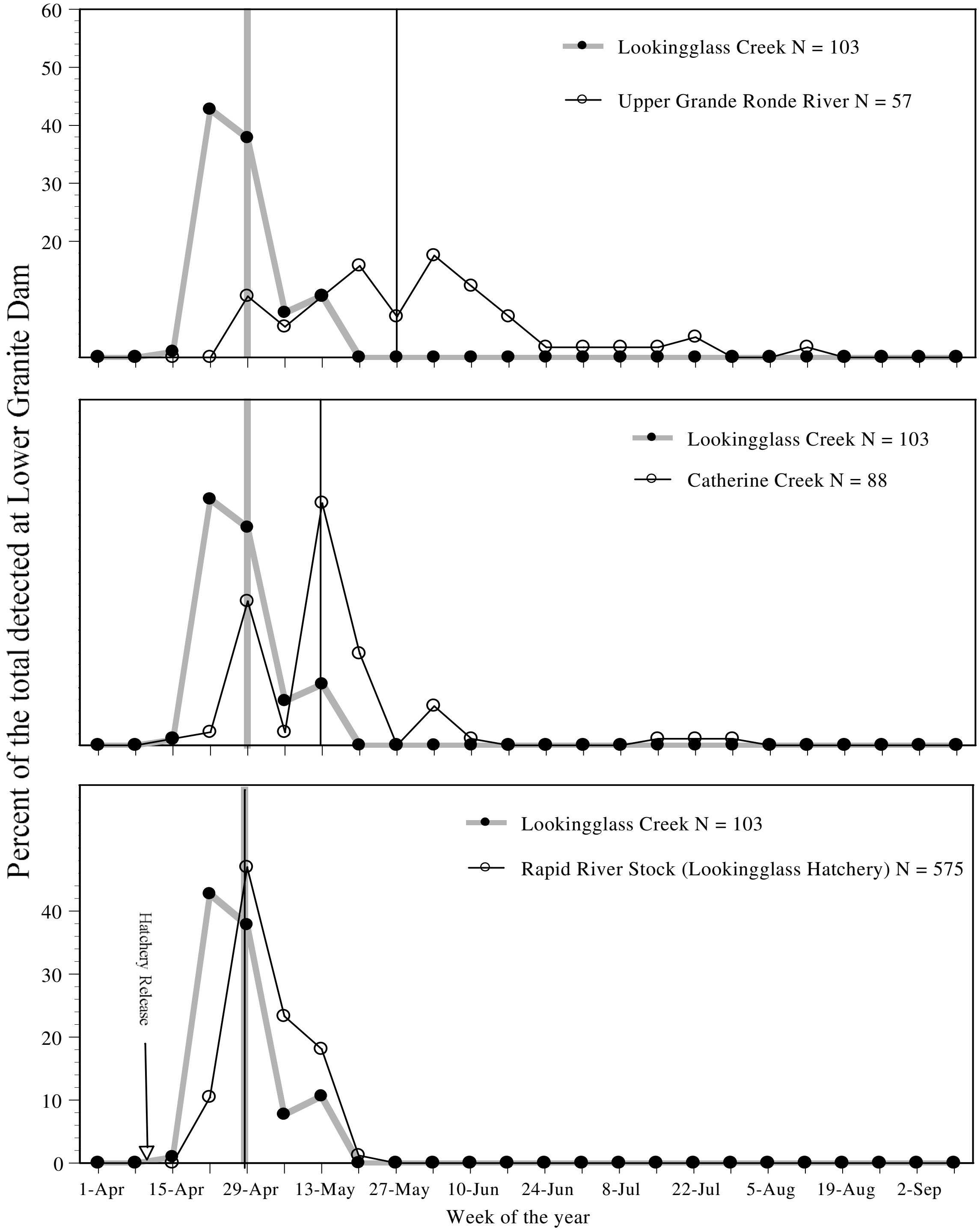

Figure 16. Arrival timing at Lower Granite Dam in 1994 of PIT-tagged juvenile spring Chinook salmon from the 1992 cohort that were tagged in 1993 from Lookingglass and Catherine creeks, the upper Grande Ronde River, and the Rapid River stock released from Lookingglass Hatchery. The vertical bars indicate the week of median arrival (when at least 50% of the fish had been detected) at the dam. N values reflect expanded detections for spill at Lower Granite Dam.

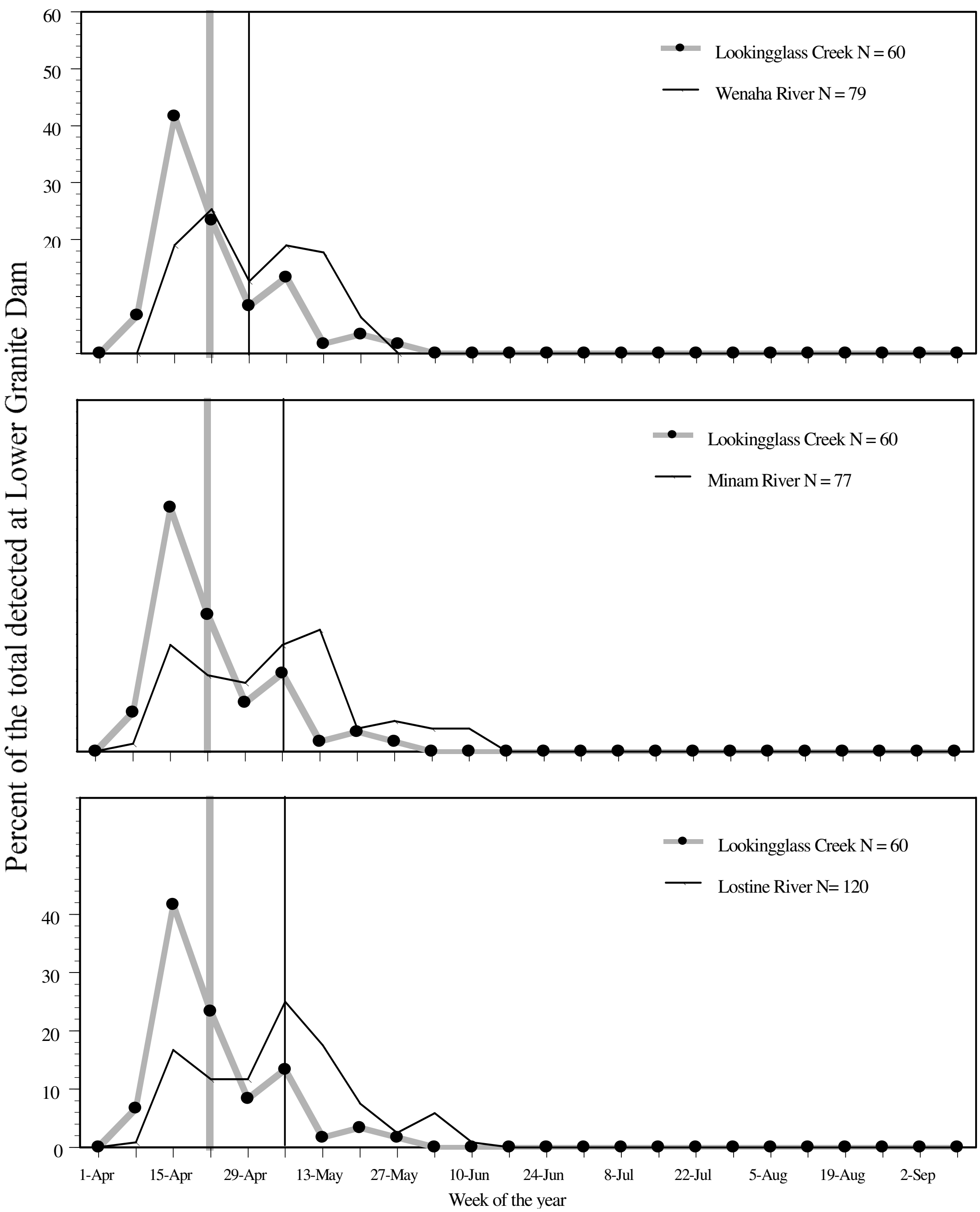

Figure 17. Arrival timing at Lower Granite Dam in 1995 of PIT-tagged juvenile spring Chinook salmon from the 1993 cohort that were tagged in 1994 from Lookingglass Creek and the Wenaha, Minam, and Lostine rivers. The vertical bars indicate the week of median arrival (when at least 50% of the fish had been detected) at the dam. N values reflect expanded detections for spill at Lower Granite Dam.

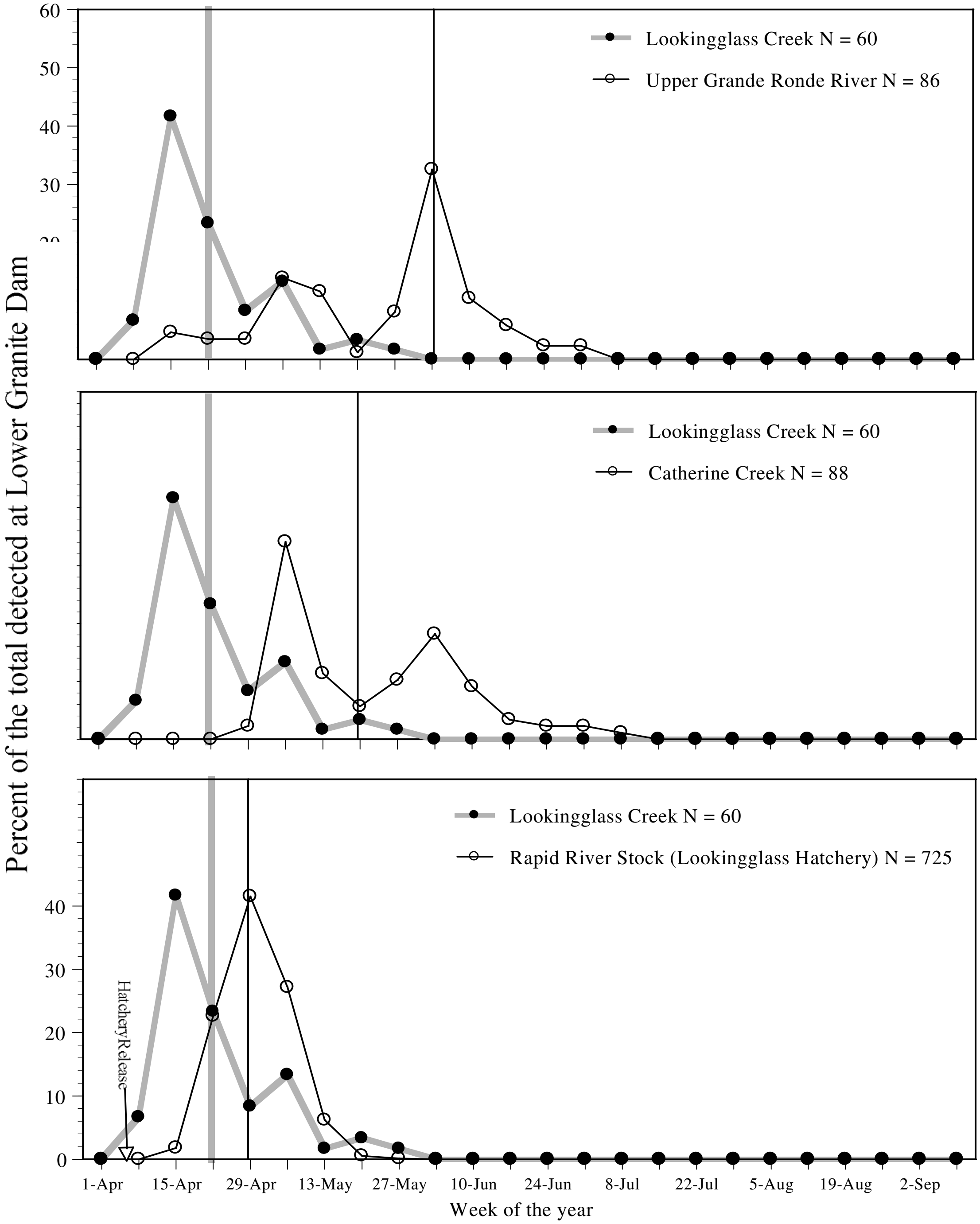

Figure 18. Arrival timing at Lower Granite Dam in 1995 of PIT-tagged juvenile spring Chinook salmon from the 1993 cohort that were tagged in 1994 from Lookingglass and Catherine creeks, the upper Grande Ronde River, and the Rapid River stock released from Lookingglass Hatchery. The vertical bars indicate the week of median arrival (when at least 50% of the fish had been detected) at the dam. N values reflect expanded detections for spill at Lower Granite Dam.

