# Lower Snake River Compensation Plan
# Confederated Tribes of the Umatilla Indian Reservation
# Evaluation Studies for 1 January to 31 December 2000

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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 52 unmarked, 114 adipose-clipped only, and 71 adipose-right-ventral clipped spring Chinook salmon adults at Lookingglass Hatchery between 19 May and 2 October 2000. All were released below the weir to spawn naturally. No fish were intentionally passed above the weir. We completed 2 surveys above the weir from 12 July to 7 September 2000 and 13 surveys below the weir from 22 August to 9 September 2000. We observed no redds above the hatchery weir and 86 below the weir. We recovered 174 carcasses below the hatchery weir and none above the weir in 2000.

Progeny-per-parent ratio for the adipose-only-clipped hatchery-produced 1995 cohort from Lookingglass Creek was 0.94 while ratios from other Grande Ronde River tributaries ranged from 0.12 to 3.59.

Movement of juveniles from the hatchery-produced 1998 cohort past the rotary screw trap in Lookingglass Creek peaked in October 1999, with smaller peaks in June of 1999 after release and March 2000. Total estimated number of juveniles passing the trap was 10,759. Movement of naturally produced juveniles from the 1998 cohort past the rotary screw trap in Lookingglass Creek also peaked in October 1999, with a smaller peak in March 2000. The total estimated number of juveniles passing the trap was 889.

The median monthly fork length of hatchery-produced fish captured in the trap ranged from 73 mm in July 1999 to 113 mm in May 2000, while that of the naturally-produced fish ranged from 75-113 mm. The range of median monthly fork lengths of hatchery-produced fish captured in the field was 74 mm in July 1999 to 85 mm in October 1999 while that of the naturally-produced fish ranged from 63-81 mm. Median fork lengths appeared similar between fish captured in the trap (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 hatchery-produced 1998 cohort from Lookingglass Creek to estimate survival and arrival timing to Lower Granite Dam. Three (seasonal) groups were tagged at the screw trap: June to September 1999 (fall), October to December 1999 (winter), and January to June 2000 (spring). One group which was seined from Lookingglass Creek in July 1999 (field). The median arrival date at Lower Granite Dam for the spring and Field groups was 26 and 28 April 2000 which was 10 to 12 days later than the other 2 groups. Groups tagged later at the trap had higher minimum survival rates: 5.2 (fall), 23.4 (winter), and 45.4% (spring). The minimum survival rate for the Field group was 11.0%. Minimum survival rates for months with at least 50 fish PIT-tagged (June 1999 through April 2000) ranged from 5.3 to 57.5%. The median date of arrival at Lower Granite Dam of larger fish in the Field group was not significantly different than that of the smaller fish in the Field group, with the median arrival dates being 27 April and 29 April 2000, respectively. Minimum survival rates among fish of four different fork length ranges from the Field group were not different ($\alpha$<0.05) from average survival for the entire group. The arrival timing at the screw trap of the hatchery-produced 1998 cohort Field group was not different from that of non-PIT-tagged fish. There were no significant differences in fork length, weight, or condition factor of the 1998 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 the1998 cohort (28 April 2000), was earlier than median arrival dates of natural populations from the Minam and Lostine rivers and Catherine Creek (3 May and 7 May 2000). The minimum survival rate to Lower Granite Dam of the Field group from the 1998 cohort (11.0%) was significantly lower than minimum survival rates observed for the Minam River (17.5%) and Lostine River (14.9%) Field groups, but was similar to that observed and Catherine Creek (10.8%) Field group.

## Introduction

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. 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).

Hatcheries were built in Oregon, Washington and Idaho under LSRCP to compensate for losses of anadromous salmonids due to the construction and operation of the lowest four Snake River dams. Lookingglass Hatchery (LH) on Lookingglass Creek, a tributary of the Grande Ronde River, was completed under LSRCP in 1982 and has served as the main incubation and rearing site for Chinook salmon programs for 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 available in Lookingglass Creek would provide an adequate opportunity for success, and the existence of the weir at LH provided the ability to easily control and document adult escapement. There was also a database on the life history and success of the endemic (now extirpated) 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 an introduced stock.

Until this study was initiated in 1992, no adult spring Chinook salmon captured at the LH weir were placed upstream of the hatchery with the exception of a few fish in 1989. The upstream migration of spring Chinook salmon has been blocked by a picket or floating weir located at the hatchery. The weir 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 from 1982-1991 (ODFW, unpublished data).

From 1992 to 1994, adults were placed above the LH 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 LH affected the 1993 cohort 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 LH water supply. Because of these concerns, the release of adults above the LH 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 LH in 1995 for supplementation as parr (i.e., artificial spawning/ incubation/ early rearing at LH and release in 1996 as parr above the weir on Lookingglass Creek) (McLean and Lofy 1998, 1999).

With continued concern about increasing pathogen prevalence in the water supply for LH, co-managers decided to release only 50 adults above the weir in 1996, fewer than the 100 to 300 fish released from 1992-1994 (McLean 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 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; McLean and Lofy 1999). All remaining unmarked fish that were trapped at LH in 1996 (20 females and 21 males) were spawned at the hatchery. Their progeny were released as smolts from the hatchery at 42.1 fish-per-pound and 19.3 fish-per-pound in 1998 (McLean and Lofy 2000a).

In 1997, all returning unmarked fish (77) trapped at LH were released above the weir while keeping the survey frequency the same as in 1996 (McLean and Lofy 1999).

In 1998, and 1999 it was again decided by co-managers to not intentionally release adult spring Chinook salmon above the LH weir due to the potential increase in pathogen prevalence in the water supply. Returning spring Chinook salmon that were captured at the LH trap were retained at the hatchery in 1998 and 1999. These fish came from several sources: unmarked (most likely of natural parentage from Lookingglass Creek), 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 LH releases that were not intercepted at Lower Granite Dam) (McLean and Lofy 1999 and 2000). All spring Chinook salmon captured at LH were transported to the CTUIR South Fork Walla Walla Facility (SFWW) due to higher priority for holding space being given to programs for endemic broodstock that are held at LH. The unmarked and adipose-only-clipped jacks were spawned at SFWW and the eggs taken to Irrigon Hatchery for incubation. After hatching and marking, these fish were released into Lookingglass Creek in July 1999. 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.

In 2000 no fish were intentionally passed above the weir and no redds were observed above the weir. All returning fish to Lookingglass Creek were allowed to spawn below the weir or be harvested in tribal fisheries. The trap at LH was operated during the return and fish were enumerated and given an opercle punch to identify it as having been trapped. These fish were then trucked downstream 1 mile and released back into the stream for harvest opportunities.

## 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). Lookingglass Creek and Little Lookingglass Creek (the largest tributary) are the only major portions of the basin where adult spring Chinook salmon spawning takes place with any regularity. LH is located at about rm 2.50 on Lookingglass Creek. Burck (1993) divided these two streams 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. The lower portion of unit 3 is entirely privately owned. In 2000 the landowner allowed access to his portion of Lookingglass Creek for spawning ground surveys.

# Methods

## Stream Flow and Temperature

We obtained and summarized 2000 stream flow data collected by the United States Geological Survey (USGS) for comparison to stream flows recorded in Lookingglass Creek from 1964 to 1971 (at about rm 2.50) (Burck 1993) (Figure 3). Mean daily stream flows (0.5-hour sample interval) in Lookingglass Creek for 2000 were estimated from an electronic stream gauging station located just below the floating weir (personal communication, Jo Miller, USGS, Walla Walla District, WA). Maximum and minimum daily mean flows for each week of the year were reported here using methods described in M<sup>c</sup>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 2000 were obtained from summaries completed by the United States Forest Service (USFS)(personal communication Scott Wallace, USFS, Umatilla National Forest, Pendleton, OR) and from an electronic thermograph (Ryan Tempmentor®2000) operated by CTUIR. Stream temperature data collected in 2000 were recorded by USFS at the forest service boundary (at about rm 7.25) and by CTUIR in the screw trap livebox 250 ft below the hatchery intake. 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<sup>c</sup>Lean and Lofy 1995). We also operated a thermograph in the Grande Ronde River 50 ft above the mouth of Lookingglass Creek from 3 June-31 December 2000. Temperature in the Grande Ronde River was recorded in 2000 in order to document the current temperature regime that exists just above the mouth of Lookingglass Creek.

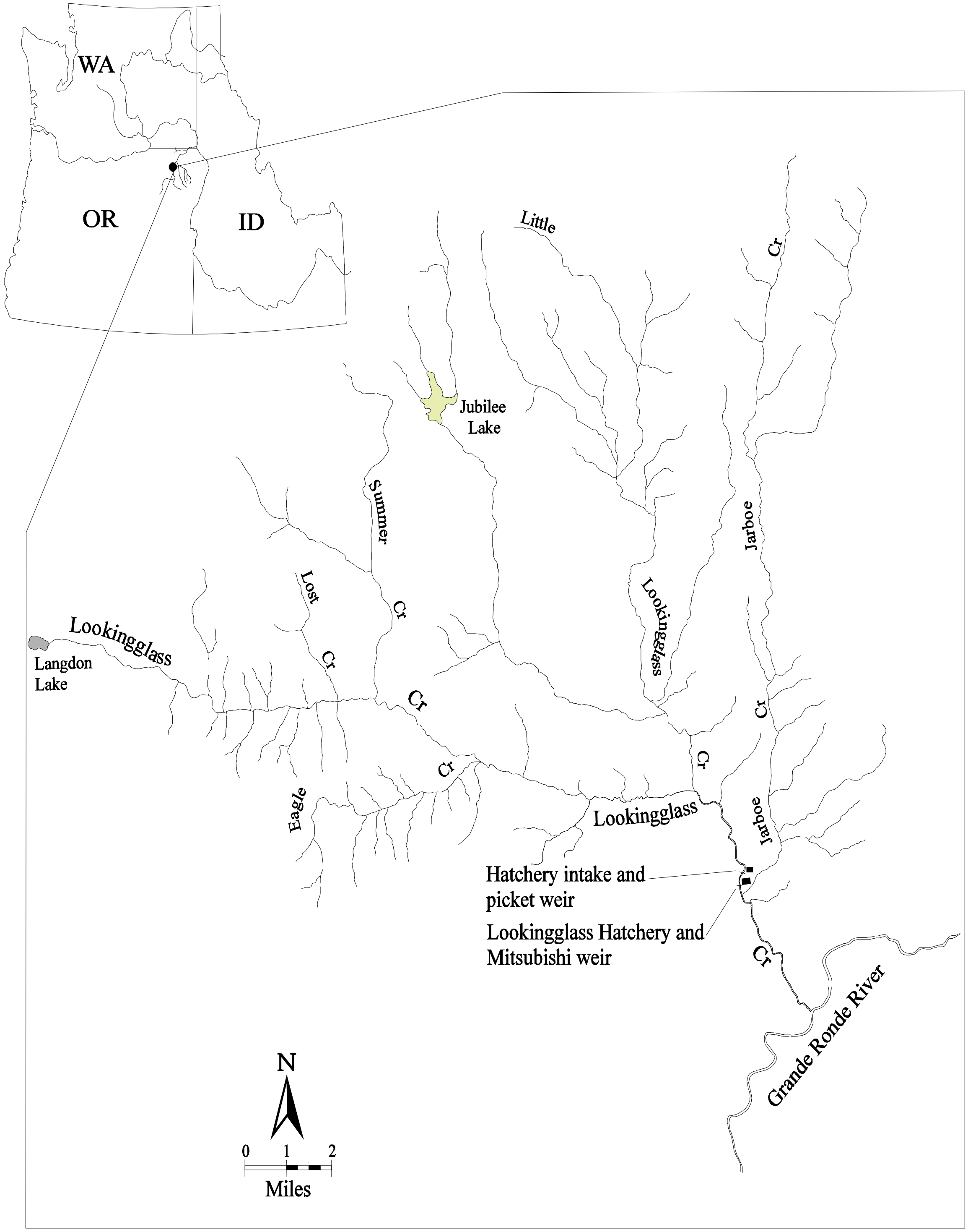


Figure 1. Map of the Lookingglass Creek basin showing the location of major tributaries and the Lookingglass Hatchery complex.

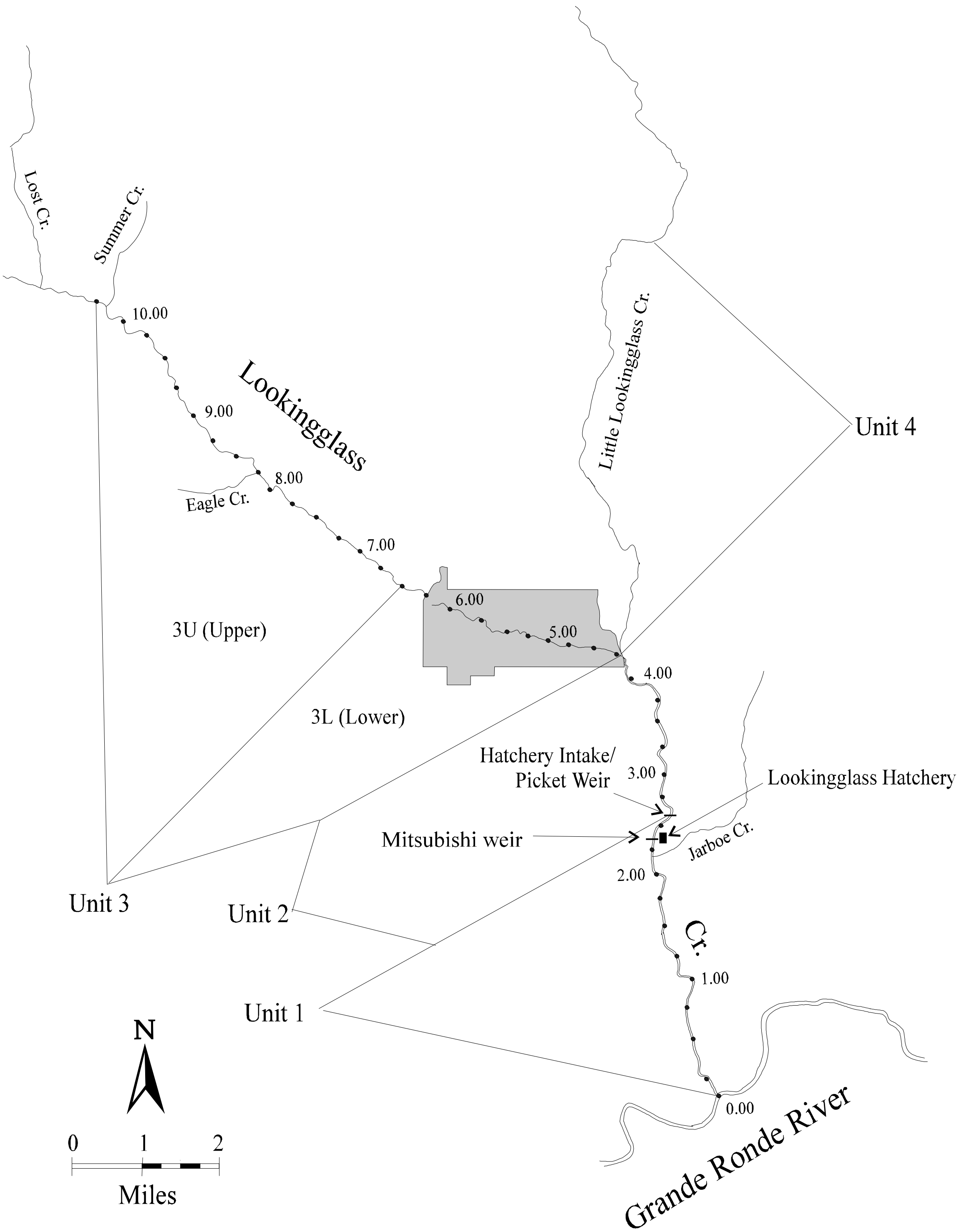


Figure 2. Unit Designations and 0.25-river mile sections of Lookingglass Creek. The shaded area is the private property where access by the landowner was limited only to spawning ground surveys in 2000.

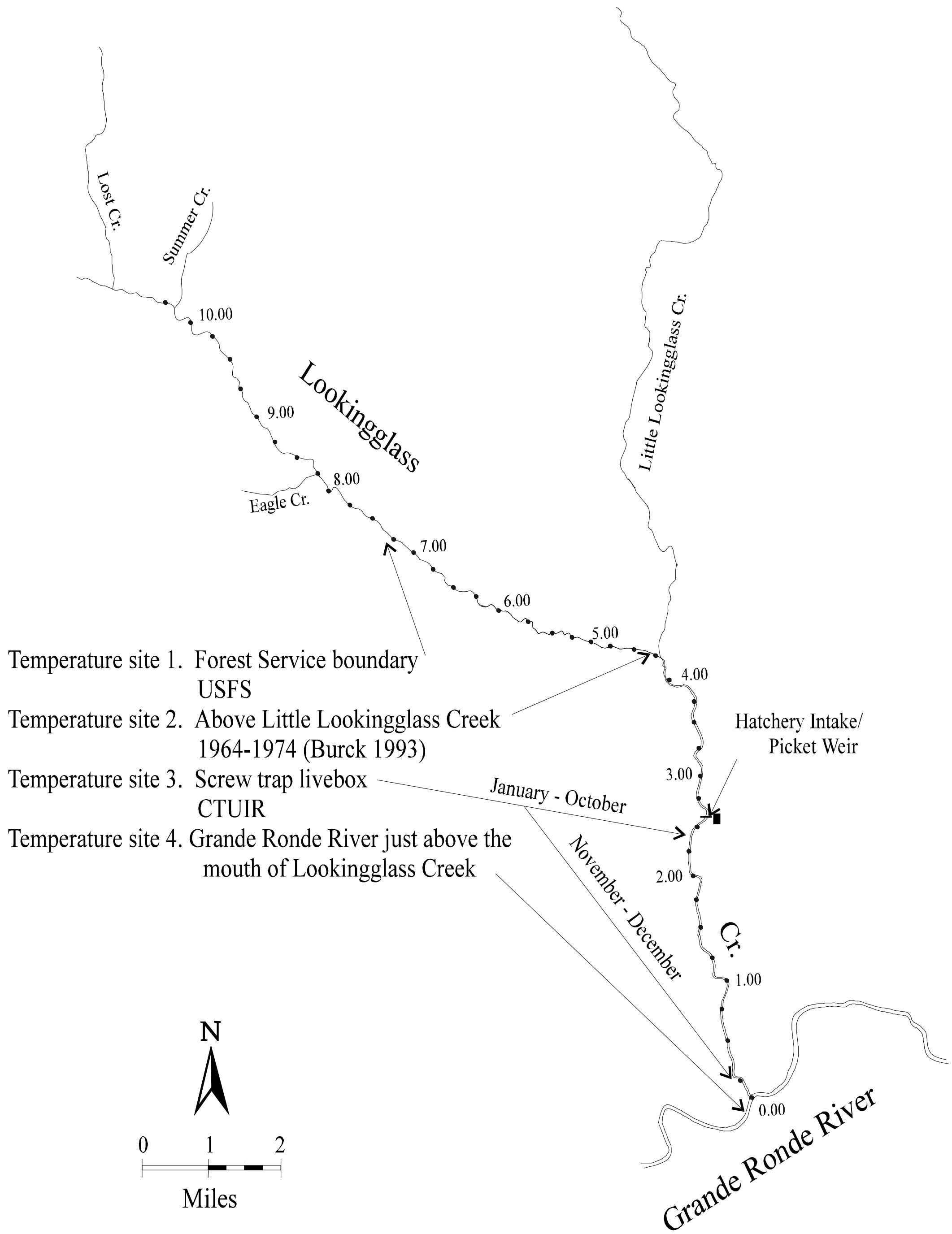


Figure 3. Location of temperature data recorders in Lookingglass Creek in 2000.

## Adult Returns to Lookingglass Hatchery

Unmarked and marked adult spring Chinook salmon returning to Lookingglass Creek were enumerated by CTUIR. Returning fish were diverted into a hatchery trap using a picket weir (upper weir), which was installed on 11 May 2000. The trap was opened on 19 May 2000 and was checked up to three times a week for the duration of the return to Lookingglass Creek (until spawning was completed in Lookingglass Creek). The picket weir was removed on 2 October 2000.

All fish captured in the trap were checked for fin clips, measured for fork length (mm), opercle punched for recapture information, then released below the trap. We took scale samples from unmarked and adipose-only-clipped salmon for age determination. Fish captured in the trap that had an opercle punch were noted and released again below the trap. All fish were transported in a fish tank below the weir to rm 1.0 to be released for a tribal fishery. The median length of captured fish was used to describe the population because the median is not sensitive to extreme values which can skew the mean.

Adult spring Chinook salmon returns to Lookingglass Creek consisted of progeny of natural fish which were not marked (1996-1997 cohorts); progeny of unmarked parents hatched and partially reared (1995 cohort, July presmolt release) and reared to smolt (1996 cohort, April release) in the hatchery which were adipose-clipped only (ad-only); and progeny of marked fish hatched and reared in the hatchery for an April smolt release (1995-1997 cohorts of Rapid River stock) which were adipose and right ventral fin-clipped (ADRV).

In 2000, all fish that were not harvested in the tribal fisheries were allowed to spawn naturally in the 2.5 rm section below the hatchery trap. No fish were intentionally released above the hatchery weir for natural production in 2000.

## Spawning Ground Surveys

In 2000, we conducted spawning ground surveys in Unit 1 of Lookingglass Creek on 13 different days to count redds and recover carcasses (Figure 2). We surveyed Units 3U, 3L, and 2 three times and Unit 4 (Little Lookingglass) only once. An index survey was completed on 7 September 2000 for the ODFW spring Chinook salmon spawning ground index count for Lookingglass Creek. In 2000, we were given permission to survey Unit 3L (private property), which in the past has not been given. Fewer surveys were completed above the weir than below 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. Surveys were conducted in Unit 1 two to three days per week after the first redds were observed (22 August 2000), to count redds and recover spawned-out adult spring Chinook salmon. We collected carcasses, and weak-swimming fish to document all spring Chinook salmon that returned to Lookingglass Creek and recover the coded-wire tags (CWT) from the snouts of some fish. Determination of whether or not a fish should be gaffed and killed was made by visual inspection of the females (flaccid abdomen and tail erosion was interpreted as a spawned fish), and length of time the females had been observed on a redd. For males we used their ability to 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 surveys, only completed redds were counted (McLean and Lofy 1995).

