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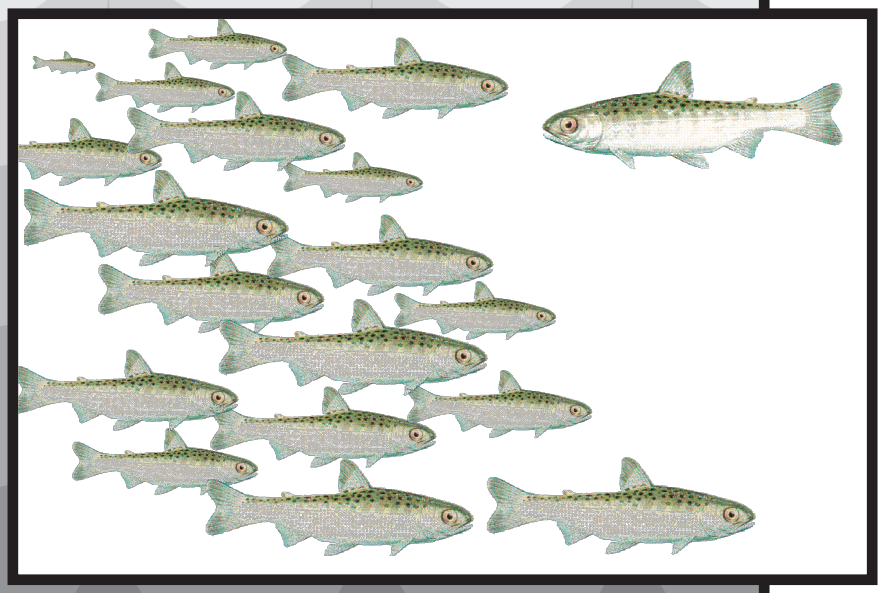
2006 Skagit River Wild Salmon Production Evaluation Annual Report



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STATE OF WASHINGTON
DEPARTMENT OF FISH AND WILDLIFE

Annual Report

2006 Skagit River Wild Salmon Production Evaluation

Funded by Seattle City Light

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Evaluating juvenile salmon production on the largest river in Washington State's Puget Sound Basin is an enormous undertaking. Dangerous work conditions and inclement weather are the norm and this work simply couldn't be done without our experienced field crew. Scientific Technicians Jim Repoz, Dean Toba and Eric Kummerow worked long hours around the clock operating and maintaining the traps, and enumerating and sampling the catches. Scientific Technician Jamie Murphy operated the coho smolt trap on Mannser Creek and tagged smolts at the Baker River Dam. Fish Biologist Mike Ackley and Scientific Technician Mat Gillum provided valuable logistical support during trap installation and removal. Mark Hino developed the database that helped analyze much of the trap data in this report. We would also like to thank Brett Barkdull and the Region 4 staff for their diligent work on the adult spawner surveys and chinook escapement estimates. Thanks also goes out to Kye Iris for her help in obtaining permits from the City of Mount Vernon, and for the additional support provided by Bob Everitt and Pat Frazier.

Evaluation of the wild Chinook production from the Skagit River was made possible with funding from Seattle City Light. The 2006 season was the tenth and final year they provided funds. Their support, combined with funds from Dingell-Johnson/ Wallop-Breaux program and matched with Washington Department of Fish & Wildlife funds, enabled with *Wild Salmon Production Evaluation Unit* to trap downstream migrants in the lower Skagit River from mid January through July.

We greatly appreciate the support of Pat Courier, adjacent property owner, for allowing us to locate our mobile field station for the mainstem trap on her property for the entire 2006 trapping season, and for allowing us access to drinking water and utilities. We would also like to thank: Dike District 17 for allowing us to park vehicles on their property; Burlington Northern-Santa Fe Railroad for continuing to allow us to anchor our mainstem trap barges to the railroad bridge; and Dexter and Joanie Sealph, who allowed us to install and access the Mannser Creek trap on their property.

Executive Summary

Skagit River Chinook returns (spring and summer/fall combined) have declined over the last fifty years. In 1999, Puget Sound Chinook salmon were listed as "Threatened" under the Endangered Species Act (ESA). To address this poor stock status, resource managers formed the multi-agency Skagit River Chinook Work Group in 1995. A major goal of this group is to determine the factors that limit Chinook production. In addition to assessing habitat and adult returns, juvenile production monitoring was initiated, as it directly measures freshwater survival. Evaluating the biological attributes of outmigration timing and size contributes to our understanding of Chinook freshwater life history. This information is useful for flow management, habitat protection and restoration, and designing hatchery programs to minimize adverse interactions.

In 1990, WDFW initiated downstream migrant trapping in the Skagit River system in Mount Vernon. Although this project was originally directed at assessing coho smolt production (April through June), we identified and enumerated all fish captured. In 1991, through a fisheries settlement agreement with state, federal and tribal agencies, Seattle City Light (operators of several dams on the Skagit River) created the Skagit Non-Flow Plan Coordinating Committee (NCC). Beginning in 1997, this program provided funding to expand our Skagit River downstream migrant trapping project to also estimate Chinook production (January through July). This report documents our investigations for all downstream-migrant salmonids during Spring 2006, the seventeenth year that we have measured downstream migrants from the Skagit River. This year is also noteworthy as it is the last year NCC provided funding for Chinook monitoring.

As in previous seasons we used two traps – a floating inclined-plane screen trap (scoop trap) and a screw trap – to capture downstream migrants in 2006. The traps were operated from January 18 through July 31, and were fished every night and every third day unless flows and associated debris loads were excessive. The methods used to estimate Chinook abundance were changed in 2006 to improve estimate precision. In the past we used a small number of releases (four to seven groups primarily comprised of marked hatchery-produced (HOR) fish) to estimate trap efficiency. In 2006 we released 49 groups of marked natural-origin (NOR) fish to better abundance using a stratified mark-recapture approach. This technique better estimates trap efficiency under changing river conditions. These groups were marked and released above the trap. Recovery rates for these calibration groups averaged slightly higher (2.63%) than the long-term mean capture rate (2.45%) of 37 zero-age Chinook (29 HOR, 8 NORs) calibration groups that we released upstream of the mainstem traps from 1998 through 2005.

We also use mark-recapture methodology for estimating coho smolt production from the Skagit River. In 2006, as in previous years, we installed a weir trap on Mannser Creek to provide a mark group for our production estimate of coho smolts. The 2006 estimate of 735,876 NOR coho smolts was made using a pooled Peterson approach. This estimate was considerably lower than the average production from 1990 through 2005 of 1,091,590 coho smolts, and is the fourth lowest on record.

Over the season we captured 61,493 and 39,767 NOR Chinook 0+ in the scoop and screw traps, respectively. The months of January, February, March, and April accounted for 72% of the season's catch; with about 50% of the NOR Chinook 0+ catch occurring at the mainstem traps by March 25. This migration timing is very near the average longer-term median migration date we have observed from 1997-2005 (March 27). Expanding catches for the intervals not fished estimates an additional

21,778 and 19,741 NOR Chinook 0+ would have been captured in the scoop and screw traps, respectively. Combining these projected catches with the actual catches estimates 142,779 NOR Chinook 0+ would have been caught in the two traps had we fished continuously from January 18 through July 31. Applying the newly implemented stratified mark-recapture approach to the expanded catch data yields a system production estimate of approximately 6.2-million zero-age NOR Chinook (CV = 5.85%, CI +/- 712,894). Average survival-to-migration is estimated at 11.4% based on a potential deposition of 54.6 million eggs (9,922 females and an average fecundity of 5,500 eggs/female) for the 2005 brood.

Over the previous sixteen seasons, flow during egg incubation has explained most of the inter-annual variation in our estimates of egg-to-migrant survival rates for NOR Chinook. The production in 2006 is very near the value estimated by this relationship. The high adult escapement in 2005 coupled with moderate flows during incubation and migration resulted in high catches and the favorable survival rate.

In addition to NOR Chinook, we caught a total of 16,423 ad-marked and coded-wire tagged (CWT) HOR Chinook 0+ in the mainstem traps. We estimate that, had the trap fished continuously, an additional 10,140 HORs would have been captured. The projected total catch of 26,563 HOR Chinook includes 9,103 summers (released at Countyline Ponds), 7,917 falls (released at Baker River) and 9,542 springs (released at Marblemount Hatchery). Application of the stratified mark recapture efficiency data from NOR fish to expanded catches yields a combined estimate of just over 1.1 million HOR Chinook 0+. Relating this estimate to the 677,882 HOR Chinook released shows we overestimated hatchery production. We believe this high production estimate and the high recapture rates of HOR Chinook, combined with fairly high flows at release times, indicate good survival of the 2005 brood hatchery groups from release to the trap site.

Introduction

The Skagit River juvenile salmon trapping project began in 1990 with the goal of estimating coho smolt production. The trapping project, which in 2006, is in its seventeenth year, has evolved from primarily focusing on coho production to also providing production estimates of juvenile natural-origin (NOR) Chinook, as well as enumerating all juvenile salmonid captured.

From 1997 through 2006 the Skagit Non-Flow Plan Coordinating Committee (NCC) has provided funding to expand our trapping operation to more accurately estimate Skagit River NOR Chinook 0+ production. The NCC was created by Seattle City Light (operators of several dams on the Skagit), through a fisheries settlement agreement with Washington Department of Fish and Wildlife (WDFW), the Skagit System Cooperative (SSC) and Federal agencies, including NOAA Fisheries, US Fish & Wildlife Service (USFWS), US Forest Service (USFS), and National Park Service (NPS). The 2006 trapping season was the final year of NCC funding for this monitoring effort. Continued future monitoring of Skagit River juvenile chinook production will require new funding sources.

Skagit River NOR Chinook returns (spring and summer/fall combined) have declined over the last fifty years (PSSSRG 1992, 1997). In 1994, the Joint Chinook Technical Committee of the Pacific Salmon Commission designated the status of these stocks as "Not Rebuilding." To address this poor stock status, resource managers formed the Skagit River Chinook work group in 1995. Composed of State, tribal, and Federal fish biologists, this group recommends and coordinates restoration and monitoring programs. A major goal of this work group is to determine the limiting factors for Chinook production. Necessary data for this purpose include an indicator-stock tagging program, habitat inventory, annual adult escapement estimation, and NOR juvenile Chinook assessment. The juvenile production evaluation is a vital link in this process because it provides a direct measure of freshwater survival.

Understanding the major sources of inter-annual variation in salmon run sizes is critical to improving harvest and habitat management. Quantifying anadromous salmonid populations as seaward migrants near saltwater entry is the most direct assessment of stock performance in freshwater because the variation resulting from marine survival and harvest are precluded. Relating juvenile salmon production to adult spawners over a number of broods empirically determines the watershed's natural production potential (capacity), provided escapement and environmental conditions are sufficient. It also enables identification of the major density-independent source(s) of inter-annual variation in freshwater survival. To accomplish these and other fish management objectives, the WDFW implemented a long-term research program directed at measuring NOR salmon production in terms of smolts and adults in selected watersheds, beginning in 1976 (Seiler *et al.*1981). In 1981 this program, which was directed primarily at coho salmon, was expanded to include additional large watersheds (Seiler *et al.*1984). In 1990, we initiated downstream migrant trapping in the Skagit River system to quantify NOR coho smolt production as part of this program and among other objectives, resolve a discrepancy in escapement estimates (Conrad *et al.* 1997). This program, now in its seventeenth year, involves trapping and marking NOR coho smolts emigrating from a lower river tributary, Mannser Creek (R.M. 35), and sampling a portion of the entire population via floating traps in the lower mainstem (R.M. 17, Burlington Northern railroad bridge).

Although our mainstem trapping was originally directed at coho smolts and only fished during the coho migration (April-June), we identified and enumerated all fish captured during the first seven

years of this study (1990-1996). We have estimated NOR Chinook production from these years, although precision of these estimates is questionable. From 1997 to present we have fished the traps through the juvenile Chinook migration period (late January through July) and have more precisely estimated NOR Chinook 0+ production, and have estimated production for both NOR coho smolts and Chinook 0+ for the past ten years.

Several factors influence our trap catch totals, including fishing effort, migration timing (relative to the interval trapped), and instantaneous trap efficiency. Other variables such as discharge, water velocity, turbidity, debris, channel configuration, trap placement, and fish size combine to affect trap efficiency. Prior to the 2006 trapping season, the accuracy and precision of our chinook production estimates for each trapping season were not estimated as we relied on several assumptions, which remained unverified. This was remedied during the 2006 season by replacing the formerly used season average or multi-year average (e.g. Seiler et al. 2004) with a stratified mark-recapture estimator described in Volkhardt et al. (2007). This method provided precision estimates for the 2006 production estimate. Nevertheless, we believe the former approach provided a reasonably accurate estimate of NOR Chinook 0+ production from these broods. We base this contention upon the significant negative correlation between the freshwater survival estimates and the severity of flow during the period that the eggs were incubating in the gravel. The survival rates in this relationship are the ratio of total Chinook 0+ emigrants estimated past the traps to the potential egg deposition (PED). System total PED is simply the product of the estimated total adult Chinook escapement, an assumed sex ratio, and a fecundity of 5,500 eggs/female (Pete Castle pers. comm.). This relationship indicates that overall egg-to-migrant survival for Skagit River Chinook has varied nearly fifteen-fold within just the first seven broods, almost entirely as a function of flow during egg incubation.