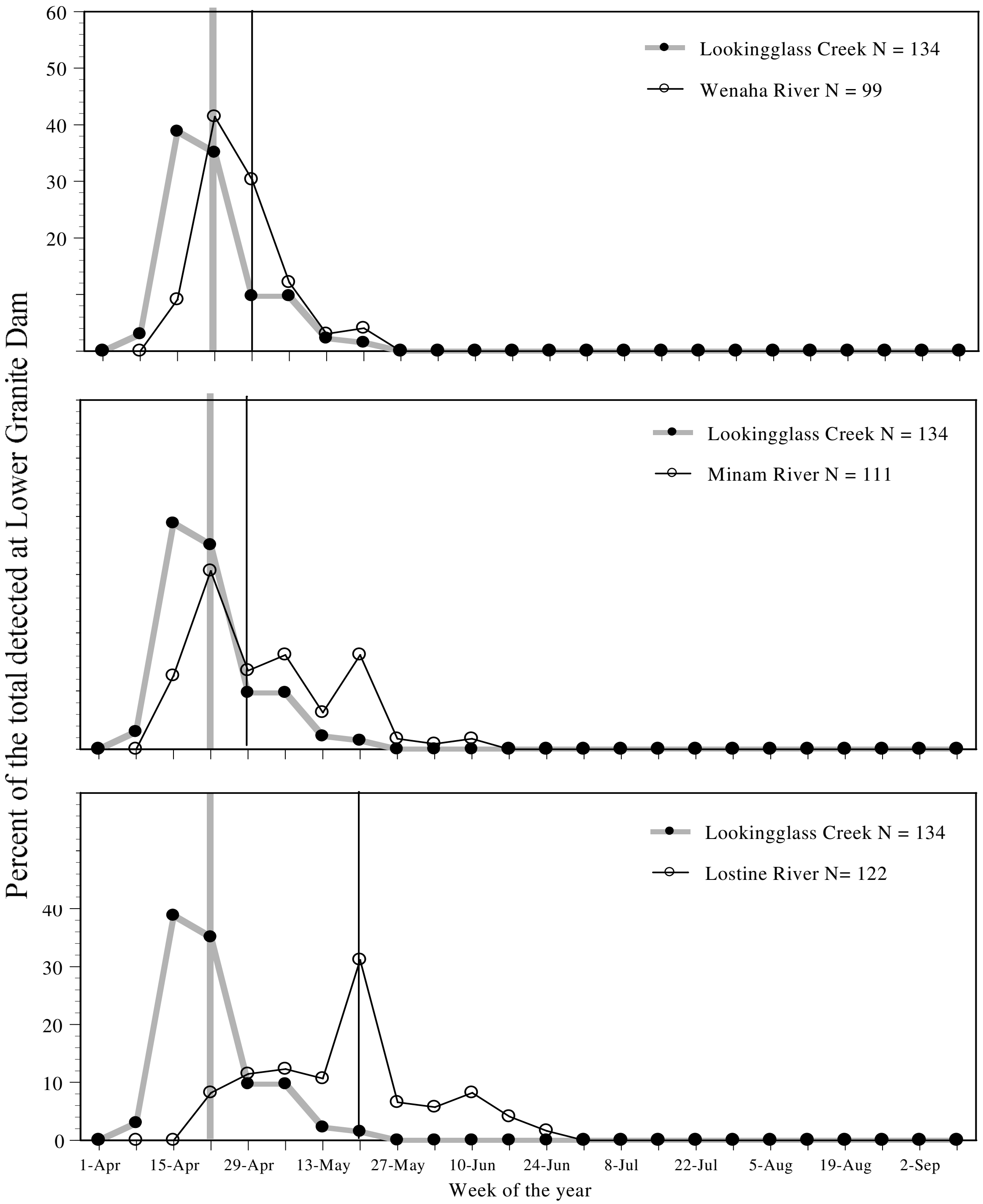

Figure 19. Arrival timing at Lower Granite Dam in 1996 of PIT-tagged juvenile spring Chinook salmon from the 1994 cohort that were tagged in 1995 from Lookingglass Creek and the Wenaha, Minam, and Lostine rivers. The vertical bars indicate the week of median arrival (when at least 50% of the fish had been detected) at the dam. N values reflect expanded detections for spill at Lower Granite Dam.

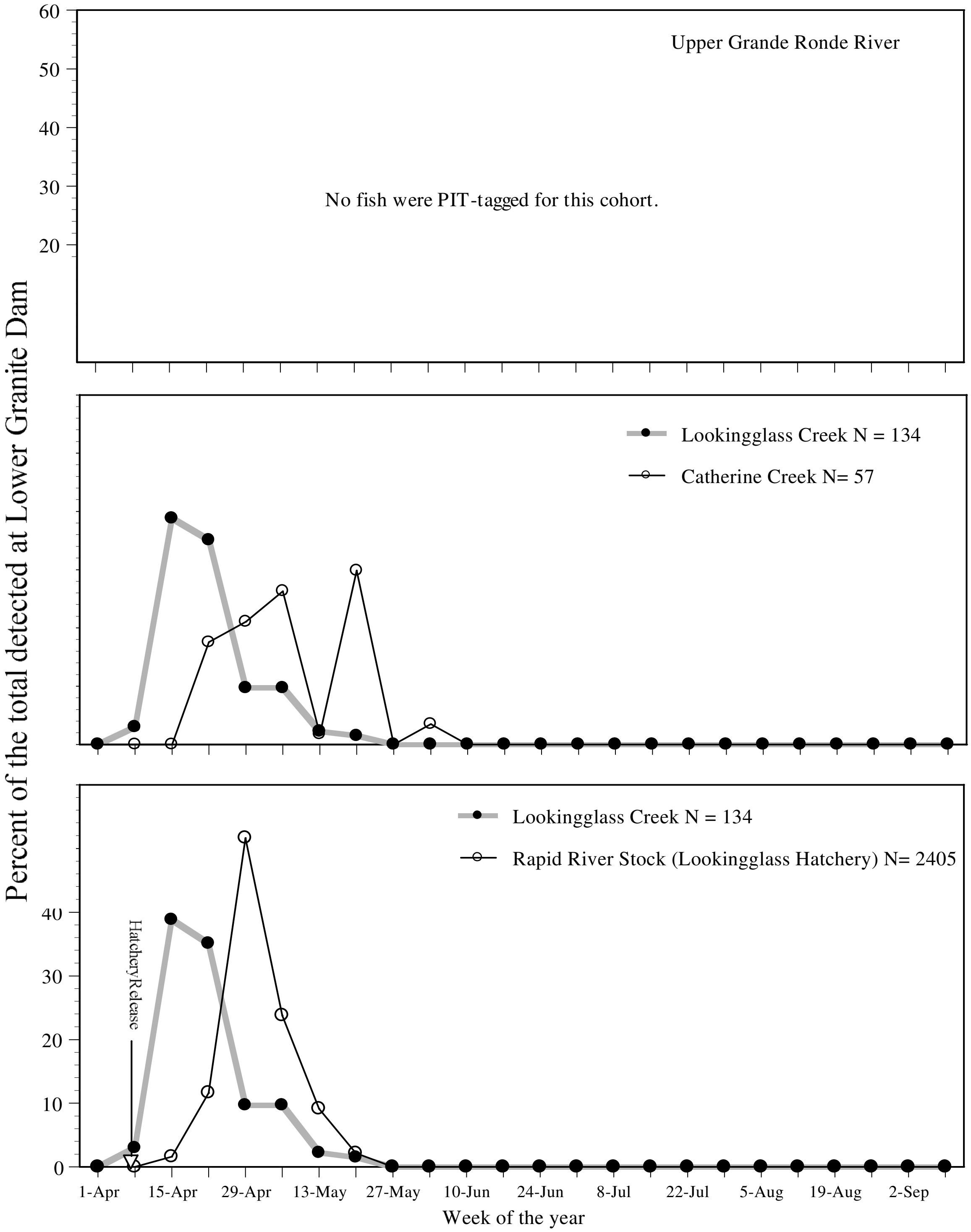

Figure 20. Arrival timing at Lower Granite Dam in 1996 of PIT-tagged juvenile spring Chinook salmon from the 1994 cohort that were tagged in 1995 from Lookingglass and Catherine creeks, the upper Grande Ronde River, and the Rapid River stock released from Lookingglass Hatchery. The vertical bars indicate the week of median arrival (when at least 50% of the fish had been detected) at the dam. N values reflect expanded detections for spill at Lower Granite Dam.

Table 7. Median arrival difference at Lower Granite Dam between juvenile spring Chinook salmon PIT-tagged in Lookingglass Creek (field group) and fish PIT-tagged in Grande Ronde River tributaries and at Lookingglass Hatchery (Rapid River stock).

Cohort,	Distance from	Difference (weeks) from Lookingglass Creek								
Tributary	Lower Granite Dam (Km)	-2	-1	Same	1	2	3	4	5	6
Lookingglass Cr.	245									
1992,										
Wenaha R.	206			X						
Lookingglass H.	238			X						
Minam R.	265			X						
Lostine R.	292			X						
Catherine Cr.	372					X				
Grande Ronde R.	415							X		
1993,										
Wenaha R.	206				X					
Lookingglass H.	238				X					
Minam R.	265					X				
Lostine R.	292					X				
Catherine Cr.	372							X		
Grande Ronde R.	415									X
1994,										
Wenaha R.	206				X					
Lookingglass H.	238				X					
Minam R.	265				X					
Lostine R.	292							X		
Catherine Cr.	372					X				

Table 8. Unique PIT tag detections at Snake and Columbia River dams for juvenile spring Chinook salmon PIT-tagged in the fall from the Grande Ronde River basin. Data were not expanded for spillway flow.

