Lower Snake River Compensation Plan
Confederated Tribes of the Umatilla Indian Reservation
Evaluation Studies for 1 January to 31 December 1999

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

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SECTION I

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

Abstract

We trapped 17 unmarked and 30 adipose only-clipped spring Chinook salmon adults at the Lookingglass Hatchery trap between 19 February and 17 September 1999. All of these fish, which were progeny of unmarked adults, were transported to the South Fork Walla Walla (SFWW) facility for hatchery production. We spawned 8 female and 15 male spring Chinook salmon for an estimated 28,000 eggs. Three males died before spawning and 18 males and 3 females were killed and not spawned. We did not release adult spring Chinook salmon above the hatchery weir in 1999. We completed 3 surveys on Lookingglass Creek between 26 August and 23 September 1999. We observed no redds above the hatchery weir and 3 below the weir. We recovered only one carcass above the hatchery weir in 1999.

Progeny-per-parent ratios for the 1992, 1993, and 1994 cohorts from Lookingglass Creek were 0.58, 0.36, and 0.31 while ratios from other Grande Ronde River tributaries ranged from 0.23 to 0.92, 0.42 to 0.95, and 0.49 to 2.74.

Movement of juveniles from the naturally-produced 1997 cohort past the rotary screw trap in Lookingglass Creek peaked in September of 1998, with a smaller peak in March of 1999. The total estimated number of juveniles passing the trap was 15,117. The range of median monthly fork lengths of fish captured in the trap ranged from 36 mm in February 1998 to 104 mm in April 1999. Median fork lengths appeared similar between fish captured in the trap (rivermile (rm) 2.50) and those sampled from rm 7.25 on a monthly basis from May 1998 to October 1998.

We PIT-tagged four groups of fish from the naturally-produced 1997 cohort from Lookingglass Creek for survival and arrival timing to Lower Granite Dam. Three groups were tagged at the screw trap: June to September 1998 (fall), October to December 1998 (winter), January to June 1999 (spring), and one group which was seined from Lookingglass Creek in July 1998 (field). The median arrival date at Lower Granite Dam for the spring group was 29 April 1999 which was 4 to 7 days later than the other 3 groups. Groups tagged later at the trap had higher minimum survival rates: 23.0 (fall), 30.1 (winter), and 50.0% (spring). The minimum survival rate for the field group was 17.3%. Minimum survival rates for months with at least 50 fish PIT-tagged (August 1998 through March 1999) ranged from 15.7 to 44.1%. The median date of arrival at Lower Granite Dam of larger fish in the field group (25 April) was not significantly different than that of the smaller fish in the field group (27 April). Minimum survival rates among fish of 7 different fork length ranges from the field group were not different from average survival for the entire group ($\alpha \leq 0.05$). The arrival timing at the screw trap of the naturally-produced 1997 cohort field group did not appear different from that of non-PIT-tagged fish. There were no significant differences in fork length, weight, or condition factor of the 1997 cohort field group between detected and non-detected fish at Lower Granite Dam. The median arrival date at Lower Granite Dam of the Lookingglass Creek field group from the1997 cohort (25 April 1998), was earlier than median arrival dates of natural populations from the Minam and Lostine rivers and Catherine Creek (29 April, 15 and 26 May, 1999), the only other Grande Ronde River basin populations tagged by ODFW that year. The minimum survival rate to Lower

Granite Dam of the field group from the 1997 cohort (17.3%) was generally similar to minimum survival rates for the Minam and Lostine rivers and Catherine Creek field groups (14.1 to 17.2%).

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 trout (*O. mykiss*) (Nehlsen et al. 1991). The dwindling of Chinook salmon and steelhead populations and extirpation of coho and sockeye salmon in the Grande Ronde River Basin was, in part, a result of construction and operation of hydroelectric facilities, overfishing, 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 (Lower Snake River Compensation Plan (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 LSRCP to compensate for losses of anadromous salmonids due to the construction and operation of the lowest 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 Snake River spring/summer Chinook salmon as "threatened" under the federal Endangered Species Act (1973) on 22 April, 1992.

This study was designed to evaluate the potential for reestablishing spring Chinook salmon natural production in Lookingglass Creek using a 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 the study in consultation with the Nez Perce Tribe. Fishery managers believed that Lookingglass Creek was a good location to evaluate reintroduction of a non-endemic hatchery stock in the Grande Ronde River Basin. 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 document adult escapement. There was also a database on the life history and success 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 relative success of a non-endemic 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 blocked by a picket or floating weir located at the hatchery (Figure 1) and has been fairly effective at preventing upstream migration. However, some fish escaped above the weir each year, as evidenced by redd counts during spawning surveys (ODFW, unpublished data).

From 1992 to 1994, adults were placed above the Lookingglass Hatchery weir (Lofy and M^{c}Lean 1995a; Lofy and M^{c}Lean 1995b; and M^{c}Lean and Lofy 1995). In the fall of 1994 an infectious hematopoietic necrosis (IHN) epizootic at Lookingglass Hatchery affected the 1993 cohort that was being reared at the hatchery. This incident created increased concern about the potential negative effects of supplementation above the hatchery weir with adult salmon increasing the pathogen prevalence in the Lookingglass Hatchery water supply. Because of these concerns, the release of adults above the Lookingglass Hatchery weir did not take place in 1995 (M^{c}Lean and Lofy 1998). Instead, CTUIR and co-managers retained the adults for artificial

propagation and used the progeny of unmarked spring Chinook salmon that returned to Lookingglass Hatchery in 1995 for supplementation as parr (i.e., artificial spawning/ incubation/ early rearing at Lookingglass Hatchery and release in 1996 as parr in Lookingglass Creek) (M^{c}Lean and Lofy 1998, 1999).

With continued concern about increasing pathogen prevalence in the water supply for Lookingglass Hatchery, co-managers decided to release only 50 adults above the weir in 1996, fewer than the 100 to 200 fish released from 1992 to 1994 (M^{c}Lean and Lofy 1999). 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 (M^{c}Lean and Lofy 1999). This was done to reduce the number of carcasses in the water, which would presumably reduce the potential pathogen load in the water supply (Letter from William Stelle, NMFS, to Michael Spear, USFWS, 16 August, 1996) (M^{c}Lean and Lofy 1999). In 1997 the strategy to release adults and the survey frequency was the same as in 1996 (M^{c}Lean and Lofy 1999).

In 1998 it was decided again by co-managers to not intentionally release adult spring Chinook salmon above the Lookingglass Hatchery weir due to the potential increase in pathogen prevalence in the water supply. Returning spring Chinook salmon that were captured at the Lookingglass Hatchery trap were retained at the hatchery in 1998. These fish came from several sources, unmarked (most likely of natural parentage from Lookingglass Creek), adipose-only-clipped jacks (returns from our 1995 cohort release of progeny of unmarked adult spring Chinook salmon), and adipose-right ventral fin-clipped fish (returns from Lookingglass Hatchery releases that were not intercepted at Lower Granite Dam) (M^{c}Lean and Lofy 1999 and 2000). All spring Chinook salmon captured at Lookingglass Hatchery were transported to the CTUIR South Fork Walla Walla Facility (SFWW) due to higher priority for holding space being given to programs for endemic broodstock that were held at Lookingglass Hatchery. The unmarked and adipose-only-clipped jacks were spawned at SFWW and the eggs were taken to Irrigon Hatchery for incubation. After hatching and marking, these fish will be scheduled for release into Lookingglass Creek in July of 1999. The gametes of the adipose-right ventral fin-clipped fish were taken at SFWW by the Nez Perce Tribe for the Rapid River stock program in Idaho. The 1999 program on Lookingglass Creek was the same as in 1998 with all returning unmarked and adipose-only-clipped fish being retained for hatchery production and adipose-right ventral fin-clipped fish taken by the Nez Perce Tribe for the Rapid River stock program in Idaho.

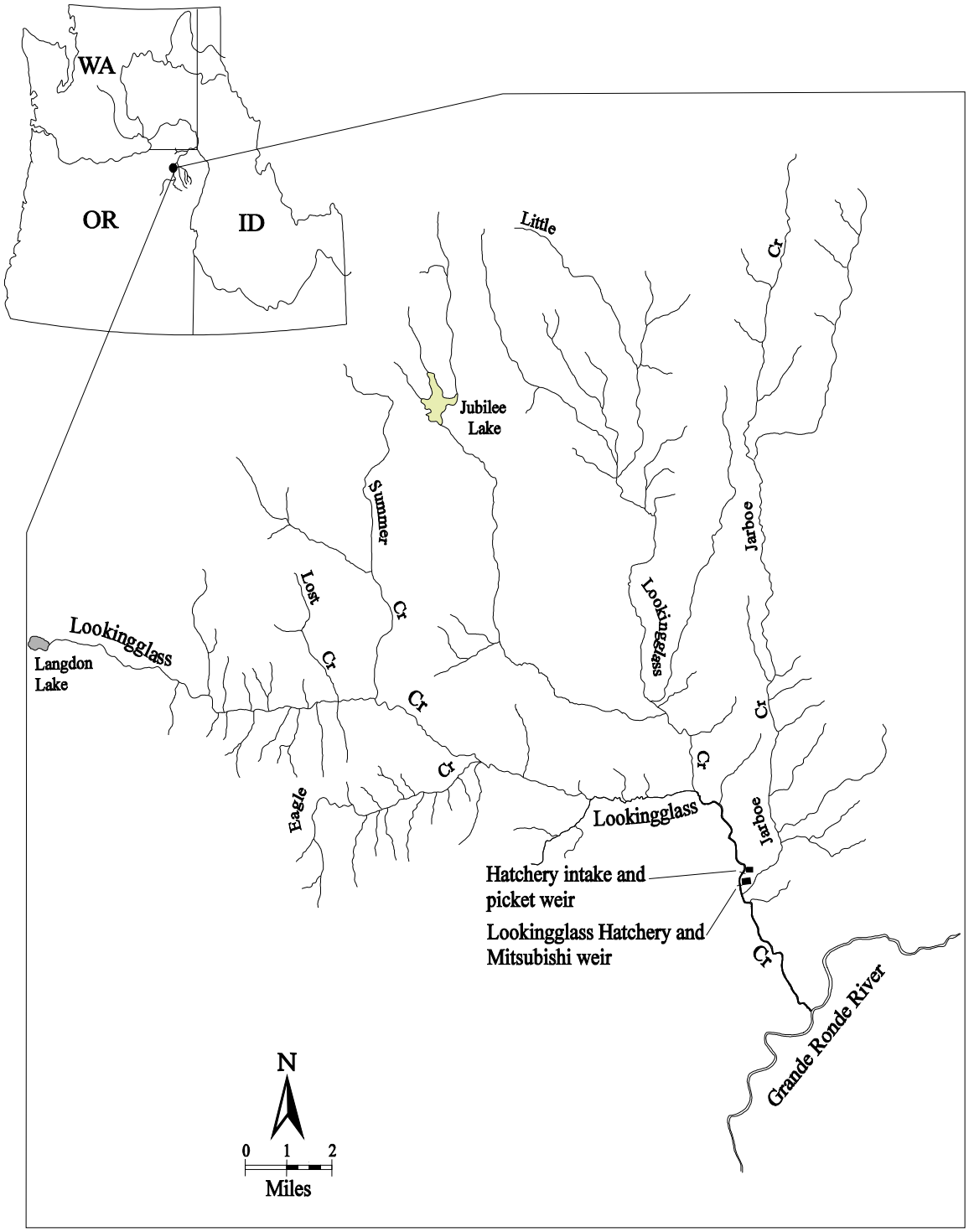

Figure 1. Map of the Lookingglass Creek basin showing the location of major tributaries and the Lookingglass Hatchery complex.

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 feet 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 feet 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 has taken place with any regularity. Lookingglass Hatchery is located at about rm 2.50 on Lookingglass Creek (Figure 2). 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). The lower portion of unit 3 is entirely privately owned. In 1999 we were not allowed any access by the landowner to this portion of Lookingglass Creek (Figure 2).

Methods

Stream Flow and Temperature

We obtained and summarized 1999 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). The mean daily stream flows (0.5-hour sample interval) in Lookingglass Creek for 1999 were estimated from an electronic stream gauging station located just below the floating weir (Mitsubishi) (Figure 3). The data were obtained from the USGS (personal communication, Jo Miller, USGS, Walla Walla District, WA, unpublished data) that 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).

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 1999 were obtained from summaries completed by the United States Forest Service (USFS)(personal communication Scott Wallace, USFS, Umatilla National Forest, Pendleton, OR) and from two electronic thermographs (Ryan Tempmentor®2000) operated by CTUIR. Stream temperature data collected in 1999 were recorded by the USFS at the forest service boundary (at about rm 7.25) and by CTUIR at approximately rm 3.75 of Lookingglass Creek and in the screw trap livebox 300 ft below the hatchery intake (Figure 3). There is about 250 ft of elevation change between rm 7.25 and the hatchery intake. We summarized all hourly stream temperature data as a weekly range (M^{c}Lean and Lofy 1995).

Adult Returns to Lookingglass Hatchery

Unmarked and marked adult spring Chinook salmon returning to the hatchery were enumerated by CTUIR and ODFW. Returning fish were diverted into one of 2 hatchery traps.

There is a picket weir at the upper trap which was installed on 19 February 1999, and a floating weir at the lower trap (at the main hatchery building), which was installed in June (date unrecorded) (Figure 3). The upper weir was taken out on 26 May 1999 due to high flows in Lookingglass Creek and was reinstalled on 8 June 1999. The floating weir was removed 2-3 weeks (date unrecorded) after installation because large *Salvelinus confluentus* (bull trout) were becoming trapped on top of the weir and dying. The traps were checked once a week for the duration of the return to Lookingglass Creek (until no spawning was observed in Lookingglass Creek below the hatchery). The upper weir was removed on 17 September 1999. All salmon in the trap were checked for fin clips, measured and injected with antibiotics. The adult spring Chinook salmon returns to Lookingglass Creek consisted of progeny of natural fish which were not marked; progeny of unmarked parents hatched and partially reared (July presmolt release) and reared to smolt (April release) in the hatchery which were adipose-clipped only; and progeny of marked fish hatched and reared in the hatchery for an April smolt release (Rapid River stock) which were adipose and right ventral fin-clipped. All unmarked and adipose-only-clipped spring Chinook salmon that returned to Lookingglass Hatchery in 1999 were trucked to SFWW each time the trap was checked. The returning adipose and right ventral clipped fish were taken by the NPT to Lyon's Ferry Hatchery and incorporated into their broodstock. The fish were taken to SFWW for spawning due to higher importance being placed on the endemic broodstock to be held at Lookingglass Hatchery. No salmon were intentionally released above the hatchery weir for natural production in 1999.

Progeny-Per-Parent Ratios

In order to evaluate the relative success of adult releases in 1992, 1993, and 1994 (Lofy and M^{c}Lean 1995a, Lofy and M^{c}Lean 1995b, and M^{c}Lean and Lofy 1995), progeny-per-parent ratios were calculated using the unmarked adult spring Chinook salmon intercepted at Lookingglass Hatchery and recovered above the weir during spawning ground surveys. The fish were enumerated, and then aged using scales to determine cohort year.

The progeny-per-parent ratio was calculated using the number of unmarked progeny that were recovered in Lookingglass Creek at or above the Lookingglass Hatchery weir from the 1992, 1993, and 1994 cohorts divided by the estimated number of adults above the weir in 1992, 1993, and 1994 (Lofy and M^{c}Lean 1995b and M^{c}Lean and Lofy 1995). Progeny-per-parent calculations assumed either no straying from Lookingglass Creek and other tributaries, or equal numbers of strays between Lookingglass Creek and other tributaries. Individuals of naturally-produced fish from Lookingglass Creek and those from other tributaries cannot be distinguished from one another.

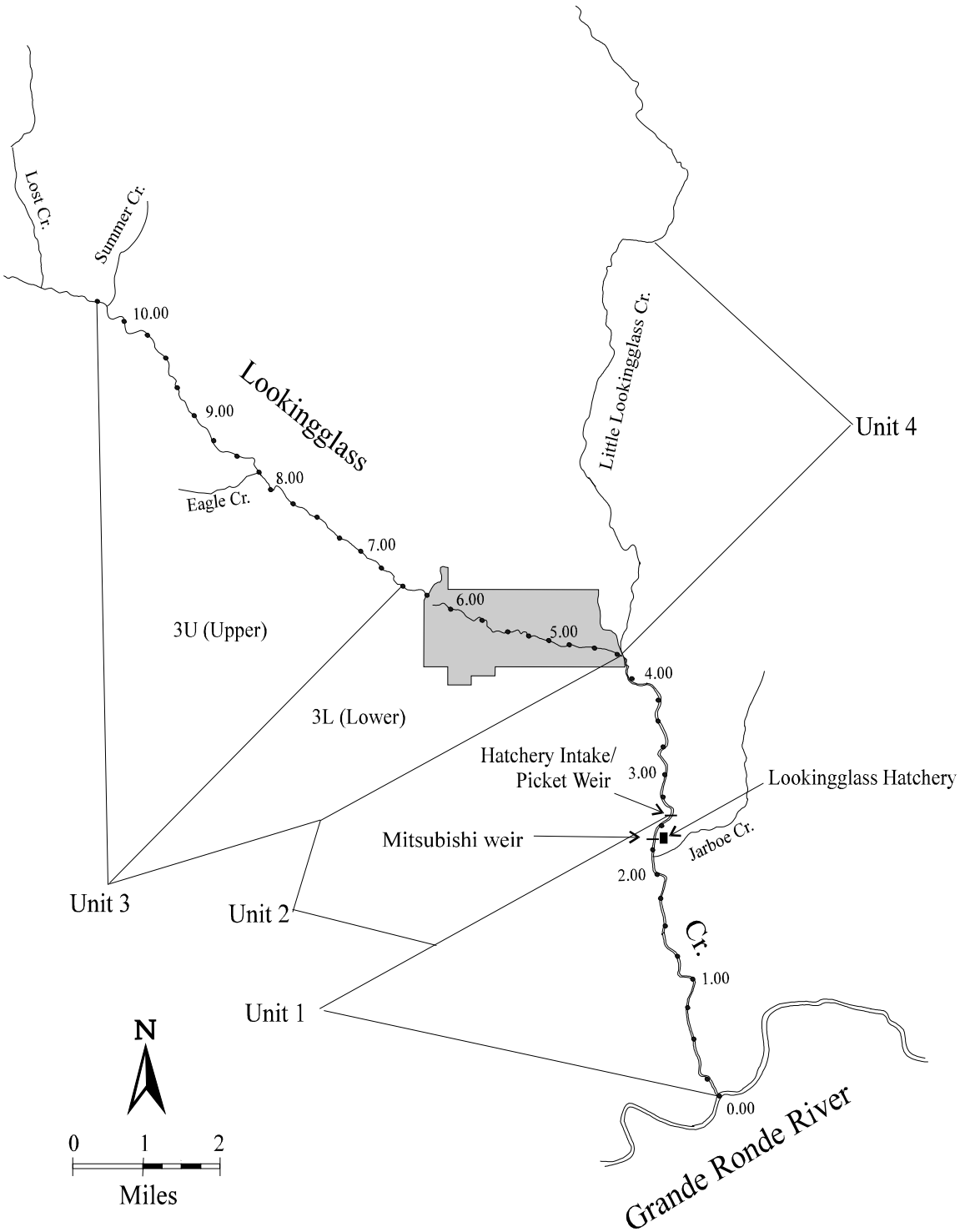

Figure 2. Unit Designations and 0.25-river mile sections of Lookingglass Creek. The shaded area is the private property where access by the landowner was not allowed in 1999.