Measuring the biological attributes of outmigration timing and size contributes to our understanding of juvenile Chinook freshwater life history. This information is useful for flow management (dams and other flow controls), habitat protection, and designing hatchery programs to minimize hatchery/NOR interactions.

We estimate coho smolt production from the Skagit River with the pooled Petersen mark and recapture strategy that we developed and have used successfully in a number of large watersheds throughout the state over many years. This method is described in Volkhardt et al. (2007) as a stratified mark-recapture approach using two traps and involves the following components:

1. Trapping all the NOR coho smolts emigrating from a selected tributary;
2. Identifying each of these smolts with an external mark; and
3. Capturing a portion of the smolt population migrating through the lower mainstem and examining each fish for the mark.

This design produces relatively precise and (we believe) unbiased production estimates, because a temporally- representative portion of the coho population is marked via 100% trapping at an upstream tributary. Therefore, trapping in the mainstem does not have to be continuous or even representative with respect to timing (Seber 1982). We explicitly developed this design to avoid the requirement of estimating gear efficiency.

Sources of Variation Affecting NOR Chinook 0+ Estimates

Estimating NOR juvenile Chinook 0+ production from trapping data involves a number of assumptions. Accuracy of the production estimates is a direct function of the veracity of these assumptions. Each assumption deals with the uncertainty resulting from the following four major sources of variation we have identified.

1. **Equal Probability of Capture**. Stratified mark-recapture estimates assume that marked and unmarked fish have equal probability of capture. We operate the traps for entire night periods after calibration releases, however, there are also periods of suspended fishing during other times. We assume the expansion of catch data to represent what would have been caught had trap operation been continuous throughout each efficiency stratum effectively meets the assumption of equal probability of capture. We further assume that all marked chinook pass the traps shortly after they are released.

2. **Day vs. night trap efficiency**. Trap efficiency may be influenced by light. For example, it may be lower during the daylight than at night. We have operated the traps primarily at night because catch rates, especially for coho and to a lesser extent Chinook, are higher at night than during the daylight. Estimating instantaneous trap efficiency during the daylight hours, however, is probably not possible because it would require that a sufficient and known number of marked NOR Chinook pass the traps within a single daylight period. The traps fish only the top 4 ft of the water column, and the depth at our site is 20-30 ft, depending on discharge. If, as a function of increasing light intensity, juvenile Chinook migrate at greater depth and/or their ability to avoid the trap increases, then trap efficiency during daylight hours would be lower. The behavior of juvenile Chinook and the biases imposed by releasing marked fish immediately upstream of the traps precludes estimating instantaneous efficiency within such a limited time interval as a single daylight period. Catches during daylight hours appear to be positively affected by increasing turbidity. If true, this positive correlation between daytime catch and turbidity results from either increased migration rate and/or an increase in trap efficiency because avoidance is reduced.

3. **Migration interval**. Skagit River Chinook 0+ emigrate over a longer season than coho smolts. Chinook begin their downstream migration in January or earlier, and continue through the summer. In the first four years, we operated the traps only over the coho smolt migration period, early-April through mid-June. Beginning in 1994, and continuing through 1996, we extended trapping as late as mid-July. In 1997, we began trapping in mid-February and continued into September. To better define the early portion of the migration period, in 1998, we began trapping in mid-January and extended trapping into September. In 1999 and 2000 we assessed late migration by operating the traps intermittently during October.

4. **Incidence of hatchery-produced fish**. Prior to 1994, releases of hatchery-produced (HOR) Chinook 0+ in the Skagit River were unmarked. Consequently, our estimates of NOR Chinook production for the first four years rely on an assumption for the number of HOR fingerlings we caught. Estimating NOR and HOR components of the migration relies on assumptions of how many HORs survived to pass the trap during the interval trapped. Beginning with the 1993 brood, (released in 1994) all HOR Chinook 0+ released into the Skagit River have been marked with an adipose fin-clip (ad-mark) and coded-wire tagged (CWT).

Study Plan for 2006

The study plan for the 2006 trapping season was directed at continuing to improve the estimates of Skagit River Chinook and coho production through achieving a better understanding of the sources of variation. In addition to continuing our analysis of the Chinook and coho trapping data collected over the previous sixteen years, the 2006 work plan included the following seven operational elements.

1. **Trapping season**. Operate traps from mid-January through July.

2. **Nightly trap operation**. Fish the scoop and screw traps nightly throughout the season.

3. **Daytime trap operation**. Trap throughout every third day; enumerate catches shortly after dawn and around dusk to separate day and night catches.

4. **NOR coho marking**. Install 100% smolt trap at Mannser Creek (tributary to the lower river) in mid-April, and operate continuously through mid-June. Enumerate and mark (left-ventral fin clip) captured coho smolts. Sampling mainstem trap catches for these marks provides the basis for estimated coho smolt production from this system. In addition, the recovery rate of these marked fish yields the season average trap efficiency.

5. **Trap efficiency strata**. In addition to the NOR coho marked and released from the Mannser Creek tributary trap, we used a stratified mark-recapture approach to estimate chinook abundance by marking and releasing frequent mark groups of NOR Chinook 0+ over the trapping season to estimate abundance over a series of discrete temporal strata.

6. **Environmental Parameters**. Relate turbidity data taken at the water withdrawal plant at Mount Vernon and flow data (USGS 12200500 Skagit River Near Mount Vernon, WA) to our day:night catch rate ratios.

7. **Assess HOR Chinook Survival.** Relate the number of ad-marked/coded-wire tagged HOR Chinook fingerlings estimated to pass the trap relative to the number released from the production facilities (Countyline Ponds, Baker River, Marblemount Hatchery) to provide a relative assessment of in-river survival.

Methods

Trapping Gear and Operation

Mainstem Traps

Two trap types are used: a floating inclined-plane screen trap (scoop trap) (Seiler *et al.* 1981, Volkhardt et al. 2007) and a screw trap (Busack *et al.* 1991, Volkhardt et al. 2007). Both traps are contained between steel pontoon barges, outfitted with two five-ton, bow-mounted anchor winches loaded with up to 600 ft of $^{3}/_{8}$-inch aircraft cable. Overall, the scoop trap barge measures 13-ft x 44-ft, while the screw trap barge is 15-ft x 30-ft. The inclined-screen of the scoop trap is 6-ft wide, and we fish it 3.5-ft deep to maintain an oblique angle to the flow. We have found that the angle formed by the 16 ft-long screen, set 3.5-ft deep at the entrance, precludes impinging even such small migrants as pink and chum fry, as there is sufficient sweep velocity across the surface relative to the direction of river flow. At this depth, the scoop trap screens a rectangular cross-sectional area of 21-ft^2. The 8-ft diameter screw trap screens a cross-sectional area of 25-ft^2, in the shape of a semi-circle.

The traps were placed in the lower Skagit River at R.M. 17 (Figure 1). With the permission of Burlington Northern-Santa Fe (BNSF) Railroad, we attached the four anchor lines to the bridge support structures. The traps were positioned side by side in the zone of highest water velocity, which is just south of the southernmost pier, approximately 70-ft from the south bank. Velocity at this site varies as a function of discharge. At low flows it averages around 5 fps, and increases to around 9 fps at high flows.

The traps were fished every night and every third day. All captured fish were enumerated by species and age and examined for external marks. To assess trap efficiency, chinook mark releases were made at the beginning of either night or continuous 36-hour night-day-night fishing periods. Samples of NOR Chinook, coho, steelhead, and char were measured (fork length ±1mm) over the season. We used the nonparametric Kolmogorov-Smirnov (K-S) two-sample test (Sokal and Rohlf 1981) to evaluate differences in the size distributions between the scoop and screw trap catches ($\alpha = 0.05$).

Mannser Creek

Mannser Creek is a small tributary that joins the Skagit River at R.M. 35.1. It provides excellent over-winter rearing habitat off of the mainstem Skagit River and is heavily utilized by juvenile coho. The Mannser Creek trap is a conventional smolt weir (Blankenship and Tivel 1980), which is installed for the duration of the coho smolt migration (mid-April through late-June). The trap was checked every day, and all fish captured were enumerated and released downstream. Coho smolts captured in the trap were enumerated and sub-sampled for fork length (±1mm); smolts in good condition were marked with a ventral fin-clip (vent-clipped) and released each day throughout the season. At the two mainstream traps, we examined every coho smolt captured to estimate the incidence of marked coho in the population. We used a two-sample K-S test to assess mainstem trap size selectivity by evaluating differences in the size distributions between the coho smolts marked and measured at Mannser and the marked coho recaptured in the mainstem traps ($\alpha = 0.05$).

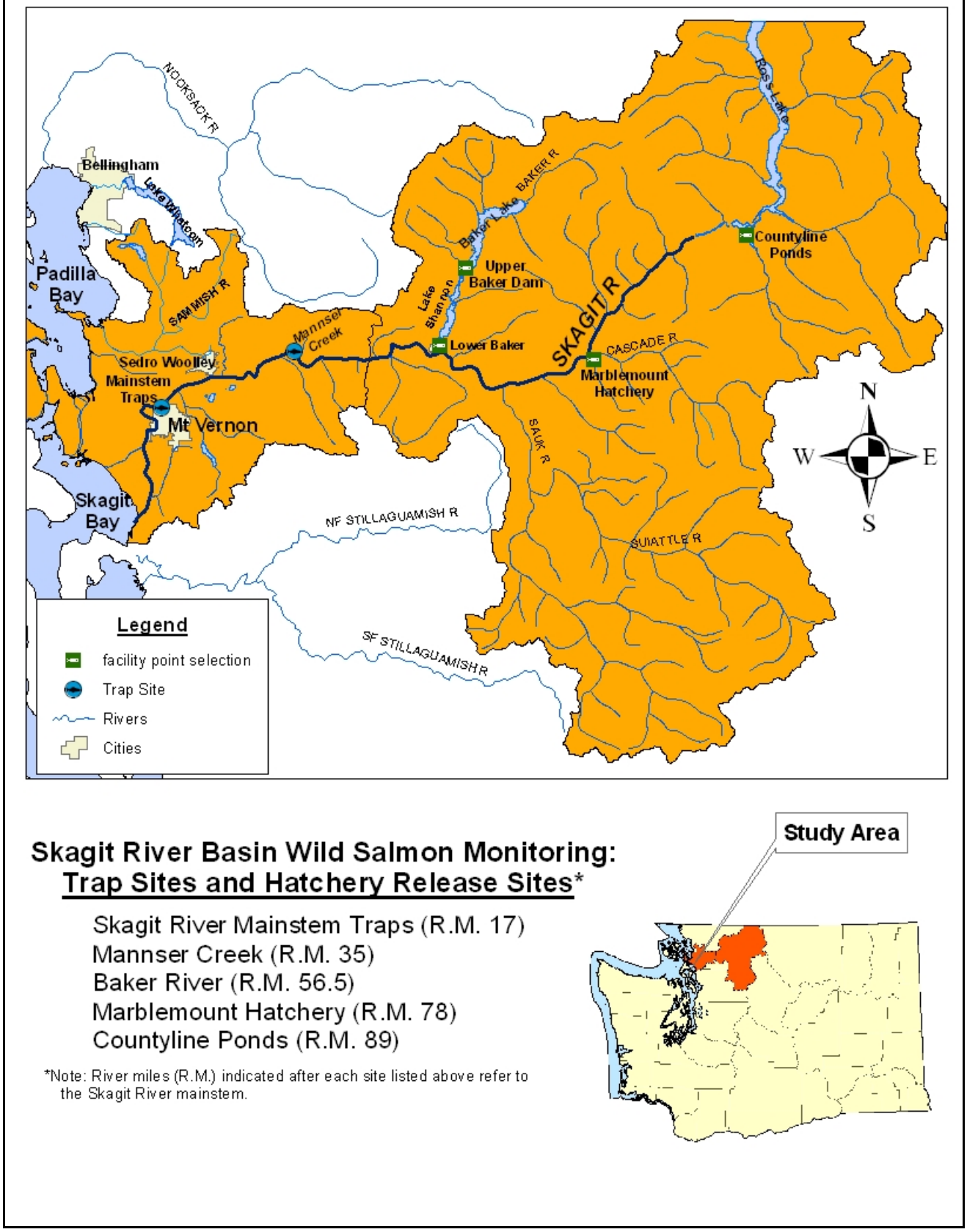

Figure 1. Map of tributary and mainstem trap sites and hatchery release sites, Skagit River NOR salmon production evaluation 2006.

Environmental Parameters

Flow is the dominant factor affecting downstream migrant trapping operations in any system. This is particularly true in the lower Skagit River due to the quantity of large woody debris this system transports during rising and high flows. We used daily mean flow data provided by the USGS gauge (#12200500), located at Mount Vernon. We also measured daily water temperatures and obtained turbidity data from the Anacortes Water Treatment Facility in Mount Vernon, located just below the trap site at R.M.16.

Estimating Migration

Naturally-Produced Chinook 0+

Basic Approach

Production estimates for NOR chinook were made using a stratified mark-recapture approach. The Petersen estimate, modified by Chapman (1951) is often used to estimate smolt abundance. Smolt abundance during each time stratum *i* is estimated by;

$$\hat{U}_i = \frac{(u_i + 1)(M_i + 1)}{(m_i + 1)} - 1 \qquad \textbf{Equation 1}$$

where:
- U_i = Migration of unmarked fish past the trap during time period *i*;
- u_i = Catch of unmarked fish during time period *i*; and
- M_i = Marked fish released above the trap during time period *i*; and
- m_i = Marked fish recaptured during time period *i*.