Cohort, Stream of tagging	Total tagged	Number detected	Percent of release[a]	+95%CI[b]
1992				
Lookingglass Creek	1,022	178	17.42	2.33
Wenaha River	998	129	12.93*	2.08
Minam River	997	213	21.36*	2.54
Lostine River	725	123	16.97	2.73
Upper Grande Ronde River	1,001	89	8.89*	1.76
Catherine Creek	1,000	166	16.60	2.31
1993				
Lookingglass Creek	997	125	12.54	2.06
Wenaha River	999	120	12.01	2.02
Minam River	996	124	12.45	2.05
Lostine River	1,002	181	18.06*	2.38
Upper Grande Ronde River	1,000	142	14.21	2.17
Catherine Creek	1,000	138	13.80	2.14
1994				
Lookingglass Creek	1,098	186	16.94	2.22
Wenaha River	997	158	15.85	2.27
Minam River	998	154	15.43	2.24
Lostine River	978	155	15.85	2.29
Upper Grande Ronde River[c]	0	--	--	--
Catherine Creek	499	89	17.84	3.36

[a] *The asterisk indicates a significant difference from Lookingglass Creek. Difference was determined by overlap of the point estimate and upper 95% confidence interval.*

[b] *The upper 95% CI was calculated using methods described in Ott and Mendenhall (1985).*

[c] *No fish were PIT-tagged from the upper Grande Ronde River for this cohort due to the low adult return in 1994.*

Literature Cited

Burck, W.A. 1964-1974. Unpublished field notes and summarization of data from the Lookingglass Creek study. Available from Oregon Department of Fish and Wildlife, Research and Development Section, La Grande, Oregon.

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

Daniel, W.W. 1990. Applied Nonparametric Statistics. PWS-Kent Publishing Company, Boston, Massachusetts.

Lofy, P.T. and M.L. McLean. 1995a. Evaluation of reestablishing natural production of Chinook salmon in Lookingglass Creek, Oregon, using a non-endemic hatchery stock. Section II. Annual Progress Report for 1 January to 31 December, 1992, for the Lower Snake River Compensation Plan. CTUIR Project Number 63, Contract Number 14-16-0001-92502, U.S. Fish and Wildlife Service Report Number AFF1/LSR 95-02. Confederated Tribes of the Umatilla Indian Reservation, Pendleton, Oregon.

Lofy, P.T. and M.L. McLean. 1995b. Evaluation of reestablishing natural production of Chinook salmon in Lookingglass Creek, Oregon, using a non-endemic hatchery stock. Section I. Annual Progress Report for 1 January to 31 December, 1994, for the Lower Snake River Compensation Plan. CTUIR Project Number 63, Contract Number 14-48-0001-94517, U.S. Fish and Wildlife Service Report. Confederated Tribes of the Umatilla Indian Reservation, Pendleton, Oregon.

Lofy, P.T., R.W. Carmichael and W.J. Groberg. 1994. Evaluation of efforts to re-establish natural production of Chinook salmon in Lookingglass Creek, using a non-endemic stock. Proposal to U.S. Fish and Wildlife Service, Lower Snake River Compensation Plan. Confederated Tribes of the Umatilla Indian Reservation, Pendleton, Oregon.

LSRCP Status Review Symposium, 1998. Proceedings of the Lower Snake River Compensation Plan Status Review Symposium, Boise, ID. Compiled by the U.S. Fish and Wildlife Service Lower Snake River Compensation Plan Office, 1387 South Vinnell Way, Suite 343, Boise, ID 83709.

McLean, M.L and P.T. Lofy. 1995. Evaluation of reestablishing natural production of spring Chinook salmon in Lookingglass Creek, Oregon, using a non-endemic hatchery stock. Section I. Annual Progress Report for 1 January to 31 December, 1993, for the Lower Snake River Compensation Plan to the U.S. Fish and Wildlife Service. CTUIR Project Number 63, Contract Number 14-48-0001-93515. Confederated Tribes of the Umatilla Indian Reservation, Pendleton, Oregon.

McLean, M.L and P.T. Lofy. 1998. Evaluation of reestablishing natural production of spring Chinook salmon in Lookingglass Creek, Oregon, using a non-endemic hatchery stock. Section I. Annual Progress Report for 1 January to 31 December, 1995, for the Lower Snake River Compensation Plan to the U.S. Fish and Wildlife Service. CTUIR Project Number 63, Contract Number 14-48-0001-95525. Confederated Tribes of the Umatilla Indian Reservation, Pendleton, Oregon.

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

Ott L. and William M. 1985. Understanding Statistics. PWS Publishers, Boston, Massachusetts.

Prentice, E.F., T.A. Flagg, and Clinton S. McCutcheon, D.F. Brastow, and D.A. Cross. 1990. Equipment, methods, and an automated data-entry station for PIT tagging. American Fisheries Society Symposium 7:335-340.

Sankovich, P., R.W. Carmichael and M. Keefe. 1996. Smolt migration characteristics and mainstem Snake and Columbia River detection rates of PIT-tagged Grande Ronde and Imnaha River naturally produced spring Chinook salmon. Annual Progress Report for January to December 1995. Bonneville Power Administration Project Number 95-37. Oregon Department of Fish and Wildlife, Fish Research Project, Portland.

Sankovich, P., R.W. Carmichael and M. Keefe. 1997. Smolt migration characteristics and mainstem Snake and Columbia River detection rates of PIT-tagged Grande Ronde and Imnaha River naturally produced spring Chinook salmon. Annual Progress Report for January to December 1996. Bonneville Power Administration Project Number 96-37. Oregon Department of Fish and Wildlife, Fish Research Project, Portland.

Thorndike, Robert, M. 1982. Principles of data collection and analysis. Gardner Press, Inc, New York, NY.

Walters, T. R., R.W. Carmichael, and M. Keefe. 1995. Smolt migration characteristics and mainstem Snake and Columbia River detection rates of PIT-tagged Grande Ronde and Imnaha River naturally produced spring Chinook salmon. Annual Progress Report for January to December 1994. Bonneville Power Administration Project Number 94-36. Oregon Department of Fish and Wildlife, Fish Research Project, Portland.

Wilkinson, L. 1996. Statistics. Systat 6.0 for Windows manual. SPSS Inc., Chicago, IL.

SECTION II

Assistance Provided to LSRCP Cooperators and Other Projects

We provided assistance to LSRCP cooperator ODFW in 1996 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 juvenile summer steelhead at Irrigon Hatchery and the Little Sheep and Big Canyon acclimation facilities and spring Chinook salmon at Lookingglass Hatchery and the Imnaha River Facility. In addition, project personnel provided assistance in sampling adult spring Chinook salmon at Oregon LSRCP facilities. Assistance was provided in data summarization and analysis for ODFW monthly and annual progress reports.

We assisted ODFW personnel who were starting to collect 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 Lookingglass Hatchery adult bypass. In addition, we have implanted PIT tags in bull trout we have captured in our rotary screw trap.

There were also concerns about the location of the CTUIR work area in the Lookingglass Hatchery building. We began 1996 working up juveniles from the screw trap in the hatch building and after concerns about disease transmission from the fish from our trap into the hatch house were brought up, we moved our work area to the intake building where direct contact with spring Chinook salmon eggs and fry would be greatly reduced.

Tribal biologists mentored an apprentice in science and engineering (ASE) in 1996. We helped develop and collect data for a study on the diet of *O. mykiss* in Lookingglass Creek. We also assisted local high schools with a two streamside aquatic insect studies.

Acknowledgments

Our thanks to Dan Herrig and Ed Crateau (United States Fish and Wildlife Service) for administering this contract and coordinating communication between Confederated Tribes of the Umatilla Indian Reservation (CTUIR) and other management and research entities. Gary James, Joe Richards and Michelle Thompson (CTUIR) provided technical and administrative support, particularly with contract modifications. Thanks go to members of the Research and Development Section of Oregon Department of Fish and Wildlife (ODFW) in La Grande: Rich Carmichael, Mike Flesher, Brian Jonasson, MaryLouise Keefe, Steve Parker, Paul Sankovich, Debra Eddy, and Tim Whitesel for their assistance in the field and the office. Thanks to Craig Contor and Steve Boe (CTUIR), Dan Herrig, Gary James, Tim Whitesel and Rich Carmichael for reviewing drafts of this report. Warren Groberg, Sam Onjukka and Karen Waln of ODFW Fish Pathology, La Grande, sampled adult Chinook salmon for pathogens and provided results. Thanks to ODFW employees: Brian Cannon, Misty Donaghy, Scott Stennfeld and Amy Wilson for assistance in capturing and PIT-tagging juvenile Chinook salmon in Lookingglass Creek. We thank Jo Miller (United States Geologic Survey) for providing stream flow data and Scott Wallace (United States Forest Service, Walla Walla District) for providing stream temperature data for 1995. Thanks go to ODFW Lookingglass Hatchery personnel: Bob Lund, Ken Danison, Gary Huser, Don Falk, and numerous seasonal personnel for assisting in handling and tagging fish, allowing us the use of facilities at the hatchery, keeping an eye on the screw trap for us and especially for cheerfully offering assistance during emergency situations that helped us prevent or minimize damage to the trap during high water incidences.

Special thanks to CTUIR technician Cynthia Danison for working under adverse conditions, often on weekends, collecting, handling and releasing fish, maintaining the screw trap, assisting in activities at the hatchery, and assisting in data analysis. Thanks go to all CTUIR personnel who assisted with the PIT-tagging of fish at Lookingglass Hatchery.

Appendices

Appendix Table A-1. Daily trapping records of the 1994 cohort from a screw trap in Lookingglass Creek.

Date	Flow m^3/s	Water temp. hourly °C High	Water temp. hourly °C Low	Daily numbers of fish trapped Actual	Daily numbers of fish trapped Mean	Trap efficiency[a] No. Rel.	Trap efficiency[a] Group	Trap efficiency[a] No. Re.	Trap efficiency[a] No. Re. from Rel. Group	Comments
01/01/95	2.0			0	0.00	0		0		Stopped trap, repair
01/02/95	1.9									
01/03/95	1.9									
01/04/95	2.0									
01/05/95	2.0									
01/06/95	2.0									
01/07/95	1.9									
01/08/95	1.9									Started trap
01/09/95	2.5			0	0.00	0		0		
01/10/95	3.8				0.00					
01/11/95	4.4			0	0.00	0		0		
01/12/95	4.2				0.00					
01/13/95	4.6			0	0.00	0		0		
01/14/95	7.4				0.33					
01/15/95	6.3				0.33					
01/16/95	5.0			1	0.34	0		0		Captured first fry from 1994 cohort
01/17/95	4.1				0.50					
01/18/95	3.9			1	0.50	0		0		
01/19/95	3.5				0.00					
01/20/95	3.1			0	0.00	0		0		
01/21/95	2.8				0.00					
01/22/95	2.7				0.00					
01/23/95	2.6			0	0.00	0		0		
01/24/95	2.6			0	0.00	0		0		
01/25/95	2.6				0.00					
01/26/95	2.5				0.00					
01/27/95	2.4			0	0.00	0		0		
01/28/95	2.3				0.00					
01/29/95	2.4				0.00					
01/30/95	2.9			0	0.00	0		0		
01/31/95	6.7			0	0.00	0		0		
02/01/95	14.2			0	0.00	0		0		Stopped trapping, high flow
02/02/95	17.2									
02/03/95	11.4									
02/04/95	8.7									Started trap, slightly upstream
02/05/95	7.6				0.00					
02/06/95	7.0			0	0.00	0		0		Observed mink entering trap
02/07/95	6.5				0.00					
02/08/95	6.1			0	0.00	0		0		
02/09/95	5.6				0.00					
02/10/95	5.2			0	0.00	0		0		
02/11/95	5.2				0.00					
02/12/95	5.4				0.00					
02/13/95	4.6			0	0.00	0		0		
02/14/95	4.2			0	0.00	0		0		Stopped trapping, freezing temperatures
02/15/95	4.1									

Appendix Table A-1 (cont.). Daily trapping records of the 1994 cohort from a screw trap in Lookingglass Creek.