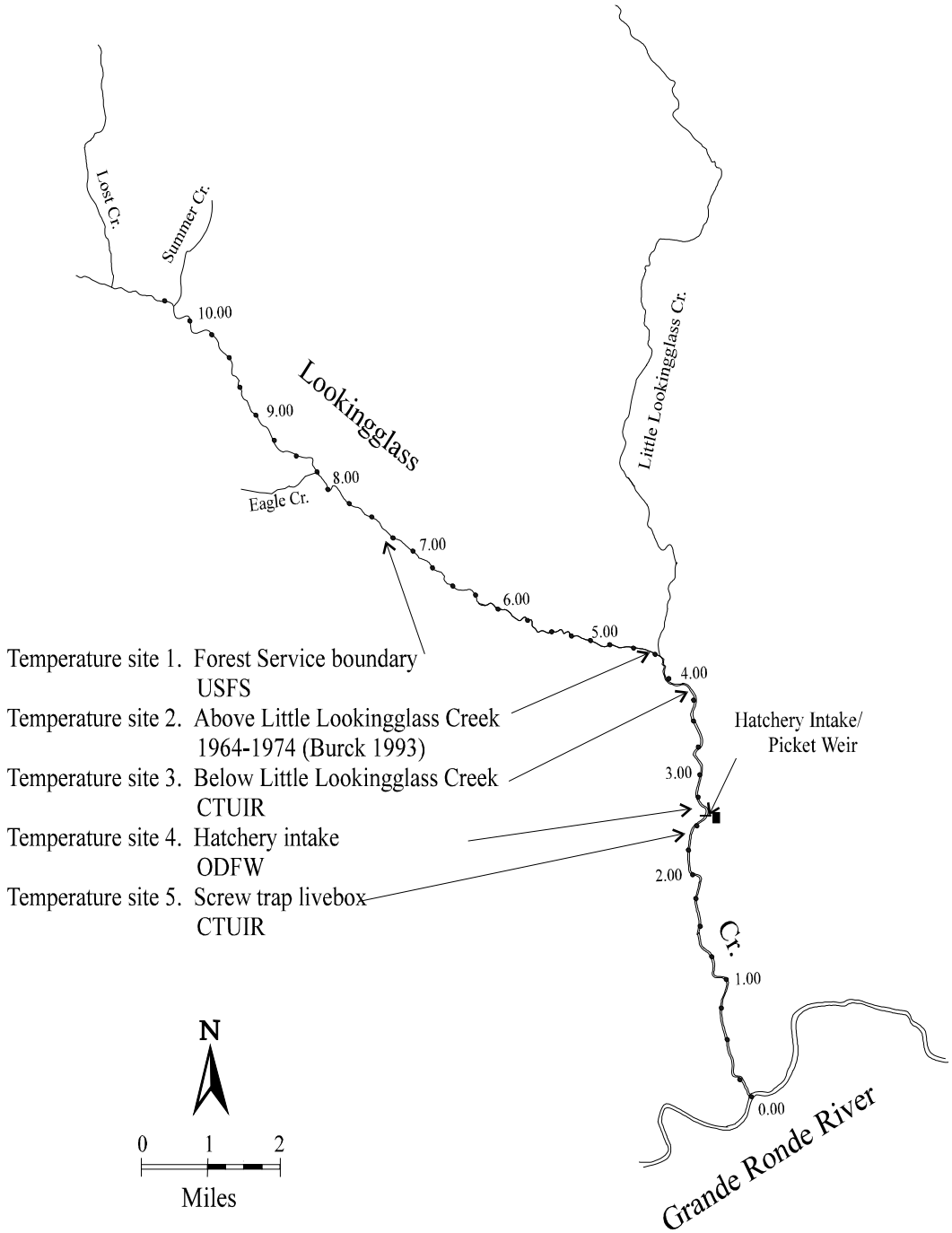

Figure 3. Location of temperature data recorders in Lookingglass Creek in 1999.

Progeny-per-parent ratios of other Grande Ronde River basin tributaries were calculated for comparison to Lookingglass Creek. Because there were no weirs or actual counts of adult returns escaping to any other Grande Ronde River basin tributaries, expanded redd counts in each of these tributaries were multiplied by the average fish-per-redd estimate of 3.26 from 1992 to 1994 in Lookingglass Creek (Lofy and M^{c}Lean 1995a, Lofy and M^{c}Lean 1995b, and M^{c}Lean and Lofy 1995) to obtain an estimate of adult escapement (Appendix Tables A-1 to A-5). Spawning ground surveys completed in the Grande Ronde River basin usually consisted of an index count (covering all sections) followed by two supplemental counts (covering an index area where most of the spawning occurs but not always every section of the stream) (Appendix Tables A-1 to A-5). The age structure for a tributary was based on scales from spring Chinook salmon carcasses recovered on spawning grounds on a return year basis throughout the Grande Ronde River basin (Appendix Table A-6). Cohort proportions within a run year were applied to all natural populations to estimate the number of fish from each cohort within each return year (ODFW, unpublished data)(Appendix Table A-6). No adjustment was made for differences in recoverability of different aged fish.

The redd counts for each tributary from 1995 to 1999 were expanded in order to account for times or places where multiple surveys were not completed. We expanded tributary redds each year by section using the average (1986-1999) percentage of redds by section which was calculated using the total number of redds counted on the last date that all sections were surveyed for each year (Appendix Tables A-1 to A-5). The average percentage for each section was then applied each year to sections where the redd counts were not complete (not surveyed on the final survey of the year) (Appendix Tables A-1 to A-5). If the expanded number of redds in a section was less than the actual number of redds counted in that section the actual number was used in the total expanded redd estimation (Appendix Tables A-1 to A-5). This method assumes that the distribution of redds at the end of spawning is similar to that on the last date a comprehensive count was completed.

Release of Adult Spring Chinook Salmon Above the Weir

We did not intentionally release any adult spring Chinook salmon above the Lookingglass Hatchery weir for natural production in 1999. All unmarked adults (ages 3, 4, and 5), and adipose-clipped only 3 and 4-year-olds from the 1995 and 1996 cohorts, which were progeny of unmarked parents collected at Lookingglass Hatchery, were taken to SFWW for spawning.

Spawning Ground Surveys

During 1999 we surveyed units 2 and 3U of Lookingglass Creek three times (Figure 2). We surveyed unit 4 (Little Lookingglass Creek) only once and below the weir 4 times (Figure 2). An index survey was done on 7 September 1999 to complete the co-managers spring Chinook salmon spawning ground index count for Lookingglass Creek. Unit 3L was not done because the landowner would not allow any access to his property which included the entire unit. Fewer surveys were completed in 1999 than in past years (1997, 1996) (M^{c}Lean and Lofy 1999 and 2000) because no fish were intentionally released above the weir and we were confident that most of the fish attempting to migrate above the weir were stopped. We removed carcasses, spawned out females, and weak-swimming males from the river channel in order to reduce the potential pathogen load in the creek. Determination of whether or not a fish should be gaffed

and killed was made by visual inspection. For females a flaccid abdomen and severe tail erosion were interpreted as evidence of completed spawning. Length of time the female had been observed on a redd was also taken into account. For males we used their ability swim or escape capture (if they were easily approached and captured by hand), or if there were surplus males available (most of the females had finished spawning). If there was any question that the fish may not be finished spawning, it was not gaffed. During the surveys, only completed redds were counted (using methods described in M^{c}Lean and Lofy 1995).

Genetic Monitoring

As part of an ongoing genetic monitoring program, the NMFS requested that we collect a tissue sample (opercle punch) for genetic analysis from unmarked and marked adult spring Chinook salmon that returned to Lookingglass Hatchery or were trucked to Lyon's Ferry Hatchery from Lower Granite Dam. After the tissue samples were collected, they were immediately placed in vials and fixed with ethanol. The tissue is being retained at our research office in La Grande, Oregon until funding can be acquired to analyze the samples.

Pre-smolt Release of the Hatchery-produced 1998 Cohort into Lookingglass Creek

Co-managers retained and spawned all unmarked adult spring Chinook salmon at SFWW in 1998. The eggs from each of 17 unmarked spring Chinook salmon females were placed in individual egg trays and spawned with unmarked males. The eggs were transferred to Irrigon Hatchery for early rearing. Final rearing (February to June 1999) was completed at Lookingglass Hatchery. All of these fish were tagged with a coded wire (CWT) in the snout and had their adipose fins removed. The 57,590 fish (127.3 fish/lb.) were released by helicopter at rm 10.25 (2 trips) on 24 June 1999.

Population Estimates of the Naturally-produced 1997 Cohort Using a Screw Trap

To evaluate the survival of naturally-produced juvenile spring Chinook salmon from the naturally-produced 1997 cohort, we operated a screw trap from 1 January 1998 to 31 December 1999 in the flume hole about 130 meters below the hatchery intake. We captured fish to estimate the timing to the trap and total number of fish moving past the trap site on Lookingglass Creek. From June 1999 to December 1999, we also captured fish from the 1998 cohort. Differences in fork length ranges made it possible to differentiate the two cohorts.

Most of the juvenile spring Chinook salmon captured in our rotary screw trap were measured (fork length, mm), weighed (g) and enumerated similar to M^{c}Lean and Lofy (1998). Others were just counted because they appeared injured or there were more fish in the trap than was necessary for the minimum sample size (we subsampled this group). Occasionally, small fry that were dipped out of the trap box into the bucket were presumed to have been eaten when they were not observed later in the bucket.

We expanded the number of fish captured each month using trap efficiency estimates (M^{c}Lean and Lofy 1998). All months were totaled to obtain the overall population estimate of fish moving past the trap. We used PIT tags as marks for estimating the trapping efficiency of the naturally-produced 1997 cohort in order to track individual fish and increase our sample size

of PIT-tagged fish for mainstem dam detections. Every healthy juvenile spring Chinook salmon captured at the trap that was at least 60 mm in fork length was tagged and released for trap efficiency estimation. For smaller fish (<60 mm) we used only a mark of Alcian blue dye applied with a battery-operated tattoo pen. Because we were not always able to differentiate between PIT-tagged fish from our releases in the upper reaches of Lookingglass Creek that were recaptured in the trap and the recaptured fish that were recently tagged and used to estimate the trap efficiency, we used a secondary mark of Alcian blue dye applied with tattoo pen on the caudal peduncle of the trap efficiency fish. The secondary mark was used so that we could recognize fish released for trap efficiency and refrain from using them for trap efficiency multiple times as well as the only mark on fish smaller than 60 mm. To calculate the variance around the estimate of total migration and the estimated numbers of fish trapped each month for the naturally-produced 1997 cohort, we used a bootstrap method described in M^{c}Lean and Lofy (1998).

Monthly Fork Length Sampling of the Naturally-produced 1997 Cohort

We conducted monthly fork length sampling of naturally-produced spring Chinook salmon from the naturally-produced 1997 cohort to compare growth patterns of fish passing the screw trap site and fish still residing in the upper reaches of Lookingglass Creek. We attempted to measure fork lengths from about 50 juvenile spring Chinook salmon at rm 7.25 around the 20th of the month (M^{c}Lean and Lofy 1998). We selected fish captured at the trap around the same dates as those sampled in the field (± 5 days) to calculate the range and median fork length for comparison.

PIT-tagging of the Naturally-produced 1997 Cohort

Four groups of juvenile spring Chinook salmon from the naturally-produced 1997 cohort were PIT-tagged to determine arrival timing at, and the minimum survival rate to Lower Granite Dam. Three of the four groups were categorized by initial arrival timing at the screw trap. The "fall group" was PIT-tagged from 26 June 1998 to 30 September 1998. The "winter group" was tagged from 1 October 1998 to 31 December 1998. The "spring group" was tagged from 1 January 1999 until the last non-precocial juvenile (defined in M^{c}Lean and Lofy 1998) from the naturally-produced 1997 cohort was captured in the screw trap. In 1999 this date was 23 April. The fourth group to be tagged (field group) was seined from and released back into the upper reaches of Lookingglass Creek on 27 to 29 July 1998. This group was tagged for comparison to other natural populations in the Grande Ronde River basin PIT-tagged during the summer of 1998 by ODFW. All of the fish were PIT-tagged using methods described in M^{c}Lean and Lofy (1998).

Weekly Arrival Timing and Minimum Survival to Lower Granite Dam

We used weekly arrival timing and minimum survival rate to Lower Granite Dam of the four groups of PIT-tagged fish from the Lookingglass Creek as well as PIT-tagged fish from other natural populations in the Grande Ronde River basin from the 1997 cohort (Tagged by ODFW in

1998) to describe the outmigration timing and to determine if a trend in survival was evident from the time of tagging to detection at the dams.

For the arrival timing of the field and trap groups, the daily detections were expanded for spill using a daily expansion factor [(Powerhouse Flow + Spillway Flow) / Powerhouse Flow] calculated from data provided by the United States Army Corp of Engineers (USACE) River Information. 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.

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, detections at Lower Granite Dam from the Lookingglass Creek field group were divided into two size categories then expanded for flow. Fish shorter than or equal to the median fork length of detected fish were included in the "< median" group. Fish longer than the median fork length comprised the "≥median" group. A Kolmogorov-Smirnov two sample test (Wilkinson 1996) was then used to compare arrival distributions of the groups of "< median" and "≥median" fish ($\alpha \leq 0.05$).

To determine the minimum survival rate of the field and trap groups to Lower Granite Dam, the total unique detections at all Snake and Columbia River dams were used. Survival rates were calculated for tagged fish by dividing the total number of unique detections by the total number of the juveniles tagged during that month or for that group. Confidence intervals (95%) for total detection percentages were calculated using methods described in Ott and Mendenhall (1985) to determine differences among or between groups based on the overlap of these intervals. Only the range from the upper bound of the confidence interval to the observed value were used for determining overlap, because the point estimate was an actual observed minimum, and was not estimated.

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 ($\alpha \leq 0.05$). 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 naturally-produced 1997 cohort were 57-65, 66-70, 71-75, 76-80, 81-85, 86-90, and 91-104 mm.

Effects of PIT-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 from the naturally-produced 1997 cohort after fish PIT-tagged in the field were released. We expanded recaptures of PIT-tagged and non-PIT-tagged fish at the trap based on the trap efficiency estimates during the period the fish were captured (M^{c}Lean and Lofy 1998) (see **Population Estimates of the Naturally-produced 1997 Cohort Using a Screw Trap**). 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 at the screw trap by month for the field group and the untagged fish within the cohort ($\alpha \leq 0.05$).

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

The field group from the naturally-produced 1997 cohort was used to compare fork length, weight, and condition factor between detected and non-detected fish. We used a Kolmogorov-Smirnov two-sample test to compare the fork length, weight, and condition factor of fish from the field group that were detected at Columbia and Snake River dams compared 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

In order to compare arrival timing at and minimum survival rates to Lower Granite Dam, we made comparisons between the Lookingglass Creek 1997 cohort field group and the same cohort from natural populations of juvenile spring Chinook salmon in the Minam and Lostine rivers and Catherine Creek. 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. Parr from no other tributaries were PIT-tagged from the 1997 cohort.

The arrival timing at Lower Granite Dam was calculated in the same manner described earlier (see **PIT-tagging of the Naturally-produced 1997 Cohort** , *Weekly Arrival Timing and Minimum Survival to Lower Granite Dam*). We illustrated arrival timing by week at Lower Granite Dam for each tributary for the 1997 cohort by graphing weekly detections as a percentage of the expanded total number of fish detected.

To determine the minimum survival rates and 95% confidence intervals to Lower Granite Dam of juvenile outmigrants for each tributary we used the same methods described earlier (see **PIT-tagging of the Naturally-produced 1997 Cohort** , *Weekly Arrival Timing and Minimum Survival to Lower Granite Dam*).

Results/Discussion

Stream Flow and Temperature

Increasing flows did not begin in Lookingglass Creek until the week of 18 February in 1999 (Figure 4). Weekly maximum flows ranged from 1 to 22 m^3/s with five major peaks occurring the weeks of 4 March, 1 and 29 April, 27 May, and 2 December (Figure 4). After the highest flows the week of 27 May, flow decreased dramatically to a summer low of about one to two m^3/s after the week of 15 July until mid November (Figure 4). There were higher flows the weeks of 25 March, 1 April, 25 November, and 2 December than were seen historically from 1964 to 1971 (Figure 4). The peak flows in April and May of 1999 were well below the maximum flows seen historically from 1964 to 1971 (Figure 4). The November flood was well outside the historic range.

Water temperature peaked at site 1 (rm 7.25) and 4 (screw trap livebox) in Lookingglass Creek for 1999 during the weeks of 9 and 16 July (18.9 and 13.6^{o}C) (Figure 4). The peak at site 4 was slightly higher than the maximum water temperature observed from 1964 to 1971 (17.8 ^{o} C) (Figure 4). The maximum temperatures during the weeks from 23 July to 3 September from 1964 to 1971 were also exceeded at site 4 in 1999 (Figure 4) which was lower in the system than from 1964 to 1971. The minimum water temperatures for all sites in 1999 were very similar to one another, generally falling within the minimums observed from 1964 to 1971 (Figure 4). Temperatures at the Lookingglass Hatchery intake were not recorded in 1999 due to problems with the main computer control system. Temperatures were not complete in 1999 at site 3 (rm 3.75) due to the fact that the electronic thermograph at that location was washed out during the high flows of May.

Adult Returns to Lookingglass Hatchery

Unmarked adult spring Chinook salmon that were trapped at Lookingglass Hatchery in 1999 included 5 three-year-olds, 8 four-year-olds, and 4 five-year-olds (Table 1). We collected 17 three-year-olds, 13 four-year-olds, and no five-year-olds that were adipose-only-clipped (progeny of unmarked parents) (Table 1). During spawning ground surveys conducted above or below the weir on Lookingglass Creek in 1999 we collected only one adult spring Chinook salmon (Table 1). There were 17 marked fish (ADRV) that swam into the Lookingglass Hatchery trap in 1999. These 17 fish were taken by the NPT for their hatchery programs in Idaho. The unmarked fish first arrived at the trap the week of 3 June with the peak arrival the weeks of 3 and 10 June (Figure 5).

We spawned 15 male and 8 female unmarked and adipose-only-clipped adult spring Chinook salmon at SFWW in 1999. Three males and no females died and 18 males and 3 females were killed while being held at the SFWW facility. The reason that the fish were killed is that all the Umatilla River spring Chinook salmon that were being held at SFWW were finished spawning and co-managers could not justify operating the SFWW facility for only 3 females from at program that is being phased out. The eggs from the spawned fish were incubated at Irrigon Hatchery. They are expected to be transferred to Lookingglass Hatchery for final rearing in March of 2000.