Seber (1982) provides and approximate unbiased estimate of the variance:

$$V(\hat{U}_i) = \frac{(M + 1)(u + 1)(M - m)(u - m)}{(m + 1)^2 (m + 2)} \qquad \textbf{Equation 2}$$

Total production over the entire smolt outmigration is estimated by;

$$\hat{N} = \sum_{i=1}^{n} \hat{U}_i \qquad \textbf{Equation 3}$$

Similarly, the variance of *N* is estimated by the sum of the variances for U_i. The normal confidence interval about *N* was calculated using:

$$\hat{N}_{95\%ci} = \hat{N} \pm 1.96\sqrt{V(\hat{N})} \qquad \textbf{Equation 4}$$

This approach assumes that marked fish and unmarked fish have the same probability of capture during each fishing period. However, recaptures of marked chinook at the Skagit River mainstem

traps occurred during a relatively short period (e.g. a few hours after release), whereas the unmarked catches they represent occurred over a longer period. Furthermore, since trapping was suspended during periods when only unmarked fish were passing the trap, the catch of unmarked fish must be estimated for the abundance estimator to be valid. In this case $\hat{u}_i$ is substituted for u_i in Equation 1. The variance, $V(\hat{U}_i)$, is now estimated using the following (see Appendix A for derivation):

$$V(\hat{U}_i) = V(\hat{u}_i)\left(\frac{(M_i+1)(M_i m_i + 3M_i + 2)}{(m_i+1)^2(m_i+2)}\right) + \left(\frac{(M_i+1)(M_i - m_i)\hat{u}_i(\hat{u}_i + m_i + 1)}{(m_i+1)^2(m_i+2)}\right) \quad \textbf{Equation 5}$$

where:

$V(\hat{u}_i)$ = Variance of the estimated unmarked catch.

Forty nine groups of marked NOR chinook were released approximately 1 mile upstream of the trap. Groups were marked with either a partial upper or lower caudal clip or Bismarck brown dye (14 ppm for 1.5 hours). Based on these releases, 49 discrete time periods were considered as initial strata. Final strata would be developed based on the number of recaptured marked fish and the similarity of flow conditions. Because we operated the trap on an every night and every third day fishing schedule, the estimated catch of unmarked NOR chinook during each stratum, $\hat{u}_i$, needed to include the actual catch, plus an estimate of catch that would have occurred during day periods not fished as well as during suspended fishing periods (both day and night periods) resulting from high river discharge and debris loading.

Day:Night Catch Rate Ratios

Chinook catch rates during the day are typically less than during the night. To assess catch rates of NOR Chinook 0+ for day and night periods, we selected sunrise and sunset as the fishing period breaks. For each trap, we sorted through the trapping interval database to select daytime fishing periods that were preceded and followed by night fishing intervals. Catch rates from the nights before and after the day period were analyzed to account for changing migration rates. Catch data were standardized by time fished in each interval and expressed as fish/hour rates. The ratio of day catch rate to night catch rate (d:n ratio) was used to indicate relative catch rates as a function of daylight and was calculated by:

$$\hat{R}_j = \frac{C_d}{h_d}\left(\frac{h_{n-1} + h_n}{C_{n-1} + C_n}\right) \quad \textbf{Equation 6}$$

where:

$\hat{R}_j$ = ratio of day to night catch rates for 36 hour period j;
C_d = catch during daylight period *d*;
C_{n-1} = catch during the night before period *n*;
C_n = catch during night period *n*;
h_{n-1} = hours during the night before period *n*;
h_n = hours during night period *n*; and

h_d = hours during day period d.

Since the d:n ratios vary with flow and turbidity, we use regression analysis to investigate the role of these covariates in explaining these catch rates. The strength of any significant relationships (α = 0.05) were considered for predicting d:n ratios. Only those relationships that resulted in an F statistic that was at least four times the significance level were considered adequate for predictive purposes (Draper and Smith 1998). Using regression, the variance of the predicted d:n ratio was estimated by;

$$V(\hat{R}) = MSE\left(1 + \frac{1}{k} + \frac{(q_i - \bar{q})^2}{(k-1)s_q^2}\right) \qquad \textbf{Equation 7}$$

where:

MSE = the mean squared error from the regression;
q_i = the independent environmental variable at time period i;
$\bar{q}$ = the mean of the environmental variable over k observations;
s_q^2 = the variance of the environmental variables over k observations; and
k = the number of measures R or q.

Where the strength of these relationships were found to be insufficient to meet this criteria, we estimated day catch using the seasonal average or median d:n ratio, depending on whether the data are approximately normally distributed. The seasonal average d:n ratio and its variance were estimated by;

$$\bar{R} = \frac{\sum R_j}{k} \qquad \textbf{Equation 8}$$

$$V(\bar{R}) = \frac{\sum (R_j - \bar{R})^2}{k(k-1)} \qquad \textbf{Equation 9}$$

Catch Expansion

To expand our unmarked NOR catches to represent catch assuming continuous trapping over each stratum, we estimate catch for all time periods (day, night and transitional) that the gear was not fished.

To estimate missed catch for nights that the traps did not fish, we used the average catch rate from the night prior to and after the trap outage and applied this rate to number of night time hours not fished. The variance was estimated by:

$$V(\hat{u}_n) = h_n^2\left(\frac{\left(\frac{u_{n-1}}{h_{n-1}} - \left(\frac{u_{n-1}+u_{n+1}}{h_{n-1}+h_{n+1}}\right)\right)^2 + \left(\frac{u_{n+1}}{h_{n+1}} - \left(\frac{u_{n-1}+u_{n+1}}{h_{n-1}+h_{n+1}}\right)\right)^2}{2}\right) \qquad \textbf{Equation 10}$$

where:

$V(\hat{u}_n)$ = Variance of the estimated catch of unmarked NORs on night *n*;
h_{n+1} = hours during the night after period *n*;
u_{n-1} = NOR catch the night prior to period *n*; and
u_{n+1} = NOR catch the night after period *n*;

We also calculated missed catch for the short time periods while the traps were out of the water to be checked (transitional periods). This missed catch was estimated applying the average catch rate for period before and after the trap was pulled to the amount of time trap did not fish. The variance was estimated using Equation 11 substituting the transitional values for the night values.

To estimate catch during daylight intervals not fished, d:n ratios predicted from regression, $\hat{R}$, or by central tendency, $\overline{R}$, were estimated using the following;

$$\hat{u}_d = R\left(\frac{u_{n-1}+u_n}{h_{n-1}+h_n}\right)h_d = R\overline{Z}h_d \qquad \textbf{Equation 11}$$

where:

R = either $\hat{R}$ or $\overline{R}$, and
$\overline{Z}$ = Average catch rate for the night prior to and following day period *d*.

The variance was estimated using the delta method (Goodman 1960);

$$V(\hat{u}_d) = h_d^2\left[V(R)\overline{Z}^2 + V(\overline{Z})R^2 - V(R)V(\overline{Z})\right] \qquad \textbf{Equation 12}$$

where:

$$V(\overline{Z}) = \left(\frac{\left(\frac{u_{n-1}}{h_{n-1}} - \left(\frac{u_{n-1}+u_n}{h_{n-1}+h_n}\right)\right)^2 + \left(\frac{u_n}{h_n} - \left(\frac{u_{n-1}+u_n}{h_{n-1}+h_n}\right)\right)^2}{2}\right) \qquad \textbf{Equation 13}$$

Actual catches and estimated catches for the various day, night, and transitional non-fishing periods were summed within each stratum to estimate $\hat{u}_i$. Similarly, $v(\hat{u}_i)$ was estimated by the sum of the estimated catch variances.

Egg-to-Migrant Survival

When we expanded our trapping season in 1997, we began to examine survival from egg deposition to NOR Chinook 0+ migration based on the following equation.

$$\hat{S} = \frac{\hat{N}_{i+1}}{\hat{G}_i \hat{E}_i \hat{F}_i}$$ **Equation 14**

Where: $\hat{N}_{i+1}$ = estimated age-Chinook 0+ migration in year i+1;

$\hat{G}_i$ = estimated proportion of females in Chinook spawning population in year i;

$\hat{E}_i$ = estimated Chinook escapement in year i; and

$\hat{F}_i$ = estimated Chinook fecundity in year i.

To estimate $\hat{G}$ and $\hat{F}$, we assumed females comprised 45% of the adult escapement, and assumed a fecundity of 5,500 eggs/female (Pete Castle, pers. comm.).

Hatchery Chinook 0+

Over the season, we captured HOR Chinook fingerlings released from Marblemount Hatchery, Baker River and Countyline Ponds. We estimated HOR migration past the trap using the same approach as described for NORs above, substituting the unmarked catch of HORs for NORs in all equations. However, recapture rates for HORs were estimated using overlapping efficiency strata groups of marked NOR chinook migrants.

HOR survival to the trap was estimated by dividing the number of HOR chinook migrating past the trap by the number released from the hatcheries. Estimation of the number of HOR migrants from each facility was complicated by the release of three different groups/stocks with the same external mark. Beginning with the release of the summer Chinook from Countyline Ponds on May 23, we systematically sacrificed a sample of ad-marked age Chinook 0+ over the entire migration period to recover tags and thereby estimate catches of each group. These results were used to apportion the catches and catch expansions of HOR migrants among the three release groups in order to estimate survival from individual facilities.

Using marked NORs to represent capture rates for HORs is potentially problematic. Although the NOR Chinook are the same species and age as the HORs, they may behave differently such that their capture rates may not accurately predict the capture rates for HOR Chinook. Therefore, survival rates estimated for HORs are considered indices.

Coho Smolts

Coho smolt production was estimated using Equation 1 and its variance using Equation 2. Production was calculated by pooling the catches of unmarked coho, releases of marked Mannser Creek coho, and recoveries of marked coho into seasonal counts representing *u*, *M*, and *m*, which were used in the equations to produce the estimators.

Results

Trap Operation and Flow

The traps were installed on January 18. Trapping operations began that afternoon, and ended on July 31. Over this 195-day season, we operated the scoop trap every night with the exception of nine nights: trap operation on three of these nights was interrupted due to mechanical problems and/or high flows and debris. We also fished the scoop trap throughout the daytime on 54 days, usually at a frequency of every third day. In total, the trap fished 2,603.7 hours out of a possible 4,646.25 hours, 56.0% of the total season. The screw trap operated on nearly the same schedule for a season total of 2,604.8 hours, 56.1 % of the total season (Table 1). From July 13 –31, the traps were operated on a four nights on/three nights off basis due to lower catches of Chinook that occur at the end of the emigration period.

Table 1. Record of Skagit River downstream migrant trap operations, all years.

Year	Gear Type	TRAPPING INTERVAL											
		Date		Season Total Days	Number of Days Fished					Hours			
					Nighttime		Daytime		Trap Out	Total	Trapped	Percent Fished
		Start	End		Full	Partial	Full	Partial				
1990	Scp/Scr	04/13	06/19	66	50	1	5	10	11	1,602.5	590.5	36.8%
1991	Scoop	04/08	06/20	73	72	1	4	18	0	1,741.5	858.0	49.3%
1992	Scoop	04/10	06/21	72	65		3	5	7	1,717.0	667.0	38.8%
1993	Scoop	04/11	06/07	57	53	2	0	8	2	1,355.5	539.5	39.8%
	Screw	04/22	06/07	46	32	0	4	5	14	1,095.0	366.5	33.5%
1994	Scoop	04/09	06/29	81	78	3	5	4	0	1,931.0	828.0	42.9%
	Screw	04/09	06/29	81	78	1	10	6	2	1,931.0	917.0	47.5%
1995	Scoop	03/25	07/15	112	112	0	5	8	0	2,724.0	1,189.0	43.6%
	Screw	03/25	07/17	114	110	2	8	8	2	2,729.5	1,207.0	44.2%
1996	Scoop	04/12	07/18	97	95	0	6	28	2	2,321.5	1,110.5	47.8%
	Screw	04/12	07/18	97	91	3	7	25	3	2,321.5	1,112.0	47.9%
1997	Scoop	02/14	09/10	208	182	9	58	53	17	4,996.0	2,719.0	54.4%
	Screw	02/14	09/10	208	174	11	56	21	23	4,996.0	2,667.0	53.4%
1998	Scoop	01/18	09/11	236	231	0	85	3	5	5,640.0	3,599.0	63.8%
	Screw	01/18	09/11	236	188	0	69	1	48	5,640.0	2,992.0	53.0%
1999	Scoop	01/16	09/06	234	223	0	72	3	11	5,595.3	3,326.9	59.5%
	Screw	01/16	09/06	234	215	0	70	1	19	5,594.8	2,353.2	42.1%
2000	Scoop	01/15	08/18	216	205	0	62	0	11	5,206.0	3,042.1	58.6%
	Screw	01/15	10/27	286	209	0	65	0	77	6,860.5	3,116.1	45.6%
2001	Scoop	01/16	07/30	195	191	1	57	3	4	4,648.7	2,701.2	58.1%
	Screw	01/16	07/30	195	184	6	53	6	5	4,648.7	2,712.8	58.4%
2002	Scoop	01/16	07/30	197	175	7	57	3	15	4,728.0	2,665.0	56.4%
	Screw	01/16	07/30	197	174	4	53	4	19	4,728.0	2,631.0	55.7%
2003	Scoop	01/15	07/30	198	180	5	56	0	13	4,693.0	2,658.0	56.6%
	Screw	01/15	07/30	198	181	2	58	2	15	4,693.0	2,651.0	56.5%
2004	Scoop	01/23	07/28	187	181	6	52	7	17	4,484.5	2,475.7	55.2%
	Screw	01/23	07/28	187	183	4	52	7	15	4,484.5	2,492.8	55.6%
2005	Scoop	01/21	07/25	185	171	5	54	14	9	4,451.7	2,567.0	57.7%
	Screw	01/21	07/25	185	170	7	56	13	8	4.451.7	2,574.9	57.8%
2006	Scoop	01/18	07/31	195	170	7	54	5	21	4,646.3	2,603.7	56.0%
	Screw	01/18	07/31	195	174	4	55	7	21	4,646.3	2,604.8	56.1%

Flows during the 2006 trapping season generally remained near the 65-year mean daily stream flow. The average daily mean flow at the Skagit River gauging station near Mount Vernon (USGS 12200500) ranged from a low of 7,820 cfs (July 30) to a high of 38,720 cfs (May 19) (Figure 2). The seasonal average daily mean flow for the duration of the 2006-trapping season was 17,064 cfs, compared to the 65-year average of 16,931 cfs for this time period.