Date	Flow m^3/s	Water temp. hourly °C High	Water temp. hourly °C Low	Daily numbers of fish trapped Actual	Daily numbers of fish trapped Mean	Trap efficiency[a] No. Rel.	Group	No. Re.	No. Re. from Rel.	Re. from Group	Comments
02/16/95	3.9										Started trap
02/17/95	4.6			0	0.00	0		0			
02/18/95	5.3				0.50						
02/19/95	7.9			1	0.50	0		0			Stopped trapping, high water
02/20/95	10.4										
02/21/95	11.0										
02/22/95	10.8										
02/23/95	9.5										Started trap
02/24/95	9.3			0	0.00	0		0			
02/25/95	10.0			0	0.00	0		0			
02/26/95	10.1			0	0.00	0		0			
02/27/95	9.3			0	0.00	0		0			
02/28/95	8.4			1	1.00	0		0			
03/01/95	8.0				0.00						
03/02/95	7.2			0	0.00	0		0			
03/03/95	6.7			0	0.00	0		0			
03/04/95	6.3			0	0.00	0		0			
03/05/95	5.9			0	0.00	0		0			
03/06/95	5.4			3	3.00	0		0			
03/07/95	5.0			0	0.00	0		0			
03/08/95	5.0			2	2.00	0		0			
03/09/95	6.1			1	1.00	0		0			
03/10/95	6.7			0	0.00	0		0			
03/11/95	7.7			0	0.00	0		0			
03/12/95	8.0			1	1.00	0		0			
03/13/95	8.4			1	1.00	0		0			
03/14/95	9.6			1	1.00	0		0			
03/15/95	14.9			0	0.00	0		0			
03/16/95	13.4			0	0.00	0		0			
03/17/95	12.1			0	0.00	0		0			
03/18/95	11.8			0	0.00	0		0			
03/19/95	12.4			2	2.00	0		0			
03/20/95	12.4			5	5.00	0		0			
03/21/95	12.5			2	2.00	0		0			
03/22/95	10.7			0	0.00	0		0			
03/23/95	9.4			0	0.00	0		0			
03/24/95	8.3			0	0.00	0		0			
03/25/95	7.4			0	0.00	0		0			
03/26/95	6.8			1	1.00	0		0			
03/27/95	6.3			0	0.00	0		0			
03/28/95	6.0			0	0.00	0		0			
03/29/95	5.7			0	0.00	0		0			
03/30/95	5.6			0	0.00	0		0			
03/31/95	5.6			1	1.00	0		0			

Appendix Table A-1 (cont.). Daily trapping records of the 1994 cohort from a screw trap in Lookingglass Creek.

Date	Flow m^3/s	Water temp. hourly °C High	Water temp. hourly °C Low	Daily numbers of fish trapped Actual	Daily numbers of fish trapped Mean	Trap efficiency[a] No. Rel.	Group	No. Re.	No. Re. from Rel. Group	Comments
04/01/95	5.8			1	1.00	0		0		
04/02/95	5.6			7	7.00	0		0		
04/03/95	5.8			1	1.00	0		0		
04/04/95	6.5			1	1.00	0		0		
04/05/95	7.5			3	3.00	0		0		Stopped trapping, release of hatchery fish
04/06/95	9.2									Started trap
04/07/95	12.7			15	15.00	0		0		Trap stopped, log in cone/started
04/08/95	14.6			0	0.00	0		0		
04/09/95	13.0			9	9.00	0		0		
04/10/95	11.6			0	0.00	0		0		
04/11/95	11.3			1	1.00	0		0		
04/12/95	10.9			0	0.00	0		0		
04/13/95	11.6			3	3.00	0		0		
04/14/95	10.7			2	2.00	0		0		
04/15/95	9.7			1	1.00	0		0		
04/16/95	9.1			1	1.00	0		0		
04/17/95	8.5			0	0.00	0		0		
04/18/95	8.1			6	6.00	0		0		
04/19/95	8.0			48	48.00	0		0		
04/20/95	7.6			8	8.00	0		0		
04/21/95	6.9			4	4.00	0		0		
04/22/95	6.7			1	1.00	0		0		
04/23/95	6.9			0	0.00	0		0		
04/24/95	8.2			2	2.00	0		0		
04/25/95	9.5			0	0.00	0		0		
04/26/95	9.9			0	0.00	0		0		
04/27/95	11.7			2	2.00	0		0		
04/28/95	15.7			2	2.00	0		0		
04/29/95	15.6			1	1.00	0		0		Trap stopped/started, debris
04/30/95	15.3			0	0.00	0		0		Trap stopped/started, debris
05/01/95	15.1			1	1.00	0		0		
05/02/95	17.1			2	2.00	0		0		
05/03/95	16.8			0	0.00	0		0		
05/04/95	15.8			0	0.00	0		0		
05/05/95	15.5			0	0.00	0		0		
05/06/95	15.5			0	0.00	0		0		
05/07/95	16.3			0	0.00	0		0		
05/08/95	16.3			0	0.00	0		0		
05/09/95	16.7			0	0.00	0		0		
05/10/95	17.5			1	1.00	0		0		
05/11/95	20.1			0	0.00	0		0		Trap stopped/started, debris
05/12/95	17.7			0	0.00	0		0		
05/13/95	15.0			0	0.00	0		0		
05/14/95	13.6			0	0.00	0		0		
05/15/95	13.4			0	0.00	0		0		

Appendix Table A-1 (cont.). Daily trapping records of the 1994 cohort from a screw trap in Lookingglass Creek.

		Water temp. hourly °C		Daily numbers of fish trapped		Trap efficiency[a]				
Date	Flow m^3/s	High	Low	Actual	Mean	No. Rel.	Group	No. Re.	No. Re. from Rel. Group	Comments
05/16/95	13.5			0	0.00	0		0		
05/17/95	13.1			0	0.00	0		0		
05/18/95	11.8			0	0.00	0		0		
05/19/95	11.1	10.0	4.5	0	0.00	0		0		
05/20/95	11.0	10.7	5.1	0	0.00	0		0		
05/21/95	11.0	10.8	6.1	0	0.00	0		0		
05/22/95	10.2	10.1	5.4	0	0.00	0		0		
05/23/95	9.5	10.6	5.6	0	0.00	0		0		
05/24/95	9.0	11.3	6.0	0	0.00	0		0		
05/25/95	8.5	10.5	6.0	1	1.00	0		0		
05/26/95	8.4	11.3	6.0	1	1.00	0		0		
05/27/95	7.7	11.0	5.9	0	0.00	0		0		
05/28/95	7.1	12.6	6.1	1	1.00	0		0		
05/29/95	6.6	13.2	6.9	2	2.00	0		0		
05/30/95	6.6	13.8	7.7	0	0.00	0		0		
05/31/95	6.6	13.8	7.7	0	0.00	0		0		
06/01/95	6.5	13.4	8.6	1	1.00	0		0		
06/02/95	6.1	12.7	9.1	1	1.00	0		0		
06/03/95	5.6	14.2	8.8	2	2.00	0		0		
06/04/95	5.4	14.1	7.9	1	1.00	0		0		
06/05/95	6.1	9.4	6.9	1	1.00	0		0		
06/06/95	5.6	6.7	5.7	5	5.00	0		0		
06/07/95	5.5	11.6	5.1	1	1.00	0		0		
06/08/95	5.4	10.4	6.4	0	0.00	0		0		
06/09/95	4.5	11.4	6.7	1	1.00	0		0		
06/10/95	4.1	13.3	6.4	1	1.00	0		0		
06/11/95	4.1	13.5	7.8	0	0.00	0		0		
06/12/95	4.1	14.2	7.5	1	1.00	0		0		
06/13/95	3.9	11.8	8.3	0	0.00	0		0		Stopped trapping, repair
06/14/95	3.9	10.8	8.3							
06/15/95	3.7	11.3	8.0							
06/16/95	3.7	11.7	8.2							
06/17/95	3.4	11.5	8.2							
06/18/95	4.1	10.3	8.0							
06/19/95	5.3	9.3	7.2							Started trap
06/20/95	5.4	9.1	7.0	2	2.00	0		0		
06/21/95	4.7	9.7	6.6	0	0.00	0		0		
06/22/95	4.5	12.6	7.2	0	0.00	0		0		
06/23/95	4.2	14.1	7.6	0	0.00	0		0		
06/24/95	4.0	15.4	8.4	0	0.00	2	a	0		
06/25/95	4.0	15.8	8.7		0.50					
06/26/95	3.7	15.8	8.5	1	0.50	0		0		
06/27/95	3.6	15.1	8.0	0	0.00	1	b	0		
06/28/95	3.3	14.8	7.8	3	3.00	0		0		
06/29/95	3.2	15.4	7.6	1	1.00	0		0		
06/30/95	3.3	16.0	8.4	0	0.00	0		0		

Appendix Table A-1 (cont.). Daily trapping records of the 1994 cohort from a screw trap in Lookingglass Creek.

		Water temp. hourly °C		Daily numbers of fish trapped		Trap efficiency[a]				
Date	Flow m^3/s	High	Low	Actual	Mean	No. Rel.	Group	No. Re.	No. Re. from Rel. Group	Comments
07/01/95	3.0	16.5	8.9	0	0.00	2	c	0		
07/02/95	3.0	12.1	9.1	0	0.00	0		0		
07/03/95	3.5	13.0	9.4	1	1.00	0		0		
07/04/95	3.1	15.1	8.4	0	0.00	0		0		
07/05/95	2.9	14.9	8.3	0	0.00	0		0		
07/06/95	2.8	15.3	9.0		0.50					
07/07/95	2.7	16.4	8.7	1	0.50	0		0		
07/08/95	2.5	17.1	9.1		0.00					
07/09/95	2.4	18.0	9.8	0	0.00	0		0		
07/10/95	2.1	14.7	10.0	1	1.00	0		0		
07/11/95	1.9	15.9	9.2	0	0.00	0		0		
07/12/95	1.9	13.2	9.1	0	0.00	1	d	0		
07/13/95	1.9	13.5	8.1		1.00					
07/14/95	1.8	16.1	7.6	2	1.00	0		0		
07/15/95	1.8	16.3	8.0	1	1.00	1	e	0		
07/16/95	1.8	17.2	8.2	0	0.00	1	f	0		
07/17/95	1.7	17.5	8.4	1	1.00	0		0		
07/18/95	1.7	16.5	8.9	0	0.00	1	g	0		
07/19/95	1.8	16.3	9.0		0.00					
07/20/95	1.7	16.7	9.3	0	0.00	0		0		
07/21/95	1.6	17.6	9.5		0.50					
07/22/95	1.5	17.3	9.6	1	0.50	0		0		
07/23/95	1.5	17.2	8.2		0.66					
07/24/95	1.5	17.1	8.5		0.66					
07/25/95	1.5	17.3	8.0	2	0.68	0		0		
07/26/95	1.5	15.5	9.5	2	2.00	0		0		
07/27/95	1.5	17.1	8.2	1	1.00	0		0		Moved trap to new location (Intake)
07/28/95	1.5	16.8	8.2							
07/29/95	1.4	14.2	9.1			6	h			Started trap at new location
07/30/95	1.3	15.5	6.8	2	2.00	0		0		
07/31/95	1.4	16.3	7.0	1	1.00	0		0		
08/01/95	1.4	16.7	7.4		0.00					
08/02/95	1.4	16.8	8.2	0	0.00	0		0		
08/03/95	1.4	16.2	8.1		0.00	3	I			
08/04/95	1.4	17.1	8.4	0	0.00	0		0		
08/05/95	1.4	17.5	8.4		0.00					
08/06/95	1.4	17.0	8.8	0	0.00	0		0		
08/07/95	1.5	12.3	8.9	0	0.00	0		0		
08/08/95	1.5	14.4	8.4	1	1.00	0		0		
08/09/95	1.4	15.7	6.7		0.00	1	j			
08/10/95	1.4	13.4	7.6	0	0.00	0		0		
08/11/95	1.4	13.6	8.3		1.00					
08/12/95	1.3	11.9	7.2		1.00					
08/13/95	1.3	13.1	6.1	3	1.00	3	k	0		
08/14/95	1.4	15.2	6.3		0.50					
08/15/95	1.4	11.9	7.7	1	0.50	1	m	0		

Appendix Table A-1 (cont.). Daily trapping records of the 1994 cohort from a screw trap in Lookingglass Creek.