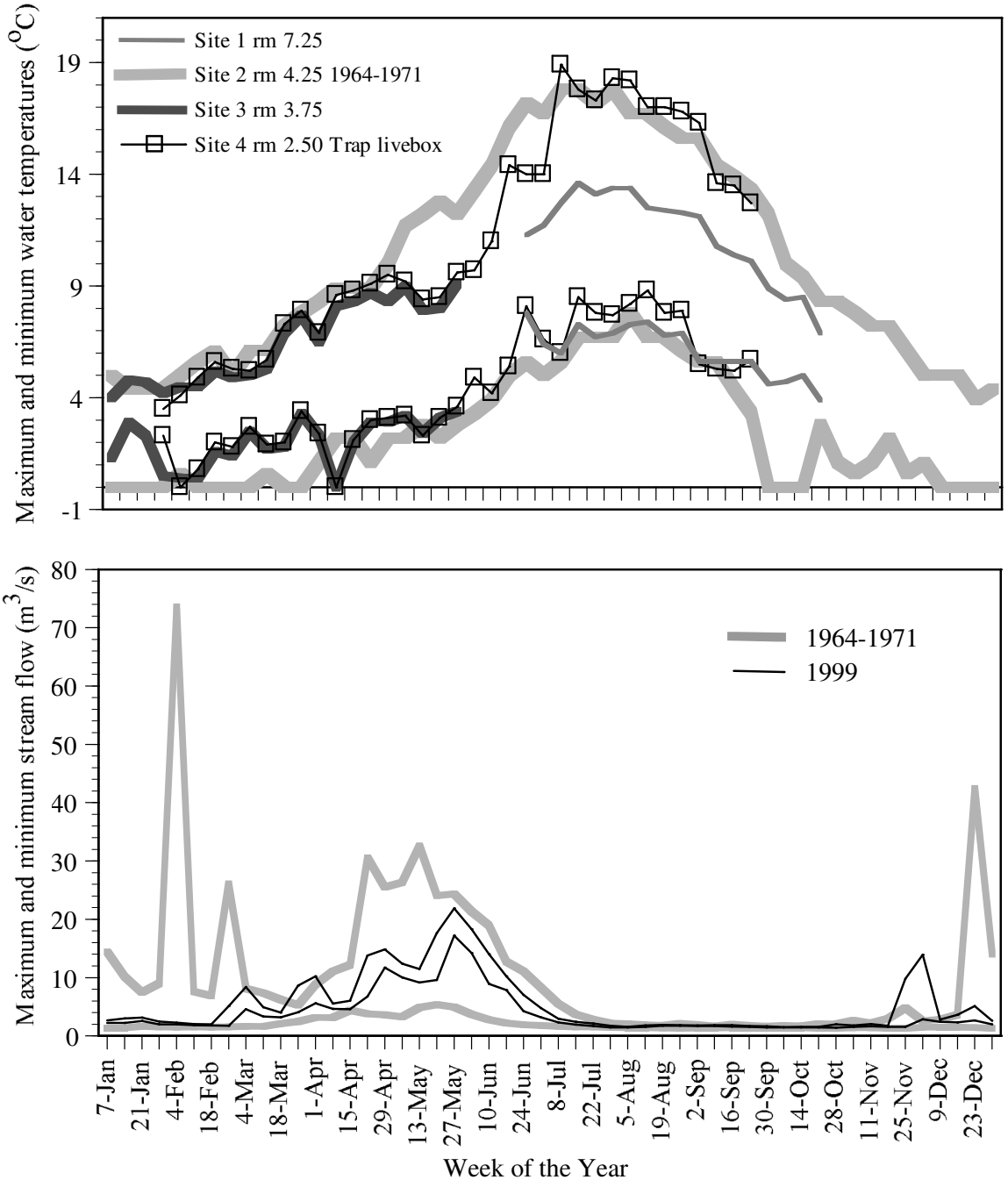

Figure 4. Historical (1964-1971) and 1999 ranges of weekly stream temperature and flow in Lookingglass Creek. Week of the year is represented by the last day of the week. Data for temperatures were provided by the USFS unpublished and Burck 1993. Data for flows were provided by USGS unpublished and Burck (1964-1974).

Table 1. Disposition, age, sex, and fork length data from spring Chinook salmon that were spawned, killed, or died at SFWW facility, or were recovered above the Lookingglass Hatchery weir but were not trapped at the hatchery in 1999.

Group, Disposition[b]	Age[c]	Males[a] N	Males[a] Fork length (mm) Range	Males[a] Fork length (mm) Median	Females[a] N	Females[a] Fork length (mm) Range	Females[a] Fork length (mm) Median
Unmarked,							
Spawned	3	2	431-517	474	0	--	--
Spawned	4	2	640-696	668	1	787	--
Spawned	5	2	910-985	948	0	--	--
Killed	3	3	415-578	422	0	--	--
Killed	4	2	692-739	716	3	676-737	683
Killed	5	1	804	--	0	--	--
Mortality	3	0	--	--	0	--	--
Mortality	4	0	--	--	0	--	--
Mortality	5	1	905	--	0	--	--
Recovered	3	0	--	--	0	--	--
Recovered	4	0	--	--	0	--	--
Recovered	5	0	--	--	0	--	--
Ad-clipped,							
Spawned	3	7	435-525	450	0	--	--
Spawned	4	2	737-776	757	7	615-758	704
Spawned	5	0	--	--	0	--	--
Killed	3	9	416-564	480	0	--	--
Killed	4	3	765-835	766	0	--	--
Killed	5	0	--	--	0	--	--
Mortality	3	1	496	--	0	--	--
Mortality	4	0	--	--	0	--	--
Mortality	5	0	--	--	0	--	--
Mortality	6	1	945	--	0	--	--

Table 1 (cont.). Disposition, age, sex, and fork length data from spring Chinook salmon that were spawned, killed, or died at SFWW facility and recovered above the Lookingglass Hatchery weir but were not trapped at the hatchery in 1999.

Group, Disposition[b]	Age[c]	Males[a] N	Males[a] Fork length (mm) Range	Males[a] Fork length (mm) Median	Females[a] N	Females[a] Fork length (mm) Range	Females[a] Fork length (mm) Median
Recovered	3	0	--	--	0	--	--
Recovered	4	1	820	--	0	--	--
Recovered	5	0	--	--	0	--	--

[a] *The sex of the spawned, dead, and recovered fish was determined by internal inspection.*

[b] *Disposition of the fish, Spawned = gametes taken at the hatchery for artificial production, Killed = Intentionally killed before spawning and the gametes were not used, Mortality = died while at Lookingglass or SFWW facilities, Recovered = found during spawning ground surveys, not trapped at weir.*

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

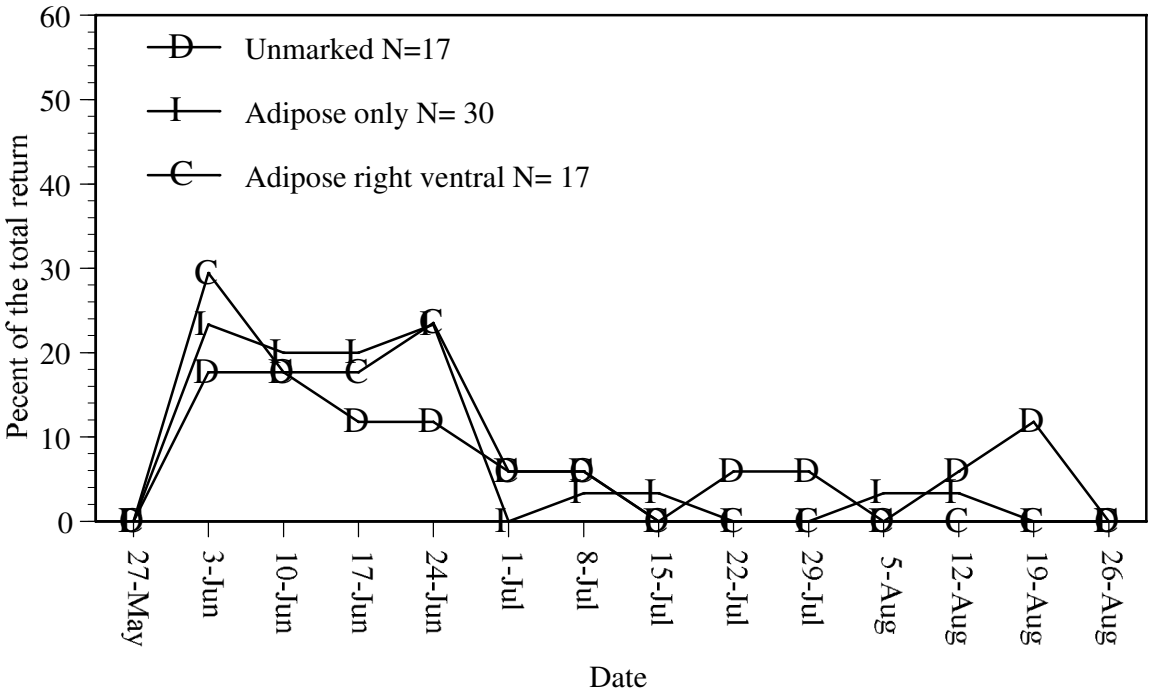

Figure 5. Arrival timing at the Lookingglass Hatchery adult trap of progeny of marked (ADRV) and unmarked (AD only and no clip) adult spring Chinook salmon in 1999. N= total number of each mark type captured at the hatchery. The trap was opened on 19 February, 1999 and was closed on 23 September, 1999.

Progeny-Per-Parent Ratios

The Lookingglass Creek progeny-per-parent ratio for the completed (3-5-year-olds) 1992, 1993, and 1994 cohorts was 0.58, 0.36, and 0.31 (Table 2). The 1992 to 1994 cohorts in other Grande Ronde River tributaries ranged from 0.23 to 0.92, 0.42 to 0.95, and 0.49 to 2.74 (Table 2). The high progeny-per-parent ratios seen for the Grande Ronde (2.74) and Lostine (1.37) rivers for the 1994 cohort may be a result of the low parent populations (5 and 18)(Table 2). A small increase in returning progeny would account for a large increase in the parent-per-progeny ratio.

In our calculation of progeny-per-parent ratios we used fish-per-redd estimates from our releases in Lookingglass Creek from 1992 to 1994. Since the sex ratio may influence production by affecting the number of eggs available for fertilization, and production of progeny, we generally tried to place an equal proportion of males and females above the weir in Lookingglass Creek each year.

It is possible that any or all of 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 a source of unmarked adult spring Chinook salmon returning to the Lookingglass Creek basin. Since we marked (fin clip, PIT tag, CWT) very few of the fish leaving Lookingglass Creek, we have no way of being certain where most of the unmarked fish originated. Some (progeny) could be strays from other basins. If a large portion of the unmarked fish returning to Lookingglass Creek are strays from other basins, this would lower the estimate of success (parent-progeny ratio) of our adult outplants (parents) in Lookingglass Creek. If indeed these are strays, we may need to take another look at the genetic make-up of the unmarked adult population in Lookingglass Creek, because of the declining status of other Grande Ronde River tributary natural populations. If the unmarked fish returning to Lookingglass Creek are from production in Lookingglass Creek we need to document the success of outplanting hatchery adults in order to re-establish natural production so that others can see that this method can be successful.

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 (the only stock released directly from Lookingglass Hatchery) conducted by ODFW suggest this is unlikely. Pre-release sampling suggest the 1992, 1993, and 1994 cohorts, released from Lookingglass Hatchery, were about 100% marked with either an adipose (AD) or right pelvic (RV) fin clip or a combination of the two (ADRV) (Table 3)(ODFW Research, La Grande, unpublished data). Recoveries of snouts (138) from unmarked spring Chinook salmon from Lookingglass Creek did not have any coded-wire-tag (which would have indicated if the fish was of hatchery origin but the fins were not clipped) (Table 4). These data are consistent with the mark retention data shown in Table 3.

Spawning Ground Surveys

We observed no redds in the units surveyed in 1999 (Units 2, 3U, and 4) above the lower weir(Figure 2). We were not allowed on the property to survey Unit 3L in 1999 (Figure 2). We counted 3 completed redds below the hatchery weir in 1999. We surveyed units 1 and 2 on 26 August, 3, 7, and 23 September 1999. We surveyed Unit 3U on 19 August and 1 and 7 September 1999. We Surveyed Unit 4 on 7 September 1999.

Table 2. Progeny-per-parent ratios for the 1992, 1993 and 1994 cohort spring Chinook salmon returning from 1995 to 1999 to Lookingglass Creek or other Grande Ronde River tributaries.

Cohort, Location	Expanded redd count[a]	Parent Population[a]	Returning progeny by age[b] 3	4	5	Progeny-per-Parent
1992						
Lookingglass Cr.	49	220	9	101	17	0.58
Grande Ronde R.	130	424	3	77	19	0.23
Catherine Cr.	106	347	17	56	31	0.30
Lostine R.	40	132	5	83	33	0.92
Minam R.	256	834	16	391	46	0.54
Wenaha R.	195	634	10	407	48	0.73
1993						
Lookingglass Cr.	132	297	3	79	25	0.36
Grande Ronde R.	113	368	4	68	81	0.42
Catherine Cr.	140	458	3	112	75	0.42
Lostine R.	102	334	4	119	78	0.60
Minam R.	155	506	19	166	166	0.69
Wenaha R.	118	383	19	172	172	0.95
1994						
Lookingglass Cr.	40	121	0	32	5	0.31
Grande Ronde R.	5	15	4	37	0	2.74
Catherine Cr.	34	111	7	34	26	0.60
Lostine R.	18	58	7	35	38	1.37
Minam R.	76	248	10	75	46	0.53
Wenaha R.	66	215	10	78	17	0.49

[a] *Table is a summary of Appendix Tables A1-A5 (ODFW Research, La Grande, unpublished data).*

[b] *Age structure from Appendix Table A6 was used to calculate the returning progeny from each cohort (ODFW Research, La Grande, unpublished data).*

Table 3. Release and fin clip quality data for the Rapid River stock spring Chinook salmon released at Lookingglass Hatchery from the 1992, 1993, and 1994 cohorts. Source: ODFW Research, La Grande, Coded-wire release reports(unpublished).

Cohort	Number released	Pre-release fin clip			
		ADRV	RV	AD	None
1992	849,273	830,968	18,305	0	0
1993	658,230	645,413	554	12,263	0
1994	139,112	114,219	503	24,390	0

Table 4. Coded-wire-tag recoveries from unmarked fish returning to Lookingglass Creek from the 1992 to 1994 cohorts. Snouts were taken from fish recovered during spawning ground surveys above the weir on Lookingglass Creek or from fish trapped at Lookingglass Hatchery. Source: ODFW coded-wire tag database.

Cohort[a]	Return year	No. of snouts collected	No. of snouts with CWT
1992	1995	0	0
	1996	12	0
	1997	13	0
1993	1996	0	0
	1997	52	0
	1998	25	0
1994	1997	0	0
	1998	32	0
	1999	4	0

[a] Cohort determined by scale reading.

Genetic Monitoring

We collected fin tissue for genetic analysis by the NMFS. The tissue from 17 unmarked and 30 adipose-clipped spring Chinook salmon was collected at the time of trapping at Lookingglass Hatchery. During spawning of the fish at Lyon's Ferry Hatchery fin tissue from 50 marked (ADRV) adult spring Chinook salmon captured at the Lookingglass Hatchery weir or Lower Granite Dam in 1999. The samples were placed in vials and preserved with ethanol. The vials are being archived at our office in La Grande, Oregon until funding can be obtained for analysis.

Population Estimates of the Naturally-produced 1997 Cohort Using a Screw Trap

We estimated that 15,117 naturally-produced juvenile spring Chinook salmon from the 1997 cohort passed the rotary screw trap during 1998 and 1999 (Table 5). We captured the first naturally-produced fry from the 1997 cohort on 17 February 1998 and the last fish on 20 September 1999 (Appendix Table A-1). The fish that were captured in the trap after 23 April 1999 appeared to be precocial fish. Most precocial fish were extruding milt and all had a dark coloration.

Of the fish estimated to have passed the trap site, 90.0% of the juveniles from the naturally-produced 1997 cohort migrated before January 1999 as sub-yearlings (Figure 8). Peak migration past the trap for the naturally-produced 1997 cohort occurred during the September trapping period (Figure 8).

On 12 March 1998 we noticed and repaired (17 March 1998) a hole in the livebox of the screw trap that was large enough for fish to escape. It is unknown how long the hole was there and how many fish escaped through it.

Monthly Fork Length Sampling of the Naturally-produced 1997 Cohort

We recorded fork length data from naturally-produced juvenile spring Chinook salmon captured at about rm 7.25 in May through October 1998 and July 1999. Median monthly fork lengths of fish captured ranged from 52 mm in May 1998 to 123 mm in July of the next year (Figure 9). Median monthly fork lengths of fish captured in the trap around the 20th of each month ranged from 36 mm for February 1998 to 104 mm about one year later (Figure 9). The median fork length of field captured and trap captured fish, for months when both were captured, appeared very similar (Figure 9).

Table 5. Naturally-produced juvenile spring Chinook salmon from the 1997 cohort captured in a rotary screw trap, releases and recaptures from trap efficiency tests, and the estimated number of migrants from Lookingglass Creek during 1998 and 1999.

Month	Total trapped	Trap efficiency release	Trap efficiency recapture	% Trap efficiency[a]	Population Estimate	±95%CI
Feb	1	0	0	8.33	12	36
Mar	60	31	3	8.33	720	1,122
Apr	10	5	0	8.33	120	192
May	30	29	7	24.14	124	143
Jun	43	35	2	5.56	774	893
Jul	2	1	0	5.56	36	50
Aug	96	95	11	11.58	829	667
Sep	989	472	97	20.55	4,812	914
Oct	1,002	673	167	24.81	4,038	549
Nov	540	510	162	31.76	1,700	229
Dec	98	98	26	26.53	369	150
Jan	21	21	3	24.18	87	50
Feb	70	70	19	24.18	290	132
Mar	138	136	20	14.71	938	500
Apr	40	40	6	15.00	267	435
May	0	0			0	
Totals	3,140	2,216	523		15,117±	1,050

Estimated # of redds above the weir in 1997 was: 21
Estimated # of female spring Chinook salmon above the weir in 1997 was: 56
Estimated # of male spring Chinook salmon above the weir in 1997 was: 36

[a] *Because the trap efficiency release was less than 25 fish for the months of February, April, and July 1998, and January 1999, the releases were combined with March (February, April) and June (July) 1998 and February (January) 1999 to make one trap efficiency estimate that was used for each individual month before and after.*

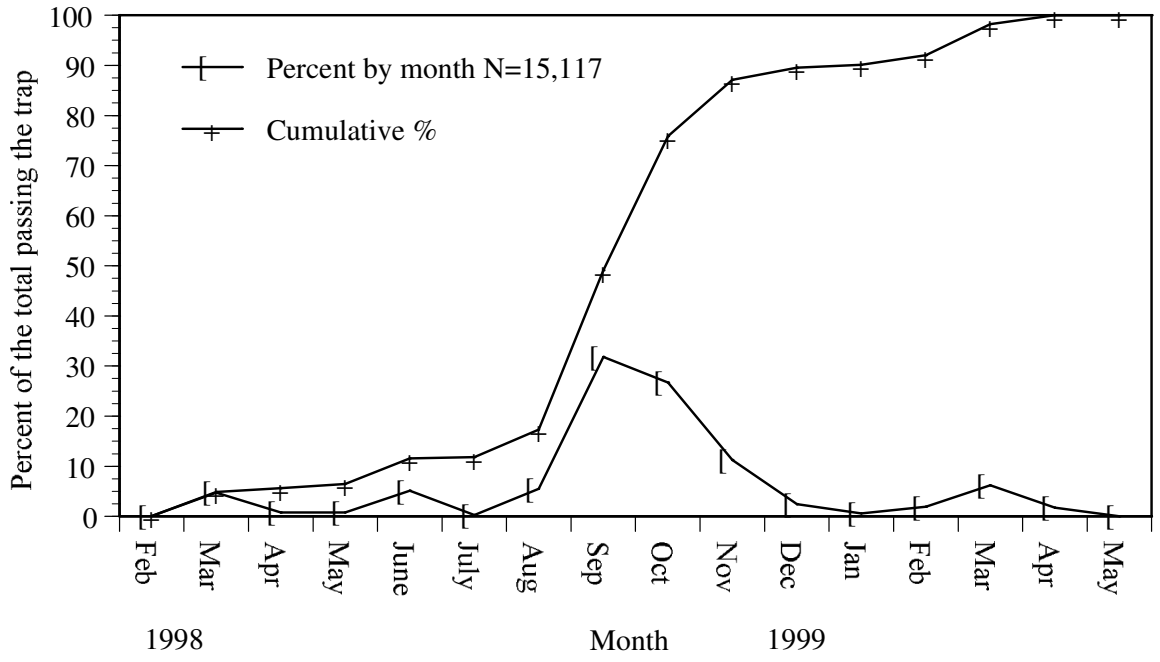

Figure 6. Percent of the total expanded numbers of naturally-produced 1997 cohort juvenile spring Chinook salmon passing the rotary screw trap site on Lookingglass Creek in 1998 and 1999. The total estimated population passing the trap (15,117) was estimated using trap efficiencies.