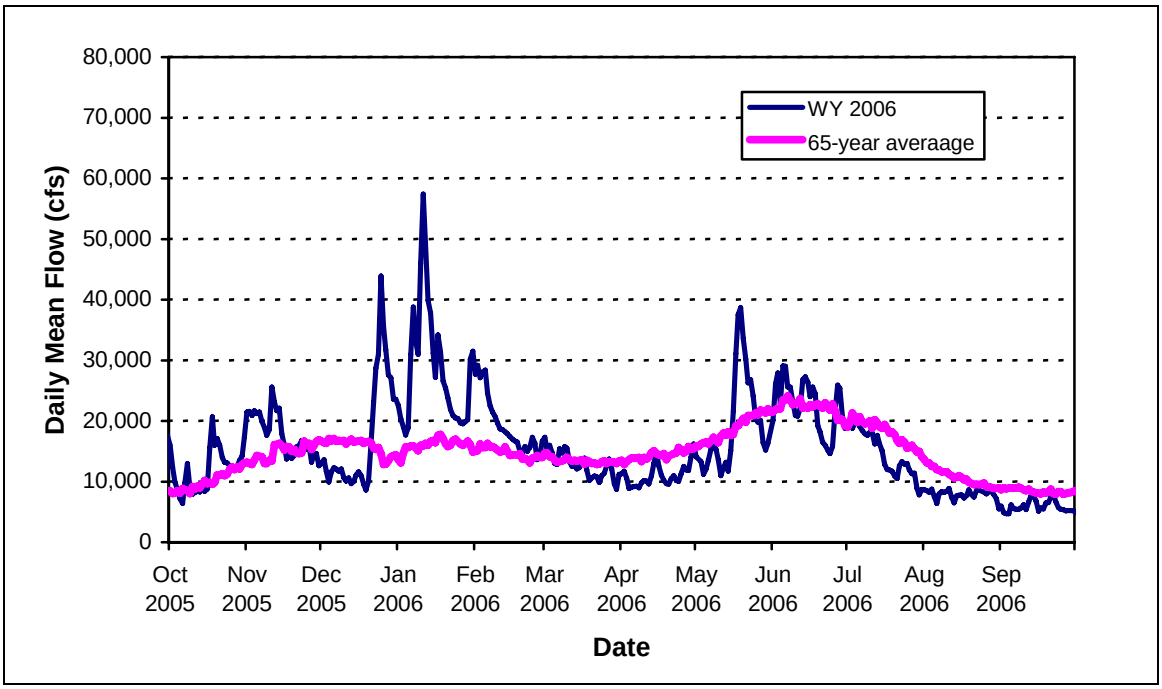

Figure 2. Comparison of daily mean flows in water year 2006 with 65-year average (water years 1940-2005), Skagit River near Mount Vernon (USGS data).

Chinook 0+

Catches

Chinook fry were moving downstream when trapping began in mid-January. A high flow event occurred on January 11 (57,400 cfs) before trapping began. Flows generally declined after this event through the month of February. Average daily mean stream flow in February was 19,454 cfs, which is well above the long-term average for February (14,754 cfs). Flows for March through April declined fairly steadily and remained below the long-term average. Flows began increasing in mid-April, with the warming weather and spring runoff, but remained below or near average until May 19. On this date, a high-water event brought the daily mean flow to 38,700 cfs, the largest flow event during the 2006 trapping season. Flows then receded, and for the month of June, remained close to the long-term daily average flow for June (22,237 cfs vs. 22,517 cfs). Flows during July were very low compared to the long-term average (14,587 cfs vs. 18,126 cfs).

Combined nightly catch rates for both screw and scoop trap started low and began rising to over 20 fish/hour by February 15. Catch rates generally remained above 20 fish/hour through April 16, and reached a peak of 165.3 fish/hour on March 26. The highest average catch rate of NOR Chinook during a night occurred on the night of March 26 (199.6 fish/hour in the scoop trap). Over the

remaining season, NOR Chinook 0+ catch rates fluctuated, but generally declined. Day-to-day variation in NOR Chinook catch rates was nearly identical between traps. The scoop trap, however, consistently out-fished the screw trap. Through the season, the scoop and screw traps captured NOR Chinook 0+ at average rates of 28 and 17 fry/hour, respectively. These rates are simply the ratio of total catches to the total hours fished for each trap.

Over the season, we captured 101,260 NOR and 16,423 HOR Chinook 0+ (Table 2). The Chinook 0+ catch numbers, NOR and HOR, do not include the recapture of those fish that were used in trap efficiency mark groups. Over the previous sixteen seasons, catches have ranged between 1,700 and 97,000 NOR zero-age Chinook, the 2006 season yielded the highest catch total we have seen in a single trapping season (Table 2 and Table 3). The combined catch of HOR Chinook 0+ in 2006 was 16,423, much greater than the average catch of 6,450 observed over the previous eight years. HOR fry catches during the previous eight years have ranged between 3,000 and 19,500 smolts.

NOR and HOR Chinook 0+ Day:Night Catch Ratios

NOR Chinook 0+ catch rates during daylight hours were compared to respective nighttime catch rates for the scoop and screw traps on 54 days each. Day:night catch rate ratios (d:n ratios) varied from 1.5% to 169.0% in the scoop trap, and from 3.3% to 657.9% in the screw trap (Table 4, Table 5). One d:n ratio was dramatically high (657.9%) in the screw trap, compared to 117.4% in the scoop trap. We have no explanation for the anomaly (flows only a little higher than normal) and excluded this outlier from the analysis. Over the season, d:n catch rate ratios averaged 48.3% and 61.0% for the scoop and screw traps, respectively (Figure 3).

To better predict catch on days the trap was not fished, we correlated d:n ratios with river discharge and turbidity. Over the dates that we computed d:n catch rate ratios for NOR Chinook 0+, flows varied from 10,300 cfs to 28,700 cfs. Given the moderate flows that dominated much of the season, we expected the brief flow increases and rises in turbidity to positively affect d:n ratios. Regression analysis found that flow explained a majority of the variation in d:n ratios for NOR zero-age Chinook in the scoop (R^2=0.46) and screw (R^2=0.38) traps over the season.

Similarly, we correlated d:n ratios for NOR Chinook 0+ with daily turbidity data through the season, and found that, as with flow, turbidity does positively influence d:n ratios but explained less of the variation (scoop R^2= 0.33; screw R^2= 0.20). We elected to use the flow based regression models to predict d:n ratios for both the scoop and screw traps to estimate catch for daytime periods not fished (Figure 3).

We used the same methods for predicting missed catch of HOR Chinook 0+ (Table 6, Table 7). Regression analysis showed that d:n catch rate ratios correlated with daily mean flows (scoop R^2=0.31; screw R^2=0.62), and could be used to predict catches of HOR smolts from daytime periods not fished.

Table 2. Downstream-migrant salmonids captured in the Skagit River mainstem traps, 1998-2006.

Species	1998		1999		2000		2001		2002		2003		2004		2005		2006	
	Scoop	Screw	Scoop	Screw	Scoop	Screw	Scoop	Screw	Scoop	Screw	Scoop	Screw	Scoop	Screw	Scoop	Screw	Scoop	Screw
Coho 1+																		
NOR	13879	9076	4904	3314	13449	14861	2581	4354	8807	9347	6236	7537	10440	6615	4589	3794	4576	5098
HOR	623	1028	673	635	624	946	103	398	453	668	447	1229	647	1511	119	246	365	1034
Coho 0+	1216	409	744	311	115	27	2604	871	1896	435	1303	366	2786	510	1453	420	209	75
Chinook 1+																		
NOR	876	350	198	87	129	105	32	26	199	228	95	94	342	205	59	57	51	42
HOR	24	12	201	41	511	360	26	50	177	161	170	122	172	212	33	24	158	108
Chinook 0+																		
NOR	33698	20001	55254	41492	23289	14944	54762	40180	35332	24908	51316	34498	13009	6694	44737	34470	61493	39767
HOR	5837	2127	3449	2213	2554	2152	1667	1354	3310	2726	2033	1611	[a]12874	[b]6600	657	440	8294	8129
Sockeye 1+	111	84	72	23	9	11	5	1	27	35	1	7	88	83	17	4	45	72
Chum 0+	37162	18498	172774	108730	39608	40234	133890	105200	16526	16664	82668	70059	66739	58488	47439	34087	44269	34767
Pink 0+	338520	102338	476	265	207530	198015	2644	1350	104782	153668	1604	1731	113975	99507	26	18	178987	127908
Steelhead 1+																		
NOR	389	1,100	99	334	95	597	32	317	118	437	32	366	337	1287	45	289	36	293
HOR	446	2,325	122	511	75	736	23	465	75	534	26	474	213	2401	16	183	17	624
Steelhead Adult	1	3	11	1	1	2	0	0	1	2	0	0	0	0	2	0	0	0
Cutthroat 1+	98	401	30	150	51	248	11	318	53	196	32	151	34	233	19	279	17	169
Cutthroat adult	2	5	4	0	0	7	0	0	0	7	0	0	0	18	0	21	0	0
Native char 1+	153	206	101	98	109	138	20	125	74	115	81	73	91	101	10	21	31	59
Trout Parr	90	83	42	57	116	155	86	123	31	44	83	102	64	61	19	13	53	59

[a] Includes 690 unmarked hatchery Chinook.

[b] Includes 341 unmarked hatchery Chinook.

Table 3. Downstream-migrant salmonids captured in the Skagit River mainstem traps, 1990-1997.

Species	1990	1991	1992	1993		1994		1995		1996		1997	
	Scoop	Scoop	Scoop	Scoop	Screw	Scoop	Screw	Scoop	Screw	Scoop	Screw	Scoop	Screw
Coho 1+													
NOR	10,204	6,904	8,620	3,636	3,690	10,767	10,211	8,661	8,824	11,520	9,134	6,437	5,975
HOR	234	382	596	[a]714	[a]723	1,880	1,873	4,800	5,274	973	1,208	334	362
Coho 0+	48	22	64	79	4	57	5	204	57	246	50	364	220
Chinook 1+													
NOR	[b]45	[b]1,132	[b]299	[b]3,567	[b]262	308	212	184	112	80	32	46	52
HOR	---	---	---	---	---	---	---	1,754	570	415	117	376	249
Chinook 0+													
NOR	[c]8,528	[d]1,706	[e]8,812	[f]7,463	[f]3,415	9,721	4,743	10,536	5,767	2,834	1,731	26,798	20,780
HOR	---	---	---	---	---	2,320	1,098	6,083	2,022	4,165	2,888	1,163	684
Sockeye 1+	2	21	2	32	16	108	45	31	17	36	56	59	48
Chum 0+	617	48,505	3,081	66,790	13,939	5,113	7,689	66,139	55,824	10,578	5,384	38,243	39,174
Pink 0+	697	0	18,682	0	0	48,532	22,952	0	0	27,482	9,778	9	17
Steelhead 1+													
NOR	198	301	332	304	663	601	1,297	532	1,184	364	778	319	531
HOR	223	66	124	658	2,381	670	3,107	1,282	4,579	751	1,751	982	2,401
Steelhead Adult	0	0	0	0	0	0	0	4	1	1	0	3	4
Cutthroat 1+	117	60	153	45	91	198	437	107	263	165	332	58	89
Cutthroat adult	0	0	0	0	0	0	0	1	0	0	2	2	13
Native char 1+	130	112	132	76	74	197	255	189	179	142	102	65	77
Trout Parr	N/A	N/A	N/A	12	7	47	69	56	47	110	68	40	61

[a] Estimated by proportion of total catch.
[b] Includes both hatchery and wild.
[c] 1989 brood released from Clark Creek = 1,728,100: falls = 1,170,800 Samish stock + 236,000 Clark Creek stock, released on June 8, 1990; and summers = 73,800 + 246,900 Clark Creek stock released on June 28, 1990.
[d] Clark Creek stock released on June 18, 1991: 1,144,500 falls and 111,120 summers.
[e] Clark Creek stock: 786,100 falls released February 25, 1992; 483,280 summers released on April 20, 1992; and 120,000 released on May 21, 1992.
[f] Clark Creek stock: 1,588,800 falls released in February 1993; 250,000 falls released on March 16, 1993; and 160,000 summers released on May 16, 1993.

Table 4. Catch/hour rates, day: night catch rate ratios of NOR Chinook 0+ during day and night periods, and corresponding flow and turbidity measurements, Skagit River scoop trap 2006.