*Coded-Wire-Tag Recovery*

The 2000 return of adult spring Chinook salmon to Lookingglass Creek completed the 1995 cohort. We collected snouts which contained CWT's from the hatchery-produced 1995 cohort to complete data collection on survival of the pre-smolt release in 1996 (M^c^Lean and Lofy 1999). We also collected snouts from unmarked fish to document the presence of any CWT's. Snouts that were collected in 2000 were given to ODFW Clackamas, Oregon, for recovery of the tags. Data were summarized from the ODFW CWT database.

*Population Estimation*

We used marked (opercle punched at the trap) and unmarked (no opercle punch) carcasses collected to estimate the total population of adult spring Chinook salmon in Lookingglass Creek. We expanded each fin-clip group population based on a marked to unmarked ratio of carcasses recovered (M^c^Lean and Lofy 1995).

*Progeny-per-Parent Estimation*

In order to evaluate the relative success of the presmolt release in 1995 (M^c^Lean and Lofy 1999), the progeny-per-parent ratio was calculated using the adipose-clipped adult spring Chinook salmon intercepted at LH and recovered above and below the weir during spawning ground surveys in 1998, 1999, and 2000. The fish were enumerated and aged using scales to determine cohort year. Snouts were taken on all of these fish and the CWT was read.

The progeny-per-parent ratio was calculated using the number of adipose-clipped fish recovered in Lookingglass Creek from 1998-2000 divided by the number of adults spawned at the hatchery in 1995 (Lofy and M^c^Lean 1995b; M^c^Lean and Lofy 1995). 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 1998 to 2000 in Lookingglass Creek to obtain an estimate of adult escapement (Appendix Tables A-1 to A-5)(McLean and Lofy 2001). 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). 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; McLean and Lofy 2001). No adjustment was made for differences in recoverability of different aged fish.

Redd counts for each tributary from 1998-2000 were expanded in order to account for times or places where multiple surveys were not completed. We expanded tributary redds each year by using the average (1986-2000) 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 (McLean and Lofy 2001). 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)(McLean and Lofy 2001). 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 (McLean and Lofy 2001). 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.

**Genetic Monitoring**

As part of an ongoing genetic monitoring program, NMFS requested that we collect a tissue sample (opercle punch) for genetic analysis from unmarked and marked adult spring Chinook salmon that returned to LH. 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 1999 Cohort into Lookingglass Creek**

Co-managers retained and spawned all unmarked and adipose-clipped (from 1995 and 1996 cohort unmarked progeny release) adult spring Chinook salmon captured at LH in 1999. Eggs from each of 8 unmarked and adipose-clipped spring Chinook salmon females were placed in individual egg trays and spawned with 15 unmarked or adipose-clipped males. Eggs were transferred to Irrigon Hatchery for early rearing and final rearing (February to June 2000) was completed at LH. All of these fish were CWT'd in the snout and had their adipose fin removed. The 24,201 fish (71.4 fish/lb.) were released into Lookingglass Creek by truck at rm 6.50 on 29 June 2000.

**Population Estimates of the Hatchery- and Naturally-produced 1998 Cohort Using a Screw Trap**

To evaluate the survival of hatchery-produced juvenile spring Chinook salmon from the 1998 cohort (released as presmolts in June 1999) and enumerate natural production above the weir, we operated a screw trap from 1 January 1999 to 15 November 2000 about 250 ft below the hatchery intake. We moved the trap to rm 0.25 of Lookingglass Creek on 16 November to accommodate the spawning that occurred below the trap. No redds were observed above the weir in 2000. We captured fish to estimate migration timing to the trap and total number of fish moving past the trap site. From June 2000 to December 2000, we also captured fish from both the naturally and hatchery-produced 1999 cohort. Differences in fork length ranges made it possible to differentiate the two cohorts.

Most 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). At times, we just counted fish because they appeared injured or there were more fish in the trap than was necessary for the minimum sample size of 50 (we subsampled this group). Occasionally, small fry that were dipped out of the trap box 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 hatchery-produced 1998 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 marked with Alcian blue dye, then released above the trap efficiency estimation. For smaller fish that could not be

PIT-tagged (<60 mm) we used only a mark of Alcian blue dye. We used a secondary mark of Alcian blue dye (applied with a battery operated tattoo pen on the caudal peduncle of the trap efficiency fish) so we could recognize fish released for trap efficiency and refrain from using them for trap efficiency multiple times. To calculate the variance around the estimate of total migration and the estimated numbers of fish trapped each month for the hatchery-produced 1998 cohort, we used a bootstrap method (M$^{c}$Lean and Lofy 1998).

**Monthly Fork Length Sampling of the Hatchery-produced 1998 Cohort**

We conducted monthly fork length sampling of hatchery- and naturally-produced spring Chinook salmon from the 1998 cohort to compare growth patterns of fish passing the screw trap 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 20$^{th}$ 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 using the Mann-Whitney test (Wilkinson 1999)($\alpha < 0.05$). The median length was used to describe the population because the median is not sensitive to extreme values which can skew the mean. We were unable to capture a large sample size of naturally-produced fish from rm 7.25 and the trap in some months.

**PIT-tagging of the Hatchery-produced 1998 Cohort**

Four groups of juvenile spring Chinook salmon from the hatchery-produced 1998 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 (Burck 1993). The “Fall group” was PIT-tagged from 24 June-30 September 1999. The “Winter group” was tagged from 1 October-31 December 1999. The “Spring group” was tagged from 1 January-19 May 2000: the date on which the last non-precocial juvenile from the hatchery-produced 1998 cohort was captured in the screw trap (M$^{c}$Lean and Lofy 1998). In 2000 this date was 19 May. The fourth group to be tagged (Field group) was seined from and released back into the upper reaches of Lookingglass Creek on 20 July 1999. This group was tagged for comparison to other natural populations in the Grande Ronde River basin PIT-tagged during the summer of 1999 by ODFW. All 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 Lookingglass Creek, as well as PIT-tagged fish from other natural populations in the Grande Ronde River basin from the 1998 cohort (tagged by ODFW in 1999) to describe outmigration timing and determine if a trend in survival was evident over time.

For 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](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 1999) was then used to compare arrival distributions of the groups of small and large fish ($\alpha < 0.05$).

To determine 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. To determine differences in survival between the trap groups from Lookingglass Creek a test of significance for population proportions with large samples (Z test) was used ($\alpha < 0.05$).

Chi-square goodness of fit analysis (Wilkinson 1999) 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 ($\alpha < 0.05$)($\chi^2$=1.31, df=3). 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 hatchery-produced 1998 cohort were 60-69, 70-74, 75-79, and 80-95 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 hatchery-produced 1998 cohort after fish PIT-tagged in the field were released. We expanded PIT tag recaptures and non-PIT-tagged captures at the trap based on the trap efficiency estimates during the period the fish were captured (see **Population Estimates of the Hatchery- and Naturally-produced 1998 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 1999) compared arrival distributions by trapping period for the Field group and the untagged fish ($\alpha < 0.05$).

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

The Field group from the hatchery-produced 1998 cohort was used to determine if size (fork length or weight) or condition factor of PIT-tagged fish detected at Columbia and Snake River dams differed from those that were not detected. 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 compared to the fish that were not detected ($\alpha < 0.05$).

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

Comparisons of arrival timing at and minimum survival rates to Lower Granite Dam were made between the Lookingglass Creek 1998 hatchery-produced cohort Field group and the same cohort from naturally-produced populations of juvenile spring Chinook salmon in the Minam and Lostine rivers and Catherine Creek. 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 (late July). Parr from no other tributaries were PIT-tagged from the 1998 cohort.

Arrival timing at Lower Granite Dam was calculated in the same manner described earlier (see **PIT-tagging of the Hatchery-produced 1998 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 1998 cohort by graphing weekly detections as a percentage of the expanded total number of fish detected.

To determine the minimum survival rates to Lower Granite Dam of juvenile outmigrants for each tributary we used the same methods described earlier (see **PIT-tagging of the Hatchery-produced 1998 Cohort**, *Weekly Arrival Timing and Minimum Survival to Lower Granite Dam*). To determine differences in survival between Lookingglass Creek and other natural populations in the Grande Ronde River basin a test of significance for population proportions with large samples (Z test) was used ($\alpha < 0.05$).

## Results/Discussion

### Stream Flow and Temperature

Increasing flows did not begin in Lookingglass Creek until the week of 11 February in 2000 (Figure 4). Weekly maximum flows ranged from 1-19 $m^3/s$ with one major peak occurring the week of 15 April. After the highest flows the week of 15 April, flow decreased dramatically to a summer low of about 1-2 $m^3/s$ after the week of 24 June and never increasing in the fall. There were higher flows the weeks of 25 March and 15 April than were seen historically from 1964 to 1971. Flows in May and June 2000 were well below the maximum flows seen historically from 1964 to 1971 for the same months.

Water temperature peaked at Site 1 (rm 7.25) during the week of 16 July (13.9°C) and at Site 3 (screw trap livebox) in Lookingglass Creek and Site 4 in the Grande Ronde River during the week of 30 July (18.7 and 30.2°C, respectively) (Figure 4). The peak at Site 4 on the Grande Ronde River was much higher (30.2°C) than the maximum water temperatures observed from 1964 to 1971 or in 2000 at any site. Maximum temperatures for 2000 at Site3 were generally similar to those from 1964 to 1971. Minimum water temperatures for all sites in 2000 were similar, generally falling within the minimums observed from 1964 to 1971.

### Adult Returns to Lookingglass Hatchery

We trapped 52 unmarked adult spring Chinook salmon at LH in 2000: 2 three-year-olds, 44 four-year-olds, 1 five-year-old, and 5 that were not aged (Table 1). We trapped 114 fish that were ad-only: 2 three-year-olds, 108 four-year-olds, 2 five-year-olds, and 2 that were not aged, and 71 fish that were ADRV: 14 three-year-olds, 54 four-year olds, 1 five-year-old, and 2 that were not aged.

Run timing for the three groups were very similar (Figure 5). We trapped 48-56% of the total for each group in the first week of trapping. There were 3 peaks in the number of recaptures at the trap: 17 June, 15 July, and 2 September.

### Spawning Ground Surveys

We conducted spawning ground surveys of Units 3U, 3L, and Unit 2 three times from 12 July-7 September 2000 and Unit 4 only once (Figure 2). There were no redds observed in these units above the weir. We surveyed Unit 1 thirteen times from 22 August-9 September 2000 and observed 86 completed redds. We observed 72 redds from the hatchery picket weir down to rm 1.75 which was 83.7% of the total redds observed. In this section, redds were grouped in areas where there was adequate spawning gravel. This grouping of redds led to overlapping of redds, which may have caused us to miss newer redds. Because of the overlapping, however, the number of redds that actually produced offspring may be closer to the number counted.

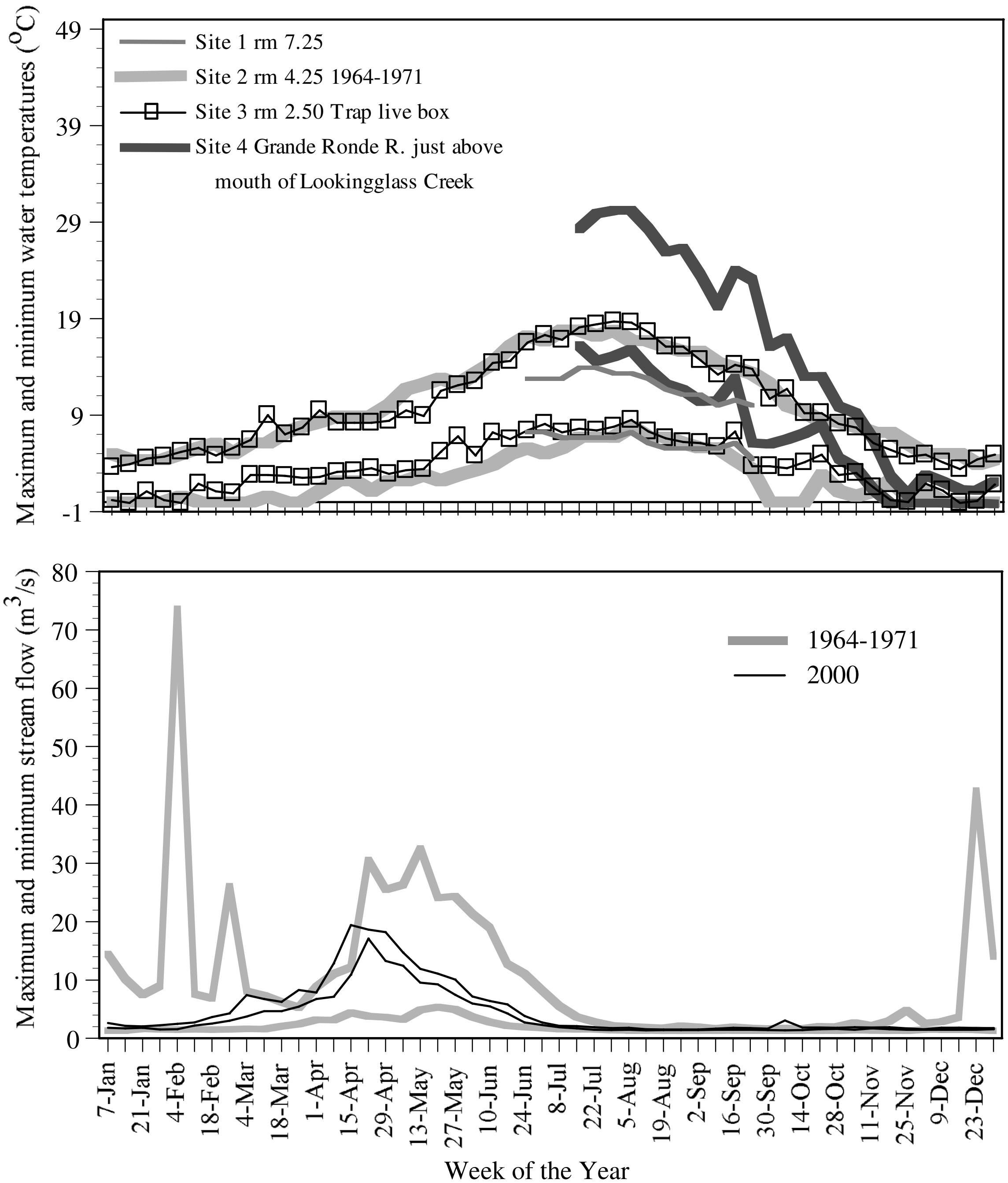


Figure 4. Historical (1964-1971) and 2000 ranges of weekly stream temperature and flow in Lookingglass Creek. Week of the year is represented by the last day of the week. Data for temperatures were provided by the USFS unpublished and Burck 1993. Data for flows were provided by USGS unpublished and Burck (1964-1974).

Table 1. Age, sex, and fork length data from spring Chinook salmon that were trapped at Lookingglass Hatchery and recovered below the hatchery weir in 2000.

| Group, | | Males [a] | | | Females [a] | | |
|---|---|---|---|---|---|---|---|
| | | Fork length (mm) | | | Fork length (mm) | | |
| Disposition [b] | Age [c] | N | Range | Median | N | Range | Median |
| Unmarked, | | | | | | | |
| Trapped | | | | | | | |
| | 3 | 2 | 505-517 | -- | -- | -- | -- |
| | 4 | 17 | 682-784 | 735 | 27 | 650-776 | 728 |
| | 5 | 1 | 870 | -- | -- | -- | -- |
| Does not include 5 fish from this group that were not measured or sexed. | | | | | | | |
| Recovered opercle punched | | | | | | | |
| | 3 | 2 | 535 | -- | -- | -- | -- |
| | 4 | 8 | 710-790 | 748 | 18 | 650-790 | 730 |
| | 5 | 1 | 805 | -- | -- | -- | -- |
| Recovered non-opercle punched | | | | | | | |
| | 3 | 2 | 415-490 | -- | -- | -- | -- |
| | 4 | 4 | 720-790 | 754 | 10 | 700-815 | 775 |
| | 5 | 1 | 860 | -- | -- | -- | -- |
| Adipose-only clipped, | | | | | | | |
| Trapped | | | | | | | |
| | 3 | 2 | 455-555 | -- | -- | -- | -- |
| | 4 | 60 | 634-785 | 726 | 48 | 670-780 | 721 |
| | 5 | 1 | 825 | -- | 1 | 805 | -- |
| Does not include 2 fish from this group that were not measured or sexed. | | | | | | | |
| Recovered opercle punched | | | | | | | |
| | 3 | 1 | 495 | -- | -- | -- | -- |
| | 4 | 27 | 560-800 | 750 | 27 | 700-770 | 730 |
| | 5 | -- | -- | -- | -- | -- | -- |
| Recovered non-opercle punched | | | | | | | |
| | 3 | 1 | 520 | -- | -- | -- | -- |
| | 4 | 5 | 700-760 | 735 | 25 | 690-780 | 730 |
| | 5 | -- | -- | -- | -- | -- | -- |

Table 1 (cont.). Age, sex, and fork length data from spring Chinook salmon that were trapped at Lookingglass Hatchery and recovered below the hatchery weir in 2000.

| Group, | | Males[a] | | | Females[a] | | |
|---|---|---|---|---|---|---|---|
| | | Fork length (mm) | | | Fork length (mm) | | |
| Disposition[b] | Age[c] | N | Range | Median | N | Range | Median |
| Adipose-right-ventral clipped, | | | | | | | |
| Trapped | | | | | | | |
| | 3 | 14 | 480-550 | 499 | -- | -- | -- |
| | 4 | 28 | 691-770 | 726 | 27 | 640-760 | 710 |
| | 5 | -- | -- | -- | 1 | 805 | -- |
| Does not include 2 fish from this group that were not measured or sexed. | | | | | | | |
| Recovered opercle punched | | | | | | | |
| | 3 | 1 | 535 | -- | -- | -- | -- |
| | 4 | 8 | 730-800 | 735 | 6 | 682-760 | 715 |
| | 5 | -- | -- | -- | 1 | 820 | -- |
| Does not include 8 fish from this group that were not measured or sexed. | | | | | | | |
| Recovered non-opercle punched | | | | | | | |
| | 3 | 5 | 480-520 | 597 | -- | -- | -- |
| | 4 | 7 | 735-775 | 756 | 5 | 660-790 | 700 |
| | 5 | -- | -- | -- | 1 | 895 | -- |

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

[b] *Disposition of the fish, Trapped = captured at the hatchery trap, Recovered opercle punched = fish previously trapped that was found during spawning ground surveys, Recovered non-opercle punched = fish not previously trapped that was found during spawning ground surveys.*

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

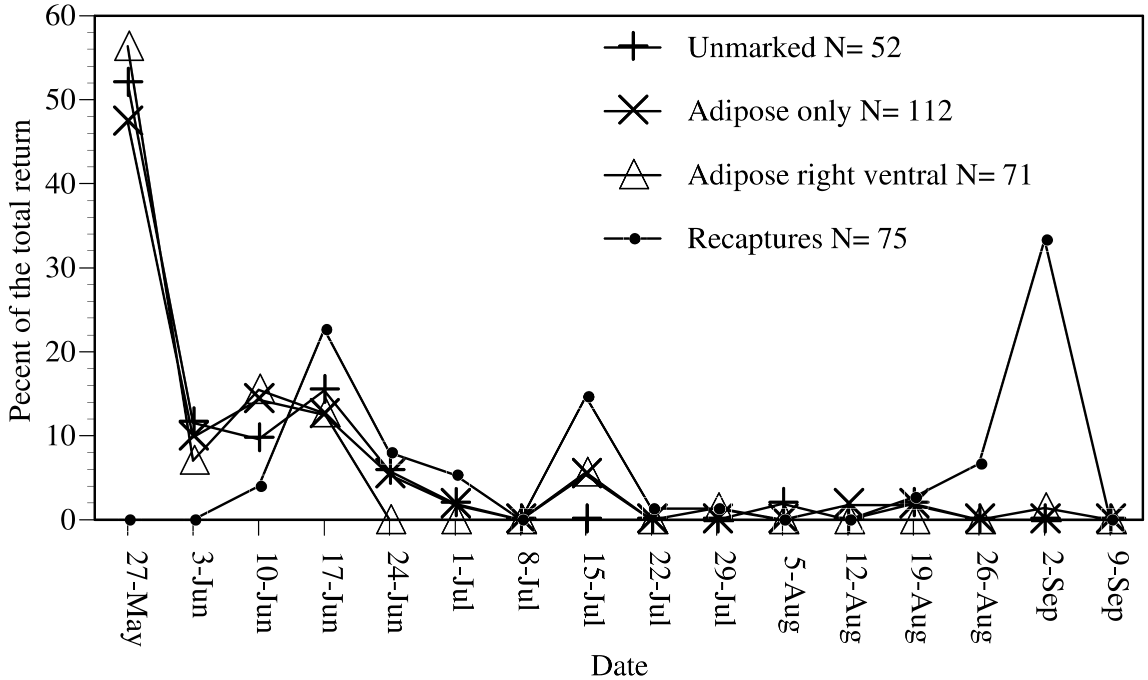


Figure 5. Arrival timing of progeny of marked (ADRV) and unmarked (AD only and no clip) adult spring Chinook salmon at the Lookingglass Hatchery adult trap in 2000. The weir was installed on 11 May 2000, opened on 19 May 2000, and closed on 2 October 2000.

We recovered 174 spring Chinook salmon carcasses during our surveys of Unit 1: 46 unmarked, 86 ad-only, and 42 ADRV, of which 108 had already been trapped at the picket weir (an opercle punch was evident)(Table 1). We recovered 93 female carcasses, all of which, except one, were completely spawned out.