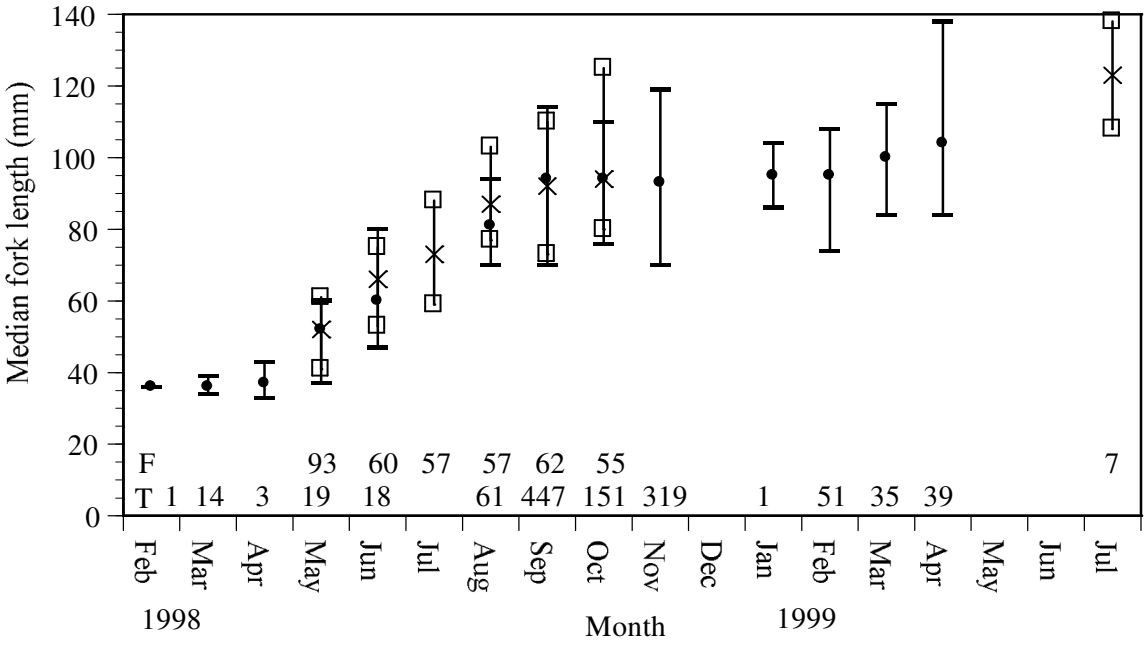

Figure 7. Monthly median and range of fork lengths from naturally-produced 1997 cohort juvenile spring Chinook salmon captured in the rotary screw trap (T) and in upper Lookingglass Creek (F) in 1998 and 1999. Length information from fish trapped and captured with a seine around the 20th of each month (± 5 days) was used. Sample size for each group is shown above the month. The X and open squares represent the field group while the dots and lines represent the trap group.

PIT-Tagging of the Naturally-Produced 1997 Cohort

We PIT-tagged a total of 513 juveniles from the fall group, 1,277 juveniles from the winter group, and 234 juveniles from the spring group for the naturally-produced 1997 cohort at the screw trap (Table 6). We PIT-tagged 1,052 naturally-produced juvenile spring Chinook salmon from the field group seined from the upper reaches of Lookingglass Creek (~rm 7.75 to rm 6.25).

Weekly Arrival Timing and Minimum Survival to Lower Granite Dam

Juvenile Chinook salmon from the naturally-produced 1997 cohort PIT-tagged at the screw trap and in the field both arrived at Lower Granite Dam the week of 8 April, with the last fish arriving the week of 3 June 1999 (Figure 8). The arrival distributions of the fall, winter, and field groups appeared similar with median dates of arrival being 22, 24 and 25 April 1999 respectively (Table 6)(Figure 8). The median arrival of the spring group was 29 April 1999 (Table 6)(Figure 8). The later arrival for the spring group may be due in part to the fact that the median date of PIT-tagging for the spring group was 2 March 1999 (Table 6) and that 17.5% of the fish PIT-tagged from that group were captured at the trap and PIT-tagged after the week of first arrival for the winter group at Lower Granite Dam.

The arrival timing of the "< median" group (< 78mm fork length) was not significantly different than the arrival timing of the "≥ median" group (≥ 78mm fork length) for the 1997 cohort field group PIT-tagged in Lookingglass Creek (P=0.98) (Figure 9). The median date of arrival for the smaller group was 27 April while that of the larger group was 25 April. The median length at tagging for all fish that were detected was 78 mm with expanded sample sizes of 19 (18 detected) for the "< median" group and 29 (25 detected) for the "≥ median" group.

Minimum survival rates of PIT-tagged juvenile spring Chinook salmon from the naturally-produced 1997 cohort for the fall, winter, spring, and field groups were 23.0, 30.1, 50.0, and 17.3%, respectively (Table 6). There was a significant difference in detection rates among the fall, winter and spring groups based on the 95% confidence interval overlap (Figure 10). The survival of the field group was significantly lower than all three of the trap groups with significantly greater survival for groups captured at the trap through time (Figure 10). Survival indices of the 1997 cohort captured at the trap and in the field by month for the months in which more than 50 tagged fish were released (August to March, not including January), ranged from 15.7 to 44.1% (Figure 10).

Minimum survival rates among 7 different size categories of fish from the naturally-produced 1997 cohort field group in Lookingglass Creek were not significantly different from one another (χ^2=2.10, P=0.72, df=6) (Figure 11).

Effects of PIT-Tagging on Fish Movement Past the Rotary Screw Trap

The field group of PIT-tagged fish from the 1997 cohort had two peaks in movement past the rotary screw trap (Figure 12). The largest peak occurred in September 1998, and a smaller peak occurred in March 1999 (Figure 12). The non-PIT-tagged fish had similar peaks in movement past the screw trap after the first date of PIT-tagging of the field group (Figure 12).

Table 6. PIT-tagging information for naturally-produced juvenile spring Chinook salmon from the naturally-produced 1997 cohort captured at the rotary screw trap and in the field from Lookingglass Creek in 1998 and 1999.

	Lookingglass Creek		Lower Granite Dam			Mainstem dams
	Number	Tagging				
Group	PIT-tagged	median	Median arrival	Actual	Expanded[a]	total
Fall (trap)	513	23 September 1998	22 April 1999	16	17	118
Winter (trap)	1,277	30 October 1998	24 April 1999	90	116	384
Spring (trap)	234	2 March 1999	29 April 1999	24	31	117
Field	1,052	28 July 1998	25 April 1999	43	54	182

[a] *Expansion factors may differ depending upon timing of individual fish.*

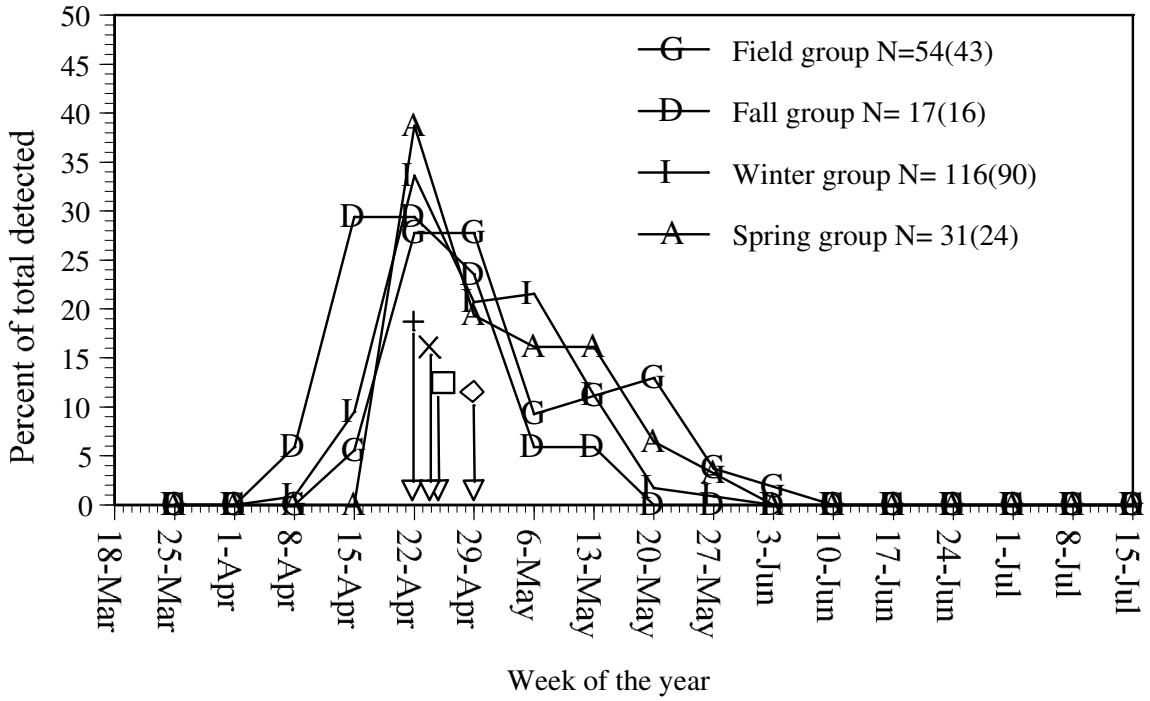

Figure 8. Arrival timing by week at Lower Granite Dam in 1999 of four groups of naturally-produced 1997 cohort juvenile spring Chinook salmon PIT-tagged at the rotary screw trap and in the upper reaches of Lookingglass Creek. The arrows indicate the median arrival date of each group. Expanded detections (N) are graphed. Actual detections are in parentheses. Week of the year is represented by the last date in the week.

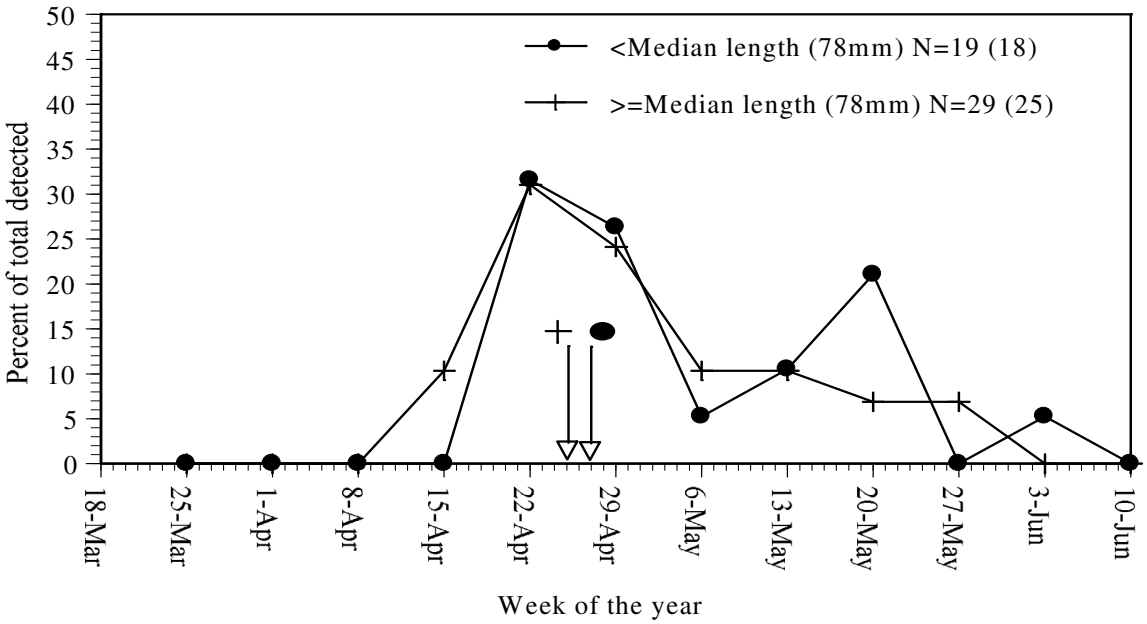

Figure 9. Arrival timing by week at Lower Granite Dam in 1999 for groups of smaller (fork length < 78 mm) and larger (fork length ≥ 78 mm) fish from the field group of naturally-produced 1997 cohort juvenile spring Chinook salmon in Lookingglass Creek. Actual detections (N) are graphed. Arrows indicate the median arrival date. Expanded detections (N) are graphed. Actual detections are in parentheses. Week of the year is represented by the last date in the week.

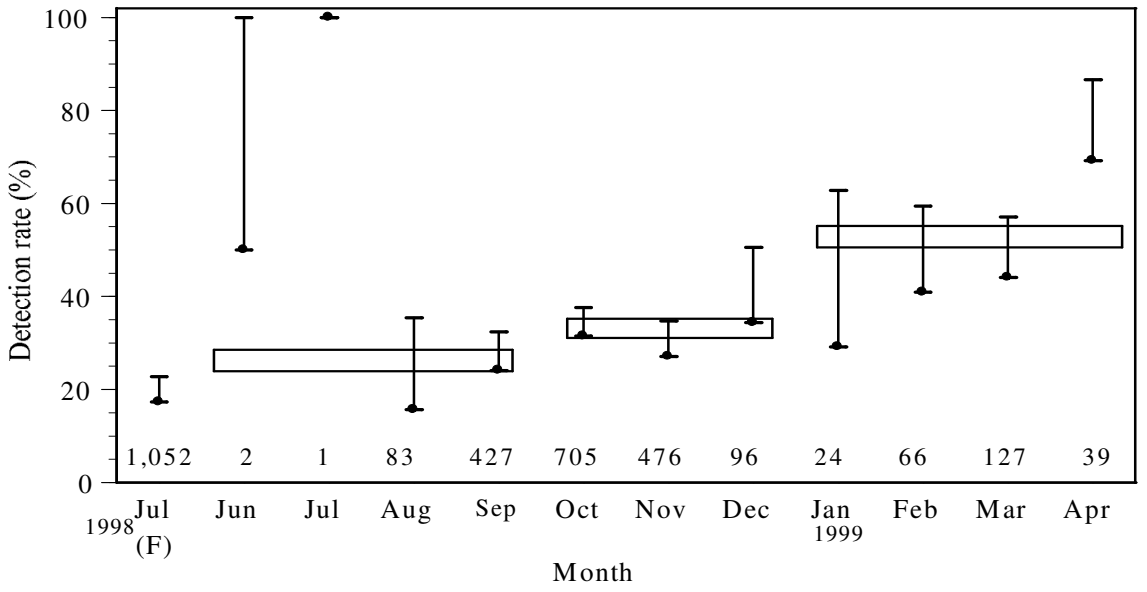

Figure 10. Total unique detection rates with upper ninety-five percent confidence intervals (bars) for naturally-produced 1997 cohort juvenile spring Chinook salmon tagged at the rotary screw trap in Lookingglass Creek and detected at Snake or Columbia River dams. The rectangles represent detection rates and upper ninety-five percent confidence intervals for fish from fall (Jun-Sep), winter (Oct-Dec), and spring (Jan-Apr) groups. Number tagged is above each month.

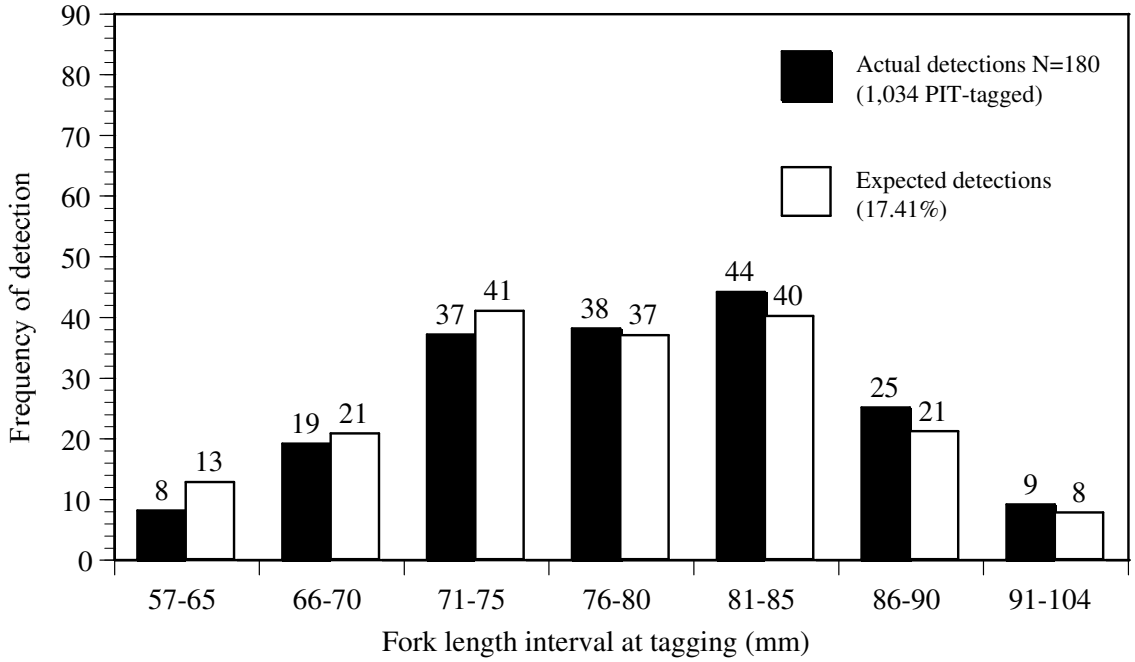

Figure 11. Comparison of actual and expected (overall survival of field group) unique PIT tag detections at Snake or Columbia River dams by fork length interval of naturally-produced 1997 cohort juvenile spring Chinook salmon seined from Lookingglass Creek (PIT-tagged in 1998). N values are shown above the bars.