NIGHT TIME							DAY TIME								
Trap Down		Trap Up		Hours	Chin	Catch	Date	Time		Hours	Chin	Catch	D:N	Flow	Turbidity
Date	Time	Date	Time	Fished	0+	Rate		Down	Up	Fished	0+	Rate	Ratio	cfs	NTU
01/20/06	17:30	01/22/06	07:25	28.50	63	2.21	01/21/06	07:55	16:45	8.83	33	3.74	169.0%	24,100	20.2
01/23/06	17:15	01/25/06	07:30	28.17	123	4.37	01/24/06	07:25	17:10	9.75	50	5.13	117.4%	21,000	12.8
01/26/06	17:00	01/28/06	07:30	28.42	192	6.76	01/27/06	08:30	17:15	8.75	46	5.26	77.8%	20,200	10.3
02/01/06	17:30	02/03/06	07:30	28.08	202	7.19	02/02/06	07:55	17:30	9.58	83	8.66	120.4%	28,700	21.3
02/05/06	20:00	02/07/06	07:45	25.75	351	13.63	02/06/06	07:55	17:30	9.58	141	14.71	107.9%	24,700	13.2
02/07/06	17:30	02/09/06	07:30	27.83	395	14.19	02/08/06	07:45	17:30	9.75	55	5.64	39.7%	21,900	10
02/10/06	17:45	02/12/06	07:30	27.58	578	20.95	02/11/06	08:00	17:45	9.75	173	17.74	84.7%	19,400	8.3
02/14/06	17:15	02/16/06	07:00	27.50	783	28.47	02/15/06	07:45	17:30	9.75	243	24.92	87.5%	18,200	8.6
02/19/06	17:30	02/21/06	07:30	27.75	1196	43.10	02/20/06	07:45	17:40	9.92	164	16.54	38.4%	15,700	8.3
02/22/06	17:30	02/24/06	07:00	27.42	1205	43.95	02/23/06	07:40	17:15	9.58	667	69.60	158.4%	16,500	8.6
02/25/06	17:50	02/27/06	07:40	26.92	1281	47.59	02/26/06	07:25	18:00	10.58	257	24.28	51.0%	14,600	8.6
02/28/06	17:45	03/02/06	07:00	26.08	1801	69.05	03/01/06	07:10	18:00	10.83	286	26.40	38.2%	18,100	9.7
03/03/06	18:00	03/05/06	07:00	25.83	1437	55.63	03/04/06	07:10	18:00	10.83	478	44.12	79.3%	15,700	7.2
03/06/06	18:00	03/08/06	07:00	25.83	2003	77.54	03/07/06	07:15	18:00	10.75	529	49.21	63.5%	16,300	6.1
03/09/06	18:30	03/11/06	07:00	25.08	1452	57.89	03/10/06	07:15	18:15	11.00	476	43.27	74.8%	16,400	7.1
03/12/06	18:30	03/14/06	07:00	24.83	990	39.87	03/13/06	07:15	18:30	11.25	125	11.11	27.9%	13,800	3.1
03/15/06	18:30	03/17/06	06:15	23.75	923	38.86	03/16/06	06:45	18:15	11.50	120	10.43	26.9%	14,700	4.7
03/18/06	18:30	03/20/06	06:30	23.83	879	36.88	03/19/06	06:40	18:30	11.83	95	8.03	21.8%	11,300	3.9
03/21/06	18:30	03/23/06	06:00	23.33	1077	46.16	03/22/06	06:45	18:30	11.75	105	8.94	19.4%	11,900	2.6
03/24/06	18:30	03/26/06	06:15	23.33	2443	104.70	03/25/06	06:30	18:30	12.00	403	33.58	32.1%	12,500	3.7
03/27/06	18:30	03/29/06	06:00	22.83	1557	68.19	03/28/06	06:15	18:30	12.25	239	19.51	28.6%	13,200	5.9
03/30/06	18:30	04/01/06	06:00	22.83	1296	56.76	03/31/06	06:10	18:30	12.33	192	15.57	27.4%	12,400	4
04/02/06	19:30	04/04/06	07:00	22.83	830	36.35	04/03/06	07:10	19:30	12.33	130	10.54	29.0%	11,600	6
04/05/06	19:45	04/07/06	06:45	21.75	769	35.36	04/06/06	07:00	19:45	12.75	57	4.47	12.6%	10,300	3.3
04/08/06	19:45	04/10/06	06:45	21.75	675	31.03	04/09/06	07:00	19:45	12.75	243	19.06	61.4%	10,900	4.2
04/12/06	20:00	04/14/06	06:45	21.33	1141	53.48	04/13/06	07:00	20:00	13.00	225	17.31	32.4%	12,000	4
04/14/06	20:00	04/16/06	06:30	19.33	1666	86.17	04/15/06	06:35	20:00	13.42	610	45.47	52.8%	15,800	17.2
04/17/06	20:00	04/19/06	06:30	21.08	269	12.76	04/18/06	07:00	19:55	12.92	32	2.48	19.4%	11,300	3.9
04/20/06	20:00	04/22/06	06:15	20.50	289	14.10	04/21/06	06:45	19:45	13.00	8	0.62	4.4%	11,600	3.7
04/23/06	20:00	04/25/06	06:00	20.08	79	3.93	04/24/06	06:25	20:00	13.58	4	0.29	7.5%	11,200	3.4
04/26/06	20:00	04/28/06	06:00	19.50	251	12.87	04/27/06	06:15	20:15	14.00	30	2.14	16.6%	13,000	3.9
04/29/06	20:15	05/01/06	06:00	19.50	759	38.92	04/30/06	06:15	16:00	9.75	157	16.10	41.4%	17,100	3.9
05/02/06	20:30	05/04/06	06:00	18.75	333	17.76	05/03/06	06:15	20:30	14.25	13	0.91	5.1%	14,300	4.3
05/05/06	20:30	05/07/06	06:00	18.75	261	13.92	05/06/06	06:15	20:30	14.25	26	1.82	13.1%	14,500	3.8
05/08/06	20:30	05/10/06	06:00	19.00	96	5.05	05/09/06	07:00	20:30	13.50	7	0.52	10.3%	16,200	4.7
05/11/06	20:45	05/13/06	05:45	18.00	72	4.00	05/12/06	06:00	20:30	14.50	6	0.41	10.3%	13,300	3.8
05/14/06	21:00	05/16/06	02:00	13.75	81	5.89	05/15/06	06:00	20:45	14.75	14	0.95	16.1%	16,000	4.3
05/26/06	21:15	05/28/06	05:30	16.50	512	31.03	05/27/06	05:45	21:00	15.25	465	30.49	98.3%	20,200	15.1
05/29/06	21:00	05/31/06	05:30	16.83	568	33.74	05/30/06	05:40	21:00	15.33	174	11.35	33.6%	16,200	10.5
06/07/06	21:30	06/09/06	05:30	15.58	268	17.20	06/08/06	05:30	21:30	16.00	171	10.69	62.1%	25,300	15
06/10/06	21:30	06/12/06	05:30	16.00	227	14.19	06/11/06	05:45	21:30	15.75	125	7.94	55.9%	20,800	8
06/13/06	21:30	06/15/06	06:00	16.25	193	11.88	06/14/06	05:30	21:15	15.75	218	13.84	116.5%	26,800	28.1
06/16/06	21:30	06/18/06	05:30	15.83	204	12.88	06/17/06	05:45	21:30	15.75	123	7.81	60.6%	25,200	8.6
06/19/06	21:30	06/21/06	05:30	15.75	124	7.87	06/20/06	05:30	21:30	16.00	101	6.31	80.2%	18,200	6.6
06/22/06	21:30	06/24/06	05:30	15.75	102	6.48	06/23/06	05:30	21:15	15.75	32	2.03	31.4%	15,100	5.3
06/28/06	21:30	06/30/06	05:30	15.75	225	14.29	06/29/06	05:45	21:30	15.75	120	7.62	53.3%	20,700	17.1
07/01/06	21:15	07/03/06	05:30	16.25	130	8.00	07/02/06	05:40	21:30	15.83	24	1.52	18.9%	19,200	7.4
07/05/06	21:30	07/07/06	05:45	16.25	149	9.17	07/06/06	06:00	21:30	15.50	63	4.06	44.3%	19,100	13.8
07/07/06	21:35	07/09/06	05:45	16.17	102	6.31	07/08/06	06:00	21:30	15.50	36	2.32	36.8%	17,900	8.4
07/10/06	21:30	07/12/06	05:30	15.75	108	6.86	07/11/06	05:45	21:35	15.83	30	1.89	27.6%	18,000	8.8
07/16/06	21:45	07/18/06	06:00	16.75	33	1.97	07/17/06	06:15	21:15	15.00	7	0.47	23.7%	11,900	6.2
07/18/06	21:30	07/20/06	06:00	17.00	74	4.35	07/19/06	06:15	21:15	15.00	1	0.07	1.5%	11,600	4.9
07/23/06	21:30	07/25/06	06:00	17.00	191	11.24	07/24/06	06:15	18:45	12.50	19	1.52	13.5%	12,800	20.5
07/25/06	21:30	07/27/06	06:00	17.08	89	5.21	07/26/06	06:15	21:15	15.00	21	1.40	26.9%	11,800	19.1
			SEASON TOTAL	1,143.92	33,097	28.93				692.42	8,252	11.92	41.2%		
			SEASON AVERAGE										48.3%		
			SEASON MEDIAN										35.2%		

Table 5. Catch/hour rates, day: night catch rate ratios of NOR Chinook 0+ during day and night periods, and corresponding flow and turbidity measurements, Skagit River scoop trap 2006.