*Coded-Wire-Tag Recovery*

We collected 157 snouts from adult spring Chinook salmon in Lookingglass Creek, 46 from unmarked fish, 80 from Ad-only fish, and 31 from ADRV fish (Table 2). There was no CWT in 82.6% of the snouts collected from unmarked fish, 7.5% of the Ad-only fish, and 25.8% of the ADRV fish. The correct fin-clip group was identified 93.2% of the time for the Ad-only fish and 91.3% of the time for the ADRV fish. Five (10.9%) CWT's from the Ad-only fin-clip group and 3 (6.5%) from the ADRV fin-clip groups were found in fish recovered from the unmarked group. Five (6.8%) CWT's from the ADRV fin-clip group were found in fish recovered from the Ad-only fin-clip group and only 2 (8.7%) CWT's from the Ad-only fin-clip group were found in fish recovered from the ADRV fin-clip group. When recovering snouts on the spawning grounds it is sometimes difficult to correctly identify fin-clips. Fins that are injured can re-grow and often look like a fin-clip. Additionally, after a fish has been dead for a while fins begin to deteriorate and can easily be mistaken for a fin-clip. The small number of snouts (2) collected from the ADRV group that had CWT's that belonged in the Ad-only group may have been misidentified at the time of collection. Another source of mixing of fin-clip groups is at the time of clipping.

Fish that are supposed to receive 2 fin-clips may have been missed or had only 1 fin removed. Pre-release sampling for the 1995-1997 cohorts of ADRV fish showed that 16.3%, 8.3%, and 24.7% were released with only an adipose fin-clip and 0.6%, 0.7%, and 1.2% were released with no clip at all (Table 3). These missed fin-clips probably account for the 3 fish recovered with no clip from the ADRV production. The slightly higher number of Ad-only production without a fin-clip may be the result of poor fin-clipping in which 2.3% were released with no fin-clip (Table 4).

Table 2. Snout and coded-wire-tag information from adult spring Chinook salmon recovered on Lookingglass Creek in 2000 (ODFW coded-wire tag database).

| Fin-clip | Number of snouts | No CWT[a] | Ad-only prod.[b] | ADRV prod.[c] | % correct | % Ad-only | % ADRV |
|---|---|---|---|---|---|---|---|
| Unmarked | 46 | 38 | 5 | 3 | 82.6 | 10.9 | 6.5 |
| Adipose-only | 80 | 6 | 69 | 5 | 93.2 | -- | 6.8 |
| Adipose-right-ventral | 31 | 8 | 2 | 21 | 91.3 | 8.7 | -- |

[a] *No coded-wire-tag was found in the snout.*

[b] *Coded-wire-tag found in snout was from a production group that should have received only an adipose-only fin clip at the hatchery.*

[c] *Coded-wire-tag found in snout was from a production group that should have received an adipose-right-ventral fin clip combination.*

Table 3. Release and fin clip quality data for the ADRV Rapid River stock spring Chinook salmon smolts released at Lookingglass Hatchery from the 1995-1997 cohorts (ODFW Research, La Grande, coded-wire release reports unpublished).

| Cohort | Number released | Pre-release fin clip ADRV (%) | RV (%) | AD (%) | None (%) |
|---|---|---|---|---|---|
| 1995 | 153,478 | 125,845 (82) | 1,773 (1) | 24,941 (16) | 919 (1) |
| 1996 | 233,121 | 208,631 (89) | 3,573 (2) | 19,380 (8) | 1,537 (1) |
| 1997 | 312,143 | 221,672 (71) | 9,552 (3) | 77,122 (25) | 3,797 (1) |

Table 4. Release and fin clip quality data for the AD-only Rapid River stock spring Chinook salmon smolts released at LH from the 1996 cohort (ODFW Research, La Grande, Coded-wire release reports unpublished).

| | Number released | Pre-release fin clip | |
|---|---|---|---|
| Cohort | with a CWT | AD (%) | None (%) |
| 1996 | 57,788 | 56,461 (94) | 1,327 (6) |

*Population Estimation*

Using a marked to unmarked ratio of carcass recoveries, we estimated the unmarked spring Chinook salmon population below the weir on Lookingglass Creek to be 82 (Table 5). We estimated the ad-only group to be 178 and the ADRV group to be 124.

*Progeny-per-Parent Estimation*

The Lookingglass Creek progeny-per-parent ratio for the completed (ages 3-5) 1995 cohort was 0.94 (Table 6). The 1995 cohort in other Grande Ronde River tributaries ranged from 0.12 to 3.59. The high progeny-per-parent ratios seen for the Lostine River (3.59) may be a result of the low parent populations (42). A small increase in returning progeny when the parent population is very low would account for a large increase in the parent-per-progeny ratio.

**Genetic Monitoring**

We collected fin tissue for genetic analysis by NMFS. Tissue samples were collected from 114 ad-only, 66 unmarked, and 21 ADRV spring Chinook salmon at the time of trapping at LH and during spawning ground surveys on Lookingglass Creek. During spawning at Lyon's Ferry Hatchery (Washington) NPT also collected fin tissue from 50 marked (ADRV) adult spring Chinook salmon captured at the LH weir or Lower Granite Dam in 2000. 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.

Table 5. Adult spring Chinook salmon population estimates (M[c]Lean and Lofy 1995) below the Lookingglass Hatchery weir.

| Group<br>Number marked and Released | Total carcass recovery | Total marked carcass recovery | Population estimate | SEM |
|---|---|---|---|---|
| Unmarked | | | | |
| 52 | 46 | 29 | 82 | 6.19 |
| Adipose-clipped only | | | | |
| 114 | 86 | 55 | 178 | 10.38 |
| Adipose-right-ventral clipped | | | | |
| 71 | 42 | 24 | 124 | 13.51 |

Table 6. Progeny-per-parent ratios for the 1995 cohort spring Chinook salmon returning to Lookingglass Creek or other Grande Ronde River tributaries, 1998-2000.

| Cohort Location | Expanded redd count[a] | Parent Population[a] | Returning progeny by age[b] 3 | 4 | 5 | Progeny-per-Parent |
|---|---|---|---|---|---|---|
| 1995 | | | | | | |
| Lookingglass Cr. | 30,880 | 16 | 0 | 13 | 2 | 0.94 |
| Grande Ronde R. | 8 | 26 | 2 | 0 | 2 | 0.12 |
| Catherine Cr. | 45 | 148 | 1 | 101 | 3 | 0.71 |
| Lostine R. | 13 | 42 | 1 | 144 | 5 | 3.59 |
| Minam R. | 43 | 141 | 3 | 166 | 15 | 1.31 |
| Wenaha R. | 26 | 86 | 3 | 64 | 10 | 0.91 |

a *Table is a summary of Appendix Tables A1-A5 (ODFW Research, La Grande, unpublished data) and data from McLean and Lofy (2001). Lookingglass fish were adipose-clipped and were released as presmolts in Lookingglass Creek (30,880).*

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

## Population Estimates of the Hatchery- and Naturally-produced 1998 Cohort Using a Screw Trap

We captured 10,759 hatchery-produced juvenile spring Chinook salmon from the 1998 cohort in the rotary screw trap through May 2000 (Table 7). Although no fish were intentionally passed above the hatchery weir, we captured an estimated 889 naturally-produced juvenile spring Chinook salmon from the 1998 cohort (Table 8). We captured the first naturally-produced fry from the 1998 cohort on 16 April 1999. We released the hatchery-produced 1998 cohort on 24 June 1999, with the first fish captured at the rotary screw trap on 25 June 1999 and the last on 14 August 2000. We captured three hatchery-produced and eight naturally-produced fish in the trap after 19 May 2000 that appeared to be precocial males: these fish were extruding milt and all had a dark coloration.

Of the fish estimated to have passed the trap site, 76.3% of the juveniles from the hatchery-produced 1998 cohort migrated before January 2000 as sub-yearlings (Figure 6). We observed a similar pattern with the naturally-produced 1998 cohort, with 71.5% migrating before January 2000 (Table 8). Peak migration past the trap occurred during the October trapping period for both the hatchery and naturally-produced 1998 cohort.

## Monthly Fork Length Sampling of the Hatchery and Naturally-produced 1998 Cohort

We recorded fork length data from hatchery- and naturally-produced spring Chinook salmon captured at about rm 7.25 from July-June 2000. Median monthly fork lengths of captured hatchery-produced fish ranged from 74 mm in July 1999 to 85 mm in October 1999, while that of the naturally-produced fish ranged from 63-81 mm (Figure 7). Median monthly fork lengths of hatchery-produced fish captured in the trap around the 20th of each month ranged from 73 mm for July 1999 to 113 mm in May of 2000, while that of the naturally-produced fish ranged from 75-113. The median fork lengths of hatchery-produced fish captured in the field were significantly shorter ($P=0.00$) than those of hatchery-produced fish, for months when both were captured (July-October).

## PIT-tagging of the Hatchery-produced 1998 Cohort

We PIT-tagged a total of 520 juveniles from the Fall group, 522 juveniles from the Winter group, and 487 juveniles from the Spring group of hatchery-produced 1998 cohort at the screw trap (Table 9). We PIT-tagged 946 hatchery-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 hatchery-produced 1998 cohort PIT-tagged at the screw trap and in the field first arrived (Fall group) at Lower Granite Dam the week of 15 April 2000, with the last fish (Winter group) arriving the week of 27 May 2000 (Figure 8). Arrival distributions of the fall and Winter groups appeared similar with median dates of arrival being 14 and 16 April 2000, respectively (Table 9). Median arrival of the spring and Field groups appeared similar with median dates of arrival being 26 and 28 April 2000, respectively (Table 9). The later arrival of the Spring group may be due, in part, to the fact that the median date of PIT-tagging for the Spring group was 6 March 2000 and that 17.2% of the fish PIT-tagged from that group were captured at the trap and PIT-tagged during or after the week of first arrival for the Winter group at Lower Granite Dam.

Table 7. Hatchery-produced juvenile spring Chinook salmon from the 1998 cohort captured in a rotary screw trap, releases and recaptures from trap efficiency tests, and the estimated number of migrants from Lookingglass Creek during 1999 and 2000.

| Month | Total trapped | Trap efficiency release | Trap efficiency recapture | % Trap efficiency[a] | Population Estimate | ±95%CI |
|---|---|---|---|---|---|---|
| Jun | 516 | 396 | 97 | 24.49 | 2,107 | 407 |
| Jul | 76 | 75 | 10 | 13.33 | 570 | 453 |
| Aug | 24 | 24 | 4 | 6.90 | 348 | 643 |
| Sep | 34 | 34 | 0 | 6.90 | 493 | 823 |
| Oct | 670 | 344 | 76 | 22.09 | 3,033 | 666 |
| Nov | 68 | 55 | 7 | 12.73 | 534 | 874 |
| Dec | 173 | 162 | 25 | 15.43 | 1,121 | 466 |
| Jan | 100 | 93 | 34 | 36.56 | 274 | 90 |
| Feb | 145 | 147 | 84 | 57.14 | 254 | 46 |
| Mar | 177 | 177 | 22 | 12.43 | 1,424 | 696 |
| Apr | 83 | 79 | 9 | 14.46 | 574 | 448 |
| May | 4 | 4 | 3 | 14.46 | 28 | 38 |
| Totals | 2,070 | 1,590 | 371 | | 10,759 | 966 |

Number of hatchery-produced fish released into Lookingglass Creek: 57,590

[a] *Because the trap efficiency release was less than 25 fish for the months of August 1999 and May 2000, the releases were combined with September(August, September) and April (April, May) to make one trap efficiency estimate that was used for each individual month.*

Table 8. Naturally-produced juvenile spring Chinook salmon from the 1998 cohort captured in a rotary screw trap, releases and recaptures from trap efficiency tests, and the estimated number of migrants from Lookingglass Creek during 1999 and 2000.

| Month | Total trapped | Trap efficiency[a] release | Trap efficiency[a] recapture | % Trap efficiency[b] | Population Estimate | ±95%CI |
|---|---|---|---|---|---|---|
| Apr | 2 | | | 6.90 | 29 | 80 |
| May | 0 | | | 0.00 | 0 | 0 |
| Jun | 0 | 396 | 97 | 24.49 | 0 | 0 |
| Jul | 5 | 75 | 10 | 13.33 | 38 | 46 |
| Aug | 0 | 24 | 4 | 6.90 | 0 | 0 |
| Sep | 5 | 34 | 0 | 6.90 | 73 | 171 |
| Oct | 84 | 344 | 76 | 22.09 | 380 | 109 |
| Nov | 5 | 55 | 7 | 12.73 | 39 | 58 |
| Dec | 12 | 162 | 25 | 15.43 | 78 | 54 |
| Jan | 7 | 93 | 34 | 36.56 | 19 | 13 |
| Feb | 6 | 147 | 84 | 57.14 | 11 | 6 |
| Mar | 20 | 177 | 22 | 12.43 | 161 | 103 |
| Apr | 8 | 79 | 9 | 14.46 | 55 | 53 |
| May | 1 | 4 | 3 | 14.46 | 7 | 15 |
| Totals | 155 | 1,590 | 371 | | 889 | 135 |

Estimated # of redds above the weir in 1998 was: 0 (Private land was not surveyed)
Estimated # of female spring Chinook salmon above the weir in 1997 was: 0
Estimated # of male spring Chinook salmon above the weir in 1997 was: 0

[a] *Because the number of naturally-produced fish captured in the trap most months was less than 25 fish, trap efficiency estimates for hatchery fish (Table 5) were used to estimate the naturally-produced fish trapped each month.*

[b] *Because the trap efficiency release was less than 25 fish for the months of August 1999 and May 2000, the releases were combined with September(August, September) and April (April, May) to make one trap efficiency estimate that was used for each individual month.*

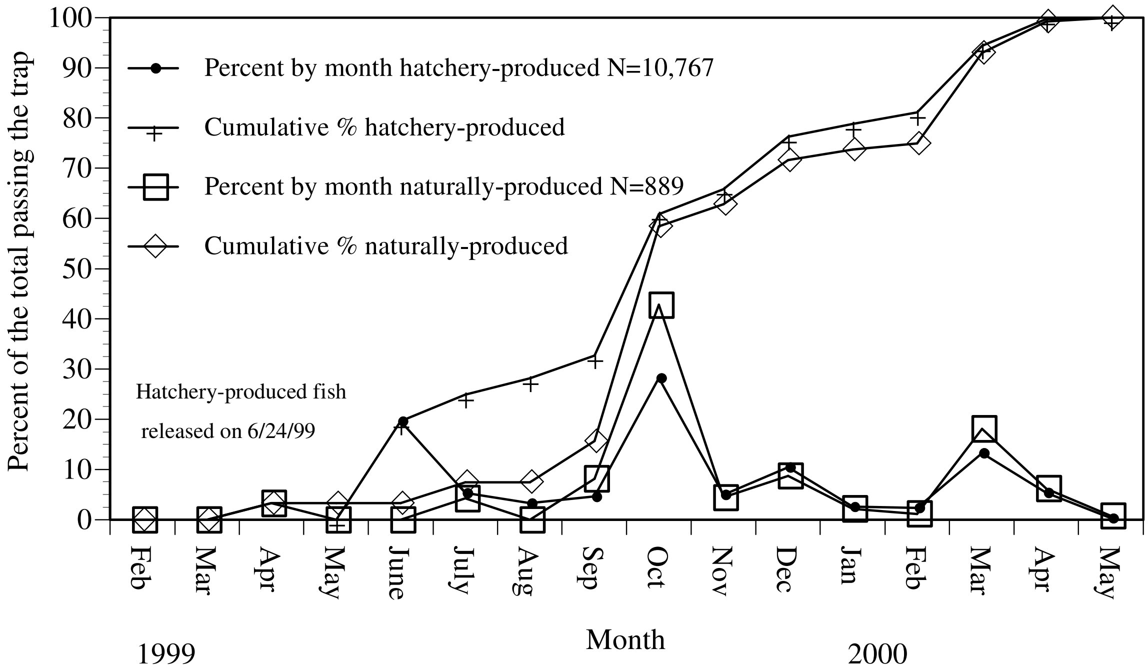


Figure 6. Percent of the total expanded numbers of hatchery- and naturally-produced 1998 cohort juvenile spring Chinook salmon passing the rotary screw trap site on Lookingglass Creek, 1999 and 2000. Total estimated population (N) passing the trap is an expanded number.

The arrival timing at Lower Granite Dam of the "< median" group (< 75mm fork length) was not significantly different than the arrival timing of the "≥ median" group (≥ 75mm fork length) for the 1998 cohort Field group PIT-tagged in Lookingglass Creek (P=0.999) (Figure 9). The median date of arrival for the smaller group was 27 April while that of the larger group was 29 April. The median length at tagging for all fish detected was 75 mm with expanded sample sizes of 21 for the small group and 20 for the large group.

Minimum survival rates of PIT-tagged juvenile spring Chinook salmon from the hatchery-produced 1998 cohort for the fall, winter, spring, and Field groups were 5.2, 23.4, 45.4, and 11.0%, respectively (Table 8). Survival of the Field group was significantly lower than the winter (P=0.000) and spring (P=0.000) groups and significantly higher than the Fall group (P=0.000) (Figure 10). When the trap groups were compared to each other a trend of significantly higher survival was seen (P=0.000). Survival indices of the 1998 cohort captured at the trap and in the field by month for the months in which more than 50 tagged fish were released (June and July 1999 and October 1999 to April 2000), ranged from 5.3 to 57.5%.

Minimum survival rates among 4 different size categories of fish from the hatchery-produced 1998 cohort Field group in Lookingglass Creek were not significantly different (P=0.727) (Figure 11).

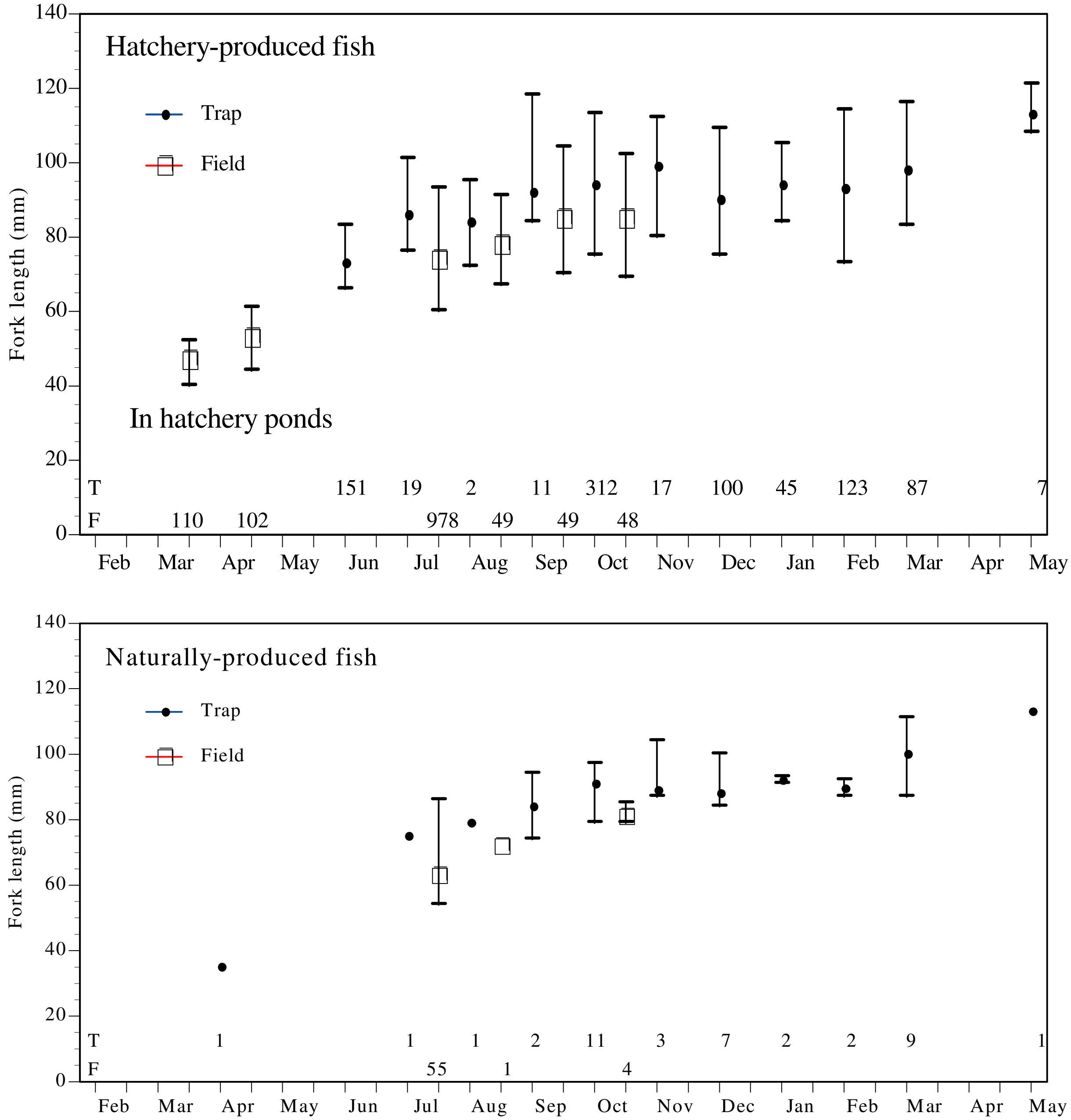


Figure 7. Monthly median and range of fork lengths from hatchery- and naturally-produced 1998 cohort juvenile spring Chinook salmon captured in the rotary screw trap (T) and in upper Lookingglass Creek (F), 1999 and 2000. Length information from fish trapped and captured with a seine around the 20$^{th}$ of each month (±5 days) was used. Sample size for each group is shown above the month.