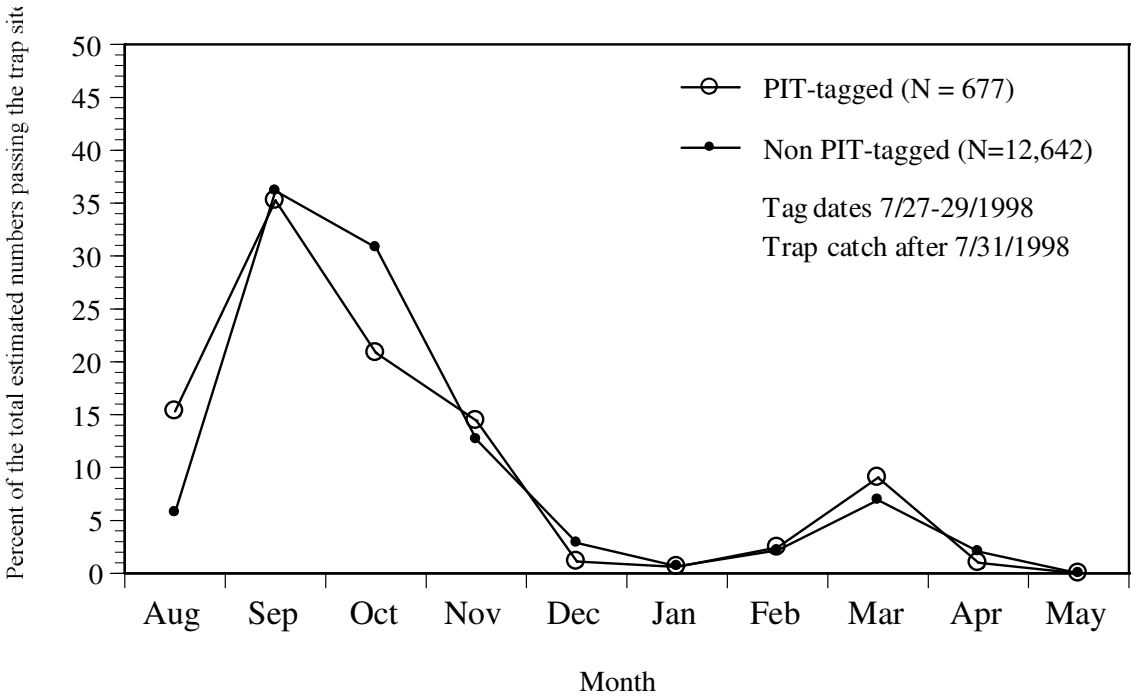

Figure 12. Arrival timing at the rotary screw trap in Lookingglass Creek of PIT-tagged and non-PIT-tagged juvenile spring Chinook salmon after commencing PIT-tagging of the naturally-produced 1997 cohort field group. N represents the total numbers of fish trapped (expanded for trap efficiency).

This similar movement pattern for PIT-tagged and non-PIT-tagged groups past the screw trap for the 1997 cohort was similar to what was seen for the 1996 cohort (M^{c}Lean and Lofy 2000a) and not similar to what was seen for the 1993 and 1994 cohorts (M^{c}Lean and Lofy 1999). For the 1993 and 1994 cohorts the PIT-tagged group peak movement past the trap was in September while the non-PIT-tagged group peaked in October (M^{c}Lean and Lofy 1999). The dates of PIT-tagging for the 1997 cohort was about 2 months earlier that that of the 1996 cohort (M^{c}Lean and Lofy 2000a).

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

There were no differences in fork length, weight, or condition factor between detected and non-detected juvenile spring Chinook salmon from Lookingglass Creek that were PIT-tagged in the field for the naturally-produced 1997 cohort (Table 7).

Table 7. Weight, fork length, and condition factor at PIT-tagging of juvenile spring Chinook salmon from the naturally-produced 1997 cohort Lookingglass Creek field group that were detected at Snake or Columbia River dams versus those that were not detected.

	Detected N=180		Not Detected N= 854
Fork length (mm)			
Min	59		57
Max	97		104
Mean	79.0		77.4
P		0.699	
Weight (g)			
Min	2.2		1.7
Max	10.8		14.3
Mean	5.9		5.5
P		0.484	
Condition Factor			
Min	0.6		0.6
Max	2.0		2.1
Mean	1.2		1.2
P		0.791	

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

The arrival timing of PIT-tagged juvenile spring Chinook salmon at Lower Granite Dam for two of the Grande Ronde River tributaries did not appear similar to that of Lookingglass Creek (Figure 13). The Minam River and Lookingglass Creek were most similar with median arrival dates of 25 and 29 April 1999 respectively (Figure 13). The median arrival dates of fish from the Lostine River and Catherine Creek were 15 and 26 May 1999 (Figure 13).

The survival of the field group from Lookingglass Creek was not significantly different from any of the other Grande Ronde River tributaries (Figure 14).

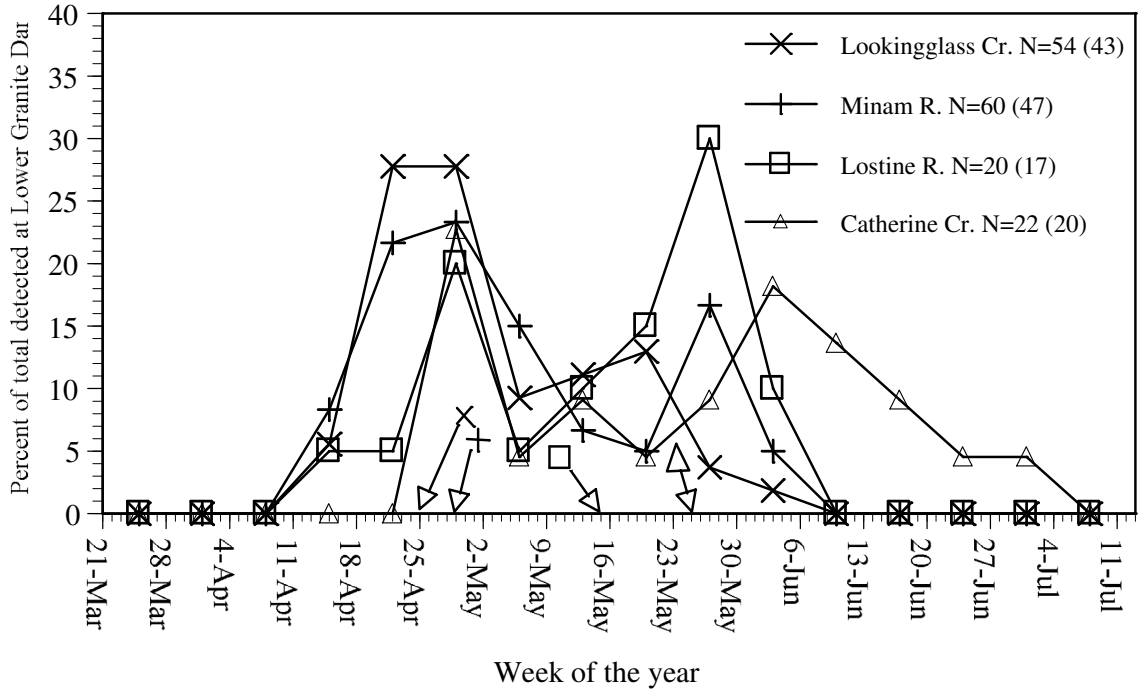

Figure 13. Arrival timing by week at Lower Granite Dam in 1999 of PIT-tagged fish from Lookingglass Creek, Minam and Lostine rivers, and Catherine Creek from the 1997 cohort. Expanded detections are graphed. Actual detections are in parentheses. Arrows indicate the median date of arrival for each group. Week of the year is represented by the last date in the week.

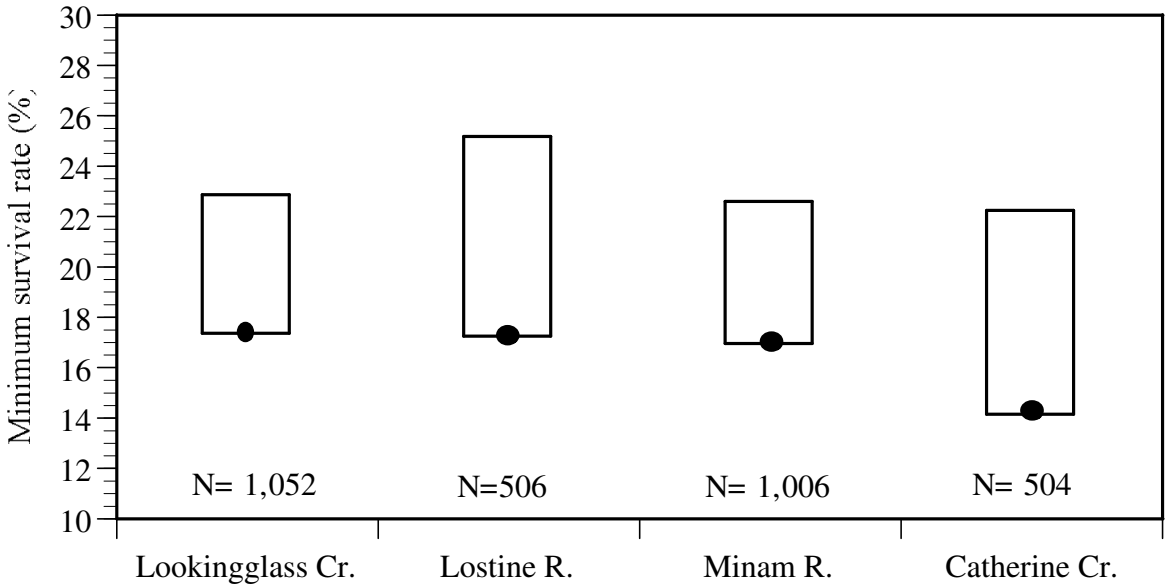

Figure 14. Total unique detection rates and upper ninety-five percent confidence intervals of 1997 cohort PIT-tagged fish from Lookingglass Creek, Minam and Lostine rivers, and Catherine Creek that were detected at Snake or Columbia River dams in 1999.

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SECTION II

Assistance Provided to LSRCP Cooperators and Other Projects

We provided assistance to LSRCP cooperator ODFW in 1999 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 Facility. In addition, project personnel provided assistance in sampling adult spring Chinook salmon at Oregon LSRCP facilities and helped with the release of juvenile spring Chinook salmon parr into Lookingglass Creek. Assistance was provided in data summarization and analysis for ODFW monthly and annual progress reports.

We assisted other Bonneville Power Administration (BPA) projects with data collection in 1999. We assisted ODFW personnel who have been collecting data on bull trout (*Salvelinus confluentus*) in the Grande Ronde River basin. We have collected fork length and weight data from bull trout we have captured in Lookingglass Creek in our screw trap and those captured in the Lookingglass Hatchery adult bypass. In addition, we have implanted PIT tags in bull trout we have captured in our rotary screw trap. We assisted the conventional adult spring Chinook salmon broodstock collection project in the Grande Ronde River and Catherine Creek in 1999 with weir building and trap checking. This is a BPA project in which CTUIR has the lead in these tributaries.

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A special thanks to ODFW for the use of their PIT-tagging data from tributaries of the Grande Ronde River basin.

Appendices

Appendix Table A-1. Redd count and redd expansion data for the Grande Ronde River from 1986 to 1999. Source: ODFW Research, La Grande, unpublished data[a].

Survey			Unit number									Redds		Est.
Year	Date	type	1	2	3	4	5	6	7	8	9	Total	Exp.	Pop.[b]
Index redds 1986-1994			290	166	64									
Unit proportions			0.57	0.32	0.12									
1986	3-SepIndex		18	19	11							48		
	Expansion		18	19	11								48	
	Redress		18	19	11								48	156
1987	20-AugSupp.			14										
	1-SepIndex		65	41	42									
	10-SepSupp.			23								185		
	Expansion		136	78	30								244	
	Redress		136	78	42								256	835
1988	30-AugIndex		77	22	5									
	6-SepSupp.			6										
	16-SepSupp.			6								116		
	Expansion		59	34	13								107	347
	Redress		77	34	13								124	405
1989	16-Aug		0	0	0							0		
	Expansion		0	0	0								0	
	Redress		0	0	0								0	0
1990	28-AugIndex		3	1	0									
	4-SepSupp.			9										
	11-SepSupp.		18	1								32		
	Expansion		21	11	4								36	
	Redress		21	11	4								36	119
1991	4-SepIndex		1	9	0									
	11-SepSupp.			4										
	18-SepSupp.			0								14		
	Expansion		23	13	5								41	
	Redress		23	13	5								41	133

Appendix Table A-1 (cont.). Redd count and redd expansion data for the Grande Ronde River from 1986 to 1999. Source: ODFW Research, La Grande, unpublished data[a].

Survey			Unit number									Redds		Est.
Year	Date	type	1	2	3	4	5	6	7	8	9	Total	Exp.	Pop.[b]
1992	2-SepIndex		76	21	2									
	9-SepSupp.		10	2										
	17-SepSupp.		2	3								116		
	Expansion		88	26	16								130	
	Redress		88	26	16								130	424
1993	3-SepIndex		49	39	4									
	10-SepSupp.		6	4										
	16-SepSupp.		1	0								103		
	Expansion		56	43	14								113	
	Redress		56	43	14								113	368
1994	30-AugIndex		1	0	0									
	7-SepSupp.		0											
	14-SepSupp.		1	2								4		
	Expansion		2	2	1								5	
	Redress		2	2	1								5	15
1995	28-AugIndex		0		0									
	5-SepSupp.		0	5										
	12-SepSupp.		0	2								7		
	Expansion		0	7	1								8	
	Redress		0	7	1								8	26
1996	26-AugIndex		2		0									
	3-SepSupp.		9											
	10-SepSupp.		0	11								22		
	Expansion		11	11	3								25	
	Redress		11	11	3								25	82
1997	25-AugIndex		10											
	2-SepSupp.		1		1									
	8-SepSupp.		2		5									
	18-SepSupp.				0							19		
	Expansion		13	9	6								28	
	Redress		13	9	6								28	91

Appendix Table A-1 (cont.). Redd count and redd expansion data for the Grande Ronde River from 1986 to 1999. Source: ODFW Research, La Grande, unpublished data[a].

Survey			Unit number									Redds		Est.
Year	Date	type	1	2	3	4	5	6	7	8	9	Total	Exp.	Pop.[b]
1998	24-Aug	Index	12		0									
	31-Aug	Supp.	8		1									
	8-Sep	Supp.	3		1							25		
	Expansion		23	12	2								37	
	Redress		23	12	2								37	120
1999	30-Aug	Index	0											
	31-Aug	Supp.			0									
	7-Sep	Supp.	0		0									
	13-Sep	Supp.	0		0							0		
	Expansion		0	0	0								0	
	Redress		0	0	0								0	0

[a] *Expansion is based on unit proportions. Only index surveys for years when all sections were surveyed were used to calculate the unit proportions. Unit proportions are the total number of redds counted in each unit during the index survey and any surveys prior to the index survey divided by the total redds for all sections. These proportions were used to estimate the total number of redds for sections when a survey was not done. Redress is used to update the unit expansions when the expanded number of redds is less than the actual number of redds counted.*

[b] *The estimated population is calculated by multiplying the total expanded redress redds by 3.26 fish-per-redd. The average 3.26 fish-per-redd was calculated from fish-per-redd estimates in Lookingglass Creek from 1992-1994 (Lofy and M^{c}Lean 1995a; Lofy and M^{c}Lean 1995b; M^{c}Lean and Lofy 1995)*

Appendix Table A-2. Redd count and redd expansion data for Catherine Creek from 1986 to 1999. Source: ODFW Research, La Grande, unpublished data[a].

Survey			Unit number									Redds		Est.
Year	Date	type	1	2	3	4	5	6	7	8	9	Total	Exp.	Pop.[b]
Index redds 1986-1999			92	9	87	144	165	94	111			702		
Unit proportions			0.13	0.01	0.12	0.21	0.24	0.13	0.16					
1986	4-SepIndex		8	0	21	47			11					
	10-SepSupp.						7					94		
	Expansion		4	0	4	6	7	4	5				30	
	Redress		8	0	21	47	7	4	11				98	321
1987	21-AugSupp.						15							
	2-SepIndex		14	6	35	28	40	35	46					
	11-SepSupp.						6					225		
	Expansion		34	3	32	53	61	35	41				260	
	Redress		34	6	35	53	61	35	46				270	881
1988	2-SepIndex		38	0	39	35	37	27	33					
	7-SepSupp.						3							
	15-SepSupp.						0					212		
	Expansion		22	2	21	35	40	23	27				170	
	Redress		38	2	39	35	40	27	33				214	698
1989	29-AugIndex		6	0	1	17	8	6	4					
	7-SepSupp.						3							
	14-SepSupp.						4					49		
	Expansion		8	1	8	13	15	9	10				64	
	Redress		8	1	8	17	15	9	10				68	221
1990	29-AugIndex		6	3	7	10	7	2	2					
	5-SepSupp.						2							
	12-SepSupp.						1					40		
	Expansion		6	1	5	9	10	6	7				43	
	Redress		6	3	7	10	10	6	7				48	158
1991	3-SepIndex		3	0	1	4	9	2	0					
	10-SepSupp.						1							
	17-SepSupp.						0					20		
	Expansion		6	1	5	9	10	6	7				43	
	Redress		6	1	5	9	10	6	7				43	139

Appendix Table A-2 (cont.). Redd count and redd expansion data for Catherine Creek from 1986 to 1999. Source: ODFW Research, La Grande, unpublished data[a].

Survey			Unit number									Redds		Est.
Year	Date	type	1	2	3	4	5	6	7	8	9	Total	Exp.	Pop.[b]
1992	3-SepIndex		5	0	0	14	18	4	1					
	10-SepSupp.						6							
	18-SepSupp.						1					49		
	Expansion		14	1	13	22	25	14	17				106	
	Redress		14	1	13	22	25	14	17				106	347
1993	2-SepIndex		7	0	2	17	31	6	19					
	8-SepSupp.						2							
	15-SepSupp.						0					84		
	Expansion		18	2	17	29	33	19	22				140	
	Redress		18	2	17	29	33	19	22				140	458
1994	29-AugIndex		0	0	0	4	0	0	0					
	6-SepSupp.						3							
	12-SepSupp.					7	1					15		
	Expansion		4	0	4	11	4	5	5				34	
	Redress		4	0	4	11	4	5	5				34	111
1995	29-AugIndex		0	0	0	2	5	0	0					
	6-SepSupp.					6	3							
	12-SepSupp.					2	2					20		
	Expansion		6	1	6	10	10	6	7				45	
	Redress		6	1	6	10	10	6	7				45	148
1996	27-AugIndex		1	0	0	1	5	2	1					
	4-SepSupp.					0	0							
	11-SepSupp.					0	2					12		
	Expansion		2	0	2	1	7	2	3				18	
	Redress		2	0	2	1	7	2	3				18	59
1997	26-AugIndex		7	0	2	6	4	2	2					
	3-SepSupp.		1	0	0	2	2	3	5					
	10-SepSupp.		0	0	0	2	3	2	3			46		
	Expansion		8	0	2	10	9	7	10				46	
	Redress		8	0	2	10	9	7	10				46	150

Appendix Table A-2 (cont.). Redd count and redd expansion data for Catherine Creek from 1986 to 1999. Source: ODFW Research, La Grande, unpublished data[a].

Survey			Unit number									Redds		Est.
Year	Date	type	1	2	3	4	5	6	7	8	9	Total	Exp.	Pop.[b]
1998	25-AugIndex		4	0	0	3	0	2	0					
	1-SepSupp.		2	0	0	4	4	4	2					
	11-SepSupp.		1	0	0	1	2	4	1			34		
	Expansion		7	0	0	8	6	10	3				34	
	Redress		7	0	0	8	6	10	3				34	111
1999	8-SepIndex		1	0	0	3	1	6	3					
	15-SepSupp.		0	0	0	1	1	3	2					
	31-AugSupp.		1	0	0	6	8	2	2			40		
	Expansion		2	0	0	10	10	11	7				40	
	Redress		2	0	0	10	10	11	7				40	130

[a] *Expansion is based on unit proportions. Only index surveys for years when all sections were surveyed were used to calculate the unit proportions. Unit proportions are the total number of redds counted in each unit during the index survey and any surveys prior to the index survey divided by the total redds for all sections. These proportions were used to estimate the total number of redds for sections when a survey was not done. Redress is used to update the unit expansions when the expanded number of redds is less than the actual number of redds counted.*

[b] *The estimated population is calculated by multiplying the total expanded redress redds by 3.26 fish-per-redd. The average 3.26 fish-per-redd was calculated from fish-per-redd estimates in Lookingglass Creek from 1992-1994 (Lofy and M[c]Lean 1995a; Lofy and M[c]Lean 1995b; M[c]Lean and Lofy 1995)*

Appendix Table A-3. Redd count and redd expansion data for the Lostine River from 1986 to 1999. Source: ODFW Research, La Grande, unpublished data[a].