NIGHT TIME							DAY TIME								
Trap Down		Trap Up		Hours	Chin	Catch	Date	Time		Hours	Chin	Catch	D:N	Flow	Turbidity
Date	Time	Date	Time	Fished	0+	Rate		Down	Up	Fished	0+	Rate	Ratio	cfs	NTU
01/20/06	17:30	01/22/06	07:30	28.83	52	1.80	01/21/06	08:00	16:55	8.92	25	2.80	155.5%	24,100	20.2
01/26/06	17:00	01/28/06	07:30	28.50	60	2.11	01/27/06	08:00	17:15	9.25	32	3.46	164.3%	20,200	10.3
02/01/06	17:30	02/03/06	07:30	28.25	94	3.33	02/02/06	07:45	17:30	9.75	46	4.72	141.8%	28,700	21.3
02/05/06	20:00	02/07/06	07:45	26.00	277	10.65	02/06/06	07:45	17:30	9.75	116	11.90	111.7%	24,700	13.2
02/07/06	17:35	02/09/06	07:45	27.83	170	6.11	02/08/06	07:45	17:40	9.92	60	6.05	99.1%	21,900	10
02/10/06	17:45	02/12/06	07:30	27.75	287	10.34	02/11/06	07:45	17:45	10.00	170	17.00	164.4%	19,400	8.3
02/14/06	17:15	02/16/06	07:00	27.75	265	9.55	02/15/06	07:30	17:30	10.00	167	16.70	174.9%	18,200	8.6
02/16/06	17:20	02/18/06	07:30	28.00	274	9.79	02/17/06	07:35	17:30	9.92	108	10.89	111.3%	17,500	8.3
02/19/06	17:30	02/21/06	07:30	27.83	540	19.40	02/20/06	07:40	17:40	10.00	81	8.10	41.8%	15,700	8.3
02/22/06	17:30	02/24/06	07:00	27.17	833	30.66	02/23/06	07:30	17:30	10.00	461	46.10	150.3%	16,500	8.6
02/25/06	17:45	02/27/06	07:30	27.08	626	23.11	06/26/06	07:15	17:55	10.67	181	16.97	73.4%	14,600	8.6
02/28/06	17:45	03/02/06	07:00	26.25	1146	43.66	03/01/06	07:00	18:00	11.00	237	21.55	49.4%	18,100	9.7
03/06/06	18:00	03/08/06	07:00	26.00	1052	40.46	03/07/06	07:00	18:00	11.00	380	34.55	85.4%	16,300	6.1
03/09/06	18:30	03/11/06	07:00	25.25	712	28.20	03/10/06	07:00	18:15	11.25	306	27.20	96.5%	16,400	7.1
03/12/06	18:30	03/14/06	07:00	25.00	579	23.16	03/13/06	07:15	18:30	11.25	105	9.33	40.3%	13,800	3.1
03/15/06	18:30	03/17/06	06:15	24.00	589	24.54	03/16/06	06:30	18:15	11.75	85	7.23	29.5%	14,700	4.7
03/18/06	18:30	03/20/06	06:30	24.00	670	27.92	03/19/06	06:30	18:30	12.00	84	7.00	25.1%	11,300	3.9
03/21/06	18:30	03/23/06	06:00	23.50	709	30.17	03/22/06	06:30	18:30	12.00	117	9.75	32.3%	11,900	2.6
03/24/06	18:30	03/26/06	06:15	23.50	1672	71.15	03/25/06	06:15	18:30	12.25	414	33.80	47.5%	12,500	3.7
03/27/06	18:30	03/29/06	06:00	23.00	925	40.22	03/28/06	06:00	18:30	12.50	181	14.48	36.0%	13,200	5.9
03/30/06	18:30	04/01/06	06:00	23.00	1125	48.91	03/31/06	06:00	18:30	12.50	237	18.96	38.8%	12,400	4
04/02/06	19:30	04/04/06	07:00	22.83	555	24.31	04/03/06	07:00	19:30	12.50	150	12.00	49.4%	11,600	6
04/05/06	19:45	04/07/06	06:45	22.00	601	27.32	04/06/06	06:45	19:45	13.00	64	4.92	18.0%	10,300	3.3
04/08/06	19:45	04/10/06	06:45	22.00	515	23.41	04/09/06	07:00	19:45	12.75	216	16.94	72.4%	10,900	4.2
04/12/06	20:00	04/14/06	06:45	21.50	747	34.74	04/13/06	07:00	20:00	13.00	194	14.92	43.0%	12,000	4
04/14/06	20:00	04/16/06	06:30	19.33	635	32.84	04/15/06	06:40	20:00	13.33	441	33.08	100.7%	15,800	17.2
04/17/06	20:00	04/19/06	06:30	21.00	163	7.76	04/18/06	06:45	20:00	13.25	16	1.21	15.6%	11,300	3.9
04/20/06	20:00	04/22/06	06:15	20.50	140	6.83	04/21/06	06:45	19:45	13.00	48	3.69	54.1%	11,600	3.7
04/23/06	20:00	04/25/06	06:00	20.25	42	2.07	04/24/06	06:15	20:00	13.75	3	0.22	10.5%	11,200	3.4
04/26/06	20:00	04/28/06	06:00	19.75	106	5.37	04/27/06	06:00	20:15	14.25	30	2.11	39.2%	13,000	3.9
04/29/06	20:15	05/01/06	06:00	19.50	317	16.26	04/30/06	06:30	16:00	9.50	142	14.95	91.9%	17,100	3.9
05/02/06	20:30	05/04/06	06:00	19.00	177	9.32	05/03/06	06:20	20:30	14.17	7	0.49	5.3%	14,300	4.3
05/05/06	20:30	05/07/06	06:00	19.00	102	5.37	05/06/06	06:00	20:30	14.50	24	1.66	30.8%	14,500	3.8
05/08/06	20:30	05/10/06	05:45	18.75	28	1.49	05/09/06	07:30	20:30	13.00	13	1.00	67.0%	16,200	4.7
05/11/06	20:45	05/13/06	05:45	18.25	30	1.64	05/12/06	05:45	20:30	14.75	3	0.20	12.4%	13,300	3.8
05/14/06	21:00	05/16/06	02:00	14.00	51	3.64	05/15/06	05:45	20:45	15.00	5	0.33	9.2%	16,000	4.3
05/26/06	21:00	05/28/06	05:30	16.50	409	24.79	05/27/06	06:00	21:00	15.00	376	25.07	101.1%	20,200	15.1
05/29/06	21:00	05/31/06	05:30	16.83	393	23.35	05/30/06	05:40	21:00	15.33	133	8.67	37.2%	16,200	10.5
06/07/06	21:45	06/09/06	05:30	15.33	277	18.07	06/08/06	05:15	21:30	16.25	216	13.29	73.6%	25,300	15
06/10/06	21:30	06/12/06	05:30	16.00	265	16.56	06/11/06	05:30	21:30	16.00	158	9.88	59.6%	20,800	8
06/13/06	21:30	06/15/06	06:00	16.42	177	10.78	06/14/06	05:30	21:15	15.75	271	17.21	159.6%	26,800	28.1
06/16/06	21:30	06/18/06	05:30	16.00	265	16.56	06/17/06	05:30	21:30	16.00	171	10.69	64.5%	25,200	8.6
06/19/06	21:30	06/21/06	05:30	16.00	126	7.88	06/20/06	05:45	21:30	15.75	64	4.06	51.6%	18,200	6.6
06/22/06	21:30	06/24/06	05:30	15.75	85	5.40	06/23/06	05:15	21:15	16.00	30	1.88	34.7%	15,100	5.3
06/28/06	21:30	06/30/06	05:30	16.00	197	12.31	06/29/06	05:30	21:30	16.00	108	6.75	54.8%	20,700	17.1
07/01/06	21:15	07/03/06	05:30	16.25	122	7.51	07/02/06	05:30	21:30	16.00	11	0.69	9.2%	19,200	7.4
07/05/06	21:30	07/07/06	05:45	16.50	138	8.36	07/06/06	05:45	21:30	15.75	46	2.92	34.9%	19,100	13.8
07/07/06	21:35	07/09/06	05:45	16.42	89	5.42	07/08/06	05:45	21:30	15.75	13	0.83	15.2%	17,900	8.4
07/10/06	21:30	07/12/06	05:30	16.00	86	5.38	07/11/06	05:45	21:30	15.75	15	0.95	17.7%	18,000	8.8
07/16/06	21:30	07/18/06	06:00	17.25	22	1.28	07/17/06	06:00	21:15	15.25	2	0.13	10.3%	11,900	6.2
07/18/06	21:30	07/20/06	06:00	17.25	34	1.97	07/19/06	06:00	21:15	15.25	1	0.07	3.3%	11,600	4.9
07/23/06	21:30	07/25/06	06:00	17.00	115	6.76	07/24/06	06:00	18:30	12.50	3	0.24	3.5%	12,800	20.5
07/25/06	21:30	07/27/06	06:00	17.00	41	2.41	07/26/06	06:00	21:20	15.33	6	0.39	16.2%	11,800	19.1
SEASON TOTAL				1,124.67	19,707	17.52				689.08	6,573	9.54	54.4%		
SEASON AVERAGE													61.0%		
SEASON MEDIAN													47.5%		

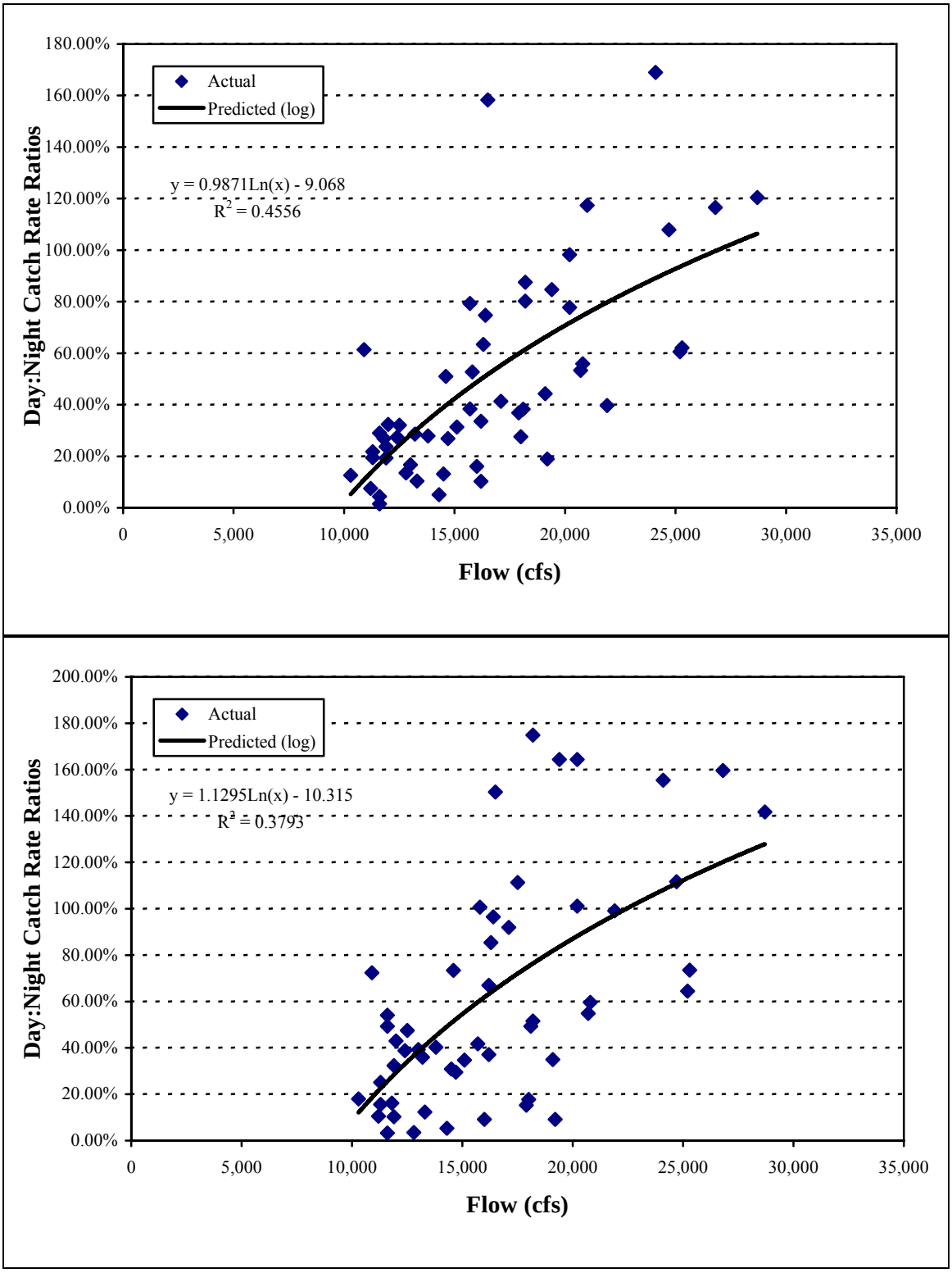

Figure 3. Day:night catch rate ratios and predicted values for Skagit River mainstem scoop and screw traps, 2006.

Table 6. Catch/hour rates, day: night catch rate ratios of HOR Chinook 0+ during day and night periods, and corresponding flow and turbidity measurements, Skagit River scoop trap 2006

NIGHT TIME							DAY TIME								
Trap Down		Trap Up		Hours	Chin	Catch	Date	Time		Hours	Chin	Catch	D:N	Flow	Turbidity
Date	Time	Date	Time	Fished	0+	Rate		Down	Up	Fished	0+	Rate	Ratio	cfs	NTU
05/26/06	21:15	05/28/06	05:30	16.50	237	14.36	05/27/06	05:45	21:00	15.25	64	4.20	29.2%	20,200	15.10
05/29/06	21:00	05/31/06	05:30	16.83	703	41.76	05/30/06	05:40	21:00	15.33	133	8.67	20.8%	16,200	10.50
06/07/06	21:30	06/09/06	05:30	15.58	492	31.57	06/08/06	05:30	21:30	16.00	227	14.19	44.9%	25,300	15.00
06/10/06	21:30	06/12/06	05:30	16.00	174	10.88	06/11/06	05:45	21:30	15.75	83	5.27	48.5%	20,800	8.00
06/13/06	21:30	06/15/06	06:00	16.25	82	5.05	06/14/06	05:30	21:15	15.75	75	4.76	94.4%	26,800	28.10
06/16/06	21:30	06/18/06	05:30	15.83	1112	70.23	06/17/06	05:45	21:30	15.75	841	53.40	76.0%	25,200	8.60
06/19/06	21:30	06/21/06	05:30	15.75	226	14.35	06/20/06	05:30	21:30	16.00	119	7.44	51.8%	18,200	6.60
06/22/06	21:30	06/24/06	05:30	15.75	87	5.52	06/23/06	05:30	21:15	15.75	22	1.40	25.3%	15,100	5.30
06/28/06	21:30	06/30/06	05:30	15.75	107	6.79	06/29/06	05:45	21:30	15.75	39	2.48	36.4%	20,700	17.10
07/01/06	21:15	07/03/06	05:30	16.25	53	3.26	07/02/06	05:40	21:30	15.83	4	0.25	7.7%	19,200	7.40
07/05/06	21:30	07/07/06	05:45	16.25	66	4.06	07/06/06	06:00	21:30	15.50	42	2.71	66.7%	19,100	13.80
07/07/06	21:35	07/09/06	05:45	16.17	37	2.29	07/08/06	06:00	21:30	15.50	21	1.35	59.2%	17,900	8.40
07/10/06	21:30	07/12/06	05:30	15.75	36	2.29	07/11/06	05:45	21:35	15.83	22	1.39	60.8%	18,000	8.80
07/16/06	21:45	07/18/06	06:00	16.75	8	0.48	07/17/06	06:15	21:15	15.00	5	0.33	69.8%	11,900	6.20
07/18/06	21:30	07/20/06	06:00	17.00	31	1.82	07/19/06	06:15	21:15	15.00	2	0.13	7.3%	11,600	4.90
07/23/06	21:30	07/25/06	06:00	17.00	39	2.29	07/24/06	06:15	18:45	12.50	6	0.48	20.9%	12,800	20.50
07/25/06	21:30	07/27/06	06:00	17.08	24	1.40	07/26/06	06:15	21:15	15.00	4	0.27	19.0%	11,800	19.10
		SEASON TOTAL		276.50	3,514	12.71				261.50	1,709	6.54	51.4%		
		SEASON AVERAGE											43.5%		
		SEASON MEDIAN											44.9%		

Table 7. Catch/hour rates, day: night catch rate ratios of HOR Chinook 0+ during day and night periods, and corresponding flow and turbidity measurements, Skagit River screw trap 2006.