Table 9. PIT tag information for hatchery-produced juvenile spring Chinook salmon from the 1998 cohort captured at the rotary screw trap and in the field from Lookingglass Creek, 1999 and 2000.

| Group | Lookingglass Cr. Number PIT-tagged | Lookingglass Cr. Tagging median date | Lower Granite Dam Median arrival | Lower Granite Dam Actual | Lower Granite Dam Expanded[a] | Mainstem dams total |
|---|---|---|---|---|---|---|
| Fall (trap) | 520 | 27 June 1999 | 14 April 2000 | 7 | 7 | 27 |
| Winter (trap) | 522 | 21 October 1999 | 16 April 2000 | 48 | 55 | 122 |
| Spring (trap) | 487 | 6 March 2000 | 26 April 2000 | 188 | 201 | 221 |
| Field | 946 | 22 July 1999 | 28 April 2000 | 40 | 45 | 104 |

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

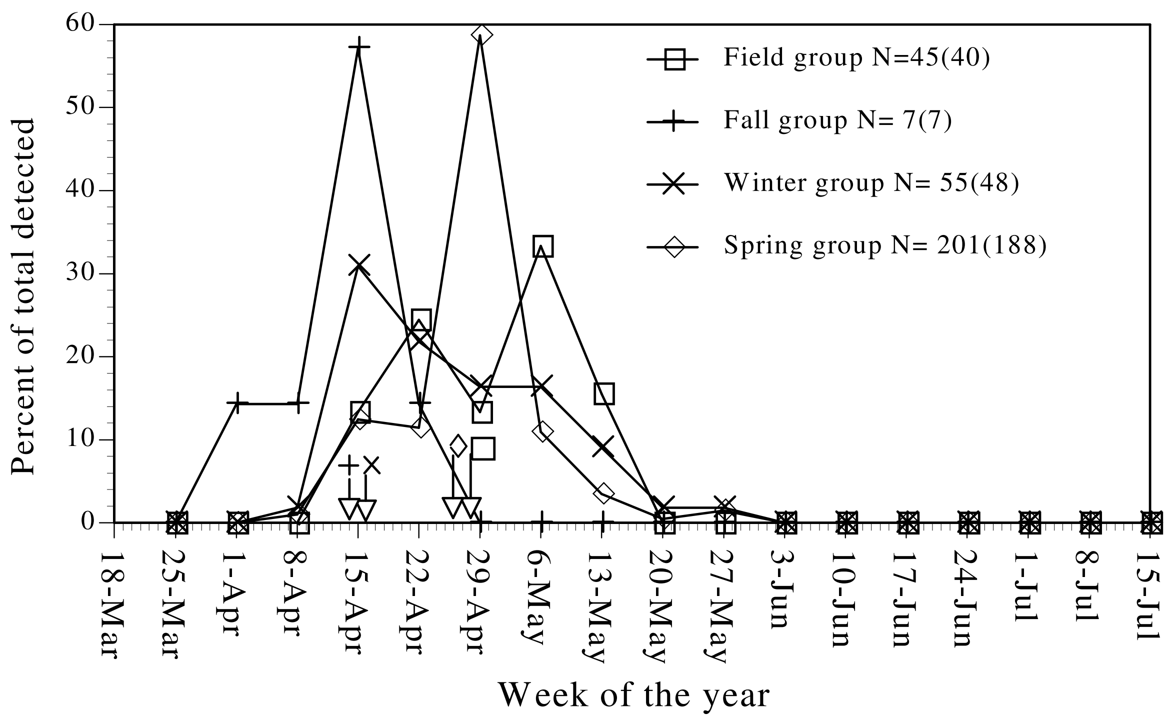


Figure 8. Arrival timing, by week, at Lower Granite Dam in 2000 of four groups of hatchery-produced 1998 cohort juvenile spring Chinook salmon PIT-tagged at the rotary screw trap and in the upper reaches of Lookingglass Creek. Arrows indicate median arrival date of each group. Expanded detections (N) are graphed. Actual detections are in parentheses. Week of the year is represented by the last date in the week.

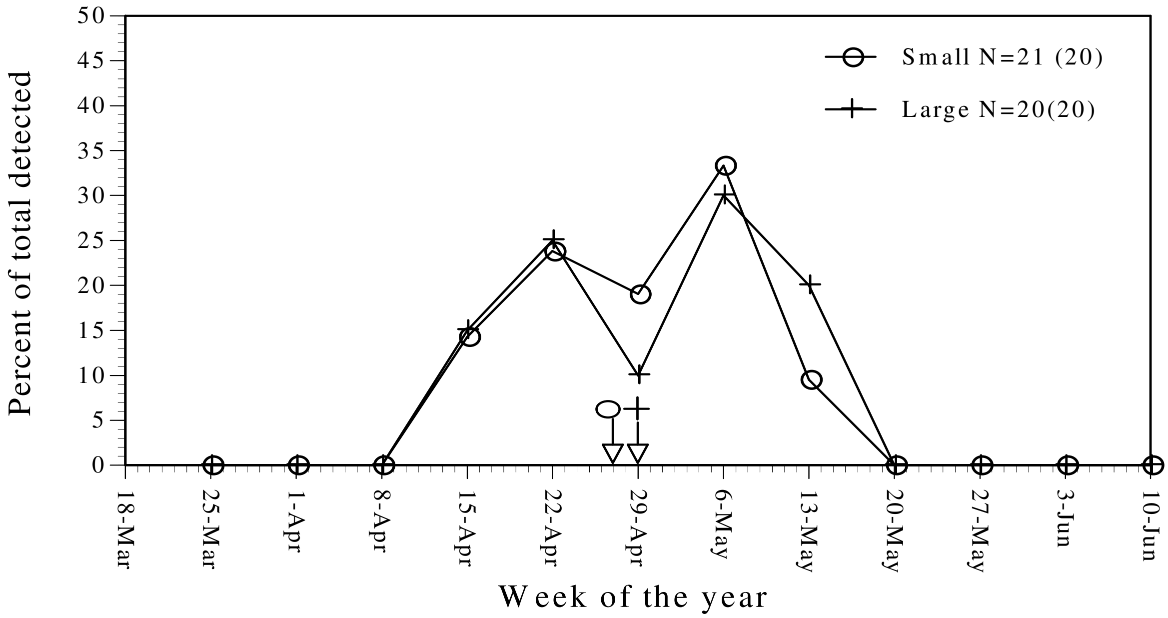


Figure 9. Arrival timing, by week, at Lower Granite Dam in 2000 for groups of smaller (fork length < 75 mm) and larger (fork length ≥ 75 mm) fish from the Field group of hatchery-produced 1998 cohort juvenile spring Chinook salmon in Lookingglass Creek. Arrows indicate the median arrival date. Expanded detections (N) are graphed. Actual detections are in parentheses. Week of the year is represented by the last date in the week.

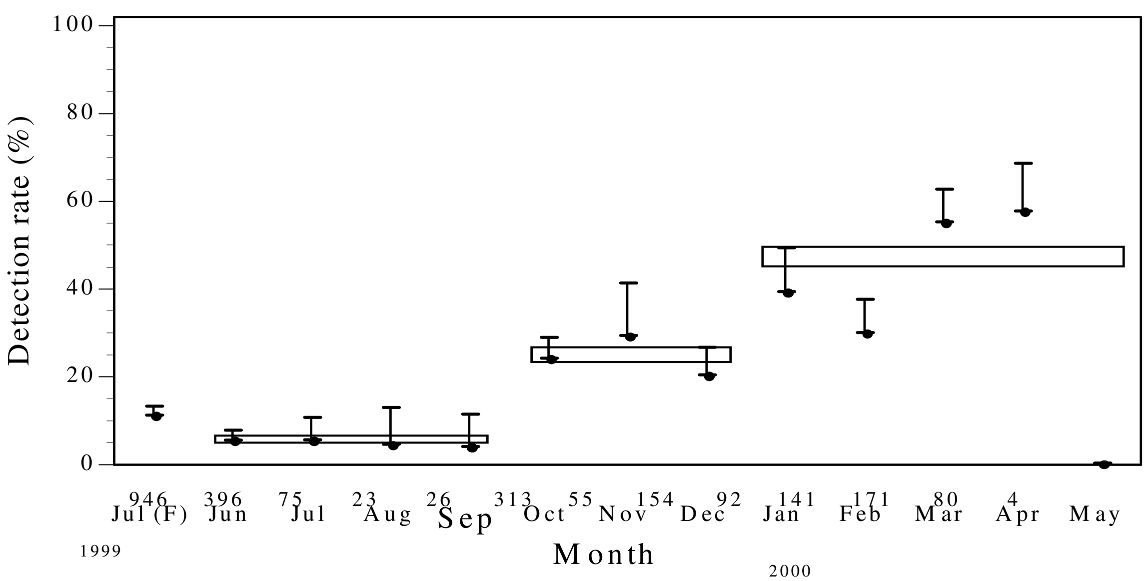


Figure 10. Total unique detection rates with upper 95% confidence intervals (bars) for hatchery-produced 1998 cohort juvenile spring Chinook salmon tagged at the rotary screw trap or in the field (~rm 7.75 to rm 6.25) in Lookingglass Creek and detected at Snake or Columbia river dams. The rectangles represent detection rates and upper 95% confidence intervals for fish from Fall (Jun-Sep), Winter (Oct-Dec), and Spring (Jan-Apr) groups. Number tagged is above each month.

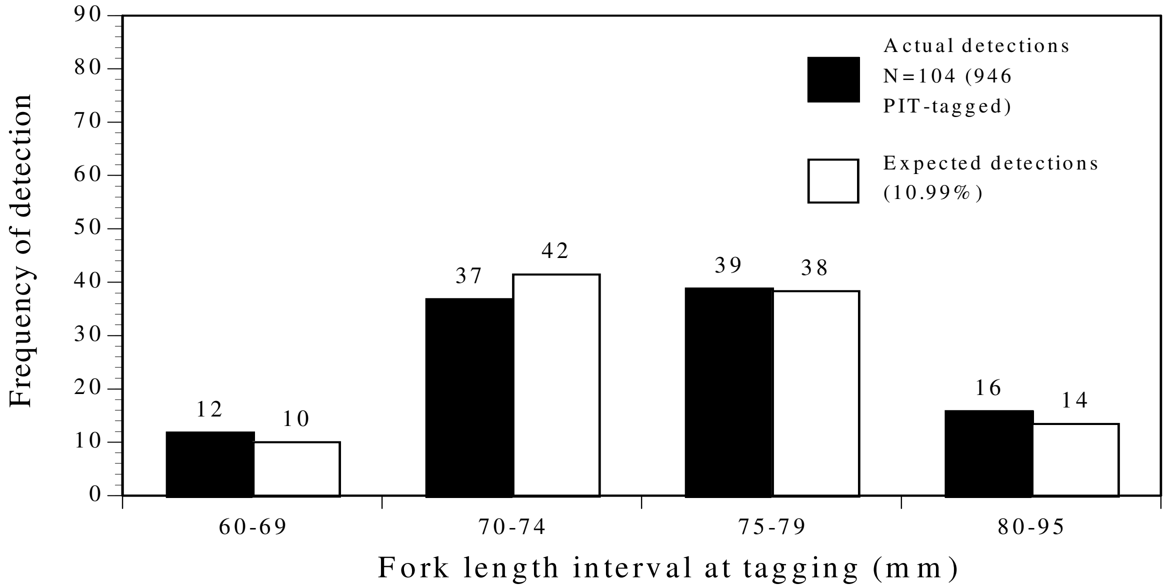


Figure 11. Comparison of actual and expected (overall survival of Field group) unique PIT tag detections at Snake or Columbia river dams, by fork length interval, of hatchery-produced 1998 cohort juvenile spring Chinook salmon seined from Lookingglass Creek (PIT-tagged in 1999). N values are shown above the bars.

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

There was little difference in arrival timing at the screw trap between the Field group of PIT-tagged fish and the non-PIT-tagged fish from the 1998 cohort until October 1999 when cumulative arrival percentage for the PIT-tagged fish (56.9%) surpassed that of the non-PIT-tagged fish (48.3%) (Figure 12). By December 1999 79.3% of the PIT-tagged fish and 68.5% of the non-PIT-tagged had passed the trap. After the first date of PIT-tagging of the Field group, the non-PIT-tagged and PIT-tagged fish had similar movement past the screw trap (P= 0.056).

This movement pattern for PIT-tagged and non-PIT-tagged groups past the screw trap for the 1998 cohort was similar to what was seen for both the 1996 and 1997 cohorts (M^c^Lean and Lofy 2000a; 2001) but different from the 1993 and 1994 cohorts, in which the PIT-tagged group peak movement was in September while the non-PIT-tagged group peaked in October (M^c^Lean and Lofy 1999). Dates of PIT-tagging for the 1998 cohort was similar to that of the 1997 cohort and about 2 months earlier that that of the 1996 cohort (M^c^Lean and Lofy 2000; 2000a; 2001).

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

There were no significant differences in fork length (P=0.637), weight (P=0.453), or condition factor (P=0.261) between detected and non-detected juvenile spring Chinook salmon from Lookingglass Creek that were PIT-tagged in the field for the hatchery-produced 1998 cohort (Table 10).

*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 the Grande Ronde River tributaries did not appear similar to that of Lookingglass Creek (Figure 13). Minam River and Lookingglass Creek were most similar with median arrival dates of 3 May and 28 April 2000, respectively. Median arrival dates of fish from Lostine River and Catherine Creek were both 7 May 2000.

Survival of the Field group from Lookingglass Creek (11.0%) was significantly less than that of fish from the Minam (17.5%)(P=0.000) and Lostine rivers (14.9%)(P=0.015) (Figure 14). Survival of fish from Lookingglass Creek was not different from fish from Catherine Creek (10.8%)(P=0.460).

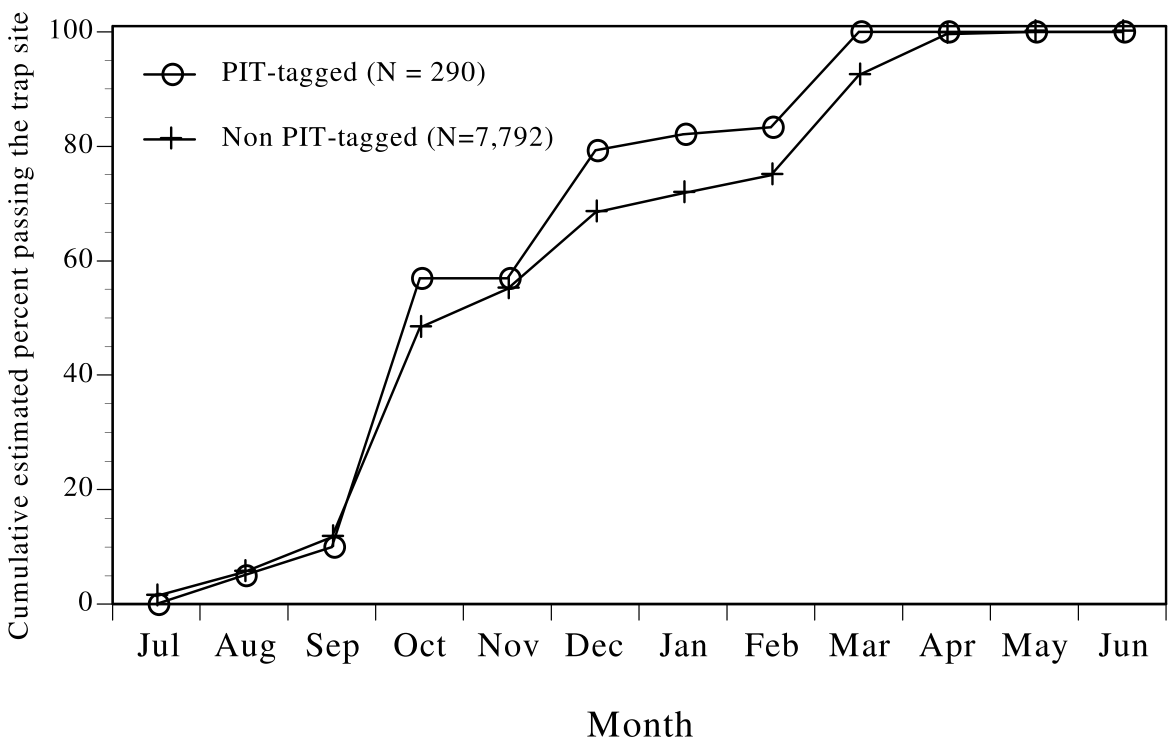


Figure 12. Arrival timing after 21 July 1999 at the rotary screw trap in Lookingglass Creek of PIT-tagged and non-PIT-tagged juvenile spring Chinook salmon after commencing PIT-tagging (22 July 1999) of the hatchery-produced 1998 cohort Field group. N represents the total numbers of fish trapped (expanded for trap efficiency).

Table 10. Minimum, Maximum, and median weight, fork length, and condition factor at PIT-tagging of juvenile spring Chinook salmon from the hatchery-produced 1998 cohort Lookingglass Creek Field group that were detected at Snake or Columbia river dams versus those that were not detected.

| | | Detected N=104 | | Not Detected N= 842 |
|---|---|---|---|---|
| Fork length (mm) | | | | |
| | Min | 62 | | 60 |
| | Max | 88 | | 93 |
| | Median | 75 | | 74 |
| | P | | 0.647 | |
| Weight (g) | | | | |
| | Min | 2.4 | | 2.2 |
| | Max | 7.7 | | 8.8 |
| | Median | 4.2 | | 4.2 |
| | P | | 0.453 | |
| Condition Factor | | | | |
| | Min | 0.8 | | 0.7 |
| | Max | 1.3 | | 1.9 |
| | Median | 1.0 | | 1.0 |
| | P | | 0.261 | |

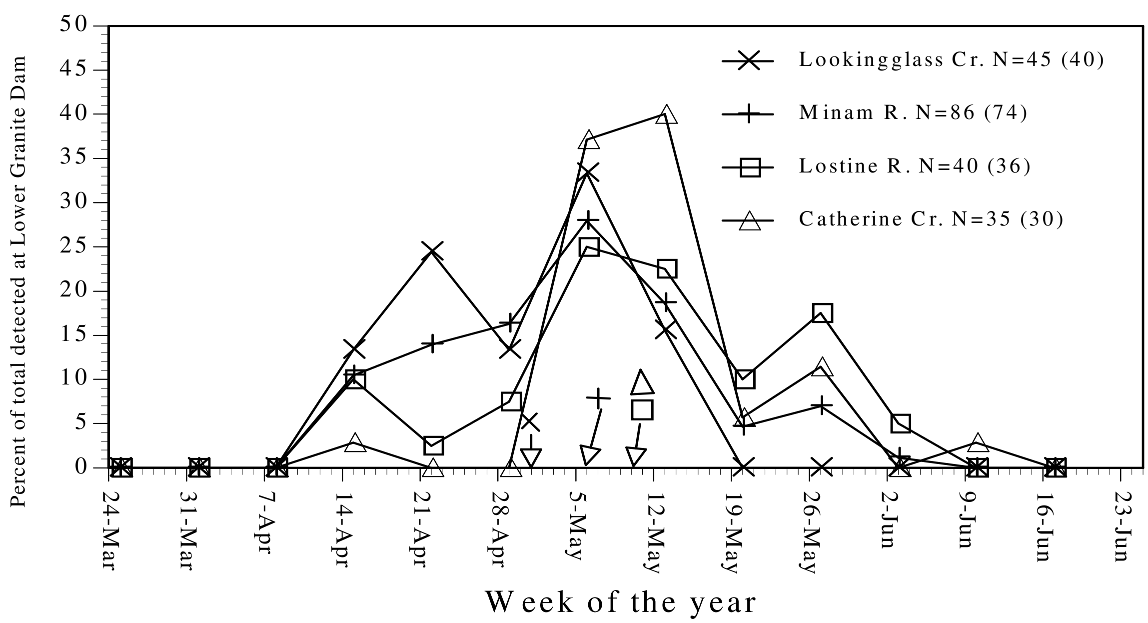


Figure 13. Arrival timing, by week, at Lower Granite Dam in 2000 of PIT-tagged fish from Lookingglass Creek, Minam and Lostine rivers, and Catherine Creek from the 1998 cohort. Expanded detections are graphed. Actual detections are in parentheses. Arrows indicate the median date of arrival for each group. Week of the year is represented by the last date in the week.

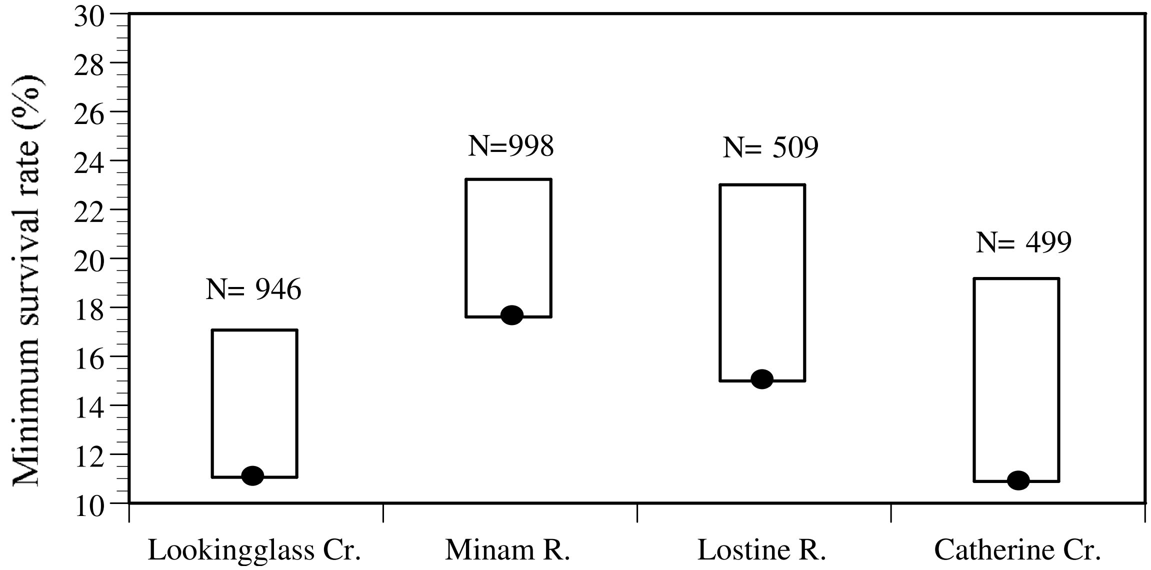


Figure 14. Total unique detection rates and upper 95% confidence intervals of 1998 cohort PIT-tagged fish from Lookingglass Creek, Minam and Lostine rivers, and Catherine Creek that were detected at Snake or Columbia river dams in 2000. N= number of fish PIT-tagged from tributary.