Survey			Unit number									Redds		Est.
Year	Date	type	1	2	3	4	5	6	7	8	9	Total	Exp.	Pop.[b]
Index redds 1986-1999				27	1	188	17	8	0	3		244		
Unit proportions				0.11	0.00	0.77	0.07	0.03	0.00	0.01				
1986	27-Aug	Index	0	0	6	48	5		2			61		
	Expansion		0	0	6	48	5	2	2	1			64	
	Redress		0	0	6	48	5	2	2	1			64	208
1987	27-Aug	Index			2	49	4			6				
	9-Sep	Supp.				7								
	17-Aug	Supp.				27						95		
	Expansion			12	0	83	8	4	0	1			108	
	Redress			12	2	83	8	4	0	6			114	372
1988	24-Aug	Index		4	18	107	30		0	5				
	3-Sep	Supp.				16								
	13-Sep	Supp.				2						182		
	Expansion			18	1	125	11	5	0	2			162	
	Redress			18	18	125	30	5	0	5			201	656
1989	23-Aug	Index		4	1	20	0	1	0	0				
	31-Aug	Supp.				21								
	12-Sep	Supp.				6						53		
	Expansion			7	0	47	4	2	0	1			61	
	Redress			7	1	47	4	2	0	1			62	201
1990	23-Aug	Index		2	0	16	0		1	0				
	30-Aug	Supp				5								
	7-Sep	Supp				2						26		
	Expansion			3	0	23	2	1	0	0			30	
	Redress			3	0	23	2	1	1	0			31	101
1991	27-Aug	Index		2	2	11	5		0	0				
	5-Sep	Supp.				6								
	12-Sep	Supp.				2						28		
	Expansion			3	0	19	2	1	0	0			25	
	Redress			3	2	19	5	1	0	0			30	97

Appendix Table A-3 (cont.). Redd count and redd expansion data for the Lostine River from 1986 to 1999. Source: ODFW Research, La Grande, unpublished data[a].

Survey			Unit number									Redds		Est.
Year	Date	type	1	2	3	4	5	6	7	8	9	Total	Exp.	Pop.[b]
1992	26-Aug	Index		2	1	14	3		1	1				
	2-Sep	Supp.				14								
	11-Sep	Supp.				1						37		
	Expansion			4	0	29	3	1	0	0			38	
	Redress			4	1	29	3	1	1	1			40	132
1993	26-Aug	Index		11	0	66	10	6	0	2				
	4-Sep	Supp.				7								
	13-Sep	Supp.				0						102		
	Expansion			10	0	73	7	3	0	1			95	
	Redress			11	0	73	10	6	0	2			102	334
1994	25-Aug	Index		4	0	7	0	0	0	0				
	1-Sep	Supp.				2								
	8-Sep	Supp.				3						16		
	Expansion			2	0	12	1	1	0	0			16	
	Redress			4	0	12	1	1	0	0			18	58
1995	23-Aug	Index		0	0	6	1	0	0	0				
	30-Aug	Supp.				2								
	6-Sep	Supp.				2						11		
	Expansion			1	0	10	1	0	0	0			13	
	Redress			1	0	10	1	0	0	0			13	43
1996	21-Aug	Index		0	0	13	3	1	0	0				
	28-Aug	Supp.		0	0	4	1	3	0	0				
	5-Sep	Supp.		0	0	0	0	2	0	0		27		
	Expansion			0	0	17	4	6	0	0			27	
	Redress			0	0	17	4	6	0	0			27	88
1997	21-Aug	Index		5	0	27	2	0	0	1				
	28-Aug	Supp.		0	0	8	1	0	0	1				
	4-Sep	Supp.		0	0	2	0	1	1	0		49		
	Expansion			5	0	37	3	1	1	2			49	
	Redress			5	0	37	3	1	1	2			49	160

Appendix Table A-3 (cont.). Redd count and redd expansion data for the Lostine River from 1986 to 1999. Source: ODFW Research, La Grande, unpublished data[a].

Survey			Unit number									Redds		Est.
Year	Date	type	1	2	3	4	5	6	7	8	9	Total	Exp.	Pop.[b]
1998	20-Aug	Index		3	0	9	0	0	0	0				
	27-Aug	Supp.	0	2	0	8	0	0	0	0				
	30-Aug	Supp.		0	1	5	0	0	0	0				
	17-Sep	Supp.								7				
	23-Sep	Supp.								0				
	1-Oct	Supp.								0		35		
	Expansion			5	1	22	0	0	0	7			35	
	Redress			5	1	22	0	0	0	7			35	114
1999	26-Aug	Index		0	0	40	1	0	0	0				
	2-Sep	Supp.		0	0	2	1	0	0	0				
	9-Sep	Supp.		0	0	1	0	0	0	1				
	16-Sep	Supp.								4				
	24-Sep	Supp.								4				
	1-Oct	Supp.								3		57		
	Expansion			0	0	43	2	0	0	12			57	
	Redress			0	0	43	2	0	0	12			57	186

[a] *Expansion is based on unit proportions. Only index surveys for years when all sections were surveyed were used to calculate the unit proportions. Unit proportions are the total number of redds counted in each unit during the index survey and any surveys prior to the index survey divided by the total redds for all sections. These proportions were used to estimate the total number of redds for sections when a survey was not done. Redress is used to update the unit expansions when the expanded number of redds is less than the actual number of redds counted.*

[b] *The estimated population is calculated by multiplying the total expanded redress redds by 3.26 fish-per-redd. The average 3.26 fish-per-redd was calculated from fish-per-redd estimates in Lookingglass Creek from 1992-1994 (Lofy and M[c]Lean 1995a; Lofy and M[c]Lean 1995b; M[c]Lean and Lofy 1995)*

Appendix Table A-4. Redd count and redd expansion data for the Minam River from 1986 to 1999. Source: ODFW Research, La Grande, unpublished data[a].

Survey			Unit number									Redds		Est.
Year	Date	type	1	2	3	4	5	6	7	8	9	Total	Exp.	Pop.[b]
Index redds 1986-1998			24	12	25	22	29	24	110	22	67	335		
Unit proportions			0.07	0.04	0.07	0.07	0.09	0.07	0.33	0.07	0.20			
1986	29-Aug	Index	0	1	15	6	5	21	14			62		
	Expansion		0	1	15	6	5	21	14	6	17		84	
	Redress		0	1	15	6	5	21	14	6	17		84	275
1987	25-Aug	Index	1		8	12	5	8	56					
	26-Sep	Supp.							56			146		
	Expansion		24	12	25	22	30	24	112	22	68		341	
	Redress		24	12	25	22	30	24	112	22	68		341	1,112
1988	10-Sep	Supp.							17					
	25-Aug	Index	12	4	9	6	6	9	41			104		
	Expansion		13	6	13	12	15	13	58	12	35		177	
	Redress		13	6	13	12	15	13	58	12	35		177	576
1989	14-Sep	Supp.							5					
	29-Aug	Index	3	1	3	0	3	4	19			38		
	Expansion		5	3	5	5	6	5	24	5	15		73	
	Redress		5	3	5	5	6	5	24	5	15		73	238
1990	28-Aug	Index	2	8	2	3	2	0	36					
	11-Sep	Supp.							5			58		
	Expansion		9	4	9	8	11	9	41	8	25		125	
	Redress		9	8	9	8	11	9	41	8	25		128	419
1991	27-Aug	Index	5	6	0	4	5	4	13					
	9-Sep	Supp.							13			50		
	Expansion		6	3	6	5	7	6	26	5	16		79	
	Redress		6	6	6	5	7	6	26	5	16		82	268
1992	27-Aug	Index	2	2	2	4	4	1	1	3	13			
	4-Sep	Supp.							77					
	16-Sep	Supp.							6			115		
	Expansion		18	9	19	17	22	18	84	17	51		256	
	Redress		18	9	19	17	22	18	84	17	51		256	834

Appendix Table A-4 (cont.). Redd count and redd expansion data for the Minam River from 1986 to 1999. Source: ODFW Research, La Grande, unpublished data[a].

Survey			Unit number									Redds		Est.
Year	Date	type	1	2	3	4	5	6	7	8	9	Total	Exp.	Pop.[b]
1993	26-AugIndex		10	4	6	8	6	3	26	6	16			
	3-SepSupp.								21					
	13-SepSupp.								4			110		
	Expansion		11	6	12	10	13	11	51	10	31		155	
	Redress		11	6	12	10	13	11	51	10	31		155	506
1994	23-AugIndex		1	0	2	1	0	1	0	0	2			
	2-SepSupp.								14					
	12-SepSupp.								11			32		
	Expansion		5	3	6	5	7	5	25	5	15		76	
	Redress		5	3	6	5	7	5	25	5	15		76	248
1995	31-AugIndex		1	0	0	0	0	0	9	3	2			
	7-SepSupp.								5					
	14-SepSupp.								0			20		
	Expansion		3	2	3	3	4	3	14	3	9		43	
	Redress		3	2	3	3	4	3	14	3	9		43	140
1996	17-AugSupp.		1		1									
	30-AugIndex		0	1	1	4	4	10	35	5	14			
	3-SepSupp.		2	0		1	2	8	8					
	10-SepSupp.				1	0	0	1	4			103		
	Expansion		9	5	3	5	6	19	47	8	26		128	
	Redress		9	5	3	5	6	19	47	8	26		128	416
1997	28-AugIndex		1	2	6	3	7	3	14	0	10			
	2-SepSupp.		0	0	0	2	3	0	3					
	9-SepSupp.					0	0	1	1			56		
	Expansion		5	2	5	5	10	4	18	4	13		67	
	Redress		5	2	6	5	10	4	18	4	13		68	222

Appendix Table A-4 (cont.). Redd count and redd expansion data for the Minam River from 1986 to 1999. Source: ODFW Research, La Grande, unpublished data[a].

Survey			Unit number									Redds		Est.
Year	Date	type	1	2	3	4	5	6	7	8	9	Total	Exp.	Pop.[b]
1998	27-AugIndex		7	2	6	0	5	2	9	0	9			
	1-SepSupp.		0	0	0	5	1	2	9					
	8-SepSupp.					0	0	1	6			64		
	Expansion		5	3	5	5	6	5	24	5	14		72	
	Redress		7	3	6	5	6	5	24	5	14		75	244
1999	26-AugIndex		1	1	1	2	3	4	16	5	1			
	1-SepSupp.					0	1	4	7					
	7-SepSupp.					0	0	0	1			47		
	Expansion		5	2	5	2	4	8	24	5	14		69	
	Redress		5	2	5	2	4	8	24	5	14		69	226

[a] *Expansion is based on unit proportions. Only index surveys for years when all sections were surveyed were used to calculate the unit proportions. Unit proportions are the total number of redds counted in each unit during the index survey and any surveys prior to the index survey divided by the total redds for all sections. These proportions were used to estimate the total number of redds for sections when a survey was not done. Redress is used to update the unit expansions when the expanded number of redds is less than the actual number of redds counted.*

[b] *The estimated population is calculated by multiplying the total expanded redress redds by 3.26 fish-per-redd. The average 3.26 fish-per-redd was calculated from fish-per-redd estimates in Lookingglass Creek from 1992-1994 (Lofy and M^{c}Lean 1995a; Lofy and M^{c}Lean 1995b; M^{c}Lean and Lofy 1995)*

Appendix Table A-5. Redd count and redd expansion data for the Wenaha River from 1986 to 1999. Source: ODFW Research, La Grande, unpublished data[a].

Survey			Unit number									Redds		Est.
Year	Date	type	1	2	3	4	5	6	7	8	9	Total	Exp.	Pop.[b]
Index redds 1986-1998			14	3	274	119	54	105	10			579		
Unit proportions			0.02	0.01	0.47	0.21	0.09	0.18	0.02					
1986	3-SepIndex				68							68		
	Expansion		3	1	68	30	13	26	2				144	
	Redress		3	1	68	30	13	26	2				144	468
1987	7-SepIndex		3	2	62	26	25	32	2			152		
	Expansion		3	2	62	26	25	32	2				152	
	Redress		3	2	62	26	25	32	2				152	496
1988	6-SepIndex		2	1	98	21	11	32	3			168		
	Expansion		2	1	98	21	11	32	3				168	
	Redress		2	1	98	21	11	32	3				168	548
1989	5-SepIndex		0	0	9	5	0	4	0			18		
	Expansion		0	0	9	5	0	4	0				18	
	Redress		0	0	9	5	0	4	0				18	59
1990	3-SepIndex		3	0	31	23	8	16	2			83		
	Expansion		3	0	31	23	8	16	2				83	
	Redress		3	0	31	23	8	16	2				83	271
1991	2-SepIndex		2	0	28	15	5	7	1					
	13-SepSupp.						7					65		
	Expansion		1	0	25	11	5	10	1				54	
	Redress		2	0	28	15	12	10	1				68	222
1992	9-SepIndex		10		58	47	14	49	5					
	14-SepSupp.				7	2						192		
	Expansion		4	1	65	49	16	30	3				168	
	Redress		10	1	65	49	16	49	5				195	634
1993	9-SepIndex		4	0	46	29	5	14	2					
	16-SepSupp.				2	2						104		
	Expansion		3	1	48	31	11	21	2				116	
	Redress		4	1	48	31	11	21	2				118	383

Appendix Table A-4 (cont.). Redd count and redd expansion data for the Wenaha River from 1986 to 1999. Source: ODFW Research, La Grande, unpublished data[a].

Survey			Unit number									Redds		Est.
Year	Date	type	1	2	3	4	5	6	7	8	9	Total	Exp.	Pop.[b]
1994	8-Sep	Index			12	16	9	5						
	15-Sep	Supp.			3	11	1	6	1			64		
	Expansion		2	0	15	27	10	11	1				66	
	Redress		2	0	15	27	10	11	1				66	215
1995	6-Sep	Index			3	11	1	6	1					
	13-Sep	Supp.	0	0	2	1						25		
	Expansion		0	0	5	12	2	4	0				24	
	Redress		0	0	5	12	2	6	1				26	86
1996	4-Sep	Index			28	30	18	21	5					
	12-Sep	Supp.			10	3	4	10				129		
	Expansion		3	1	38	33	22	31	5				133	
	Redress		3	1	38	33	22	31	5				133	433
1997	4-Sep	Index		0	26	9	8	16	4					
	11-Sep	Supp.		0	0	4	1	1				69		
	Expansion		2	0	26	13	9	17	1				68	
	Redress		2	0	26	13	9	17	4				71	230
1998	3-Sep	Index		0	24	9	17	12	3					
	10-Sep	Supp.		0	2	4	1	4				76		
	Expansion		2	0	26	13	18	16	1				76	
	Redress		2	0	26	13	18	16	3				78	254
1999	7-Sep	Index		0	5	4	6	5	2					
	16-Sep	Supp.		0	0	0	1	2	0			25		
	Expansion		1	0	5	4	7	7	2				26	
	Redress		1	0	5	4	7	7	2				26	84

Appendix Table A-4 (cont.). Redd count and redd expansion data for the Wenaha River from 1986 to 1999. Source: ODFW Research, La Grande, unpublished data[a].

Survey			Unit number									Redds		Est.
Year	Date	type	1	2	3	4	5	6	7	8	9	Total	Exp.	Pop.[b]

[a] *Expansion is based on unit proportions. Only index surveys for years when all sections were surveyed were used to calculate the unit proportions. Unit proportions are the total number of redds counted in each unit during the index survey and any surveys prior to the index survey divided by the total redds for all sections. These proportions were used to estimate the total number of redds for sections when a survey was not done. Redress is used to update the unit expansions when the expanded number of redds is less than the actual number of redds counted.*

[b] *The estimated population is calculated by multiplying the total expanded redress redds by 3.26 fish-per-redd. The average 3.26 fish-per-redd was calculated from fish-per-redd estimates in Lookingglass Creek from 1992-1994 (Lofy and M^{c}Lean 1995a; Lofy and M^{c}Lean 1995b; M^{c}Lean and Lofy 1995)*

Appendix Table A-6. Carcass recoveries and age structure for Grande Ronde River basin tributaries from 1987 to 1999. Source: ODFW Research, La Grande, unpublished data.

Run		Scale age				Basin age structure		
Year	Tributary	3	4	5	Total	3	4	5
1987	Grande Ronde R.	0	46	1	47			
	Catherine Cr.	1	59	3	63			
	Lostine R.	0	21	14	35			
	Minam R.	1	2	3	6			
	Wenaha R.	0	38	6	44			
	Totals	**2**	**166**	**27**	**195**	**0.01**	**0.85**	**0.14**
1988	Grande Ronde R.	3	20	27	50			
	Catherine Cr.	1	27	18	46			
	Lostine R.	0	16	56	72			
	Minam R.	1	12	20	33			
	Wenaha R.	0	17	37	54			
	Totals	**5**	**92**	**158**	**255**	**0.02**	**0.36**	**0.62**
1989	Grande Ronde R.	0	2	0	2			
	Catherine Cr.	0	9	1	10			
	Lostine R.	1	15	6	22			
	Minam R.	0	8	2	10			
	Wenaha R.	1	0	3	4			
	Totals	**2**	**34**	**12**	**48**	**0.04**	**0.71**	**0.25**
1990	Grande Ronde R.	0	10	7	17			
	Catherine Cr.	0	6	2	8			
	Lostine R.	0	9	6	15			
	Minam R.	0	15	4	19			
	Wenaha R.	0	12	0	12			
	Totals	**0**	**52**	**19**	**71**	**0.00**	**0.73**	**0.27**
1991	Grande Ronde R.	1	7	1	9			
	Catherine Cr.	1	13	2	16			
	Lostine R.	0	7	18	25			
	Minam R.	0	5	8	13			
	Wenaha R.	0	10	8	18			
	Totals	**2**	**42**	**37**	**81**	**0.02**	**0.52**	**0.46**

Appendix Table A-6 (cont.). Carcass recoveries and age structure for Grande Ronde River basin tributaries from 1987 to 1999. Source: ODFW Research, La Grande, unpublished data.

Run Year	Tributary	Scale age 3	4	5	Total	Basin age structure 3	4	5
1992	Grande Ronde R.	0	76	7	83			
	Catherine Cr.	0	9	0	9			
	Lostine R.	0	22	8	30			
	Minam R.	0	37	9	46			
	Wenaha R.	2	43	10	55			
	Totals	**2**	**187**	**34**	**223**	**0.01**	**0.84**	**0.15**
1993	Grande Ronde R.	0	3	42	45			
	Catherine Cr.	2	2	24	28			
	Lostine R.	0	16	58	74			
	Minam R.	0	18	26	44			
	Wenaha R.	0	8	21	29			
	Totals	**2**	**47**	**171**	**220**	**0.01**	**0.21**	**0.78**
1994	Grande Ronde R.	0	0	0	0			
	Catherine Cr.	0	2	3	5			
	Lostine R.	0	2	15	17			
	Minam R.	0	7	5	12			
	Wenaha R.	0	3	3	6			
	Totals	**0**	**14**	**26**	**40**	**0.00**	**0.35**	**0.65**
1995	Grande Ronde R.	0	1	0	1			
	Catherine Cr.	1	5	0	6			
	Lostine R.	0	3	0	3			
	Minam R.	0	4	0	4			
	Wenaha R.	1	2	0	3			
	Totals	**2**	**15**	**0**	**17**	**0.12**	**0.88**	**0.00**
1996	Grande Ronde R.	0	1	0	1			
	Catherine Cr.	0	5	0	5			
	Lostine R.	1	21	1	23			
	Minam R.	2	57	0	59			
	Wenaha R.	3	42	1	46			
	Totals	**6**	**126**	**2**	**134**	**0.04**	**0.94**	**0.01**

Appendix Table A-6 (cont.). Carcass recoveries and age structure for Grande Ronde River basin tributaries from 1987 to 1999. Source: ODFW Research, La Grande, unpublished data.