NIGHT TIME							DAY TIME								
Trap Down		Trap Up		Hours	Chin	Catch	Date	Time		Hours	Chin	Catch	D:N	Flow	Turbidity
Date	Time	Date	Time	Fished	0+	Rate		Down	Up	Fished	0+	Rate	Ratio	cfs	NTU
05/26/06	21:00	05/28/06	05:30	16.50	229	13.88	05/27/06	06:00	21:00	15.00	55	3.67	26.4%	20,200	15.1
05/29/06	21:00	05/31/06	05:30	16.83	509	30.24	05/30/06	05:40	21:00	15.33	64	4.17	13.8%	16,200	10.5
06/07/06	21:45	06/09/06	05:30	15.33	466	30.39	06/08/06	05:15	21:30	16.25	163	10.03	33.0%	25,300	15
06/10/06	21:30	06/12/06	05:30	16.00	223	13.94	06/11/06	05:30	21:30	16.00	113	7.06	50.7%	20,800	8
06/13/06	21:30	06/15/06	06:00	16.42	100	6.09	06/14/06	05:30	21:15	15.75	119	7.56	124.0%	26,800	28.1
06/16/06	21:30	06/18/06	05:30	16.00	1282	80.13	06/17/06	05:30	21:30	16.00	888	55.50	69.3%	25,200	8.6
06/19/06	21:30	06/21/06	05:30	16.00	230	14.38	06/20/06	05:45	21:30	15.75	97	6.16	42.8%	18,200	6.6
06/22/06	21:30	06/24/06	05:30	15.75	54	3.43	06/23/06	05:15	21:15	16.00	14	0.88	25.5%	15,100	5.3
06/28/06	21:30	06/30/06	05:30	16.00	125	7.81	06/29/06	05:30	21:30	16.00	52	3.25	41.6%	20,700	17.1
07/01/06	21:15	07/03/06	05:30	16.25	46	2.83	07/02/06	05:30	21:30	16.00	3	0.19	6.6%	19,200	7.4
07/05/06	21:30	07/07/06	05:45	16.50	47	2.85	07/06/06	05:45	21:30	15.75	18	1.14	40.1%	19,100	13.8
07/07/06	21:35	07/09/06	05:45	16.42	40	2.44	07/08/06	05:45	21:30	15.75	5	0.32	13.0%	17,900	8.4
07/10/06	21:30	07/12/06	05:30	16.00	28	1.75	07/11/06	05:45	21:30	15.75	13	0.83	47.2%	18,000	8.8
07/16/06	21:30	07/18/06	06:00	17.25	8	0.46	07/17/06	06:00	21:15	15.25	1	0.07	14.1%	11,900	6.2
07/18/06	21:30	07/20/06	06:00	17.25	8	0.46	07/19/06	06:00	21:15	15.25	0	0.00	0.0%	11,600	4.9
07/23/06	21:30	07/25/06	06:00	17.00	55	3.24	07/24/06	06:00	18:30	12.50	2	0.16	4.9%	12,800	20.5
07/25/06	21:30	07/27/06	06:00	17.00	8	0.47	07/26/06	06:00	21:20	15.33	3	0.20	41.6%	11,800	19.1
		SEASON TOTAL		278.50	3,458	12.42				263.67	1,610	6.11	49.2%		
		SEASON AVERAGE											35.0%		
		SEASON MEDIAN											33.0%		

Chinook Trap Efficiency

A total of one HOR group and 49 NOR Chinook 0+ groups were released over the season using three different mark types (Bismarck-brown dye or upper/lower lobe partial caudal fin-clip). The first group was released on the night of February 14, and the last on the night of July 19. Releases of these groups occurred in the evening and the traps were fished continuously over the night or over night-day-night fishing period. Recapture rates ranged from 0% to 7.01%, and averaged 2.72% (Table 8). Only one paired HOR and NOR Chinook 0+ calibration group was released during the season, on the evening of June 12. We captured HOR Chinook at a higher efficiency (5.88%) than their NOR counterparts (3.08%).

Hatchery Chinook 0+ Production Groups

Four groups of ad-marked and coded-wire tagged (ad-CWT) HOR Chinook fingerlings were released from production facilities in Spring 2006 (Table 8). The locations of these releases are shown in Figure 1:

- May 23, the release of two different CWT groups of summer Chinook (205,170 and 5,473) from Countyline Ponds (R.M. 89);
- June 5, the release of 215,044 fall Chinook from the lower Baker River (Baker River Mile: 1.0, Skagit River R.M. 56.5);
- June 15, the release of 252,195 spring Chinook from Marblemount Hatchery (R.M. 78).

Over the season, a total of 16,423 ad-CWT HOR Chinook 0+ were captured in the mainstem traps: 8,294 in the scoop trap and 8,129 in the screw trap. This includes one fish in the screw trap that was captured on April 29, well before reported hatchery release dates.

Apportioning the catch among the four release groups required recovering tags. On May 26, we began sampling HOR smolts for tag recovery. Over the season, we sacrificed 1,640 ad-marked Chinook and recovered 1,622 tags. These were used to estimate the proportions of Countyline Ponds summers, Marblemount springs, and Baker River fall Chinook in our total HOR catch (Table 9). Three ad-marked CWT Marblemount spring Chinook 0+ were captured before the reported June 15 release. These fish were hatchery escapees, and were included when we apportioned CWT recovery sample data (Table 9). The one fish captured in the screw trap on April 29, a month before the official hatchery release, was not included.

Table 8. Groups of marked salmon released into the Skagit River in 2006 and the numbers recovered at the mainstem traps.

	Stock	Species/ Age	Mark Type	Releases Date	Releases Number	Recap Date	Actual Catch Scoop	Actual Catch Screw	Actual Catch Total	Capture Rate Scoop	Capture Rate Screw	Capture Rate Total
	NOR (Mannser Creek)	Coho 1+	LV	04/14-06/12	17,873	04/19-06/12	112	122	234	0.63%	0.68%	1.31%
Calibration Groups	NOR	Chin0+	Dye	02/14	326	02/15	5	5	10	1.53%	1.53%	3.07%
	NOR	Chin0+	Dye	02/16	676	02/17	8	4	12	1.18%	0.59%	1.78%
	NOR	Chin0+	Dye	02/19	576	02/20	7	3	10	1.22%	0.52%	1.74%
	NOR	Chin0+	Dye	02/22	306	02/23	5	1	6	1.63%	0.33%	1.96%
	NOR	Chin0+	Dye	02/25	688	02/26	15	4	19	2.18%	0.58%	2.76%
	NOR	Chin0+	Dye	02/28	695	03/01	3	1	4	0.43%	0.14%	0.58%
	NOR	Chin0+	Dye	03/03	703	03/04	16	5	21	2.28%	0.71%	2.99%
	NOR	Chin0+	Dye	03/06	692	03/07	11	2	13	1.59%	0.29%	1.88%
	NOR	Chin0+	Dye	03/12	694	03/13	19	3	22	2.74%	0.43%	3.17%
	NOR	Chin0+	Dye	03/16	715	03/17	6	6	12	0.84%	0.84%	1.68%
	NOR	Chin0+	Dye	03/18	685	03/19	8	5	13	1.17%	0.73%	1.90%
	NOR	Chin0+	Dye	03/21	689	03/22	8	2	10	1.16%	0.29%	1.45%
	NOR	Chin0+	Dye	03/25	696	03/26	7	4	11	1.01%	0.57%	1.58%
	NOR	Chin0+	Dye	03/27	704	03/28	14	5	19	1.99%	0.71%	2.70%
	NOR	Chin0+	Dye	03/30	443	03/31	13	6	19	2.93%	1.35%	4.29%
	NOR	Chin0+	Dye	04/02	692	04/03	14	6	20	2.02%	0.87%	2.89%
	NOR	Chin0+	Dye	04/05	505	04/06	4	7	11	0.79%	1.39%	2.18%
	NOR	Chin0+	Dye	04/08	382	04/09	8	8	16	2.09%	2.09%	4.19%
	NOR	Chin0+	Dye	04/11	731	04/12	20	4	24	2.74%	0.55%	3.28%
	NOR	Chin0+	Dye	04/14	679	04/15	17	4	21	2.50%	0.59%	3.09%
	NOR	Chin0+	Dye	04/17	418	04/18	7	8	15	1.67%	1.91%	3.59%
	NOR	Chin0+	Dye	04/21	199	04/22	2	0	2	1.01%	0.00%	1.01%
	NOR	Chin0+	Dye	04/24	219	04/25	4	2	6	1.83%	0.91%	2.74%
	NOR	Chin0+	Dye	04/28	402	04/29	9	15	24	2.24%	3.73%	5.97%
	NOR	Chin0+	Dye	05/02	617	05/03	17	2	19	2.76%	0.32%	3.08%
	NOR	Chin0+	Dye	05/06	298	05/07	2	1	3	0.67%	0.34%	1.01%
	NOR	Chin0+	UC	05/28	594	05/29	10	7	17	1.68%	1.18%	2.86%
	NOR	Chin0+	Dye	06/12	130	06/13	2	2	4	1.54%	1.54%	3.08%
	HOR	Chin0+	Dye/Ad	06/12	102	06/13	4	2	6	3.92%	1.96%	5.88%
	NOR	Chin0+	UC	06/15	405	06/16	3	3	6	0.74%	0.74%	1.48%
	NOR	Chin0+	LC	06/19	167	06/20	2	0	2	1.20%	0.00%	1.20%
	NOR	Chin0+	UC	06/21	107	06/22	3	0	3	2.80%	0.00%	2.80%
	NOR	Chin0+	UC	06/23	141	06/24	1	1	2	0.71%	0.71%	1.42%
	NOR	Chin0+	UC	06/24	91	06/25	2	0	2	2.20%	0.00%	2.20%
	NOR	Chin0+	UC	06/25	97	06/26	3	2	5	3.09%	2.06%	5.15%
	NOR	Chin0+	LC	06/26	157	06/27	6	5	11	3.82%	3.18%	7.01%
	NOR	Chin0+	LC	06/29	247	06/30	7	1	8	2.83%	0.40%	3.24%
	NOR	Chin0+	LC	06/30	116	07/01	5	1	6	4.31%	0.86%	5.17%
	NOR	Chin0+	LC	07/01	87	07/02	5	1	6	5.75%	1.15%	6.90%
	NOR	Chin0+	LC	07/02	137	07/03	2	2	4	1.46%	1.46%	2.92%
	NOR	Chin0+	UC	07/03	135	07/04	3	3	6	2.22%	2.22%	4.44%
	NOR	Chin0+	UC	07/06	261	07/07	6	2	8	2.30%	0.77%	3.07%
	NOR	Chin0+	UC	07/07	110	07/08	1	1	2	0.91%	0.91%	1.82%
	NOR	Chin0+	UC	07/08	141	07/09	1	2	3	0.71%	1.42%	2.13%
	NOR	Chin0+	UC	07/09	83	07/10	2	1	3	2.41%	1.20%	3.61%
	NOR	Chin0+	LC	07/11	142	07/11	2	1	3	1.41%	0.70%	2.11%
	NOR	Chin0+	LC	07/12	87	07/13	1	0	1	1.15%	0.00%	1.15%
	NOR	Chin0+	UC	07/17	38	07/18	0	0	0	0.00%	0.00%	0.00%
	NOR	Chin0+	UC	07/18	20	07/19	0	0	0	0.00%	0.00%	0.00%
	NOR	Chin0+	UC	07/19	50	07/20	0	0	0	0.00%	0.00%	0.00%
Hatchery	County Line Ponds/ smr	Chin0+	Ad/CWT	05/23	205,170					See Table 8		
	County Line Ponds/ smr	Chin0+	Ad/CWT	05/23	5,473							
	Baker River/ fall	Chin0+	Ad/CWT	06/05	215,044							
	Marblemount/ spr	Chin0+	Ad/CWT	06/15	252,195							

Table 9. Results of CWTs recovered from ad-marked/CWT Chinook 0+ sampled at the Skagit River mainstem traps 2006.