## SECTION 2

## Oncorhynchus mykiss Investigations in Lookingglass Creek and Other Grande Ronde River Tributaries

### Abstract

We trapped 11 adult summer steelhead at the LH trap between 19 May and 2 October 2000. All of these fish were released above the weir to spawn naturally. From 1997 to 1999 we captured 10, 14, and 40 adult summer steelhead at the LH trap. From 1965 to 1974 trap captures at the current weir site ranged from 17 fish in 1966 to 120 fish in 1971.

We began collecting tissue samples from juvenile *O. mykiss* for genetics monitoring in 1999. Co-managers sampled between 55 and 116 juvenile *O. mykiss* from the sample stream in each unit of the Grande Ronde and Imnaha River basins used to index the genetic makeup of *O. mykiss* within each unit. The size range of the fish collected was from 25 to 85 mm fork length. In 2000 co-managers sampled between 73 and 111 juvenile *O. mykiss* from the sample stream in each unit with the size of the fish collected ranging from 24 to 85 mm fork length.

Since 1993, we have operated a rotary screw trap on Lookingglass Creek which has captured juvenile *O. mykiss*. During this period the annual numbers of *O. mykiss* trapped has ranged from 485 to 2,620 fish. There are two main peaks of movement past the trap, most migrate during the spring while a secondary peak occurs in the fall. The spring and fall movement of the smaller fish (<30-109mm) generally peaked 1 to 2 months later than the spring and fall movement of the larger fish (110-189mm, and 190- >249mm). Most (49.0%) of the fish captured in the trap were from the medium size group (110-189mm), while only 44.2% and 6.8% were from the small (<30-109mm) and large groups (190- >249mm) respectively.

We PIT-tagged 183 juvenile *O. mykiss* at the rotary screw trap in April 1999. These PIT-tagged fish ranged in size from 141 to 233 mm FL. PIT-tagged fish were first detected at Lower Granite Dam the week of 22 April 1999 with a median date of arrival on 29 April 1999. The minimum survival rate to Lower Granite Dam for these fish was 70% with no difference in survival among fish of 7 different fork length intervals. A similar (length and time of tagging) group of juvenile *O. mykiss* PIT-tagged about 85 miles downstream near the mouth of the Grande Ronde River had similar arrival timing with a median date of arrival 4 days earlier than the group from Lookingglass Creek. The lower river group also had a higher minimum survival rate to Lower Granite Dam of 88%.

## 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 decline 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 summer steelhead due to the construction and operation of the lowest four Snake River dams. Despite these harvest-driven hatchery programs, natural summer steelhead populations continued to decline as evidenced by declining counts at Lower Granite Dam since 1995 (Columbia River Data Access in Real Time, DART) and low steelhead redd counts on index streams in the Grande Ronde Basin (Oregon Department of Fish and Wildlife, District Annual Reports 1949-1998). There has also been a high hatchery-to-natural ratio in the creel surveys since 1991 (Flesher et. al. 1991 and Flesher et. al. 1992-1999) and of fish trapped in Grande Ronde River tributaries, Five Point Creek (personal communication Paul Sankovich, ODFW Research) in 1998 and Lookingglass creek in 1997. Because of low escapement the Snake River summer steelhead were listed as threatened under the Endangered Species Act of 1973 by the National Marine Fisheries Service (NMFS) on 18 August, 1997. Co-managers have also discontinued off-station releases of juvenile Wallowa stock (non-endemic) hatchery summer steelhead into Catherine Creek in 1998 and the upper Grande Ronde River in 1999.

Data are lacking on adult return numbers and the genetic make-up of populations that return to tributaries of the Grande Ronde River basin. Attempts at maintaining weirs in streams to capture adult steelhead in the Grande Ronde River basin have met with limited success due to high spring flows. Adult summer steelhead return to Lookingglass Creek as evidenced by the weir counts at LH from 1997-2000 which are summarized in this report. Data were also collected on summer steelhead adults returning to Lookingglass Creek during a study of spring Chinook salmon from 1964 to 1974 (Burck 1964-1974). These data are also summarized in this report. We believe Lookingglass Creek data are important because they describe a population that may not have been affected by summer steelhead hatchery programs in the Grande Ronde River basin.

Data are also lacking on juvenile *O. mykiss* migration characteristics and the proportions of resident and anadromous forms found in tributaries. We have captured juvenile *O. mykiss* in our screw trap since 1992 and the data collected are summarized in this report. At present we are unable to differentiate between the resident and anadromous forms of juvenile *O. mykiss* found in tributaries. The use of PIT tags may help in determining which of the juveniles captured at the screw trap result from the anadromous form. Since the spring of 1999 we began PIT-tagging juvenile *O. mykiss* captured in our screw trap to investigate their arrival timing and survival to Snake and Columbia River dams.

## Methods

### Adult Summer Steelhead Returns Trapped in Lookingglass Creek

Adult summer steelhead returning to Lookingglass Creek that were captured in the hatchery trap were enumerated by CTUIR and ODFW beginning in 1997. The trap at LH is usually installed to capture adult spring Chinook salmon. Since 1997, the trap and weir has been installed earlier than normal in an attempt to sample and enumerate adult summer steelhead passing the weir site. Returning fish were diverted by a picket weir into the upper trap near the hatchery intake (Figure 3). We attempted to install this trap in mid-March of each year to catch adult summer steelhead.

From 1965 to 1974 a similar trap in the same area was installed typically around mid-March to mid-April (Burck 1964-1974). The traps from both time periods were checked up to three times a week into September during most years. This collection period is thought to encompass the migration period of adult spring Chinook salmon and adult summer steelhead.

From 1997 to 2000 all adult summer steelhead captured were checked for fin clips, measured and opercle punched for identification. The fish were then placed immediately above the weir. From 1965 to 1974 the only data available were counts of captured fish (Burck 1964-1974). No measurements or genetic samples were taken from the captured fish.

### Genetic Monitoring

*Adult Summer Steelhead*

Beginning in 1999 we used a paper hole punch to remove a small amount of tissue from the operculum of adult summer steelhead passing the Lookingglass Creek weir site. This tissue will be used for population genetics analysis. Individual tissue samples were immediately placed in vials and fixed with 70% ethanol. These tissue samples are being retained at our research office in La Grande, Oregon until funding can be acquired to analyze the samples.

*Juvenile Oncorhynchus mykiss*

Foreseeing the need for genetics data to manage the ESA listing of the summer steelhead, co-managers decided to collect tissue samples from Grande Ronde and Imnaha River basin juvenile *O. mykiss* populations beginning in 1999. These two basins were divided into 17 different units with one major tributary in each unit selected for sample collection (Figures 15 and 16). The NPT collected all of the samples from the Imnaha River basin. ODFW and CTUIR cooperatively sampled the Grande Ronde River basin. Up to 100 samples were collected from each tributary during mid-July. We directed our sampling towards smaller fish, < 100 mm (age 0+), to ensure that most of the juveniles were progeny of adult *O. mykiss* spawning the previous spring. To collect these juvenile fish, we used a Smith-Root electro-fisher (smooth or continuous DC, 400-600 volts). Fish were anaesthetized with 40-60 mg/l dose of MS-222 (tricaine methanesulfonate). A 1-2 mm diameter piece of caudal or anal fin was removed using scissors and immediately placed in a vial of ethanol for storage. The fish was then measured (FL) and placed in fresh water until it was fully recovered, then released near the area of capture. We attempted to sample a large portion of the rearing habitat available to the juvenile *O. mykiss* within each tributary. Some areas could not be sampled because some tributaries were dewatered, were located on private land, or were in deep canyons without easy access. Our criteria for the selection of sampling areas were to use areas of the stream that were currently easily accessible and would remain accessible in the future (e.g. road crossings on federal land). Depending on the length of the stream that was accessible, we also tried to distribute the sample sites evenly along the stream (every 1.0 or 0.5 miles).

### Juvenile Migrant Trapping Using a Rotary Screw Trap

We have operated a screw trap in Lookingglass Creek since November 1993 to evaluate the spring Chinook salmon reintroduction program. During this time we have also captured juvenile *O. mykiss*. Because *O. mykiss* were not our target species we did not conduct trap efficiency tests for these fish. Trap operating procedures are reported in M$^{c}$Lean and Lofy (1998). Juvenile *O. mykiss* were removed from the trap, counted, and subsampled for lengths (first 40 fish netted from the sample bucket, target of about 40 per week) from November 1993 to March 1999. Occasionally, we only enumerated fish because they appeared injured or there were more fish in the trap than was necessary for the weekly sub-sample. Beginning April 1999 to present, we measured and weighed all *O. mykiss* captured in the trap. Juvenile *O. mykiss* captured in our rotary screw trap were measured (fork length, mm), weighed (g) and enumerated (M$^{c}$Lean and Lofy 1998). To graphically illustrate the distribution of sizes of fish captured at the screw trap over time, we divided fish into fork length intervals: small fish: <30-49, 50-69, 70-89, and 90-109 mm; medium fish: 110-129, 130-149, 150-169, and 170-189 mm; large fish: 190-209, 210-229, 230-249, and >249 mm.

### PIT-tagging of Juvenile *O. mykiss* at the Rotary Screw Trap

We PIT-tagged juvenile *O. mykiss* at our rotary screw trap to determine arrival timing at Lower Granite Dam. We also used these PIT-tagged fish to determine if there was a relationship between detection rate and timing and size of the fish at arrival at our screw trap. All healthy *O. mykiss* captured between 16 and 24 April 1999 (Group 1) that were between 139 mm and 240 mm fork length were PIT-tagged with 400 kHz tags. We tagged fish only in this size and date range because the 400 kHz tags were being replaced with the 134.2 kHz tags beginning with the 2000 migration year. We used this group to generally describe arrival timing and survival to Lower Granite Dam. Beginning June 1999, we PIT-tagged all *O. mykiss* captured (> 50 mm fork length) with 134.2 KHz PIT tags (Group 2) (new standard for the Columbia Basin data collection in fisheries). We will report the results of this tagging when detection data is complete in 2002.

*Weekly Arrival Timing and Minimum Survival to Lower Granite Dam*

To determine arrival timing of PIT-tagged *O. mykiss* from Group 1 (400 kHz tags) at Lower Granite Dam, 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 (www.cbr.washington.edu/dart/river_det). Arrival timing at Lower Granite Dam was graphed using the expanded weekly detections as a percentage of the total expanded number of fish detected from Group 1.

To determine the minimum survival rate of the PIT-tagged *O. mykiss* 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.

Chi-square goodness of fit analysis was used with Group 1 to determine if minimum survival rates to Lower Granite Dam differed among fish of different fork lengths at tagging ($\alpha \leq 0.05$) ($\chi^2$=1.14, df=6). Fish from Group 1 were categorized into 10-mm intervals except at the extremes of the fork length distribution, where intervals were combined to increase the expected detections to a minimum of 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 Group 1 were 140-149, 150-159, 160-169, 170-179, 180-189, 190-199, and 200-239 mm.

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

Comparisons of arrival timing at and minimum survival rates to Lower Granite Dam were made between Group 1 from Lookingglass Creek and *O. mykiss* PIT-tagged during the same time period and from the same length range at a screw trap operated by ODFW near the mouth of the Grande Ronde River. The arrival timing at Lower Granite Dam was calculated in the same manner described earlier (see **PIT-tagging of Juvenile *O. mykiss* at the Rotary Screw Trap**, *Weekly Arrival Timing and Minimum Survival to Lower Granite Dam*). We illustrated arrival timing by week at Lower Granite Dam by graphing weekly detections as a percentage of the expanded total number of fish detected. To determine the minimum survival rates of juvenile outmigrants we used the same methods described earlier (see **PIT-tagging of Juvenile *O. mykiss* at the Rotary Screw Trap**, *Weekly Arrival Timing and Minimum Survival to Lower Granite Dam*). To determine differences in survival between Lookingglass Creek and other natural populations in the Grande Ronde River basin a test of significance for population proportions with large samples (Z test) was used ($\alpha < 0.05$).

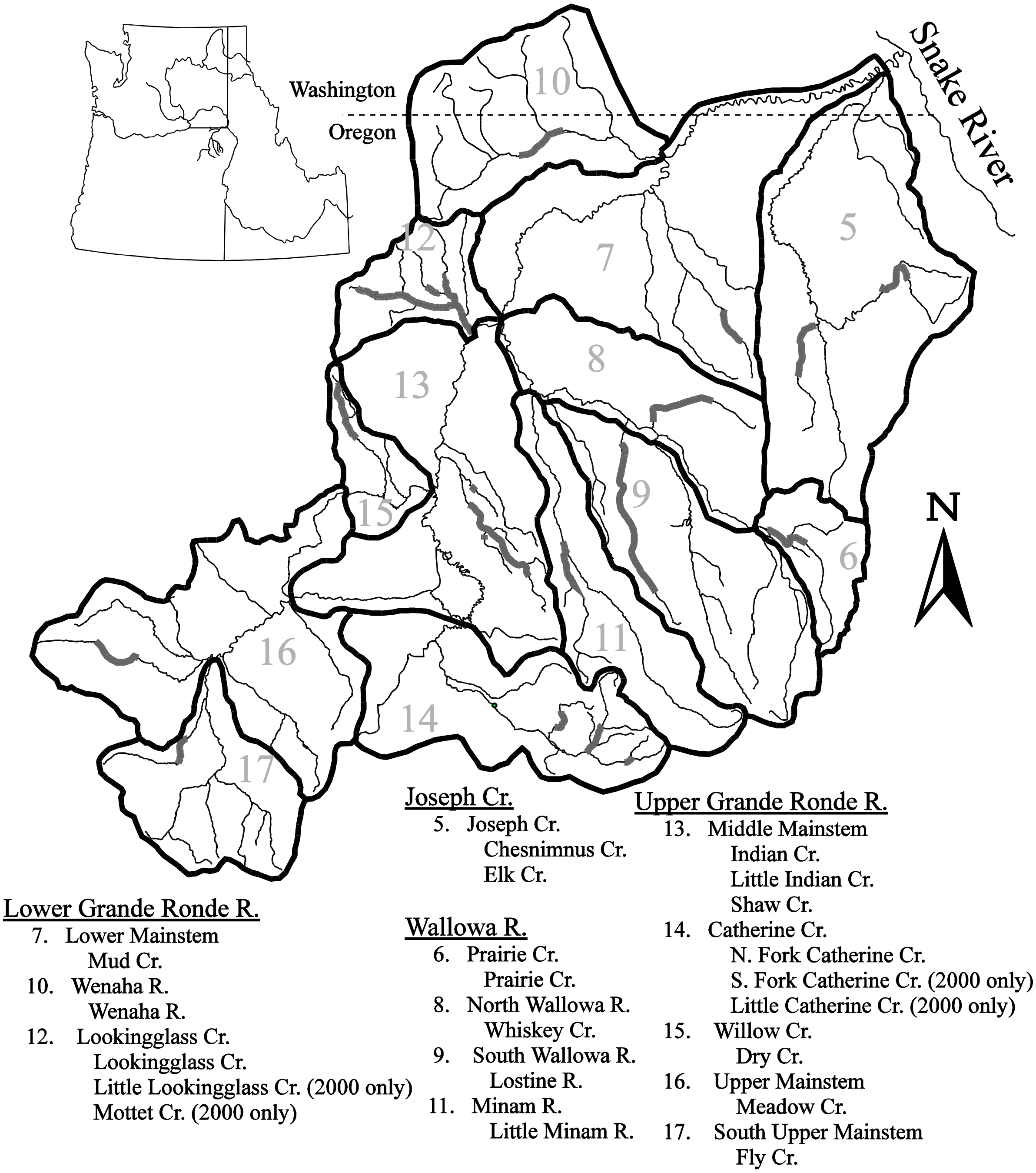


Figure 15. Map of the Grande Ronde River basin showing the 13 management units. Shaded areas on tributaries within each management unit indicate the juvenile *O. mykiss* sample area range.

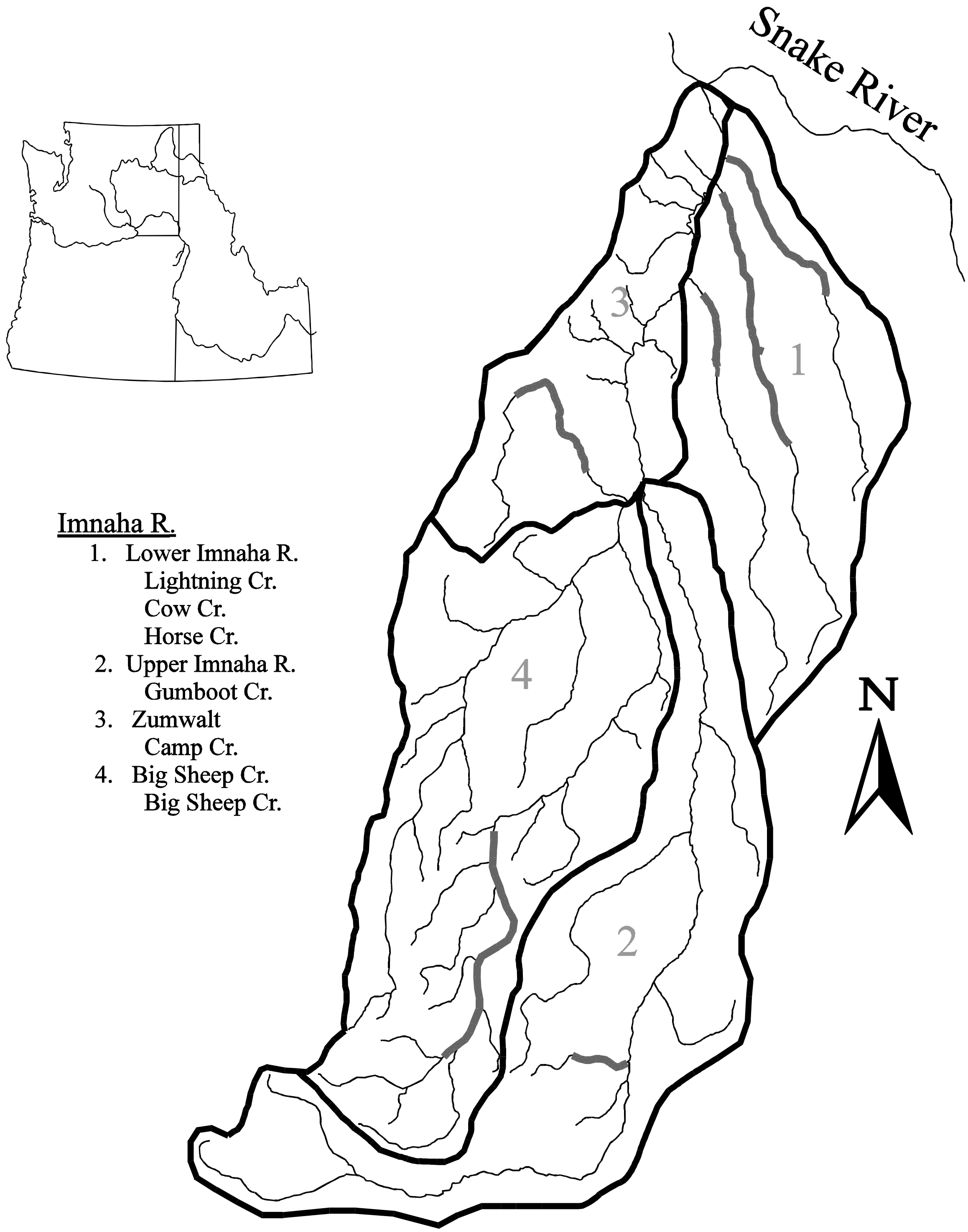


Figure 16. Map of the Imnaha River basin the 4 management units. Shaded areas on tributaries within each management unit indicate the juvenile *O. mykiss* sample area range.

## Results/Discussion

### Adult Summer Steelhead Returns Trapped in Lookingglass Creek

From 1965 to 1974 the earliest adult summer steelhead arrived at the trap was the week of 11 March 1970 (Figures 17 and 18). The week of median arrival at the trap ranged from 6 May 1968-3 June 1967 and 1974. Trap captures from 1965-1974 ranged from 17 fish in 1966 to 120 fish in 1971.

In 1997, the first adult summer steelhead captured at the Lookingglass Creek trap was the week of 11 March (Figure 19), however, the date of weir and trap installation was not recorded. One of the 10 fish captured in 1997 was a hatchery summer steelhead and it was released above the weir. In 1998, the date of weir and trap installation was again not recorded with the first adult summer steelhead captured the week of 25 March. In 1998, 4 of the 14 fish captured were of hatchery origin and all were released above the weir. In 1999, the weir and trap were installed on 19 February and the first fish was captured the week of 25 March. We captured a total of 40 adult summer steelhead in 1999 and none of the fish were fin-clipped. In 2000, the weir and trap were installed 11 and 19 May respectively, which was later than in previous years. We trapped 11 fish, all of which were not fin-clipped.

### Genetic Monitoring

*Adult Summer Steelhead*

In 1999, we collected tissue samples from 40 unmarked adult summer steelhead trapped at the upper hatchery weir on Lookingglass Creek. In 2000, we collected tissue samples from 11 unmarked adult summer steelhead trapped at the upper hatchery weir.

*Juvenile Oncorhynchus mykiss*

In 1999, co-managers sampled 55-116 juvenile *O. mykiss* from the sample stream in each unit of the Grande Ronde and Imnaha River basins used to index the genetic makeup of *O. mykiss* within each unit (Table 11, Figures 15 and 16). Samples were collected from 26 July-4 November 1999 with most collected near the end of July. Size range of the fish collected was 25-85 mm fork length with the median length ranging from 31.0-71.0 mm.