Run Year	Tributary	Scale age 3	4	5	Total	Basin age structure 3	4	5
1997	Grande Ronde R.	0	7	3	10			
	Catherine Cr.	4	28	2	34			
	Lostine R.	4	46	23	73			
	Minam R.	1	49	4	54			
	Wenaha R.	1	41	16	58			
	Totals	**10**	**171**	**48**	**229**	**0.04**	**0.75**	**0.21**
1998	Grande Ronde R.	0	6	23	29			
	Catherine Cr.	1	4	14	19			
	Lostine R.	1	5	25	31			
	Minam R.	0	7	22	29			
	Wenaha R.	0	25	20	45			
	Totals	**2**	**47**	**104**	**153**	**0.01**	**0.31**	**0.68**
1999[a]	Grande Ronde R.	0	0	0	0			
	Catherine Cr.	0	14	0	14			
	Lostine R.	2	36	8	46			
	Minam R.	0	12	8	20			
	Wenaha R.	0	7	2	9			
	Totals	**2**	**69**	**18**	**89**	**0.02**	**0.78**	**0.20**

[a] *Age by scale reading was not finished at the time of this report. Age was determined by fork length of the fish <=600 = 3-year-old, >600 and <=800 = 4-year-old, >800 = 5-year-old.*

Appendix Table A-7. Daily trapping records of the naturally-produced 1997 cohort from a screw trap in Lookingglass Creek.

Date	Flow m^3/s	Water temp. hourly °C High	Low	Fish trapped Live	Dead	Trap efficiency[a] No. Rel. grp.		Re. on date	Re. From Rel. grp.	Rel. grp. on date	Comments
02/20/98	2.4	6.1	4.0	0							
02/21/98	2.9	6.0	3.8								
02/22/98	2.9	5.0	3.0	0							
02/23/98	2.7	6.0	3.0	0							
02/24/98	2.7	5.4	2.8	0							
02/25/98	2.7	5.0	2.0								
02/26/98	2.5	5.0	2.8	0							
02/27/98	2.3	5.0	2.0								
02/28/98	2.3	4.0	2.0								
03/01/98	2.3	5.2	3.0								
03/02/98	2.4	5.3	3.5	1	1						
03/03/98	2.4	5.1	2.9	0							
03/04/98	2.5	5.1	3.0	0							
03/05/98	2.4	5.1	2.0								
03/06/98	2.5	5.4	1.5								
03/07/98	2.4	5.4	1.7								
03/08/98	2.5	5.0	3.0								
03/09/98	2.4	7.0	3.0	0							
03/10/98	2.5	6.3	3.7								
03/11/98	2.6	8.0	4.0	0							
03/12/98	2.7	8.0	3.0								
03/13/98	2.9	8.0	3.0	0							
03/14/98	3.5	8.0	3.0								
03/15/98	3.8	6.1	4.0	0							
03/16/98	3.9	7.0	3.0								
03/17/98	3.6	6.0	3.0	9		7	a				Repaired hole livebox
03/18/98	3.4	6.2	2.8								
03/19/98	3.2	7.1	2.8	0							
03/20/98	3.2	8.1	3.0								
03/21/98	3.5	7.0	3.8	0							
03/22/98	5.3	6.0	4.0	0							
03/23/98	8.6	5.0	3.0	17		17	a				
03/24/98	10.4	6.0	3.0	22	2						
03/25/98	9.4	6.1	3.0	6	1	6	a				
03/26/98	8.3	5.4	3.7	1		1	a				
03/27/98	7.1	5.0	2.9								
03/28/98	6.4	5.0	2.0	0							
03/29/98	5.7	6.1	2.0								
03/30/98	5.1	6.4	2.0	0							
03/31/98	4.9	6.4	3.0								

Appendix Table A-7 (cont.). Daily trapping records of the naturally-produced 1997 cohort from a screw trap in Lookingglass Creek.

Date	Flow m^3/s	Water temp. hourly °C High	Low	Fish trapped Live	Dead	Trap efficiency[a] No. Rel.	grp.	Re. on date	Re. From Rel. grp.	Rel. grp. on date	Comments
04/02/98	4.6	6.0	4.0	4		4	a				
04/03/98	4.4	6.0	3.8								
04/04/98	4.4	7.0	4.0								
04/05/98	4.3	7.0	3.7	0							
04/06/98	4.4	7.0	3.0								
04/07/98	4.2	7.1	4.0	3							
04/08/98	4.1	6.0	2.7								
04/09/98	4.1	7.0	3.8								
04/10/98	4.4	7.0	4.0	0							
04/11/98	4.5	7.0	4.0								
04/12/98	4.4	7.0	3.0	0							
04/13/98	4.3	6.0	2.7								
04/14/98	4.3	7.0	2.0								
04/15/98	4.1	6.0	3.7								
04/16/98	3.9	8.0	3.0	1		1	a				
04/17/98	3.8	7.2	3.5								
04/18/98	3.9	7.1	2.9	0							
04/19/98	3.9	9.1	4.5								
04/20/98	4.0	10.0	3.0								
04/21/98	4.9	10.0	4.0								
04/22/98	6.1	9.0	4.0	0							
04/23/98	8.5	8.0	4.0	0							
04/24/98	9.8	6.2	3.9	1	1						
04/25/98	8.6	6.4	3.6								
04/26/98	8.0	8.0	2.8	0							
04/27/98	9.0	9.0	3.0								
04/28/98	9.2	9.0	3.7								
04/29/98	10.9	9.0	3.7	0							
04/30/98	12.2	9.0	4.0	--							Trap stopped, log 8p
05/01/98	13.6	9.0	4.0	0							
05/02/98	14.8	9.0	4.0	0							
05/03/98	16.4	9.0	4.0	0							Pulled trap 8p
05/04/98	16.1	9.3	4.6	--							Started trap 1p
05/05/98	15.3	10.0	5.0	0							
05/06/98	14.4	9.3	5.0	0							
05/07/98	13.5	10.3	5.6	0							Pulled trap 8p
05/08/98	11.9	9.0	5.0	--							
05/09/98	11.8	7.0	5.0	--							Started trap 10a
05/10/98	9.9	10.0	5.5	0							
05/11/98	8.7	9.0	6.0								
05/12/98	8.1	9.3	6.0	0							
05/13/98	7.6	7.3	6.0	0							
05/14/98	7.4	7.0	5.6								
05/15/98	6.9	8.0	4.7								

Appendix Table A-7 (cont.). Daily trapping records of the naturally-produced 1997 cohort from a screw trap in Lookingglass Creek.

Date	Flow m^3/s	Water temp. hourly °C High	Low	Fish trapped Live	Dead	Trap efficiency[a] No. Rel.	grp.	Re. on date	Re. From Rel. grp.	Rel. grp. on date	Comments
05/16/98	6.4	6.2	5.0								
05/17/98	6.3	6.3	5.0	2	1	2	a				
05/18/98	6.2	9.0	4.9								
05/19/98	5.9	10.3	5.0								
05/20/98	5.6	10.0	6.0	6		6	a				
05/21/98	5.4	7.3	6.0								
05/22/98	6.6	7.3	6.0	6		6	a		1	a	
05/23/98	5.8	8.1	6.0	1		1	a		2	a	
05/24/98	5.5	9.4	6.0								
05/25/98	7.0	8.0	6.0								
05/26/98	6.9	6.3	5.0	8		8	a				
05/27/98	6.5	8.2	5.0								
05/28/98	6.6	10.4	4.6	3		3	a		3	a	
05/29/98	6.3	9.1	6.8	3		3	a		1	a	
05/30/98	5.7	10.0	5.8								
05/31/98	5.6	12.0	6.0								
06/01/98	5.2	13.0	7.0								
06/02/98	4.9	12.0	7.0	14	5	14	a		1	a	MS-222 morts
06/03/98	5.0	11.2	7.7								
06/04/98	4.9	13.0	7.0								
06/05/98	4.7	11.0	8.0	0							
06/06/98	4.4	11.1	7.0								
06/07/98	4.4	9.3	7.0								
06/08/98	4.2	11.0	7.6	0							
06/09/98	3.7	12.2	7.0								
06/10/98	3.5	12.3	7.8	0							
06/11/98	3.6	13.0	8.6								
06/12/98	3.4	14.0	8.7	2		2	a				
06/13/98	3.2	14.0	9.0								
06/14/98	2.9	15.0	8.0	0							
06/15/98	3.0	14.1	9.0								
06/16/98	3.3	10.0	7.7								
06/17/98	3.0	13.4	6.6	8	1	8	a				
06/18/98	2.9	15.0	7.9								
06/19/98	2.7	12.0	8.0	0	1				1	a	
06/20/98	2.6	14.1	7.0								
06/21/98	2.4	14.4	8.0								
06/22/98	2.4	13.0	8.0	7		7	a				
06/23/98	2.3	15.3	8.0								
06/24/98	2.3	11.0	8.8	0							
06/25/98	2.3	12.0	8.0								
06/26/98	2.3	12.0	8.0	2	1	2	b				
06/27/98	2.3	14.0	6.8								
06/28/98	2.1	16.0	7.6	2		2	a				

Appendix Table A-7 (cont.). Daily trapping records of the naturally-produced 1997 cohort from a screw trap in Lookingglass Creek.

Date	Flow m^3/s	Water temp. hourly °C High	Low	Fish trapped Live	Dead	Trap efficiency[a] No. Rel.	grp.	Re. on date	Re. From Rel. grp.	Rel. grp. on date	Comments
06/29/98	2.1	16.0	8.0	0							
06/30/98	2.1	17.0	9.0								
07/01/98	2.1	17.0	9.0	0							
07/02/98	2.2	17.0	9.0								
07/03/98	2.2	15.3	9.6	0							
07/04/98	2.0	16.2	9.7								
07/05/98	2.0	17.0	9.0								
07/06/98	1.9	17.3	8.9	1		1	c				
07/07/98	1.9	18.0	9.0								
07/08/98	1.8	18.0	9.8	0							Stopped trap for repair
07/09/98	2.5	18.0	9.5	--							
07/10/98	2.1	15.3	10.0	--							Started trap
07/11/98	2.0	17.0	9.9								
07/12/98	1.8	17.0	9.0								
07/13/98	1.8	17.0	9.0	0	1						
07/14/98	2.0	17.0	9.0								
07/15/98	2.0	17.2	9.0	0							
07/16/98	1.9	18.0	9.0								
07/17/98	1.9	18.3	9.7								
07/18/98	2.1	18.0	9.5								
07/19/98	1.9	18.0	9.0								
07/20/98	1.8	17.1	8.0	0							Trap stopped on bottom
07/21/98	1.9	17.3	8.5								
07/22/98	1.8	18.0	9.0	0							
07/23/98	1.8	13.1	9.0								
07/24/98	1.8	17.2	9.6	0							
07/25/98	1.8	18.0	9.0								
07/26/98	1.8	18.0	9.6								
07/27/98	1.8	18.0	9.5								
07/28/98	1.9	18.0	9.8	0							
07/29/98	1.8	15.2	9.5								
07/30/98	1.8	16.0	10.0	0							
07/31/98	1.7	16.1	10.0	0							
08/01/98	1.9	14.3	9.7								
08/02/98	1.6	17.2	9.0								
08/03/98	1.7	17.4	9.0	0							
08/04/98	1.7	18.0	9.0								
08/05/98	1.6	17.1	9.0	1		1	d				
08/06/98	1.7	17.0	9.0								
08/07/98	1.6	16.0	8.5	0							
08/08/98	1.6	16.0	7.7								
08/09/98	1.6	16.4	8.0								
08/10/98	1.5	17.0	8.7	0	1						
08/11/98	1.7	17.0	8.5								

Appendix Table A-7 (cont.). Daily trapping records of the naturally-produced 1997 cohort from a screw trap in Lookingglass Creek.

Date	Flow m^3/s	Water temp. hourly °C High	Low	Fish trapped Live	Dead	Trap efficiency[a] No. Rel.	grp.	Re. on date	Re. From Rel. grp.	Rel. grp. on date	Comments
08/12/98	2.0	17.0	8.5								
08/13/98	1.6	17.0	8.8								
08/14/98	1.5	17.0	8.6	7		7	e	1			
08/15/98	1.6	16.2	8.7								
08/16/98	1.6	15.0	8.0								
08/17/98	1.6	14.4	7.0	9		9	f	1			
08/18/98	1.6	14.4	6.6								
08/19/98	1.6	15.0	6.7	16		16	g	1	1	f1	
08/20/98	1.6	15.1	8.0								
08/21/98	1.6	15.2	8.0	7		7	h		1	g1	
08/22/98	1.6	15.0	7.8								
08/23/98	1.6	14.0	9.0								
08/24/98	1.7	14.3	7.0	27		27	j	6			
08/25/98	1.6	15.0	7.0								
08/26/98	1.6	14.3	7.0	17		17	k	2	6	j6	
08/27/98	1.5	14.3	6.7								
08/28/98	1.5	15.0	7.0	5		5	m	1	2	k2	
08/29/98	1.4	15.0	7.6								
08/30/98	1.5	15.0	7.0								
08/31/98	1.4	15.0	7.6	6		6	n	2	1	m1	
09/01/98	1.4	15.0	7.7								
09/02/98	1.5	15.0	7.7	5		5	o	1	1	n1	
09/03/98	1.4	15.0	7.0								
09/04/98	1.5	15.0	7.8	6		6	p	1	1	o1	
09/05/98	1.3	14.4	7.9								
09/06/98	1.3	15.0	7.5								
09/07/98	1.4	12.0	8.0								
09/08/98	1.3	14.0	8.0								
09/09/98	1.3	12.0	8.9	6		6	q	2	1	p1	
09/10/98	1.4	12.0	8.5								
09/11/98	1.3	14.0	7.0	14		14	r		1	q1	
09/12/98	1.3	13.4	7.0								
09/13/98	1.3	13.4	6.9								
09/14/98	1.2	14.0	6.9	22		22	s	3			
09/15/98	1.3	14.0	7.0								
09/16/98	1.4	14.0	8.9								
09/17/98	1.3	13.0	7.9								
09/18/98	1.2	10.0	7.5	24		27	t	5	3	s2,n1	Recaps used again
09/19/98	1.4	10.1	8.0								
09/20/98	1.2	11.0	7.7								
09/21/98	1.3	12.0	6.0	105	1	105	u	18	6	t5,s1	
09/22/98	1.6	12.0	7.0								
09/23/98	1.3	12.0	7.0	201	1	204	v	53	18	u18	Recaps used again
09/24/98	1.3	12.0	6.6	19	1	20	w	11	51	v50,a1	

Appendix Table A-7 (cont.). Daily trapping records of the naturally-produced 1997 cohort from a screw trap in Lookingglass Creek.

Date	Flow m^3/s	Water temp. hourly °C High	Low	Fish trapped Live	Dead	Trap efficiency[a] No. Rel.	grp.	Re. on date	Re. From Rel. grp.	Rel. grp. on date	Comments
09/25/98	1.2	9.4	8.0	9		9	x		11	w8,v3	
09/26/98	1.2	11.4	7.0								
09/27/98	1.1	11.2	6.0								
09/28/98	1.1	11.4	6.0	497					3	w3	
09/29/98	1.2	11.1	5.8	5	24	5	y	2			Killed for OSU study
09/30/98	1.1	11.2	6.0	49		49	z	23	2	y2	
10/01/98	1.0	10.4	6.0	92					23	z23	
10/02/98	1.1	10.0	6.9	59		59	aa	17			
10/03/98	1.3	9.0	6.0								
10/04/98	1.1	9.1	5.9	51		51	ab	14	17	aa16,a1	
10/05/98	1.2	9.0	4.6	15		16	ac	6	14	ab14	Recaps used again
10/06/98	1.2	9.3	4.7	53	1	52	ad	3	7	ac6,a1	
10/07/98	1.3	10.0	5.6	11		11	ae	3	2	ad2	
10/08/98	1.3	8.4	5.5								
10/09/98	1.3	8.1	5.0	7		7	af		3	ae3	
10/10/98	1.3	8.0	5.0								
10/11/98	1.4	8.0	4.0								
10/12/98	1.4	9.0	4.8	151					1	ad1	
10/13/98	1.4	9.0	6.0	63		63	ag	13			
10/14/98	1.4	8.1	6.0	16	23	15	ah	4	12	ag12	Killed for OSU study
10/15/98	1.4	8.0	5.0	7	10	7	aj	2	5	ah4,ag1	Killed for OSU study
10/16/98	1.4	7.3	4.0	17		17	ak	8	2	aj2	
10/17/98	1.4	7.0	3.6								
10/18/98	1.4	8.0	5.0								
10/19/98	1.4	7.2	3.8	33		33	am	16	6	ak6	
10/20/98	1.4	7.1	3.5	4		4	an	1	12	am12	
10/21/98	1.4	7.2	3.5	18		18	ao	6			
10/22/98	1.4	7.1	3.7								
10/23/98	1.4	8.0	4.0	29		29	ap	5	8	ao6,am2	
10/24/98	1.4	8.0	4.0								
10/25/98	1.4	8.2	5.5								
10/26/98	1.4	8.0	4.0	18		18	aq	4	7	ap4,am2,ak1	
10/27/98	1.4	8.0	4.0								
10/28/98	1.4	7.2	5.0	21					4	aq4	
10/29/98	1.4	6.4	3.8	191	30	191	ar	70			Killed for OSU study
10/30/98	1.4	6.0	2.8	82		82	as	18	46	ar46	
10/31/98	1.4	6.4	3.0								
11/01/98	1.4	7.0	4.0								
11/02/98	1.4	6.4	3.0	33	1	33	at	7	36	as14,ar22	
11/03/98	1.4	6.0	2.9								
11/04/98	1.4	7.0	4.9	17					9	at6,as2,ar1	Eff. Rel. next day
11/05/98	1.5	7.0	5.0	7		16	au	6	2	as1,ap1	100% tr., Rel. next day
11/06/98	1.5	6.0	3.8	14		21	av	5	4	au4	100% tr.
11/07/98	1.6	5.4	3.0								

Appendix Table A-7 (cont.). Daily trapping records of the naturally-produced 1997 cohort from a screw trap in Lookingglass Creek.