Date	Flow m^3/s	Water temp. hourly °C High	Water temp. hourly °C Low	Daily numbers of fish trapped Actual	Daily numbers of fish trapped Mean	Trap efficiency[a] No. Rel.	Group	No. Re.	No. Re. from Rel. Group	Comments
08/16/95	1.4	12.6	8.2		0.00					
08/17/95	1.3	11.8	8.0	0	0.00	0		0		
08/18/95	1.3	14.0	6.1	2	2.00	2	n	0		
08/19/95	1.3	14.9	6.3		0.00					
08/20/95	1.4	15.4	6.8		0.00					
08/21/95	1.4	15.8	7.1	0	0.00	0		0		
08/22/95	1.3	15.2	7.1		1.50					
08/23/95	1.3	15.0	8.3	3	1.50	3	o	0		
08/24/95	1.3	14.2	7.4		2.50					
08/25/95	1.3	14.4	6.1	5	2.50	5	p	0		
08/26/95	1.3	14.5	6.9		3.00					
08/27/95	1.2	14.3	6.3	6	3.00	6	q	1	o1	
08/28/95	1.3	14.6	6.6		0.00					
08/29/95	1.3	13.7	8.1	0	0.00	0		0		
08/30/95	1.3	14.2	6.6		1.50					
08/31/95	1.3	14.6	6.7	3	1.50	3	r	2	q2	
09/01/95	1.3	14.7	7.0	1	1.00	1	s	0		
09/02/95	1.3	14.7	7.2		1.00					
09/03/95	1.3	12.2	7.7		1.00					
09/04/95	1.3	14.9	7.7	3	1.00	4	t	1	s1	
09/05/95	1.3	13.3	7.4	0	0.00	0		1	t1	
09/06/95	1.4	13.6	6.9	0	0.00	0		3	t3	
09/07/95	1.6	10.7	8.7	7	7.00	0		1	i1	
09/08/95	1.5	12.2	7.7		6.30					
09/09/95	1.5	13.5	7.6		6.30					
09/10/95	1.4	13.9	7.5	19	6.40	0		0		
09/11/95	1.4	13.8	7.2	7	7.00	27	u	1	a1	
09/12/95	1.4	13.5	7.1	6	6.00	7	v	0		
09/13/95	1.5	13.8	7.5		5.00	6	w			
09/14/95	1.4	13.1	7.5	10	5.00	0		1	v1	
09/15/95	1.3	13.6	7.1		4.33	10	x			
09/16/95	1.2	13.4	7.2		4.33					
09/17/95	1.2	13.9	7.7	13	4.34	0		0		
09/18/95	1.2	13.0	6.7	2	2.00	0		1	x1	
09/19/95	1.2	12.0	6.5		2.50	14	y			
09/20/95	1.2	11.5	6.1		2.50					
09/21/95	1.2	10.9	4.7		2.50					
09/22/95	1.2	10.7	4.5	10	2.50	0		1	y1	
09/23/95	1.2	11.1	4.8		7.50					
09/24/95	1.2	11.3	5.0	15	7.50	0		0		
09/25/95	1.2	10.5	6.2	42	42.00	0		5	y5	
09/26/95	1.2	10.4	6.9	24	24.00	0		0		
09/27/95	1.3	10.1	7.3		44.00	10	z			
09/28/95	1.3	9.5	6.9	88	44.00	32	aa	3	z3	16 right bank, 16 left bank
09/29/95	1.5	10.0	7.3	78	78.00	0		1	z1	
09/30/95	1.2	10.0	7.0	28	28.00	65	ab	0		27 right bank, 38 left bank

Appendix Table A-1 (cont.). Daily trapping records of the 1994 cohort from a screw trap in Lookingglass Creek.

Date	Flow m^3/s	Water temp. hourly °C High	Water temp. hourly °C Low	Daily numbers of fish trapped Actual	Daily numbers of fish trapped Mean	Trap efficiency[a] No. Rel.	Trap efficiency[a] Group	Trap efficiency[a] No. Re.	Trap efficiency[a] No. Re. from Rel. Group			Comments
10/01/95	1.2	10.0	5.8	19	19.00	0		9	ab4	aa5		
10/02/95	1.1	7.7	5.5	13	13.00	0		0				
10/03/95	2.2	9.4	6.8	70	70.00	49	ac	13	ac12	ab1		26 right bank, 23 left bank
10/04/95	1.9	9.0	5.7	17	17.00	0		1	ac1			Trap stopped/started, debris
10/05/95	1.3	8.8	4.4	22	22.00	0		0				Trap repositioned
10/06/95	1.3	9.5	5.4	20	20.00	106	ad	3	ac3			50 right bank, 53 left bank
10/07/95	1.2	9.3	5.3	5	5.00	0		12	ad12			
10/08/95	1.2	8.4	4.8	6	6.00	0		3	ad2	aa1		
10/09/95	1.2	8.2	6.0	9	9.00	0		0				
10/10/95	1.2	9.6	5.9	17	17.00	40	ae	2	ad1	v1		20 right bank, 19 left bank
10/11/95	1.3	7.4	6.7	6	6.00	0		3	ae3			
10/12/95	1.3	8.0	5.4	14	14.00	0		2	ae2			
10/13/95	1.2	8.1	4.1	9	9.00	34	af	0				17 right bank, 16 left bank
10/14/95	1.2	8.6	4.3	18	18.00	0		10	af9	ae1		
10/15/95	1.2	8.8	4.3	18	18.00	0		1	af1			
10/16/95	1.2	8.4	5.9	4	4.00	0		1	af1			
10/17/95	1.3	7.7	5.8	2	2.00	42	ag	1	af1			21 right bank, 21 left bank
10/18/95	1.4	8.4	4.9	19	19.00	0		7	ag7			
10/19/95	1.2	7.2	3.5	3	3.00	20	ah	2	ag2			10 right bank, 10 left bank
10/20/95	1.2	7.6	4.0	18	18.00	0		7	ah7			
10/21/95	1.2	6.4	4.9	13	13.00	0		0				
10/22/95	1.3	7.6	4.4	8	8.00	0		2	af1	ae1		
10/23/95	1.2	6.7	3.7	12	12.00	0		3	ag1	ad1	ab1	
10/24/95	1.2	7.6	3.9	15	15.00	0		2	ah1	ae1		
10/25/95	1.3	6.8	4.7	14	14.00	68	ai	2	ah2			32 right bank, 34 left bank
10/26/95	1.5	7.8	5.7	40	40.00	0		10	ai10			
10/27/95	1.3	7.6	4.8	8	8.00	54	aj	0				27 right bank, 27 left bank
10/28/95	1.2	6.6	3.7	6	6.00	0		15	aj15			
10/29/95	1.2	6.5	3.8	26	26.00	0		0				
10/30/95	1.2	5.6	2.7	15	15.00	0		0				
10/31/95	1.2	5.1	2.2	16	16.00	55	ak	1	aj15			27 right bank, 28 left bank
11/01/95	1.2	4.4	1.5	44	44.00	0		8	ak8			
11/02/95	1.2	4.1	1.1	49	49.00	0		1	aj15			
11/03/95	1.2	4.3	1.2	23	23.00	108	am	0				54 right bank, 54 left bank
11/04/95	1.2	4.9	1.8	28	28.00	0		0				
11/05/95	1.3	6.0	4.2	16	16.00	0		24	am24			
11/06/95	1.3	5.9	3.8	3	3.00	0		1	am1			
11/07/95	1.3	5.2	2.5	0	0.00	0		0				
11/08/95	2.2	5.7	4.5	8	8.00	70	an	1	ad1			34 right bank, 36 left bank
11/09/95	3.2	4.6	3.4	2	2.00	0		1	an1			Trap repositioned
11/10/95	2.0	5.1	3.4	22	22.00	10	ao	0				5 right bank, 5 left bank
11/11/95	4.2	5.4	4.0	25	25.00	0		3	ao2	am1		
11/12/95	4.8	5.5	4.1	5	5.00	0		0				Stopped trapping, repair/started
11/13/95	4.6	5.6	4.8	3	3.00	0		0				Trap stopped, log/started
11/14/95	4.4	6.5	5.4	10	10.00	52	ap	0				25 right bank, 27 left bank
11/15/95	3.8	6.8	5.6	5	5.00	0		6	ap6			

Appendix Table A-1 (cont.). Daily trapping records of the 1994 cohort from a screw trap in Lookingglass Creek.