In 2000, co-managers sampled 73-111 juvenile *O. mykiss* from the sample stream in each unit of the Grande Ronde and Imnaha River basins (Table 12). Samples were collected from 20 July-26 September 2000 with most collected near the end of July. Size range of the fish collected was 24-85 mm fork length with the median length ranging from 36.5-60.5 mm.

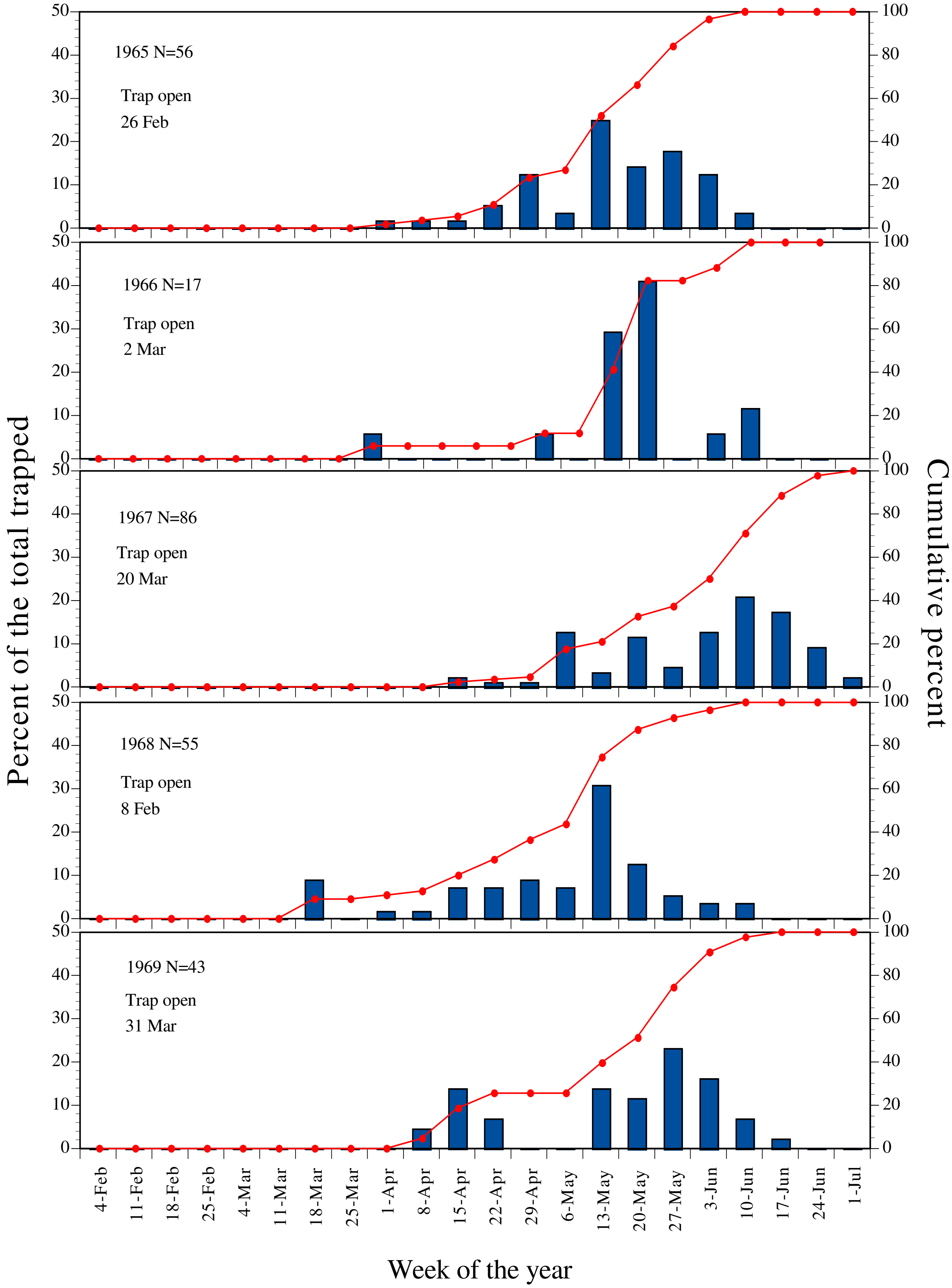


Figure 17. Arrival timing of adult summer steelhead at a trap on Lookingglass Falls from 1965 to 1969 (Burck 1964-1974).

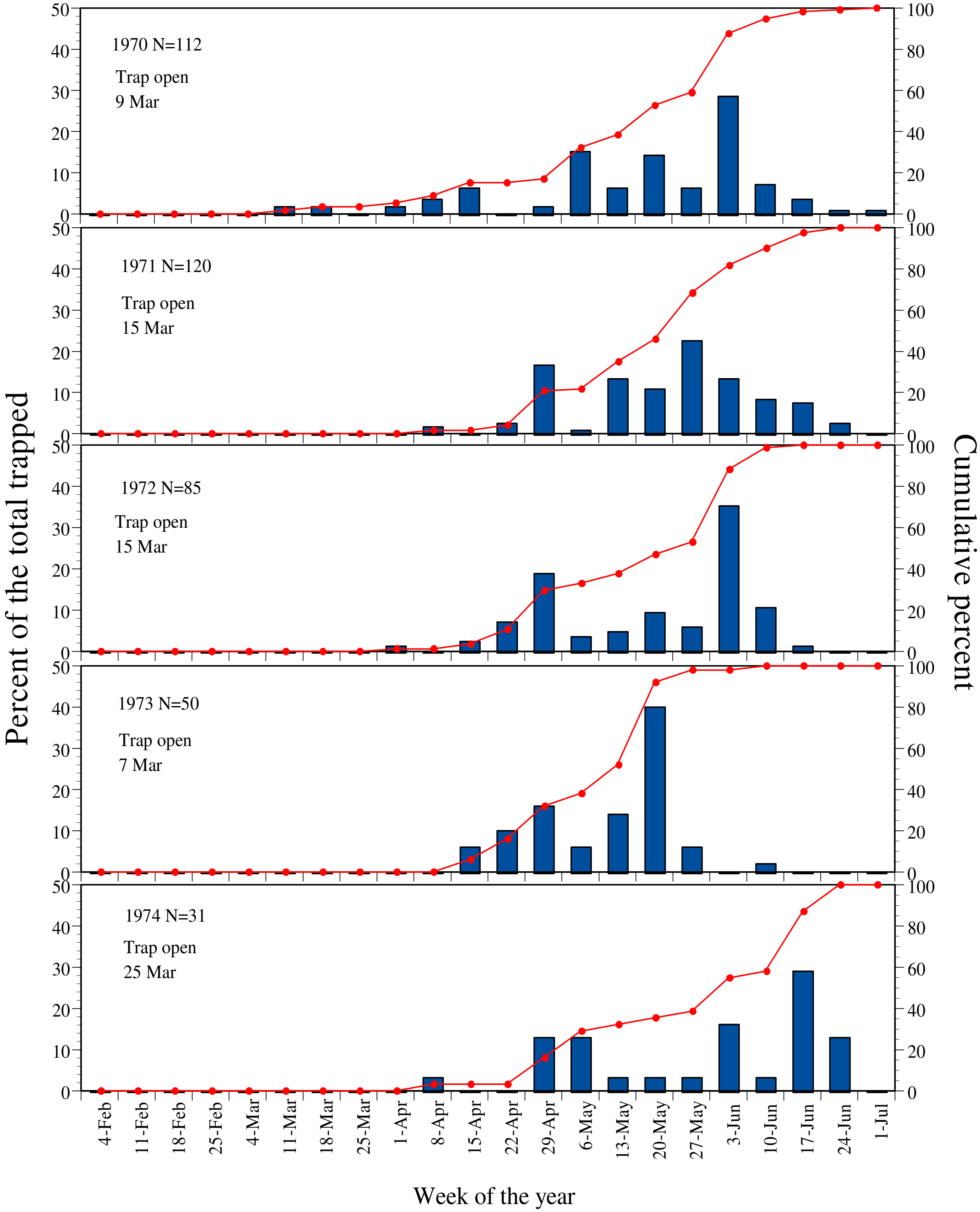


Figure 18. Arrival timing of adult summer steelhead at a trap on Lookingglass Falls from 1970 to 1974 (Burck 1964-1974).

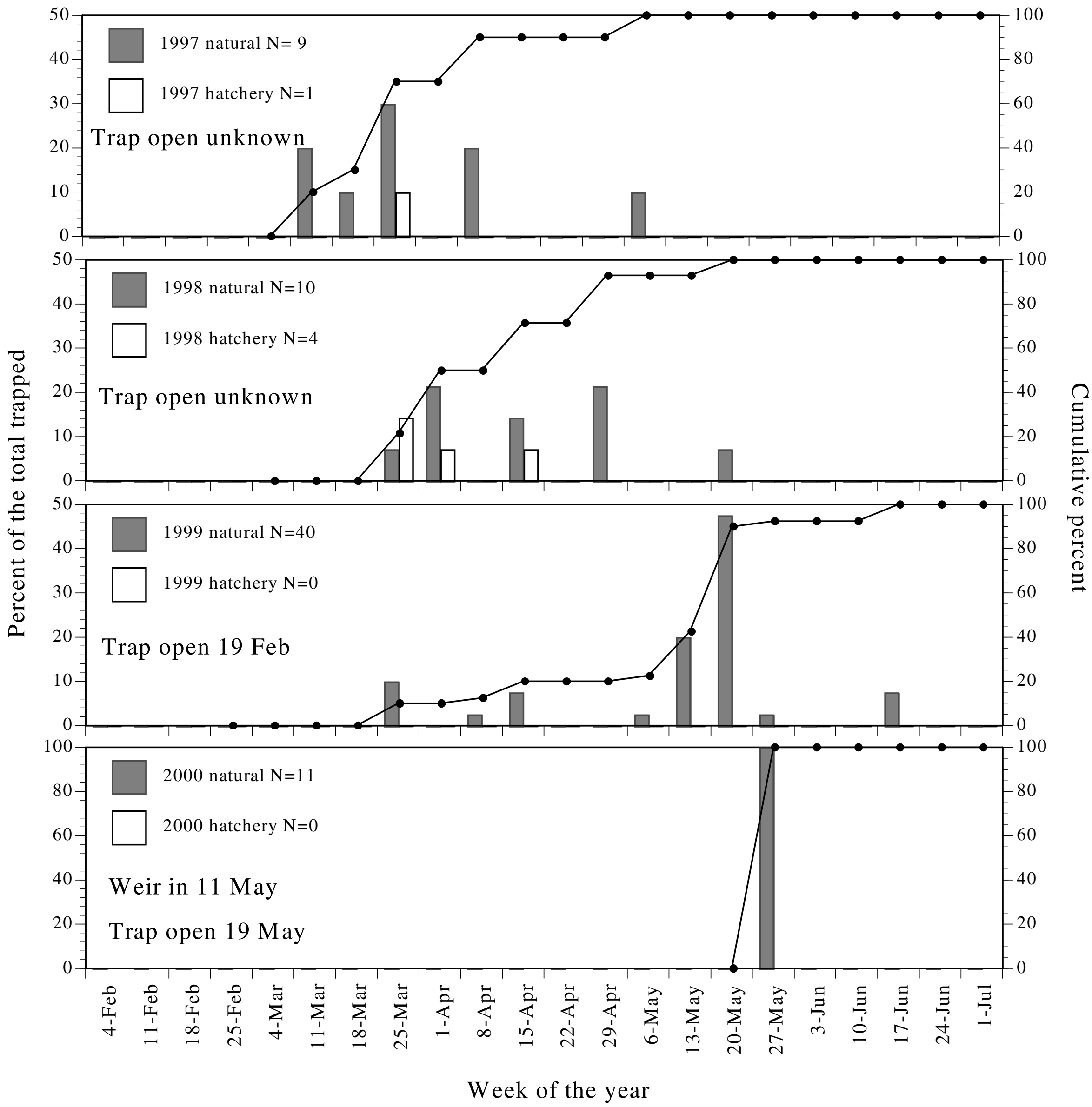


Figure 19. Arrival timing of adult summer steelhead at a trap on Lookingglass Falls from 1997 to 2000.

Table 11. Juvenile *O. mykiss* sample locations and dates, number collected, and fork length range and median in 1999.

| Basin | Mngmt. unit[a] | Sample location | Fork length (mm) N[b] | range | median | Dates collected |
|---|---|---|---|---|---|---|
| Grande Ronde R. | | | | | | |
| | 5 | Chesnimnus Cr.[c] | 70 | 32-62 | 45.0 | 7/27 |
| | 5 | Elk Cr.[c] | 92 | 36-64 | 52.0 | 8/5 |
| | 6 | Prairie Cr. | 65 | 30-60 | 50.0 | 7/29 |
| | 7 | Mud Cr. | 100 | 24-53 | 42.0 | 7/27 |
| | 8 | Whiskey Cr. | 100 | 33-60 | 54.0 | 7/28 |
| | 9 | Lostine R. | 59 | 25-59 | 38.0 | 7/30,8/13,8/23-25 |
| | 10 | Wenaha R. | 100 | 29-54 | 38.0 | 8/1-2 |
| | 11 | Little Minam R. | 64 | 24-39 | 31.0 | 8/5 |
| | 12 | Lookingglass Cr. | 151 | 24-65 | 37.0 | 7/28,8/18 |
| | 13 | Indian Cr. | 73 | 24-60 | 47.0 | 7/26,8/23 |
| | 14 | Catherine Cr. | 116 | 27-83 | 51.0 | 7/27,8/11,8/16 |
| | 15 | Dry Cr. | 100 | 25-50 | 34.0 | 7/30 |
| | 16 | Meadow Cr. | 100 | 40-69 | 58.0 | 7/29 |
| | 17 | Fly Cr. | 100 | 29-58 | 50.0 | 7/26 |
| Imnaha River | | | | | | |
| | 1 | Lightning Cr.[c] | 90 | 26-83 | 64.0 | 7/21,7/23,9/27-28,10/11-12 |
| | 1 | Horse Cr.[c] | 94 | 47-85 | 71.0 | 9/29 |
| | 1 | Cow Cr.[c] | 95 | 51-86 | 70.0 | 9/28 |
| | 2 | Gumboot Cr.[c] | 72 | 40-72 | 56.0 | 9/28 |
| | 3 | Camp Cr.[c] | 100 | 42-65 | 59.0 | 7/27 |
| | 4 | Big Sheep Cr.[c] | 66 | 25-85 | 59.5 | 7/28-29,10/13-14,11/4 |

[a] *The management units can be found in Figures 14 and 15. The first stream listed from the management unit is the stream selected by co-managers to represent that unit.*

[b] *The N shown is the total number collected from the stream. There were some fish that were not measured within each unit: 4 fish from the Lostine R., 1 fish from the Wenaha R., 1 fish from Lookingglass Cr., 3 fish from Fly Cr., and 2 fish from Mud Cr.*

[c] *Taken from Miller et al. 2001.*

Table 12. Juvenile *O. mykiss* sample locations and dates, number collected, and fork length range and median in 2000.

| Basin | Mngmt. unit[a] | Sample location | Fork length (mm) N[b] | range | median | Dates collected |
|---|---|---|---|---|---|---|
| Grande Ronde R. | | | | | | |
| | 5 | Chesnimnus Cr.[c] | 85 | 31-60 | 46.0 | 7/31 |
| | 5 | Elk Cr.[c] | 89 | 36-71 | 51.0 | 8/1 |
| | 6 | Prairie Cr. | 100 | 39-88 | 61.0 | 8/3 |
| | 7 | Mud Cr. | 73 | 21-55 | 44.0 | 8/4 |
| | 8 | Whiskey Cr. | 100 | 38-92 | 60.5 | 8/2 |
| | 9 | Lostine R. | 111 | 22-72 | 43.0 | 8/9,8/21-24 |
| | 10 | Wenaha R. | 99 | 29-68 | 43.0 | 8/13-14 |
| | 11 | Little Minam R. | 91 | 24-62 | 40.0 | 8/17-18 |
| | 12 | Lookingglass Cr. | 96 | 22-65 | 36.5 | 7/20-21,7/28,8/10,8/23 |
| | 13 | Indian Cr. | 100 | 20-72 | 38.5 | 8/7,8/25 |
| | 14 | Catherine Cr. | 104 | 23-80 | 42.0 | 7/22,7/24,7/26,8/8,8/16 |
| | 15 | Dry Cr. | 100 | 25-53 | 44.0 | 7/31 |
| | 16 | Meadow Cr. | 100 | 51-72 | 60.0 | 8/7 |
| | 17 | Fly Cr. | 100 | 37-62 | 53.0 | 8/1 |
| Imnaha R. | | | | | | |
| | 1 | Lightning Cr.[c] | 77 | 22-85 | 53.0 | 7/18-19,8/8,9/26 |
| | 1 | Horse Cr.[c] | 100 | 31-69 | 49.0 | 8/3 |
| | 1 | Cow Cr.[c] | 100 | 35-68 | 55.0 | 8/4 |
| | 2 | Gumboot Cr.[c] | 92 | 28-55 | 46.0 | 8/2 |
| | 3 | Camp Cr.[c] | 100 | 34-74 | 58.0 | 7/28 |
| | 4 | Big Sheep Cr.[c] | 85 | 22-64 | 38.5 | 7/25-26,8/7 |

[a] *The map units can be found in Figures 14 and 15. The NPT also sampled Elk Creek from map unit 5 in the Grande Ronde Basin and Horse and Cow Creeks from map unit 1 in the Imnaha Basin.*

[b] *The N shown is the total number collected from the stream.*

[c] *Taken from Miller et al. 2001.*

## Juvenile Migrant Trapping Using a Rotary Screw Trap

Since November of 1993 the yearly total of juvenile *O. mykiss* trapped has fluctuated from 485 in 1999 to 2,620 in 1995 (Table 13).

Table 13. Juvenile *O. mykiss* captured in the rotary screw trap on Lookingglass Creek from 1993 to 2000.

| Month | 1993 | 1994 | 1995 | 1996 | 1997 | 1998 | 1999 | 2000 |
|---|---|---|---|---|---|---|---|---|
| Jan | | 37 | 43 | 19 | 118 | 9 | 7 | 0 |
| Feb | | 40 | 175 | 13 | 40 | 11 | 5 | 7 |
| Mar | | 195 | 98 | 25 | 105 | 242 | 33 | 31 |
| Apr | | 624 | 165 | 33 | 43 | 126 | 214 | 138 |
| May | | 409 | 222 | 4 | 66 | 202 | 4 | 185 |
| Jun | | 305 | 363 | | 152 | 308 | 20 | 171 |
| Jul | | 140 | 233 | 7 | 6 | 4 | 29 | 47 |
| Aug | | 86 | 107 | 40 | 8 | 8 | 3 | 11 |
| Sep | | 140 | 257 | 62 | 56 | 172 | 5 | 63 |
| Oct | 14 | 309 | 427 | 336 | 13 | 123 | 91 | 68 |
| Nov | 138 | 181 | 471 | 94 | 29 | 100 | 50 | 25 |
| Dec | 97 | 30 | 59 | 15 | 3 | 4 | 24 | 32 |
| Total | 249 | 2,496 | 2,620 | 648 | 639 | 1,309 | 485 | 778 |

The main peaks in *O. mykiss* movement past the trap generally occur in the spring (March to June) and in the fall (September to October) (Figures 20 to 26). The small (FL) group generally peaked 1 to 2 months later during the spring and fall peaks than the medium and large (FL) groups. From 1994-2000 the percentage of fish moving past the trap from the large (FL) group was 6.8% in comparison to the medium (FL) and small (FL) groups at 44.2 and 49.0% respectively (Table 14).

## PIT-tagging of Juvenile *O. mykiss* at the Rotary Screw Trap

We PIT-tagged 183 juvenile *O. mykiss* at the rotary screw trap from 16-24 April 1999 ranging in size from 141-233 mm. These fish comprised Group 1 which was PIT-tagged with 400 kHz tags.

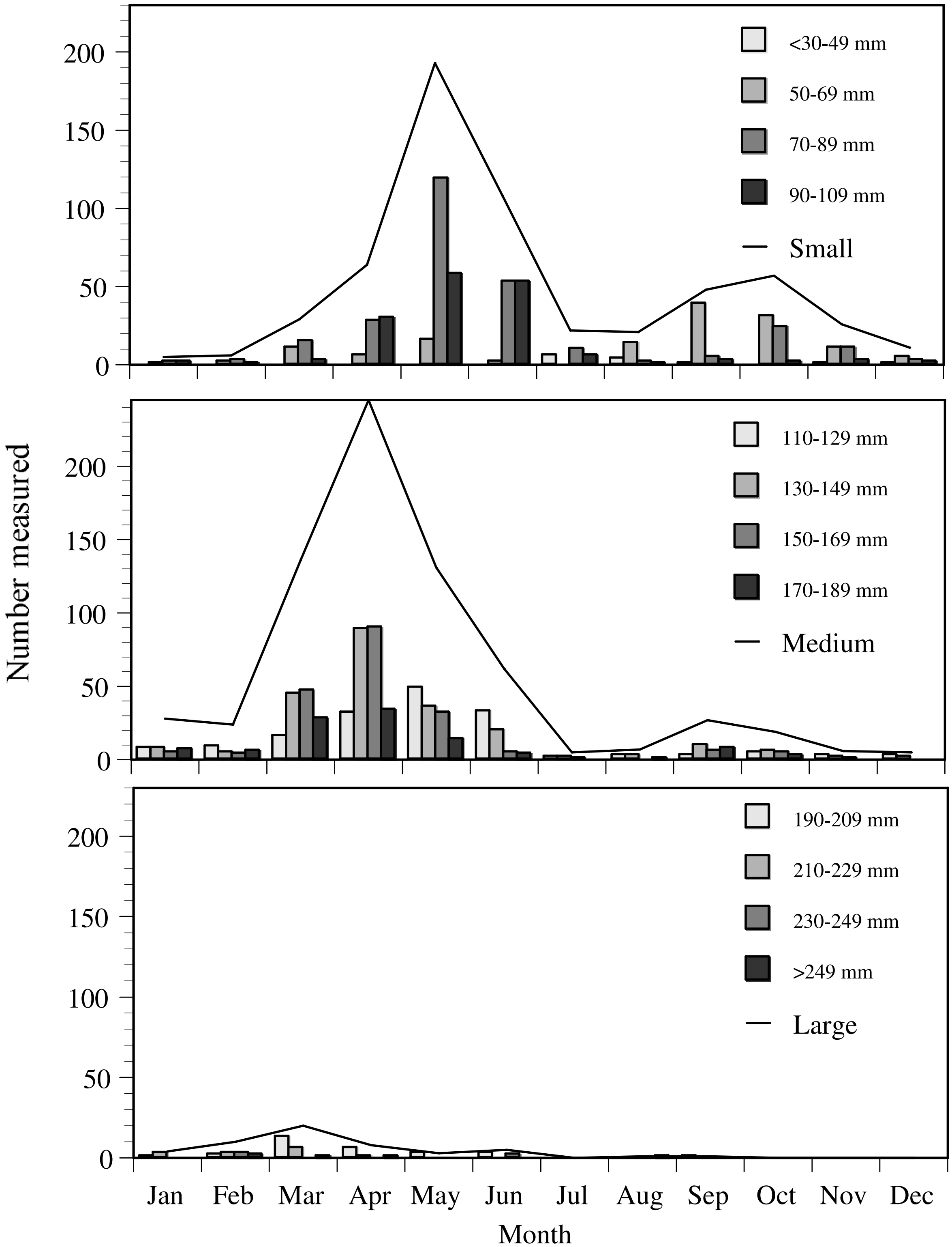


Figure 20. Monthly *O. mykiss* arrival timing by fork length group at the screw trap on Lookingglass Creek in 1994.