Date	Flow m^3/s	Water temp. hourly °C High	Low	Fish trapped Live	Dead	Trap efficiency[a] No. Rel.	grp.	Re. on date	Re. From Rel. grp.	Rel. grp. on date	Comments
11/08/98	1.5	6.0	3.8								
11/09/98	1.4	5.1	4.0	35					5	av5	Eff. Release next day
11/10/98	1.4	5.0	3.8	21		35	aw	1			100% tr.,Eff. Rel 11/12
11/11/98	1.4	6.0	4.0								
11/12/98	1.4	6.0	4.0	118		114	ax	39	1	aw1	100% tr., Rel next day
11/13/98	1.4	6.0	5.0	10		35	ay	3	37	ax37	100% tag retention
11/14/98	1.5	7.0	5.0								
11/15/98	1.6	7.0	5.0								
11/16/98	1.6	6.0	4.0	3	23				10	ay3,ax2,au1,at1,as1,ar1,e1	Trap was stopped
11/17/98	1.6	6.0	4.9	4		3	az	1			Morts previous day due
11/18/98	1.6	6.0	4.6	2		6	ba	2	1	az1	to pump failure
11/19/98	1.5	6.0	4.0								
11/20/98	1.5	5.2	4.9	3		3	bb	1	2	ba2	
11/21/98	1.8	6.0	4.8	98	4				1	bb1	Full debris,trap stopped
11/22/98	2.0	5.2	4.0	88	1				2	au1,q1	Tree in cone, turning
11/23/98	2.4	5.0	2.9	14		200	bc	37	1	ak1	
11/24/98	2.5	5.1	4.0	18		19	bd	6	38	bc37,aa1	Recaps used again
11/25/98	2.3	6.0	4.5	4		4	be		3	bd3	
11/26/98	2.2	6.0	5.0								
11/27/98	2.2	6.0	4.8	18	2	19	bf	9	3	bd3	
11/28/98	2.2	5.2	4.0								
11/29/98	2.0	5.0	3.8								
11/30/98	2.3	5.0	3.0	2		2	bg		7	bf7	
12/01/98	2.5	5.1	3.8								
12/02/98	3.4	5.1	4.0	3		3	bh		2	bf2	
12/03/98	3.5	5.0	3.8	38		38	bj	13			
12/04/98	3.3	5.0	3.6	10		10	bk	3	12	bj12	
12/05/98	2.7	4.0	2.7								
12/06/98	2.3	4.3	2.0								
12/07/98	1.8	4.0	1.9	7		7	bm	1	4	bk3,bj1	
12/08/98	2.0	4.0	2.0								
12/09/98	1.9	3.4	1.5	6		6	bn		1	bm1	
12/10/98	1.8	4.0	1.0								
12/11/98	1.8	4.0	1.6	2		2	bo				
12/12/98	1.8	4.4	2.8								
12/13/98	1.9	4.3	3.0								
12/14/98	1.9	4.1	2.5	1		1	bp				
12/15/98	1.8	4.4	2.0								
12/16/98	1.7	4.2	2.8	0							
12/17/98	1.6	4.1	2.0								
12/18/98	1.4	3.2	1.0	0							
12/19/98	1.1	1.0	0.0								
12/20/98	1.2	0.1	-0.1	0							Trap frozen, raised cone
12/21/98	1.3	0.0	-0.1	--							

Appendix Table A-7 (cont.). Daily trapping records of the naturally-produced 1997 cohort from a screw trap in Lookingglass Creek.

Date	Flow m^3/s	Water temp. hourly °C High	Low	Fish trapped Live	Dead	Trap efficiency[a] No. Rel.	grp.	Re. on date	Re. From Rel. grp.	Rel. grp. on date	Comments
12/22/98	1.4	0.4	-0.1	--							
12/23/98	1.5	1.0	-0.1	--							
12/24/98	1.6	1.3	-0.1	--							
12/25/98	1.8	2.0	0.0	--							
12/26/98	2.1	3.0	2.0	--							Started trap
12/27/98	2.3	3.1	0.8								
12/28/98	3.4	4.0	1.8	7		7	bq	2			Trap stopped, log
12/29/98	3.3	3.1	2.5	10		10	br	3	2	bq2	
12/30/98	3.1	3.1	2.0	8		8	bs	2	3	br3	
12/31/98	2.8	4.0	2.8	6		6	bt		2	bs2	Moved closer to bank
01/01/99	2.7										Dead batt.tempmentor
01/02/99	2.6			5		5	bu				
01/03/99	2.5			0							
01/04/99	2.5			0							Trap was frozen
01/05/99	2.4										Moved into higher flow
01/06/99	2.3			0							
01/07/99	2.2										
01/08/99	2.2			0							
01/09/99	2.3										
01/10/99	2.3										
01/11/99	2.2			0							
01/12/99	2.3			0							
01/13/99	2.7										
01/14/99	3.0										
01/15/99	3.1			7		7	bv				Moved closer to bank
01/16/99	2.8			0							
01/17/99	2.7										
01/18/99	2.6										
01/19/99	2.6			2		2	bw				
01/20/99	2.5			0							
01/21/99	2.5			1		1	bx				
01/22/99	2.5			0							
01/23/99	2.4			1		1	by				
01/24/99	2.2			0							
01/25/99	2.0			0							
01/26/99	2.0										
01/27/99	2.1			4		4	bz	3			
01/28/99	2.1	3.5	2.3								
01/29/99	2.3	3.5	2.1	1		1	ca	1	3	bz3	
01/30/99	2.2	3.8	2.8								
01/31/99	2.2	4.1	2.7								
02/01/99	2.1	4.1	2.8	1		1	cb		1	ca1	
02/02/99	2.1	3.2	0.0								
02/03/99	2.0	4.1	2.6	3		3	cc				

Appendix Table A-7 (cont.). Daily trapping records of the naturally-produced 1997 cohort from a screw trap in Lookingglass Creek.

Date	Flow m^3/s	Water temp. hourly °C High	Low	Fish trapped Live	Dead	Trap efficiency[a] No. Rel.	grp.	Re. on date	Re. From Rel. grp.	Rel. grp. on date	Comments
02/04/99	2.0	3.4	3.2								
02/05/99	2.0	4.4	1.0	3		3	cd				
02/06/99	2.0	4.1	2.6								
02/07/99	2.0	4.9	2.8								
02/08/99	2.0	3.7	1.8	4		4	ce	1			
02/09/99	1.9	3.4	2.4								
02/10/99	1.8	4.0	1.7	2		2	cf	1	1	ce1	
02/11/99	1.8	3.7	0.8	0							Trap frozen,started 11a
02/12/99	1.9	4.3	2.0	1		1	cg		1	cf1	
02/13/99	2.0	5.1	3.2								
02/14/99	1.9	5.1	2.2								
02/15/99	1.9	5.1	3.2								
02/16/99	1.9	5.6	3.0	8		8	ch	4			
02/17/99	1.8	5.1	3.2								
02/18/99	1.8	3.6	3.1								
02/19/99	1.8	5.2	2.7	5		5	cj	1	4	ch4	
02/20/99	1.8	4.7	1.8								
02/21/99	1.8	5.3	3.5								
02/22/99	1.8	3.7	2.4	3		3	ck	2	1	cj1	
02/23/99	2.2	4.9	3.7								
02/24/99	4.5	4.1	3.6	9		9	cm	2	2	ck2	
02/25/99	5.1	4.5	3.4	17		17	cn	6	2	cm2	
02/26/99	4.6	5.0	3.0	11		11	co	1	6	cn6	
02/27/99	4.8	3.8	2.7	3		3	cp		1	co1	
02/28/99	8.0	4.9	3.6								
03/01/99	8.4	5.2	3.2	28	1	28	cq	8			Trap stopped, log
03/02/99	7.1	5.2	2.7	11		11	cr	2	7	cq7	
03/03/99	6.4	5.2	3.4	12		12	cs	2	3	cr2,cq1	
03/04/99	5.5	4.4	2.8	7		6	ct	1	2	cs2	
03/05/99	4.9	5.3	2.8								
03/06/99	4.4	5.1	1.9	21		21	cu	4	1	ct1	
03/07/99	4.1	5.3	2.5								
03/08/99	3.9	4.7	1.9	6		6	cv		4	cu4	
03/09/99	3.7	5.5	2.8								
03/10/99	3.4	5.6	1.9	7		7	cw	2			
03/11/99	3.3	5.7	2.1								
03/12/99	3.2	5.7	2.0	4		4	cx		2	cw2	
03/13/99	3.3	6.4	4.1								
03/14/99	3.4	6.9	3.9								
03/15/99	3.7	7.3	3.1	0							
03/16/99	4.0	5.7	3.1								
03/17/99	3.9	6.6	2.8	16		16	cy		1	an1	
03/18/99	3.8	6.8	3.7								
03/19/99	4.1	7.9	3.4	6		6	cz				

Appendix Table A-7 (cont.). Daily trapping records of the naturally-produced 1997 cohort from a screw trap in Lookingglass Creek.

Date	Flow m^3/s	Water temp. hourly °C High	Low	Fish trapped Live	Dead	Trap efficiency[a] No. Rel.	grp.	Re. on date	Re. From Rel. grp.	Rel. grp. on date	Comments
03/20/99	5.2	7.1	3.4	7		7	da				
03/21/99	6.3	5.7	3.8								
03/22/99	6.9	7.4	3.5	5		5	db				Trap stopped, log, started
03/23/99	7.5	6.9	3.8								
03/24/99	7.9	5.4	3.6								
03/25/99	8.6	6.7	4.1	0							Trap stopped,log,started
03/26/99	10.2	5.4	3.6								
03/27/99	9.1	5.2	2.9	6		6	dc				
03/28/99	7.8	5.7	2.4	1		1	dd				
03/29/99	6.8	3.9	3.5								
03/30/99	6.2	4.8	3.2	0							Moved closer to bank
03/31/99	5.9	6.5	2.8	0							
04/01/99	5.6	6.9	2.7								
04/02/99	5.5	7.3	2.6	0							
04/03/99	5.5	6.2	3.2								
04/04/99	5.2	5.1	3.4								
04/05/99	4.9	6.2	3.4	0							Moved trap into flow
04/06/99	4.7	7.1	3.5								
04/07/99	4.6	8.6	0.0	0							
04/08/99	5.2	6.4	4.0								
04/09/99	5.0	6.9	3.2	0							
04/10/99	4.7	6.8	2.1								
04/11/99	4.6	8.8	2.7	0							
04/12/99	4.8	7.1	3.1								
04/13/99	5.2	8.7	3.6								
04/14/99	5.7	8.4	2.8	7		7	de				
04/15/99	6.0	8.6	2.8								
04/16/99	6.7	9.1	3.0	6		6	df	1			
04/17/99	8.0	8.8	3.5								
04/18/99	10.3	7.9	4.0	16		16	dg	3	1	df1	
04/19/99	12.9	6.5	4.1	6		6	dh		2	dg2	Moved trap to bank
04/20/99	13.8	6.6	3.9	2		2	dj	1	1	dg1	
04/21/99	13.1	6.9	3.7	0					1	dj1	
04/22/99	11.9	7.3	3.8	2		2	dk				
04/23/99	11.7	8.7	3.5	1		1	dm	1			
04/24/99	13.2	8.8	3.5	0					1	dm1	
04/25/99	14.6	7.2	3.5								
04/26/99	14.8	9.5	3.7	0							
04/27/99	13.7	6.1	3.1								
04/28/99	12.7	5.4	3.9	0							
04/29/99	11.8	6.2	3.4	0							
04/30/99	12.2	8.2	3.6	0							Trap cable broke
05/01/99	12.4	5.8	4.1								
05/02/99	12.3	5.9	3.9								

Appendix Table A-7 (cont.). Daily trapping records of the naturally-produced 1997 cohort from a screw trap in Lookingglass Creek.

Date	Flow m^3/s	Water temp. hourly °C High	Low	Fish trapped Live	Dead	Trap efficiency[a] No. Rel. grp.	Re. on date	Re. From Rel. grp.	Rel. grp. on date	Comments
05/03/99	12.3	5.7	4.1	0						
05/04/99	11.3	6.5	3.4							
05/05/99	10.0	7.9	3.4	0						
05/06/99	10.2	9.2	3.2							
05/07/99	11.5	7.1	3.3	0						
05/08/99	10.5	6.1	3.3							
05/09/99	9.9	7.2	3.0							
05/10/99	9.2	6.9	2.3	0						
05/11/99	9.4	8.4	2.8							
05/12/99	9.9	7.7	4.1	0						
05/13/99	10.0	6.9	3.7							
05/14/99	9.7	6.6	3.1	0						Raised cone
05/15/99	9.6	8.1	3.2	--						98 brood to LGH
05/16/99	10.1	8.3	3.1	--						release in June
05/17/99	11.4	6.6	4.4	--						
05/18/99	15.0	7.9	4.4	--						
05/19/99	16.6	8.5	3.9	--						
05/20/99	17.6	7.2	4.1	--						
05/21/99	17.2	8.3	3.8	--						
05/22/99	17.3	9.1	3.6	--						
05/23/99	18.6	9.4	4.1	--						
05/24/99	20.7	9.6	4.3	--						
05/25/99	21.9	9.0	4.7	--						
05/26/99	20.7	8.7	4.0	--						
05/27/99	19.1	9.5	4.3	--						
05/28/99	18.3	9.3	5.5	--						
05/29/99	17.1	9.5	5.3	--						
05/30/99	16.3	9.7	5.4	--						
05/31/99	15.6	8.6	4.9	--						
06/01/99	16.2	9.1	6.0	--						
06/02/99	15.0	6.8	5.5	--						
06/03/99	14.2	9.1	5.3	--						
06/04/99	14.0	10.7	5.4	--						
06/05/99	13.1	9.1	6.7	--						
06/06/99	12.8	7.7	5.2	--						
06/07/99	11.8	8.4	4.4	--						
06/08/99	11.0	7.7	5.4	--						
06/09/99	9.3	9.8	4.2	--						
06/10/99	8.9	11.0	4.8	--						
06/11/99	8.9	10.8	5.4	--						
06/12/99	8.9	12.9	6.6	--						
06/13/99	9.0	13.5	8.2	--						
06/14/99	10.2	13.8	7.9	--						
06/15/99	10.1	14.4	8.7	--						

Appendix Table A-7 (cont.). Daily trapping records of the naturally-produced 1997 cohort from a screw trap in Lookingglass Creek.

Date	Flow m^3/s	Water temp. hourly °C High	Low	Fish trapped Live	Dead	Trap efficiency[a] No. Rel. grp.	Re. on date	Re. From Rel. grp.	Rel. grp. on date	Comments
06/16/99	8.5	14.4	9.1	--						
06/17/99	7.9	13.1	8.7	--						
06/18/99	7.0	14.0	9.1	--						
06/19/99	6.5	13.1	8.1	--						
06/20/99	6.1	12.7	8.3	--						
06/21/99	5.3	11.1	9.1	--						
06/22/99	4.8	12.7	8.9	--						
06/23/99	4.6			--						Lowered cone
06/24/99	4.2	13.3	8.7	0						
06/25/99	4.8	10.7	8.0	0						
06/26/99	4.0	11.7	6.9	0						
06/27/99	3.6	12.8	6.6	0						
06/28/99	3.2	11.5	6.7	0						
06/29/99	3.5			0						
06/30/99	3.3	13.5	9.1	0						
07/01/99	3.2	14.0	8.8							
07/02/99	2.9	11.2	7.9	0						
07/03/99	2.7	13.3	6.0							
07/04/99	2.5	12.0	7.9							
07/05/99	2.5	14.9	6.3							
07/06/99	2.3	18.9	7.5	2						Precocial 97 cohort
07/07/99	2.4	15.8	9.4							
07/08/99	2.5	15.8	7.4	0						
07/09/99	2.4	16.3	8.5							
07/10/99	2.3	17.0	9.1							
07/11/99	2.4	17.7	9.6							
07/12/99	2.1	17.8	9.6	0						
07/13/99	2.0	17.5	9.3							
07/14/99	2.0	15.8	9.5	0						
07/15/99	1.9	15.3	8.7	0						
07/16/99	2.1	15.9	9.1							
07/17/99	1.8	14.9	9.3							
07/18/99	1.8	16.2	7.8							
07/19/99	2.0	16.7	8.7	0						
07/20/99	1.8	15.9	9.8							
07/21/99	1.7	16.4	8.6							
07/22/99	1.7	17.3	8.5							
07/23/99	1.6	17.7	8.7	1						
07/24/99	1.7	12.8	9.4							
07/25/99	1.7	16.7	8.1							
07/26/99	1.8	17.4	7.7							
07/27/99	1.6	18.2	8.9	0						
07/28/99	1.5	18.3	9.1							
07/29/99	1.5	18.2	9.9	0						Mink raiding trap

Appendix Table A-7 (cont.). Daily trapping records of the naturally-produced 1997 cohort from a screw trap in Lookingglass Creek.

Date	Flow m^3/s	Water temp. hourly °C High	Low	Fish trapped Live	Dead	Trap efficiency[a] No. Rel. grp.	Re. on date	Re. From Rel. grp.	Rel. grp. on date	Comments
07/30/99	1.4	17.4	9.0							
07/31/99	1.4	17.2	8.2							
08/01/99	1.6	15.2	8.6							
08/02/99	1.5	17.8	9.6							
08/03/99	1.5	14.4	9.6							
08/04/99	1.6	18.2	10.1	0						
08/05/99	1.6	16.5	9.7							
08/06/99	1.6	17.0	9.9	0						
08/07/99	1.6	12.6	10.0							
08/08/99	1.8	16.5	8.8							
08/09/99	1.6	16.4	9.0							
08/10/99	1.6	16.5	9.2							
08/11/99	1.6	14.8	10.3							
08/12/99	1.7	16.5	8.8	0						Mink traps set
08/13/99	1.8	11.7	9.3							
08/14/99	1.8	13.7	8.9							
08/15/99	1.8	13.4	7.9							
08/16/99	1.9	15.9	7.8	0						
08/17/99	1.9	16.6	8.5							
08/18/99	1.8	15.1	8.8							
08/19/99	1.8	17.0	9.1	0						Tempmentor moved into
08/20/99	1.8	16.6	8.9							the flume hole
08/21/99	1.7	16.8	9.3							
08/22/99	1.8	16.1	7.9							
08/23/99	1.8	15.9	8.3	0						Trapped stopped
08/24/99	1.8	16.2	9.8							
08/25/99	1.8	16.3	8.9							
08/26/99	1.8	16.2	8.6	0						
08/27/99	1.8	16.3	9.0							
08/28/99	1.7	16.3	9.1							
08/29/99	1.8	15.8	9.4							
08/30/99	1.8	11.7	8.3	1						
08/31/99	1.8	10.9	7.7							
09/01/99	1.8	12.9	5.6	1						
09/02/99	1.7	10.1	5.5							
09/03/99	1.8	13.0	5.3							
09/04/99	1.8	11.9	5.9							
09/05/99	1.8	13.6	6.3							
09/06/99	1.7	12.1	8.4							
09/07/99	1.7	12.6	5.7							
09/08/99	1.7	12.9	5.5	1						
09/09/99	1.7	12.0	6.1							
09/10/99	1.6	13.5	6.7							

Appendix Table A-7 (cont.). Daily trapping records of the naturally-produced 1997 cohort from a screw trap in Lookingglass Creek.

Date	Flow m^3/s	Water temp. hourly °C High	Low	Fish trapped Live	Dead	Trap efficiency[a] No. Rel. grp.	Re. on date	Re. From Rel. grp.	Rel. grp. on date	Comments
09/11/99	1.7	12.5	5.6							
09/12/99	1.6	12.4	5.2							
09/13/99	1.7	12.7	5.7	2						
09/14/99	1.7	13.0	6.0							
09/15/99	1.6	13.0	6.6							
09/16/99	1.8	12.5	6.3	0						
09/17/99	1.6	12.5	6.2							
09/18/99	1.6	12.7	6.3							
09/19/99	1.7	12.6	6.5							
09/20/99	1.5	12.1	5.7	2						Last 97 cohort trapped

[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. Grp is a release group code that day. Re.on date is the number of trap efficiency fish recaptured on that day. Re. from Rel. Grp. is the total number of trap efficiency fish recaptured from specific release group. Re. Grp. on date is the number of fish from the release group captured on that date.*