Date	Flow m^3/s	Water temp. hourly °C High	Water temp. hourly °C Low	Daily numbers of fish trapped Actual	Daily numbers of fish trapped Mean	Trap efficiency[a] No. Rel.	Group	No. Re.	No. Re. from Rel. Group	Comments
11/16/95	3.5	7.1	5.9	3	3.00	0		0		
11/17/95	3.2	7.0	5.8	3	3.00	17	aq	0		9 right bank, 8 left bank
11/18/95	3.0	6.8	4.5	1	1.00	0		2	aq2	
11/19/95	2.7	5.3	3.5		0.50					
11/20/95	2.5	4.9	3.5	1	0.50	0		0		
11/21/95	2.4	5.4	3.4	0	0.00	5	ar	0		3 right bank, 2 left bank
11/22/95	2.5	6.3	4.2	1	1.00	0		1	ar1	
11/23/95	2.5	6.6	5.7	1	1.00	0		0		
11/24/95	2.5	7.2	5.8	1	1.00	0		0		
11/25/95	4.0	6.5	5.4	0	0.00	0		0		
11/26/95	4.4	5.7	4.6	1	1.00	0		0		
11/27/95	4.2	4.8	2.0	2	2.00	0		0		
11/28/95	24.1	4.8	2.1							Trap stopped, flood damage
11/29/95	20.9	5.2	4.8							Moved to flume hole
11/30/95	25.3	5.5	5.0							
12/01/95	24.5	5.4	4.4							
12/02/95	18.1	4.3	3.8							
12/03/95	13.3	4.3	3.8							
12/04/95	11.6	4.1	2.7							
12/05/95	9.4	3.0	2.2							
12/06/95	8.2	2.8	1.9							Trap started at 1500
12/07/95	7.5	3.4	2.6	0	0.00	0		0		
12/08/95	6.5	2.4	1.6	2	2.00	0		0		
12/09/95	6.1	2.9	1.9	4	4.00	0		0		
12/10/95	5.9	3.8	3.0	1	1.00	0		0		
12/11/95	6.7	4.3	3.4		0.00					
12/12/95	16.0	5.1	3.9		0.00	7	as			
12/13/95	14.8	4.6	4.0	0	0.00	0		0		
12/14/95	12.6	4.1	3.6	0	0.00	0		0		
12/15/95	11.0	4.5	3.8	0	0.00	0		0		
12/16/95	9.3	4.2	3.4	0	0.00	0		0		
12/17/95	8.2	3.2	2.2	0	0.00	0		0		
12/18/95	7.4	3.6	2.9	0	0.00	0		0		
12/19/95	6.8	3.7	3.0	0	0.00	0		0		
12/20/95	6.4	4.0	3.4		0.00					
12/21/95	6.1	3.5	2.8	0	0.00	0		0		
12/22/95	5.1	2.7	1.6		0.00					
12/23/95	4.6	1.8	0.9	0	0.00	0		0		
12/24/95	4.2	1.5	0.6		0.00					
12/25/95	3.9	1.7	0.6	0	0.00	0		0		
12/26/95	3.7	1.4	0.4		0.00					
12/27/95	3.5	2.1	0.6	0	0.00	0		0		
12/28/95	3.4	3.0	1.9		0.00					
12/29/95	3.4	2.2	1.2	0	0.00	0		0		
12/30/95	3.9	2.8	1.2		0.00					
12/31/95	5.1	3.3	2.2	0	0.00	0		1	as1	

Appendix Table A-1 (cont.). Daily trapping records of the 1994 cohort from a screw trap in Lookingglass Creek.

Date	Flow m^3/s	Water temp. hourly °C High	Water temp. hourly °C Low	Daily numbers of fish trapped Actual	Daily numbers of fish trapped Mean	Trap efficiency[a] No. Rel.	Trap efficiency[a] Group	Trap efficiency[a] No. Re.	Trap efficiency[a] No. Re. from Rel. Group	Comments
01/01/96	4.7	4.1	3.1	0	0.00	0		0		
01/02/96	4.6	4.1	3.4	1	1.00	0		0		
01/03/96	5.1	4.4	3.3		0.00					
01/04/96	5.1	3.7	2.8	0	0.00	0		0		
01/05/96	4.8	3.8	2.7		0.00					
01/06/96	4.6	4.1	2.7		0.00	1	at			
01/07/96	4.4	4.1	3.3	0	0.00	0		0		
01/08/96	4.7	4.7	3.4		0.50					
01/09/96	5.3	4.1	3.4	1	0.50	0		0		
01/10/96	5.8	4.5	3.4		0.00					
01/11/96	5.4	3.8	2.9	0	0.00	1	au	0		
01/12/96	5.1	4.0	2.5		0.00					
01/13/96	4.8	3.4	2.4	0	0.00	0		0		
01/14/96	4.6	4.5	2.8		0.50					
01/15/96	4.9	4.6	3.9	1	0.50	0		0		
01/16/96	5.3	4.4	3.3	0	0.00	1	av	0		
01/17/96	5.2	3.4	2.7	1	1.00	0		0		
01/18/96	4.8	2.8	1.3		0.50					
01/19/96	4.9	2.4	1.2	1	0.50	0		0		
01/20/96	4.8	2.8	1.3	1	1.00	1	aw	0		
01/21/96	4.6	2.7	2.1	0	0.00	1	ax	0		Trap stopped, cable broke
01/22/96	4.1	3.0	2.0		0.00					Started trap
01/23/96	3.9	3.0	1.3		0.00					
01/24/96	3.9	3.1	0.7	0	0.00	0		0		
01/25/96	3.8	3.1	2.0		0.00					
01/26/96	3.4	3.2	2.0	0	0.00	0		0		
01/27/96	3.4	2.1	0.9	0	0.00	0		0		
01/28/96	3.3	2.3	1.2	0	0.00	0		0		
01/29/96	3.0	2.6	0.3	6	6.00	0		0		
01/30/96	2.5	0.6	-0.1	1	1.00	0		0		Trap stopped, frozen
01/31/96	1.5	0.0	-0.1							
02/01/96	1.6	0.0	-0.1							
02/02/96	1.7	0.0	-0.1							
02/03/96	2.0	0.0	-0.1							
02/04/96	2.4	2.6	0.0							
02/05/96	3.1	3.8	2.0							
02/06/96	4.3	3.4	2.1							
02/07/96	18.5	2.1	0.9							
02/08/96	37.9	2.8	1.2							
02/09/96	53.0	3.1	1.9							
02/10/96	34.5	3.4	2.1							
02/11/96	23.8	3.6	2.3							
02/12/96	18.8	3.8	2.4							
02/13/96	15.5	4.2	2.6							Started trap
02/14/96	13.3	4.2	2.8	0	0.00	0		0		
02/15/96	11.8	4.2	2.7		0.00					Trap stopped, cable broke

Appendix Table A-1 (cont.). Daily trapping records of the 1994 cohort from a screw trap in Lookingglass Creek.

		Water temp. hourly °C		Daily numbers of fish trapped		Trap efficiency[a]				
Date	Flow m^3/s	High	Low	Actual	Mean	No. Rel.	Group	No. Re.	No. Re. from Rel. Group	Comments
02/16/96	10.6	4.7	2.8		0.00					Started trap
02/17/96	11.4	4.9	3.7	0	0.00	0		0		
02/18/96	18.7	4.8	3.7		0.50					
02/19/96	26.0	4.7	3.6	1	0.50	0		0		
02/20/96	22.5	4.9	3.7		0.00					
02/21/96	19.9	4.1	3.0		0.00					
02/22/96	16.7	4.0	2.7	0	0.00	0		0		
02/23/96	14.4	3.4	2.2		0.00					
02/24/96	12.4	3.5	2.4		0.00					
02/25/96	10.7	3.5	2.1	0	0.00	0		0		
02/26/96	9.5	2.6	0.6		0.00					
02/27/96	8.5	2.1	-0.1	0	0.00	0		0		
02/28/96	7.8	3.1	0.7		0.00					
02/29/96	7.1	3.8	0.4	0	0.00	0		0		
03/01/96	7.3	4.6	0.7		0.00					
03/02/96	7.1	5.4	1.2	0	0.00	0		0		
03/03/96	7.0	4.7	2.4		0.00					
03/04/96	7.3	4.7	2.8	0	0.00	0		0		
03/05/96	7.1	4.1	2.7		0.00					
03/06/96	6.6	5.3	2.6	0	0.00	0		0		
03/07/96	6.4	6.1	2.8		0.00					
03/08/96	6.7	7.4	3.8	0	0.00	0		0		
03/09/96	7.2	6.7	3.4		0.00					
03/10/96	8.0	6.8	3.7	0	0.00	0		0		
03/11/96	9.6	6.2	4.1	0	0.00	0		0		Trap stopped, log/started
03/12/96	11.0	5.3	3.9		0.50					
03/13/96	11.0	5.6	3.4	1	0.50	0		0		
03/14/96	10.4	5.8	3.0		0.00	1	ay			
03/15/96	10.1	5.8	3.3	0	0.00	0		0		
03/16/96	9.6	5.1	3.1		0.00					
03/17/96	9.2	6.1	3.1	0	0.00	0		0		
03/18/96	8.8	6.2	2.7		0.00					
03/19/96	8.3	6.6	3.2	0	0.00	0		0		
03/20/96	8.0	5.9	3.4		0.66					
03/21/96	7.7	0.0	0.0		0.66					
03/22/96	7.8	5.3	4.1	2	0.68	0		0		
03/23/96	7.5	5.7	2.3		0.00	2	az			
03/24/96	7.2	4.1	1.8	0	0.00	0		0		
03/25/96	6.8	4.9	0.9		0.00					
03/26/96	6.5	5.3	1.8	0	0.00	0		0		
03/27/96	6.2	4.9	3.0		0.50					
03/28/96	6.1	6.0	2.7	1	0.50	0		1	az1	
03/29/96	5.7	4.8	2.4	0	0.00	1	ba	0		
03/30/96	5.5	6.4	3.0		1.00					
03/31/96	5.5	6.2	3.6	2	1.00	0		0		

Appendix Table A-1 (cont.). Daily trapping records of the 1994 cohort from a screw trap in Lookingglass Creek.

Date	Flow m^3/s	Water temp. hourly °C High	Water temp. hourly °C Low	Daily numbers of fish trapped Actual	Daily numbers of fish trapped Mean	Trap efficiency[a] No. Rel.	Trap efficiency[a] Group	Trap efficiency[a] No. Re.	Trap efficiency[a] No. Rel.	Trap efficiency[a] Re. from Group	Comments
04/01/96	6.3	6.6	4.3		1.00	2	bb				
04/02/96	6.7	6.8	4.0	2	1.00	0		0			
04/03/96	6.5	6.6	3.0		0.00	2	bc				
04/04/96	6.4	7.5	2.8	0	0.00	0		0			
04/05/96	6.6	8.3	3.3		0.00						
04/06/96	7.1	8.8	4.0	0	0.00	0		0			
04/07/96	8.2	9.1	4.3		0.00						
04/08/96	10.1	8.9	4.4	0	0.00	0		0			
04/09/96	12.5	7.9	4.6	0	0.00	0		0			
04/10/96	13.5	5.7	4.5	0	0.00	0		0			Trap stopped, anchor broke
04/11/96	12.7	6.3	4.1		0.00						
04/12/96	11.6	6.1	3.5		0.00						
04/13/96	10.5	6.6	3.6		0.00						
04/14/96	9.5	7.6	3.1		0.00						
04/15/96	8.9	7.3	4.3		0.00						
04/16/96	9.6	6.9	4.9		0.00						
04/17/96	9.4	6.7	4.1		0.00						Started trap
04/18/96	9.1	6.0	3.6	0	0.00	0		0			
04/19/96	8.2	6.0	3.3		1.00						
04/20/96	7.7	7.0	3.4	2	1.00	0		0			
04/21/96	7.2	6.8	3.0	0	0.00	0		0			
04/22/96	6.9	6.6	4.2	0	0.00	0		0			Trap stopped, high water
04/23/96	13.1	5.5	5.0		0.00						
04/24/96	26.5	5.4	4.1		0.00						
04/25/96	20.4	5.7	3.8		0.00						
04/26/96	17.3	7.0	3.7		0.00	2	bd				Started trap
04/27/96	14.9	5.8	3.6		0.00						
04/28/96	12.9	7.7	3.1	0	0.00	0		0			
04/29/96	11.4	7.1	4.9	0	0.00	0		0			
04/30/96	10.8	7.8	4.1		0.00						
05/01/96	10.8	7.6	4.9	0	0.00	0		0			Decided to Stop trapping 1994 cohort
05/02/96	9.9	7.7	4.1								
05/03/96	8.6	6.4	3.8								
05/04/96	8.1	7.1	3.7								
05/05/96	7.2	8.0	3.4								
05/06/96	6.9	7.6	3.6								
05/07/96	7.2	8.6	4.5								
05/08/96	6.3	8.6	3.9								
05/09/96	6.1	8.9	3.5								
05/10/96	6.0	8.4	3.8								
05/11/96	6.4	8.9	5.7								
05/12/96	7.1	10.2	6.3								
05/13/96	7.8	8.3	6.8								
05/14/96	9.4	9.0	6.6								
05/15/96	11.2	8.2	6.4								

Appendix Table A-1 (cont.). Daily trapping records of the 1994 cohort from a screw trap in Lookingglass Creek.