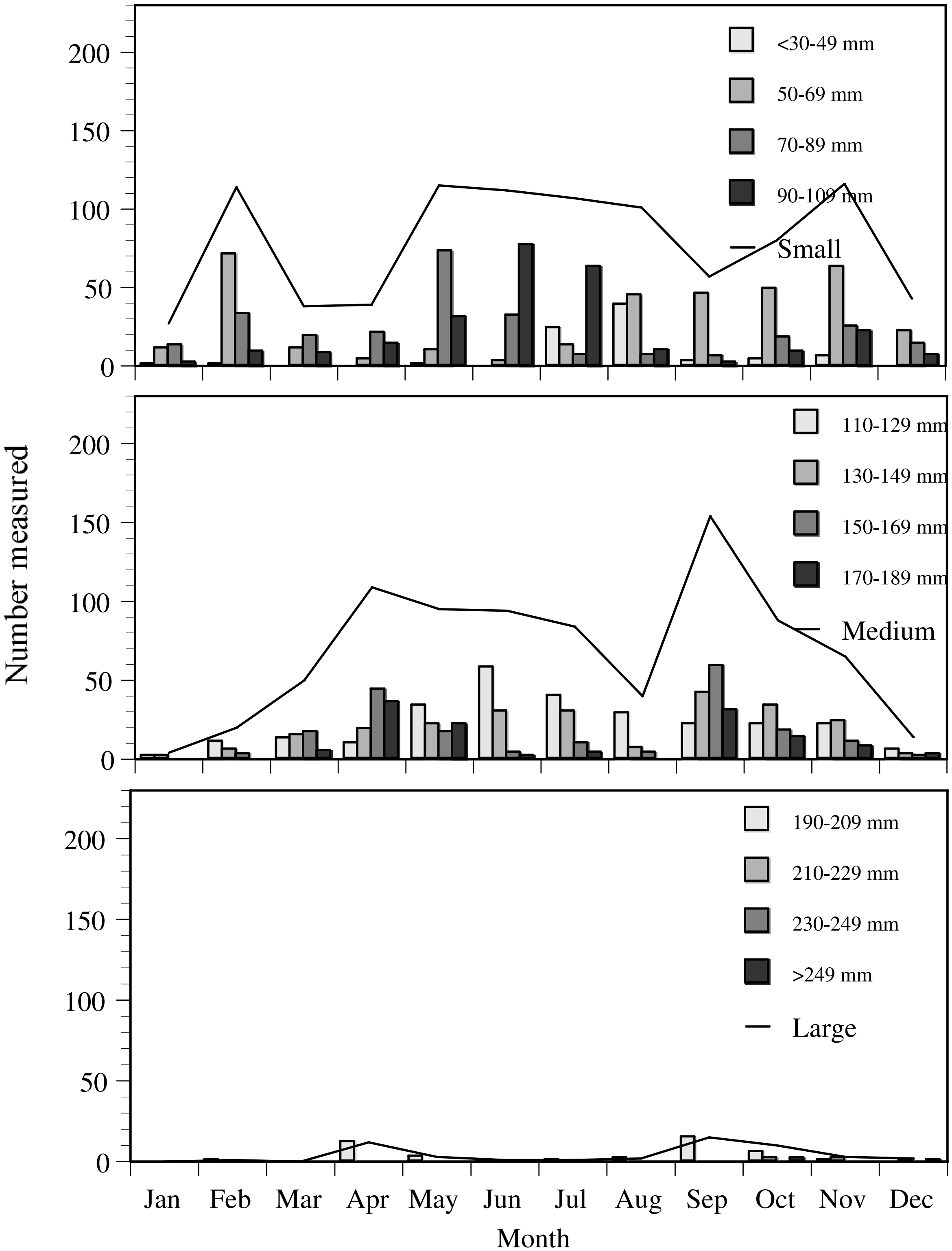


Figure 21. Monthly *O. mykiss* arrival timing by fork length group at the screw trap on Lookingglass Creek in 1995.

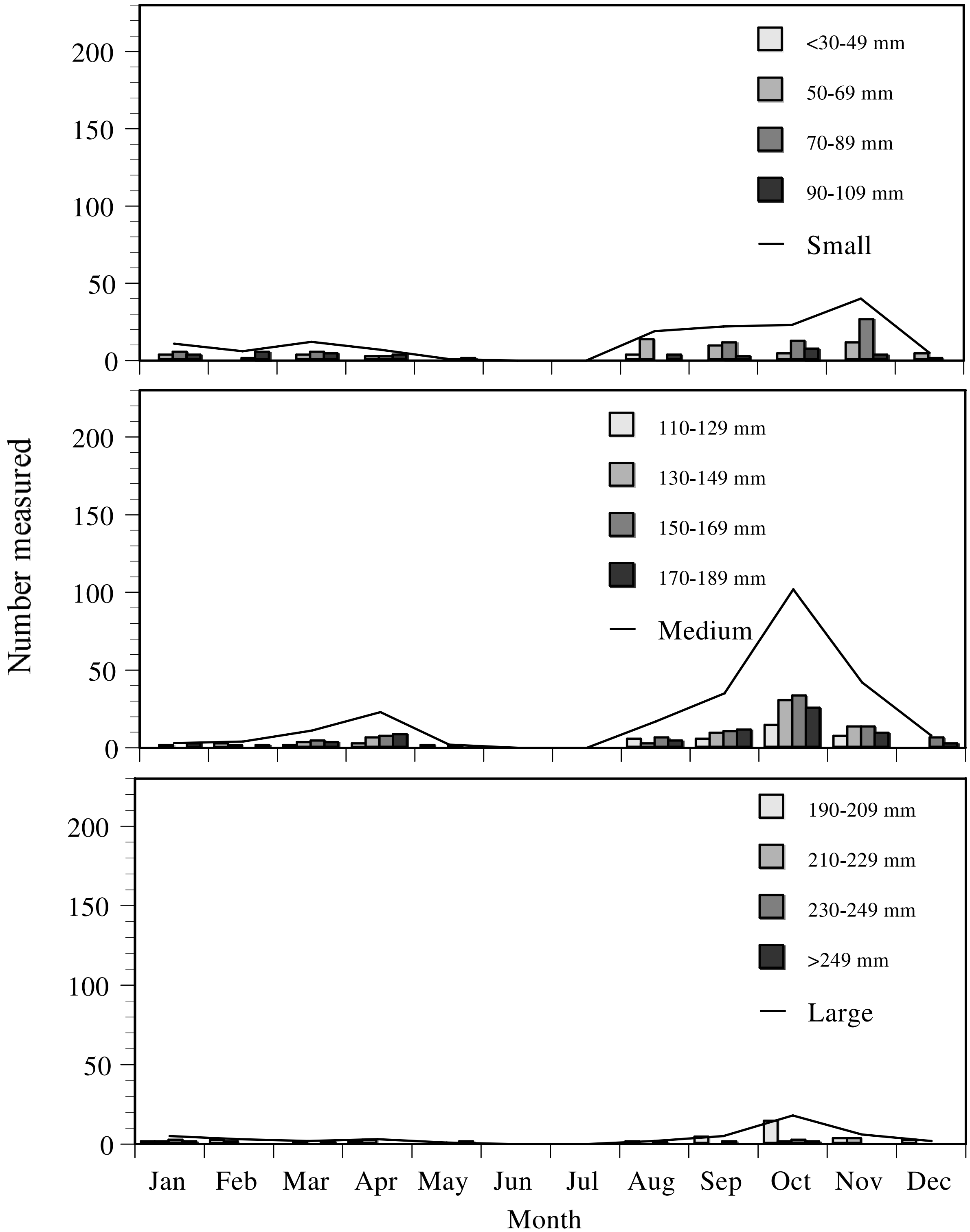


Figure 22. Monthly *O. mykiss* arrival timing by fork length group at the screw trap on Lookingglass Creek in 1996.

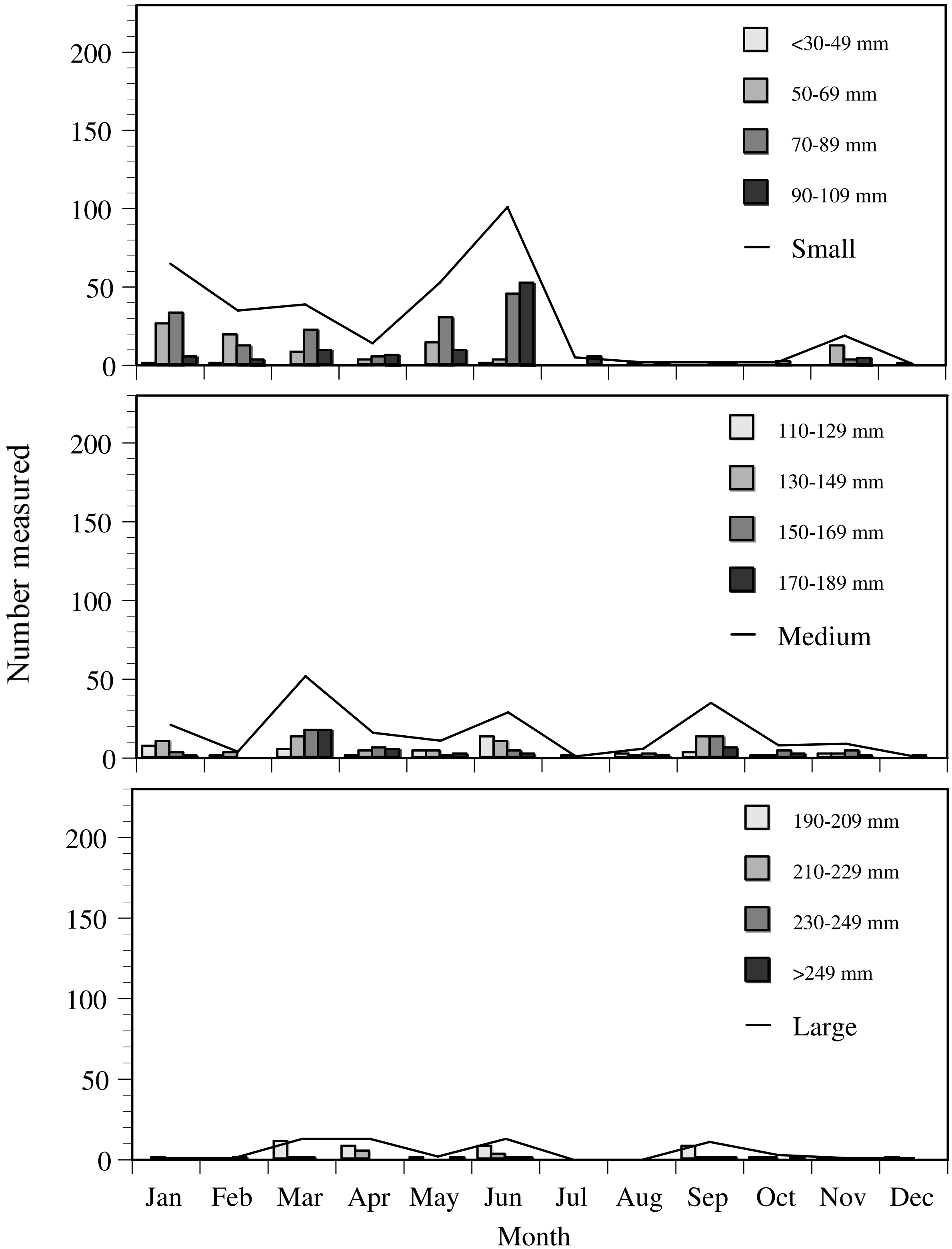


Figure 23. Monthly *O. mykiss* arrival timing by fork length group at the screw trap on Lookingglass Creek in 1997.

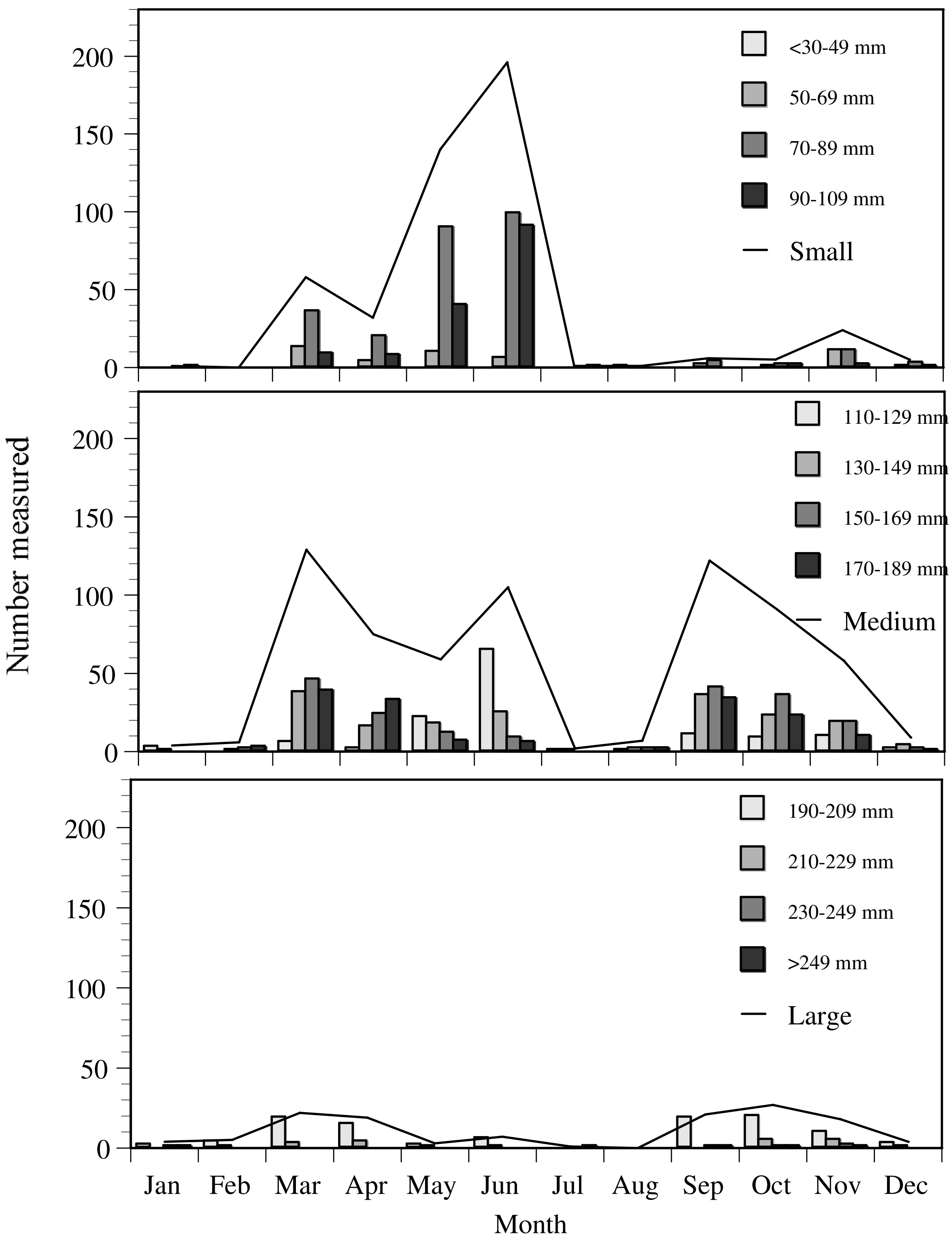


Figure 24. Monthly *O. mykiss* arrival timing by fork length group at the screw trap on Lookingglass Creek in 1998.

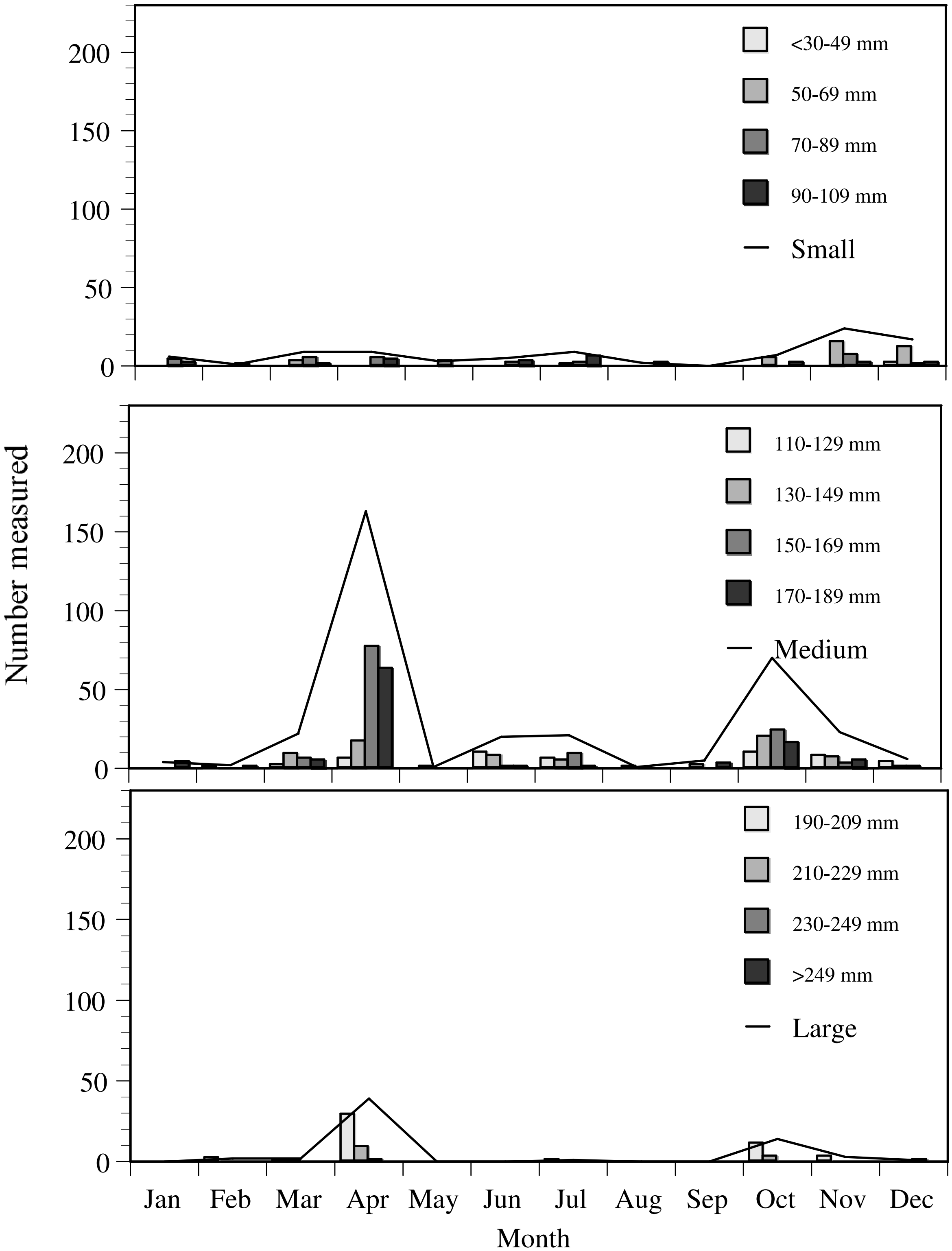


Figure 25. Monthly *O. mykiss* arrival timing by fork length group at the screw trap on Lookingglass Creek in 1999.