Date	Flow m^3/s	Water temp. hourly °C High	Water temp. hourly °C Low	Daily numbers of fish trapped Actual	Daily numbers of fish trapped Mean	Trap efficiency[a] No. Rel.	Trap efficiency[a] Group	Trap efficiency[a] No. Re.	Trap efficiency[a] No. Re. from Rel. Group	Comments
05/16/96	11.5	8.1	6.2							
05/17/96	12.5	8.2	6.5							
05/18/96	12.4	8.2	5.4							
05/19/96	12.0	8.8	5.9							
05/20/96	9.7	8.2	4.9							
05/21/96	8.9	8.2	5.3							
05/22/96	9.2	7.8	5.8							
05/23/96	8.2	8.6	5.0							
05/24/96	8.0	9.2	5.0							
05/25/96	7.2	11.8	5.7							
05/26/96	7.1	11.9	6.6							
05/27/96	7.0	11.5	6.9							
05/28/96	6.5	10.3	6.4							
05/29/96	6.0	10.3	5.3							
05/30/96	5.6	10.3	5.5							
05/31/96	5.0	11.2	5.2							
06/01/96	4.8	11.8	5.9							
06/02/96	4.5	13.8	7.4							
06/03/96	4.4	12.6	8.5							
06/04/96	4.3	13.8	8.9							
06/05/96	4.3	13.7	7.6							
06/06/96	3.9	14.5	7.6							
06/07/96	3.8	15.5	8.3							
06/08/96	3.7	15.1	8.8							
06/09/96	3.4	14.0	8.0							
06/10/96	3.2	14.3	7.4							
06/11/96	3.1	14.4	8.0							
06/12/96	2.9	14.4	7.4							
06/13/96	2.8	15.2	7.6							
06/14/96	2.7	15.7	8.8							
06/15/96	2.6	14.6	8.3							
06/16/96	2.5	15.4	8.2							
06/17/96	2.4	10.5	8.1							
06/18/96	2.4	11.1	6.9							
06/19/96	2.3	13.5	5.6							
06/20/96	2.2	12.7	6.9							
06/21/96	2.2	11.8	7.0							
06/22/96	2.2	14.6	7.8							
06/23/96	2.1	10.2	7.5							
06/24/96	2.4	12.0	7.3							
06/25/96	2.5	11.9	7.2							
06/26/96	2.4	14.0	8.0							
06/27/96	2.5	10.0	8.5							
06/28/96	2.6	12.3	7.5							
06/29/96	2.4	15.5	7.3							
06/30/96	2.3	15.8	8.3							

Appendix Table A-1 (cont.). Daily trapping records of the 1994 cohort from a screw trap in Lookingglass Creek.

	Flow	Water temp. hourly °C		Daily numbers of fish trapped		Trap efficiency[a]				
Date	m^3/s	High	Low	Actual	Mean	No. Rel.	Group	No. Re.	No. Rel.	Re. from Group	Comments
07/01/96	2.3	16.7	8.3								
07/02/96	2.2	17.1	9.1								
07/03/96	2.2	17.3	9.1								
07/04/96	2.1	15.0	9.6								
07/05/96	2.0	15.3	7.6								
07/06/96	1.9	15.8	7.3								
07/07/96	2.0	16.3	7.7								
07/08/96	2.0	16.7	8.1								
07/09/96	2.0	16.8	8.7								
07/10/96	2.0	16.3	8.2								
07/11/96	2.0	16.6	8.0								
07/12/96	2.1	16.8	8.3								
07/13/96	2.2	17.1	8.4								
07/14/96	2.1	16.4	8.7								
07/15/96	2.0	17.3	9.0								
07/16/96	2.2	16.5	8.6								
07/17/96	2.0	15.3	8.3								
07/18/96	1.9	13.9	8.3								
07/19/96	2.1	14.6	7.4								
07/20/96	2.0	14.9	8.0								
07/21/96	2.0	16.1	7.7								
07/22/96	1.9	16.7	8.2								
07/23/96	1.9	16.7	8.3								
07/24/96	1.9	14.8	8.4								
07/25/96	1.9	16.8	8.3								
07/26/96	2.0	16.8	8.1								
07/27/96	2.0	15.1	8.5	0	0.00	0		0			Start with fyke net trap at intake
07/28/96	2.0	16.3	9.0	0	0.00	0		0			
07/29/96	2.0	12.9	10.0	0	0.00	0		0			
07/30/96	1.9	14.5	8.6		0.00						
07/31/96	1.9	16.4	8.5	0	0.00	0		0			
08/01/96	1.9	15.9	8.1	0	0.00	0		0			
08/02/96	1.9	12.4	8.4	0	0.00	0		0			Started screw trap
08/03/96	1.9	13.1	8.0	0	0.00	0		0			Took fyke net out
08/04/96	1.8	12.5	7.8		0.00						
08/05/96	1.8	12.9	8.3	0	0.00	0		0			
08/06/96	1.9	14.6	6.6		0.00						
08/07/96	1.8	15.4	7.0		0.00						
08/08/96	1.9	15.9	7.7	0	0.00	0		0			
08/09/96	1.9	16.0	7.9		0.00						
08/10/96	1.9	16.1	7.9		0.00						
08/11/96	1.9	16.3	8.4	0	0.00	0		0			
08/12/96	1.8	15.2	7.5		0.33						
08/13/96	1.7	13.6	8.1		0.33						
08/14/96	1.7	15.0	8.8	1	0.34	0		0			First precocial fish, 1994 cohort
08/15/96	1.8	15.4	8.2		0.00						

Appendix Table A-1 (cont.). Daily trapping records of the 1994 cohort from a screw trap in Lookingglass Creek.

Date	Flow m^3/s	Water temp. hourly °C High	Water temp. hourly °C Low	Daily numbers of fish trapped Actual	Daily numbers of fish trapped Mean	Trap efficiency[a] No. Rel.	Trap efficiency[a] Group	Trap efficiency[a] No. Re.	Trap efficiency[a] No. Re. from Rel. Group	Comments
08/16/96	1.8	14.6	7.5	0	0.00	0		0		
08/17/96	1.8	11.4	7.7		0.00					
08/18/96	1.8	13.4	6.9		0.00					
08/19/96	1.7	14.0	6.5	0	0.00	0		0		
08/20/96	1.8	12.8	7.7	0	0.00	0		0		
08/21/96	1.7	13.8	6.6		0.00					
08/22/96	1.7	14.0	6.7	0	0.00	0		0		
08/23/96	1.8	14.3	6.8		0.00					
08/24/96	1.9	14.1	7.0		0.00					
08/25/96	2.0	14.1	7.5		0.00					
08/26/96	1.8	13.0	7.6	0	0.00	0		0		
08/27/96	1.9	10.5	8.6		0.25					
08/28/96	1.9	13.2	8.2		0.25					
08/29/96	1.8	14.1	7.6		0.25					
08/30/96	1.8	14.2	7.8	1	0.25	0		0		
08/31/96	1.7	13.4	7.2	0	0.00	0		0		
09/01/96	1.8	12.7	6.5		0.00					
09/02/96	1.7	12.8	6.2		0.00					
09/03/96	1.9	12.6	7.1		0.00					
09/04/96	1.7	11.0	7.7		0.00					
09/05/96	1.6	10.6	7.3		0.00					
09/06/96	1.7	11.6	5.6		0.00					
09/07/96	1.7	12.6	7.2	0	0.00	0		0		
09/08/96	1.7	12.8	6.6		0.00					
09/09/96	1.7	13.1	6.6		0.00					
09/10/96	2.0	13.1	7.0	0	0.00	0		0		
09/11/96	1.7	13.3	7.5		0.25					
09/12/96	1.7	11.4	7.6		0.25					
09/13/96	1.7	12.3	7.7		0.25					
09/14/96	1.7	10.4	7.9	1	0.25	0		0		
09/15/96	1.7	10.2	7.5		0.00					
09/16/96	1.6	8.5	6.7	0	0.00	0		0		
09/17/96	1.7	9.3	6.2		0.00					
09/18/96	1.7	9.4	5.8		0.00					
09/19/96	1.8	10.0	7.0		0.00					
09/20/96	1.7	9.4	6.1	0	0.00	0		0		

Appendix Table A-1 (cont.). Daily trapping records of the 1994 cohort from a screw trap in Lookingglass Creek.

Date	Flow m^3/s	Water temp. hourly °C High	Water temp. hourly °C Low	Daily numbers of fish trapped Actual	Daily numbers of fish trapped Mean	Trap efficiency[a] No. Rel.	Trap efficiency[a] Group	Trap efficiency[a] No. Re.	Trap efficiency[a] No. Re. from Rel. Group	Comments
09/21/96	1.7	9.7	5.3		0.00					
09/22/96	1.6	8.8	5.9		0.00					
09/23/96	1.6	8.8	4.3	0	0.00	0		0		
09/24/96	1.6	9.0	5.5		0.33					
09/25/96	1.6	9.1	4.2		0.33					
09/26/96	1.6	9.6	4.7	1	0.34	0		0		Last fish, 1994 cohort (precocial)

[a] *PIT tags were used to mark all trap efficiency fish. The release groups in this table were identified by letter combinations each day of release. The trap efficiency recaptures were separated both by the total number of fish that were recaptured on a given date as well as the number of fish from each release group that were captured on that date. No. Rel. ; is the number of PIT-tagged fish released for trap efficiency, Group; is a release group code that day, No. Re.; is the number of trap efficiency fish recaptured on that day, No. Re. from Rel. Group.; is the number of trap efficiency fish recaptured from specific release group.*

Appendix Table A-2. Pre-release sex, weight, fork length, tag number, and age data on adult spring Chinook salmon released above the upper weir in 1996.

Sex estimate[a]	Weight (Kg)	Fork length (mm)	Tag no.	Age[b]	Carcass recovery[c]
F	4.10	750	3264	4	Yes
M	4.87	790	3257	4	
M	4.89	794	3173	4	
M	4.03	721	3155	4	
F	3.64	698	3206	4	Yes
M	5.28	802	3050	4	
M	5.42	817	3177	4	
M	2.80	654	3217	4	
M	5.97	852	3174	4	
M	4.46	748	3213	4	Yes
M	2.66	620	3074	4	
M	3.84	736	3200	4	
M	4.12	757	3172	4	
F	3.93	710	3261	4	Yes
M	5.30	809	3274	4	
M	5.30	817	3275	4	
F	4.22	745	3139	4	
F	4.10	727	3268	4	Yes
M	3.43	695	3144	4	
M	5.66	819	3271	4	
F	4.90	734	3223	4	Yes
M	3.06	663	3272	3	
F	4.22	711	3022	4	Yes
M	5.01	760	3170	4	
F	4.91	774	3043	4	
F	4.40	729	3088	4	
M	5.38	789	3262	4	
M	4.38	736	3017	4	
F	3.47	699	3189	4	Yes
F	4.30	727	3118	4	
F	3.71	699	3187	4	Yes
M	5.46	803	3134	4	

Appendix Table A-2 (cont.). Pre-release sex, weight, fork length, tag number, and age data on adult spring Chinook salmon released above the upper weir in 1996.

Sex estimate[a]	Weight (Kg)	Fork length (mm)	Tag no.	Age[b]	Carcass recovery[c]
M	4.60	763	3221	4	
F	3.77	733	3060	4	Yes
M	4.67	741	3195	4	
M	3.63	702	3208	4	
F	4.80	748	3066	4	
F	3.80	708	3092	4	
F	4.17	741	3198	4	
F	3.47	683	3216	4	Yes
F	4.84	756	3182	4	Yes
F	3.98	687	3192	4	Yes
M	4.84	760	3042	4	
M	6.33	850	3215	4	Yes
F	4.31	728	3079	4	Yes
F	4.10	730	3185	4	
F	4.79	746	3186	4	Yes
F	3.51	694	3474	4	
F	5.02	753	3169	4	Yes
F	4.21	713	3019	4	

[a] *The sex was estimated at the time of release on 26 August.*

[b] *The age was determined by ODFW scale analysis.*

[c] *This indicates whether the individual fish was positively identified at recovery. Fish recovered from the release group that could not be positively identified (e.g. opercle was missing) were not included in the table (see Appendix Table A-3).*

Appendix Table A-3. New redds and carcass data from spawning ground surveys conducted in Unit 3U of Lookingglass Creek in 1996.

		Redds			Carcasses					
		Live Fish			Sex				Pathology	
Date of Survey	0.25 rm section	On	Off	number	Init.	Recov.	Tag No.[a]	% spawn	sample number[b]	Notes[c]
08/30	9.75	2	0	1						
	9.50	2	0	2						
	9.25	2	0	3						
	8.75	2	0	4						
	8.50	1	0	5						
	8.25	1	0	6						
	8.25	1	0	7	F	F	3060	95	1	Gaffed, whole
	8.25	2	0	8						
	8.25	1	0	9						
	8.00	1	0	10						
	7.50	2	0	11						
	7.00	1	0	12						
	7.00	3	0	13						
	6.75	1	0	14						
09/01	7.50	0	0	15						
09/04	7.75	1	0	16						
	7.75	0	1		M	M	3213		2	Gaffed, whole
	7.75	1	0	17						
	7.25	2	0	18						
	7.25	0	0		M	M	3215		3	Dead, whole
	7.00	2	0	19						
09/06	10.25	0	0	22	F	F	3216	100	4	Dead
	9.50	1	0	2	F	F		100	5	Gaffed
	8.75	1	0	4	F	F	3261	100	6	Gaffed
	8.25	0	1		M	M		100	7	Gaffed
	8.25	1	0	6	F	F		100	8	Gaffed
	8.00	1	0	10	F	F		100	9	Gaffed

Appendix Table A-3 (cont.). New redds and carcass data from spawning ground surveys conducted in Unit 3U of Lookingglass Creek in 1996.

		Redds			Carcasses					
		Live Fish			Sex				Pathology	
Date of Survey	.25 rm section	On	Off	number	Init.	Recov.[a]	Tag No.	% spawn	sample number[b]	Notes[c]
09/06	7.75	0	1		M	M			10	Gaffed
	7.75	0	1		F	F	3268	100	11	Gaffed
	7.50	1	0	11	F	F	3206	100	12	Gaffed
	7.25	0	1		M	M			13	Gaffed
	7.00	0	0	20						
	7.00	0	1	13	M	M			14	Gaffed
	7.00	1	0	21						
	7.00	1	0	13	F	F	3169	100	15	Gaffed
	6.75	1	0	14	F	F	3187	100	16	Gaffed
09/09	10.25	0	0	22						
	9.75	0	0	23						
	9.75	1	0	1	F	F	3186	100	17	Gaffed
	9.25	1	0	3	F	F		100	18	Gaffed
	8.50	1	0	5	F	F	3189	100	19	Gaffed
	8.50	0	0	24						
	8.25	1	0	8	F	F	3264	100	20	Gaffed
	8.25	1	0	9	M	M			21	Gaffed
	8.25	1	0	9	F	F		100	22	Gaffed
	8.00	1	0	10	F	F	3192	97	23	Gaffed
	7.75	1	0	16	F	F	3223	100	24	Gaffed
	7.75	1	0	16	M	M			25	Gaffed
	7.00	1	0	21	M	M			26	Gaffed
	7.00	1	0	21	F	F		100	27	Gaffed
	6.75	0	1		M	M			28	Gaffed
	6.75	0	1		M	M			29	Gaffed
	6.75	0	1		M	M			30	Gaffed
	6.75	0	1		M	M			31	Gaffed
	6.75	0	1		M	M			32	Gaffed

Appendix Table A-3 (cont.). New redds and carcass data from spawning ground surveys conducted in Unit 3U of Lookingglass Creek in 1996.

		Redds			Carcasses					
		Live Fish			Sex				Pathology	
Date of Survey	.25 rm section	On	Off	number	Init.	Recov.[a]	Tag No.	% spawn	sample number[b]	Notes[c]
09/09	6.75	0	1		M	M			33	Gaffed
	6.75	0	1		M	M			34	Gaffed
09/11	9.75	1	0	23	F	F		100	37	Gaffed
	7.75	1	0	17	F	F	3079	100	38	Gaffed
09/13	6.75	1	0	14	F	F	3022	100	39	Gaffed
	6.75	1	0	14	M	M			40	Gaffed
	6.75	1	0	14	M	M			41	Gaffed
	8.50	1	0	24	M	M			42	Gaffed
	7.25	0	1		M	M			43	Gaffed
	6.75	0	1		M	M			44	Gaffed
09/16	8.50	1	0	24	F	F	3182	100	46	Gaffed
	6.75	0	1		M	M			47	Gaffed
09/20	Upper weir removed									

[a] *All carcasses observed were from the release group (Appendix Table A-2). No unhandled fish were recovered.*

[b] *Sample number corresponds with the sample number in Appendix Table A-5. Kidney samples were taken unless otherwise recorded in "Notes".*

[c] *Whole, indicates that the entire carcass was collected and frozen for pathology. Gaffed, indicates that the fish was still alive when encountered. Dead, indicates that the fish was dead when encountered.*

Appendix Table A-4. New redds and carcass data from spawning ground surveys conducted in Units 1, 2, 3L, and 4 of Lookingglass and Little Lookingglass creeks in 1996.

		Redds			Carcasses					
		Live Fish			Sex				Pathology sample	
Date of Survey	.25 rm Unit	On	Off	number	Init.	Recov.[a]	Tag No.	% spawn	number[b]	Notes[c]
09/10	1	1	0	25						
	1	0	0	26						
	1	0	0	27						
	1	0	0	28						
	1	0	0	29						
	1	0	0	30						
	1	0	0	31	--	F		100	35	Dead
	1	0	0		--	F		100	36	Dead
	2	0	0							
	4	0	0							
09/13	3L	0	0							
09/16	1	0	0		--	F		100	45	Dead

[a] *None of the carcasses observed were opercle punched indicating they were from the release group (Appendix Table A-2).*

[b] *Sample number corresponds with the sample number in Appendix Table A-5. Kidney samples were taken unless otherwise recorded in "Notes".*

[c] *Whole, indicates that the entire carcass was collected and frozen for pathology. Gaffed, indicates that the fish was still alive when encountered. Dead, indicates that the fish was dead when encountered.*

Appendix Table A-5. Results of analyses by ODFW Fish Pathology for pathogens of adult spring Chinook salmon recovered above the weir on Lookingglass Creek in 1996.

			Renibacterium salmoninarum		*Ceratomyxa*	Culture[c]		
Date	Sample number	Sex	OD[a] level	ELISA level	*shasta* infection[b]	Aeromonad pseudomonad	*Yersinia ruckeri*	*Flexibacter psychrophilus*
08/30	1	F	0.133	Low	High			
09/04	2	M	0.150	Low	Low			
09/04	3	M	0.120	Low	Negative	Y		
09/06	4	F	0.180	Low	ND			
09/06	5	F	0.167	Low	ND	Y		
09/06	6	F	0.455	Moderate	ND			
09/06	7	M	0.131	Low	ND			
09/06	8	F	0.457	Moderate	ND	Y		
09/06	9	F	0.185	Low	ND	Y		
09/06	10	M	0.132	Low	ND			Y
09/06	11	F	0.150	Low	ND			
09/06	12	F	0.176	Low	ND			Y
09/06	13	M	0.168	Low	ND	Y		
09/06	14	M	0.119	Low	ND	Y		
09/06	15	F	0.168	Low	ND	Y		
09/06	16	F	0.847	High	ND	Y		
09/09	17	F	0.138	Low	ND	Y		
09/09	18	F	0.321	Moderate	ND			Y
09/09	19	F	0.327	Moderate	ND	Y		
09/09	20	F	0.195	Low	ND		Y	
09/09	21	M	0.133	Low	ND	Y		
09/09	22	F	0.213	Low	ND	Y		
09/09	23	F	0.133	Low	ND			
09/09	24	F	0.138	Low	ND			
09/09	25	M	0.219	Low	ND	Y		
09/09	26	M	0.127	Low	ND			Y
09/09	27	F	0.147	Low	ND			
09/09	28	M	0.155	Low	ND	Y		
09/09	29	M	0.141	Low	ND			
09/09	30	M	0.213	Low	ND	Y		

Appendix Table A-5(cont.). Results of analyses by ODFW Fish Pathology for pathogens of adult spring Chinook salmon recovered above the weir on Lookingglass Creek in 1996.

			Renibacterium salmoninarum		*Ceratomyxa*	Culture[c]		
Date	Sample number	Sex	OD[a] level	ELISA level	*shasta* infection[b]	Aeromonad pseudomonad	*Yersinia ruckeri*	*Flexibacter psychrophilus*
09/09	31	M	0.151	Low	ND			
09/09	32	M	0.183	Low	ND	Y		
09/09	33	M	0.149	Low	ND	Y		
09/09	34	M	0.133	Low	ND	Y		
09/10	35	F	0.438	Moderate	ND		Recovered below weir	
09/10	36	F	0.211	Low	ND		Recovered below weir	
09/11	37	F	0.153	Low	ND			
09/11	38	F	0.194	Low	ND			
09/11	39	F	0.182	Low	ND	Y		
09/11	40	M	0.163	Low	ND			
09/11	41	M	0.154	Low	ND	Y		
09/13	42	M	0.193	Low	ND	Y		
09/13	43	M	0.167	Low	ND	Y		
09/13	44	M	0.190	Low	ND			
09/16	45	F	0.203	Low	ND		Recovered below weir	
09/16	46	F	0.191	Low	ND			
09/16	47	M	0.142	Low	ND		Y	

[a] *ELISA = Enzyme-linked immunosorbent assay; OD=optical density.*

[b] *ND = analyses not done. Low, Moderate or High = C. shasta spores were observed. Negative = no spores were observed.*

[c] *The most common bacteria type in the culture is shown. Samples without a "Y" indicate that no bacteria were cultured.*