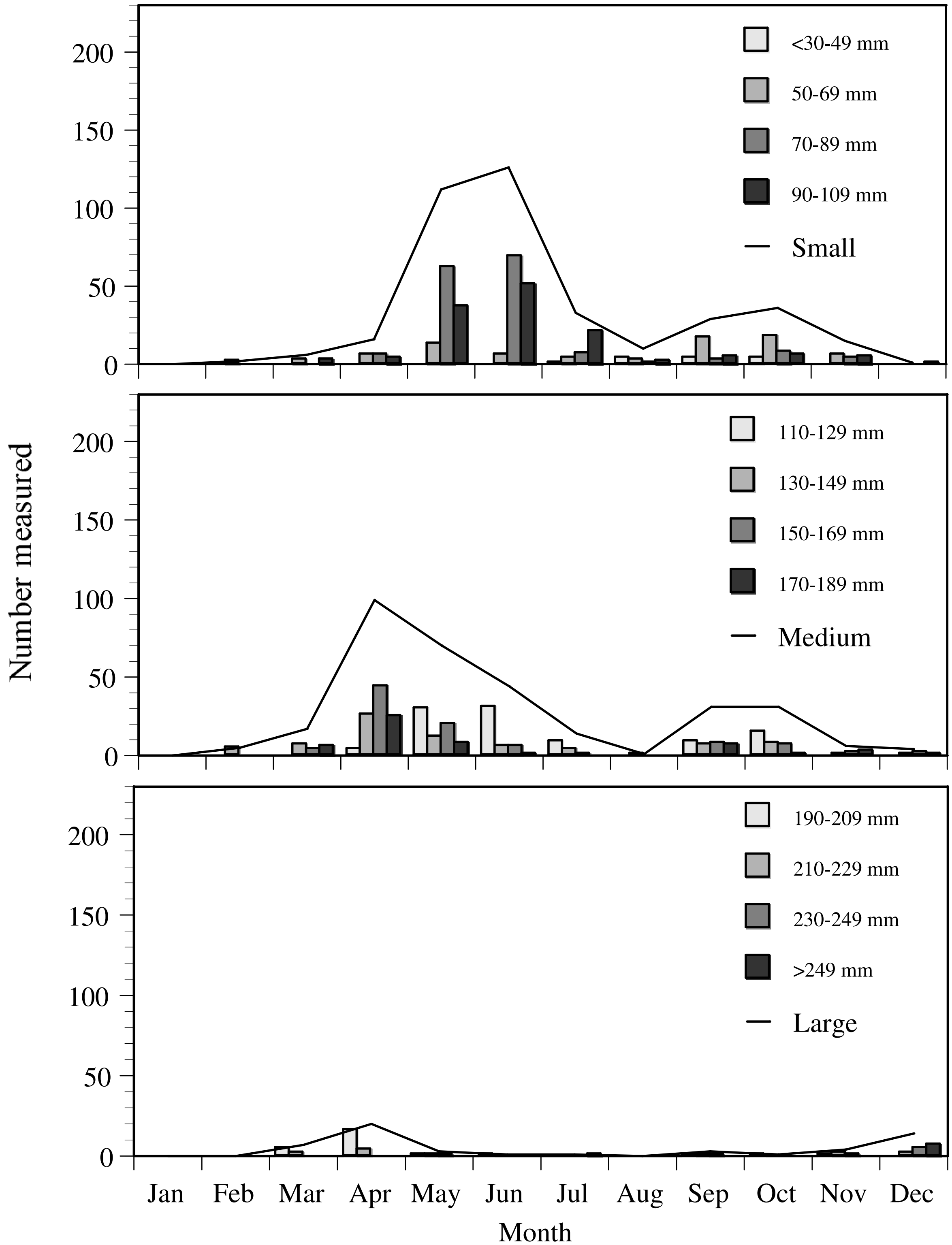


Figure 26. Monthly *O. mykiss* arrival timing by fork length group at the screw trap on Lookingglass Creek in 2000.

Table 14. Juvenile *O. mykiss* captured in the rotary screw trap by size group on Lookingglass Creek from 1994 to 2000.

| | Number | | | Percentage | | |
|---|---|---|---|---|---|---|
| Year | Small | Medium | Large | Small | Medium | Large |
| 1994 | 590 | 695 | 52 | 44.1 | 52.0 | 3.9 |
| 1995 | 949 | 817 | 50 | 52.3 | 45.0 | 2.8 |
| 1996 | 146 | 247 | 47 | 33.2 | 56.1 | 10.7 |
| 1997 | 338 | 193 | 59 | 57.3 | 32.7 | 10.0 |
| 1998 | 469 | 667 | 131 | 37.0 | 52.6 | 10.3 |
| 1999 | 92 | 338 | 62 | 18.7 | 68.7 | 12.6 |
| 2000 | 386 | 332 | 54 | 50.0 | 43.0 | 7.0 |
| Total | 2,970 | 3,289 | 455 | 44.2 | 49.0 | 6.8 |

*Weekly Arrival Timing and Minimum Survival to Lower Granite Dam*

PIT-tagged juvenile *O. mykiss* from Group 1 arrived at Lower Granite Dam the week of 22 April 1999 with the median date of arrival on 29 April 1999 (Figure 27). The *O. mykiss* PIT-tagged from Group 1 had a minimum survival rate to Lower Granite Dam of 69.95% (Figure 28). There was no significant difference in minimum survival rate among fish of 7 different fork length intervals (P=0.903).

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

Juvenile *O. mykiss* PIT-tagged from Group 1 in Lookingglass Creek had similar arrival timing at Lower Granite Dam as a similar group of fish that was tagged at a screw trap operated by ODFW near the mouth of the Grande Ronde River. The median date of arrival at Lower Granite Dam for Group 1 (29 April), however, was 4 days later than the group from the Lower Grande Ronde River (25 April)(Figure 27). This later median date of arrival for the Lookingglass Creek fish is most likely due to the travel time of Group 1 to the point where the lower river fish were PIT-tagged, which is about 85 rivermiles.

The minimum survival rate for Group 1 (69.95%) to Lower Granite Dam was significantly less (P=0.000) less than that of a similar group from the Lower Grande Ronde River (87.58%) (Figure 29). This difference in survival over such a short period of time could be a significant limiting factor for juvenile *O. mykiss* migrating from the upper reaches of the basin to the ocean.

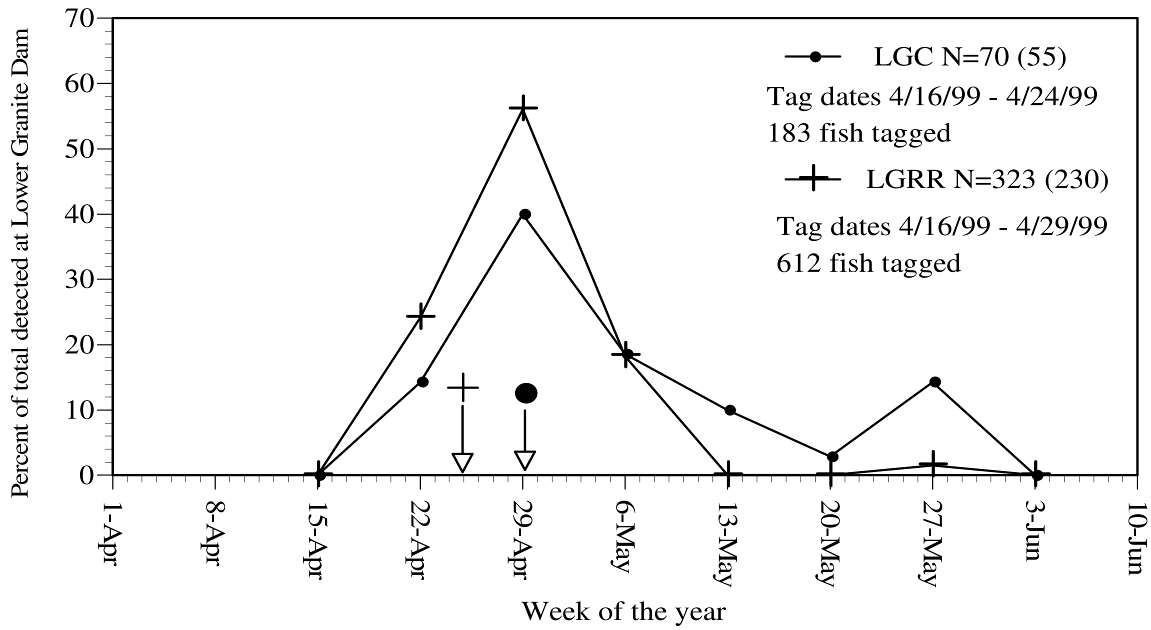


Figure 27. Arrival timing by week at Lower Granite Dam in 1999 of PIT-tagged *O. mykiss* from Lookingglass Creek (LGC) and the lower Grande Ronde River (LGRR). Fork length of fish PIT-tagged ranged from 140-239 mm. Expanded detections are graphed, actual detections are in parentheses. Arrows indicate the median date of arrival for each group. Week of the year is represented by the last date in the week.

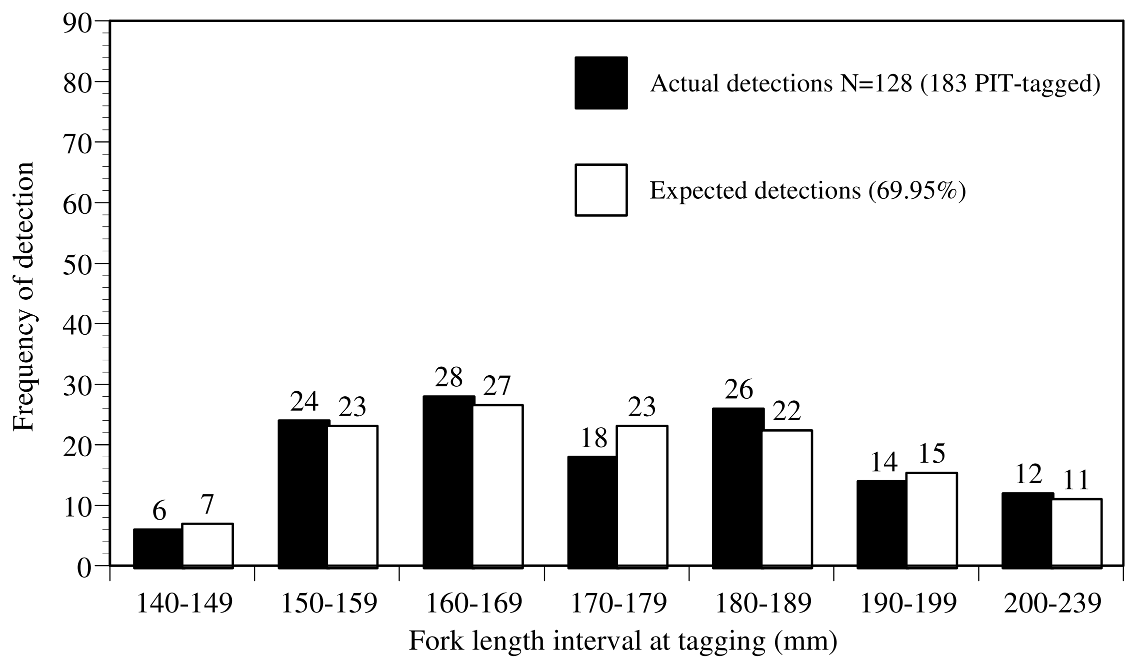


Figure 28. Comparison of actual and expected (overall survival of group) unique PIT tag detections in 1999 at Snake or Columbia River dams by fork length interval of *O. mykiss* from Lookingglass Creek (PIT-tagged in 1999). N values are shown above the bars.

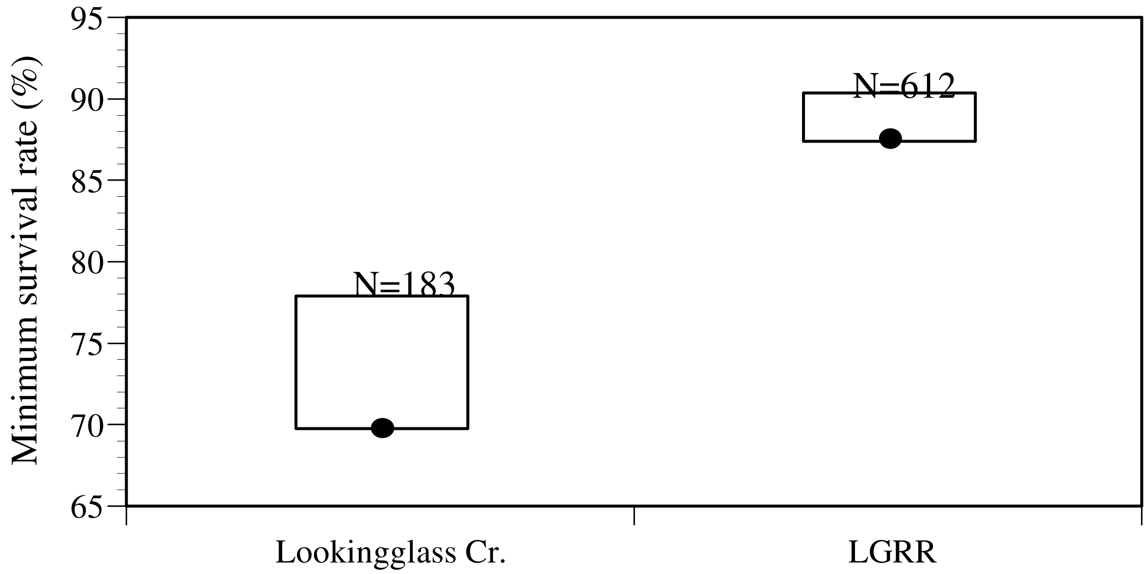


Figure 29. Total unique detection rates and upper ninety-five percent confidence intervals of *O. mykiss* from Lookingglass Creek and the lower Grande Ronde River (LGRR) that were detected at Snake or Columbia River dams in 1999. N= number of fish PIT-tagged from tributary.

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## SECTION II

### Assistance Provided to LSRCP Cooperators and Other Projects

We provided assistance to LSRCP cooperator ODFW in 2000 for ongoing hatchery evaluation research. Project personnel completed extensive spawning ground surveys for spring Chinook salmon in the Grande Ronde and Imnaha river basins. We provided assistance in pre-release sampling of spring Chinook salmon at LH. In addition, project personnel provided assistance in sampling adult spring Chinook salmon at Oregon LSRCP facilities and helped with the release of juvenile spring Chinook salmon parr into Lookingglass Creek. Assistance was provided in data summarization and analysis for ODFW monthly and annual progress reports.

We assisted other Bonneville Power Administration (BPA) projects with data collection in 2000. We assisted ODFW personnel who have been collecting data on bull trout (*Salvelinus confluentus*) in the Grande Ronde River basin. We have collected fork length and weight data from bull trout we have captured in Lookingglass Creek in our screw trap and those captured in the LH adult bypass. In addition, we have implanted PIT tags in bull trout we have captured in our rotary screw trap. We assisted the conventional adult spring Chinook salmon broodstock collection project in the Grande Ronde River and Catherine Creek in 2000 with weir building and trap checking. This is a BPA project in which CTUIR has the lead in these tributaries.

## Acknowledgments

Our thanks to Dan Herrig (United States Fish and Wildlife Service) for administering this contract and coordinating communication between Confederated Tribes of the Umatilla Indian Reservation (CTUIR) and other management and research entities. Gary James, Michelle Thompson, Julie Burke, and Celeste Reeves (CTUIR) provided technical and administrative support, particularly with contract modifications. Thanks go to members of the Research and Development Section of Oregon Department of Fish and Wildlife (ODFW) in La Grande: Rich Carmichael, Mike Flesher, Brian Jonasson, MaryLouise Keefe, Pat Keniry, Paul Sankovich, Debra Eddy, and Tim Whitesel for their assistance in the field and the office. Thanks to Craig Contor, Dan Herrig, Gary James and Rich Carmichael for reviewing drafts of this report. We thank Jo Miller (United States Geologic Survey) and Darline Robison (United States Forest Service) for providing stream flow and temperature data. Thanks go to ODFW LH personnel: Bob Lund, Chris Lauman, Gary Huser, Don Falk, Steve Landweir and numerous seasonal personnel for assisting in handling and tagging fish, allowing us the use of facilities at the hatchery, keeping an eye on the screw trap for us and especially for cheerfully offering assistance during emergency situations that helped us prevent or minimize damage to the trap during high water incidents. Special thanks to CTUIR technician Ryan Seeger for working under adverse conditions, often on weekends, collecting, handling and releasing fish, maintaining the screw trap, assisting in activities at the hatchery, and assisting in data analysis.

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

## Appendix Tables

Appendix Table A-1. Redd count and redd expansion data for the Grande Ronde River in 2000. 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 | | | | | | | | | |
| 2000 | 28-Aug | Index | 4 | | 0 | | | | | | | | | |
| | 5-Sep | Supp. | 1 | | 5 | | | | | | | | | |
| | 11-Sep | Supp. | 1 | | 7 | | | | | | | | | |
| | 18-Sep | Supp. | 0 | 2 | 0 | | | | | | | 20 | | |
| | 21-Sep | Supp. | 0 | 0 | 0 | | | | | | | | | |
| | **Expansion** | | 6 | 2 | 12 | | | | | | | | 20 | |
| | **Redress** | | 6 | 2 | 12 | | | | | | | | 20 | 65 |

a *Expansion is based on unit proportions. Only index surveys for years when all sections were surveyed were used to calculate the unit proportions (McLean and Lofy 2001). 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 McLean 1995a; Lofy and McLean 1995b; McLean and Lofy 1995)*

Appendix Table A-2. Redd count and redd expansion data for Catherine Creek in 2000. 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 1986-2000** | | | 92 | 11 | 87 | 148 | 166 | 96 | 111 | | | | | |
| **Unit proportions** | | | 0.13 | 0.02 | 0.12 | 0.21 | 0.23 | 0.14 | 0.16 | | | | | |
| 2000 | 29-Aug | Index | 0 | 2 | 0 | 4 | 1 | 2 | 0 | | | | | |
| | 6-Sep | Supp. | 0 | 1 | 1 | 2 | 4 | 3 | 3 | | | | | |
| | 12-Sep | Supp. | 0 | 0 | 1 | 2 | 2 | 0 | 6 | | | 34 | | |
| | **Expansion** | | 0 | 3 | 2 | 8 | 7 | 5 | 9 | | | | 34 | |
| | **Redress** | | 0 | 3 | 2 | 8 | 7 | 5 | 9 | | | | 34 | 111 |

[a] *Expansion is based on unit proportions. Only index surveys for years when all sections were surveyed were used to calculate the unit proportions (McLean and Lofy 2001). 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 McLean 1995a; Lofy and McLean 1995b; McLean and Lofy 1995)*

Appendix Table A-3. Redd count and redd expansion data for the Lostine River in 2000. 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 1986-2000** | | | | 27 | 2 | 222 | 18 | 8 | 1 | 3 | | | | |
| **Unit proportions** | | | | 0.10 | 0.01 | 0.79 | 0.06 | 0.03 | 0.00 | 0.01 | | | | |
| 2000 | 25-Aug | Index | 0 | 0 | 1 | 34 | 1 | 0 | 1 | 0 | | | | |
| | 1-Sep | Supp. | 0 | 0 | 0 | 10 | 0 | 0 | 0 | 2 | | | | |
| | 8-Sep | Supp. | 0 | 0 | 0 | 3 | 0 | 1 | 2 | 6 | | | | |
| | 15-Sep | Supp. | | | | | | | | 1 | | | | |
| | 20-Sep | Supp. | | | | | | | | 1 | | | | |
| | 29-Sep | Supp. | | | | | | | | 1 | | 64 | | |
| | **Expansion** | | | 0 | 1 | 47 | 1 | 1 | 3 | 11 | | | 64 | |
| | **Redress** | | | 0 | 1 | 47 | 1 | 1 | 3 | 11 | | | 64 | 209 |

[a] *Expansion is based on unit proportions. Only index surveys for years when all sections were surveyed were used to calculate the unit proportions (McLean and Lofy 2001). 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 in 2000. 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 1986-2000** | | | 26 | 14 | 30 | 28 | 47 | 31 | 133 | 28 | 72 | | | |
| **Unit proportions** | | | 0.06 | 0.03 | 0.07 | 0.07 | 0.11 | 0.08 | 0.33 | 0.07 | 0.18 | | | |
| 2000 | 29-Aug | Index | 2 | 2 | 5 | 6 | 18 | 7 | 23 | 6 | 5 | | | |
| | 6-Sep | Supp. | | | | 2 | 3 | 2 | 30 | | | | | |
| | 13-Sep | Supp. | | | | 0 | 1 | 7 | 20 | | | 139 | | |
| | **Expansion** | | 13 | 7 | 15 | 8 | 22 | 16 | 73 | 14 | 36 | | 204 | |
| | **Redress** | | 13 | 7 | 15 | 8 | 22 | 16 | 73 | 14 | 36 | | 204 | 664 |

[a] *Expansion is based on unit proportions. Only index surveys for years when all sections were surveyed were used to calculate the unit proportions (McLean and Lofy 2001). 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 in 2000. 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 1986-2000** | | | 14 | 5 | 329 | 147 | 70 | 119 | 14 | | | | | |
| **Unit proportions** | | | 0.02 | 0.01 | 0.47 | 0.21 | 0.10 | 0.17 | 0.02 | | | | | |
| 2000 | 7-Sep | Index | 0 | 2 | 55 | 28 | 16 | 14 | 4 | | | | | |
| | 14-Sep | Supp. | 0 | 1 | 7 | 6 | 1 | 2 | 2 | | | 138 | | |
| | **Expansion** | | 0 | 3 | 62 | 34 | 17 | 16 | 6 | | | | 138 | |
| | **Redress** | | 0 | 3 | 62 | 34 | 17 | 16 | 6 | | | | 138 | 450 |

[a] *Expansion is based on unit proportions. Only index surveys for years when all sections were surveyed were used to calculate the unit proportions (McLean and Lofy 2001). 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 McLean 1995a; Lofy and McLean 1995b; McLean and Lofy 1995)*

Appendix Table A-6. Carcass recoveries and age structure for Grande Ronde River basin tributaries in 2000. Source: ODFW Research, La Grande, unpublished data.

| Run | | Scale age | | | | Basin age structure | | |
|---|---|---|---|---|---|---|---|---|
| Year | Tributary | 3 | 4 | 5 | Total | 3 | 4 | 5 |
| 2000 | Grande Ronde R. | 1 | 13 | 0 | 14 | | | |
| | Catherine Cr. | 1 | 4 | 1 | 6 | | | |
| | Lostine R. | 6 | 47 | 4 | 57 | | | |
| | Minam R. | 2 | 73 | 0 | 75 | | | |
| | Wenaha R. | 1 | 64 | 0 | 65 | | | |
| | **Totals** | **11** | **201** | **5** | **217** | **0.05** | **0.93** | **0.02** |