Date	H-Admk Catch			Number Sampled			County Line-Summer 21-06/77		21-28/27		Mablemount-Spr 63-33/64		Baker River-Fall 21-06/85	
	Scoop	Screw	Total	Scoop	Screw	Total	Total	%	Total	%	Total	%	Total	%
05/26/06	26	10	36	10	9	19	19	100.00%		0.00%		0.00%		0.00%
05/27/06	226	187	413	22	17	39	38	97.44%	1	2.56%		0.00%		0.00%
05/28/06	75	97	172	8	10	18	18	100.00%		0.00%		0.00%		0.00%
05/29/06	398	271	669	39	27	66	65	98.48%	1	1.52%		0.00%		0.00%
05/30/06	470	262	732	47	26	73	72	98.63%		0.00%	1	1.37%		0.00%
05/31/06	366	311	677	37	30	67	67	100.00%		0.00%		0.00%		0.00%
06/01/06	174	141	315	16	14	30	30	100.00%		0.00%		0.00%		0.00%
06/02/06	228	235	463	23	24	47	47	100.00%		0.00%		0.00%		0.00%
06/03/06	137	143	280	14	14	28	28	100.00%		0.00%		0.00%		0.00%
06/04/06	87	102	189	9	10	19	19	100.00%		0.00%		0.00%		0.00%
06/05/06	170	187	357	17	19	36	36	100.00%		0.00%		0.00%		0.00%
06/06/06	296	340	636	26	33	59	17	28.81%		0.00%		0.00%	42	71.19%
06/07/06	579	545	1,124	56	52	108	19	17.59%		0.00%		0.00%	89	82.41%
06/08/06	615	500	1,115	21	89	110	14	12.73%		0.00%	1	0.91%	95	86.36%
06/09/06	104	129	233	9	13	22	1	4.55%		0.00%		0.00%	21	95.45%
06/10/06	87	117	204	9	12	21	2	9.52%		0.00%	1	4.76%	18	85.71%
06/11/06	190	252	442	19	25	44	4	9.09%		0.00%		0.00%	40	90.91%
06/12/06	67	84	151	6	8	14	1	7.14%		0.00%		0.00%	13	92.86%
06/13/06	68	105	173	7	10	17	2	11.76%		0.00%		0.00%	15	88.24%
06/14/06	127	179	306	5	25	30	5	16.67%		0.00%		0.00%	25	83.33%
06/15/06	30	40	70	3	4	7	3	42.86%		0.00%		0.00%	4	57.14%
06/16/06	54	48	102	4	5	9		0.00%		0.00%	7	77.78%	2	22.22%
06/17/06	1,438	1,495	2,933	138	144	282	3	1.06%		0.00%	264	93.62%	15	5.32%
06/18/06	515	675	1,190	50	66	116		0.00%		0.00%	113	97.41%	3	2.59%
06/19/06	258	303	561	25	30	55		0.00%		0.00%	53	96.36%	2	3.64%
06/20/06	235	228	463	23	22	45	1	2.22%		0.00%	39	86.67%	5	11.11%
06/21/06	110	99	209	11	10	21		0.00%		0.00%	17	80.95%	4	19.05%
06/22/06	55	43	98	5	4	9		0.00%		0.00%	8	88.89%	1	11.11%
06/23/06	64	36	100	7	4	11		0.00%		0.00%	10	90.91%	1	9.09%
06/24/06	45	32	77	4	3	7		0.00%		0.00%	6	85.71%	1	14.29%
06/25/06	59	35	94	6	3	9	2	22.22%		0.00%	7	77.78%		0.00%
06/26/06	97	91	188	10	9	19	2	10.53%		0.00%	14	73.68%	3	15.79%
06/27/06	118	178	296	11	18	29	6	20.69%		0.00%	16	55.17%	7	24.14%
06/28/06	55	60	115	6	6	12	1	8.33%		0.00%	6	50.00%	5	41.67%
06/29/06	111	133	244	11	14	25	2	8.00%		0.00%	19	76.00%	4	16.00%
06/30/06	35	44	79	4	4	8		0.00%		0.00%	6	75.00%	2	25.00%
07/01/06	28	29	57	2	3	5		0.00%		0.00%	5	100.00%		0.00%
07/02/06	29	26	55	3	2	5	1	20.00%		0.00%	2	40.00%	2	40.00%
07/03/06	28	23	51	3	3	6		0.00%		0.00%	4	66.67%	2	33.33%
07/04/06	13	29	42	1	3	4		0.00%		0.00%		0.00%	4	100.00%
07/05/06						0		3.85%		0.00%		26.93%		69.23%
07/06/06	79	51	130	8	5	13	1	7.69%		0.00%	7	53.85%	5	38.46%
07/07/06	29	14	43	3	2	5		0.00%		0.00%	3	60.00%	2	40.00%
07/08/06	45	28	73	5	3	8	1	12.50%		0.00%	3	37.50%	4	50.00%
07/09/06	13	17	30	1	2	3		0.00%		0.00%	3	100.00%		0.00%
07/10/06	18	10	28	2	1	3		0.00%		0.00%	2	66.67%	1	33.33%
07/11/06	41	30	71	4	3	7		0.00%		0.00%	3	42.86%	4	57.14%
07/12/06	17	11	28	2	1	3		0.00%		0.00%	1	33.33%	2	66.67%
07/13/06	62	38	100	7	3	10	1	10.00%		0.00%	6	60.00%	3	30.00%
07/17/06	9	8	17		1	1		0.00%		0.00%	1	100.00%		0.00%
07/18/06	4	1	5			0		0.00%		0.00%		100.00%		0.00%
07/19/06	15	5	20	2		2		0.00%		0.00%	2	100.00%		0.00%
07/20/06	18	3	21	1	1	2		0.00%		0.00%	2	100.00%		0.00%
07/24/06	23	21	44	3	1	4		0.00%		0.00%	2	50.00%	2	50.00%
07/25/06	22	36	58	2	3	5		0.00%		0.00%	3	60.00%	2	40.00%
07/26/06	25	5	30	2	1	3		0.00%		0.00%	2	66.67%	1	33.33%
07/27/06	3	6	9	1	1	2		0.00%		0.00%	1	50.00%	1	50.00%
07/31/06	4		4			0		0.00%		0.00%		50.00%		50.00%
	8,294	8,128	16,422	770	852	1,622	528		2		640		452	

NOR & HOR Chinook 0+ Production Estimates

Catch Projection

Expansion of catches for the intervals not fished estimates an additional 21,778 and 19,741 NOR Chinook 0+ would have been captured in the scoop and screw traps, respectively (Table 10). Combining projected with actual catch (61,493 and 39,767 fry, respectively), estimates 142,779 NOR Chinook 0+ would have been caught in the two traps had we fished continuously from January 18 through July 31 (Figure 4). Actual catch represents 70.9% of the total projected catch.

Expanding actual catches for the intervals not fished following release of the hatchery production groups estimates an additional 10,140 HOR Chinook 0+ would have been captured in the scoop and screw traps (Table 10). Actual catch represents 61.8% of the total projected HOR catch.

Table 10. Summary of actual and projected NOR and HOR Chinook 0+ catches in the Skagit River mainstem traps 2006.

Group	Scoop Trap			Screw Trap			Total		
	Actual	Projected	Total	Actual	Projected	Total	Actual	Projected	Total
NOR	61,493	21,778	83,271	39,767	19,741	59,508	101,260	41,519	142,779
HOR	8,294	5,241	13,535	8,129	4,899	13,028	16,423	10,140	26,563

Applying CWT recovery results to the sum of actual and projected daily catches during selected strata, estimates the proportion of each group within the ad-marked/CWT HOR Chinook catch: 9,103 Countyline Pond summers (two tag codes combined), 9,542 Marblemount Hatchery springs, and 7,917 Baker River falls (Table 11). Relating these projected catches to the numbers released yields capture rates of 4.32%, 3.78%, and 3.68% for summer, spring and fall Chinook 0+, respectively (analysis did not include 1 HOR Chinook captured April 29). As these rates are simply the ratio of estimated recoveries to reported releases, they are biased low by such factors as mortality and residualism.

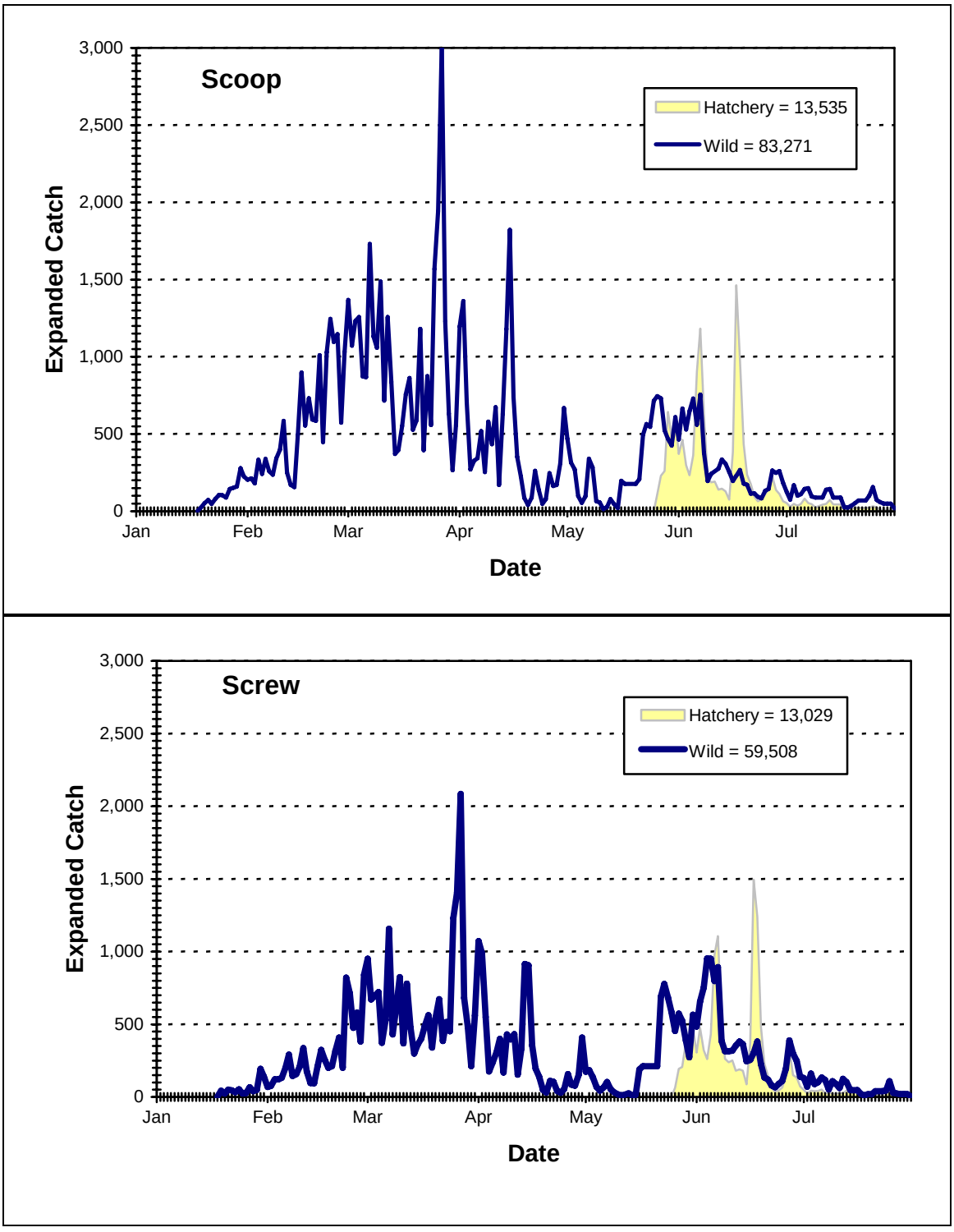

Figure 4. Projected NOR and HOR Chinook 0+ catches, Skagit River mainstem traps 2006.

Table 11. Projected 24-hour HOR Chinook 0+ catches, by tag group, Skagit River mainstem traps 2006.

Release Site/Stock	Tag Code	Number Released	Recovery Period	Projected 24-Hour Catch [a]	Catch Rate
Countyline Ponds/ summer	21-06/77	205,170	May 26-July 13	9,077	4.42%
	21-28/27	5,473	May 27-May 29	26	0.48%
	Pooled	210,643		9,103	4.32%
Marblemount/ spring	63-33/64	252,195	May 30-July 27	9,542	3.78%
Baker River/ fall	21-06/85	215,044	June 6-July 27	7,917	3.68%
	Total	677,882	May 26-July 27	26,562[b]	3.92%

[a] Estimated by applying the proportion of cwt recoveries to projected 24-hour HOR catch (Table 9).
[b] Analysis does not include 1 HOR CWT captured on April 29 in screw trap.

Production

We released groups of marked NOR Chinook 0+ on 49 different occasions throughout the trapping season to estimate trap efficiency. All recaptures of marked Chinook 0+ occurred within the evening following the release. Because some releases resulted in few or no recaptures, adjacent release groups were pooled where similar flows occurred to develop 32 final strata consisting of at least four recoveries. Capture rates for these strata ranged from 1.19% to 5.97% (Table 12). Application of the stratified mark-recapture approach using the 32 final strata estimates NOR production during the trapping season at 6.2 million ($\pm$ 0.7 million) Chinook 0+ (Figure 5). Variance estimates shown (Table 12) underestimate the true variance. Covariance in the estimation of day:night ratios were not included when Equation 7 was used (Ryding, pers comm.). This oversight will be corrected in the 2007 annual report if this approach is used.

NOR Chinook were captured on the first night of trapping on January 18, indicating that the migration had already begun. We selected a migration start date of January 1, to estimate migration before trapping began. Logarithmic extrapolation from January 1 to January 18, estimated an additional 7,677 NOR Chinook 0+. This extrapolated portion of the migration accounts for only 0.12% of the total migration.

Hatchery production was also estimated by using efficiency data from NOR release groups. We used data from a total of 23 NOR mark-releases, and grouped data into eleven catch period strata based on environmental conditions and the number of recoveries (Table 13). Using this data we estimated a production of just over 1.1 million HOR Chinook smolts. If the hatchery release numbers were as reported (677,882 Chinook 0+), this overestimates hatchery production by a factor of 1.72 if survival was 100%. This over-estimate was also indicated by results from the single paired-release of marked HOR and NOR Chinook 0+. During this efficiency trial, the HORs were recaptured at 1.9 times the NOR rate. These results suggest that the accuracy of the HOR migration estimate is poor; nevertheless, it indicates excellent survival of these fish past the mainstem traps.

Table 12. Estimated catch and migration by strata, for NOR Chinook 0+, Skagit River 2006

Strata	Date		Total Estimated Catch	Capture Rate	Migration	Variance
	Begin	End				
1	01/18/06	02/15/06	9,142	3.07%	298,029	6.03E+09
2	02/15/06	02/18/06	2,971	1.78%	167,366	1.76E+09
3	02/18/06	02/21/06	3,126	1.74%	180,058	2.34E+09
4	02/21/06	02/24/06	4,457	1.96%	227,307	4.82E+09
5	02/24/06	03/04/06	14,090	2.11%	667,994	9.75E+09
6	03/04/06	03/10/06	11,083	1.88%	589,957	2.04E+10
7	03/10/06	03/15/06	5,860	3.17%	184,856	1.45E+09
8	03/15/06	03/18/06	3,321	1.68%	197,876	2.53E+09
9	03/18/06	03/20/06	2,037	1.90%	107,334	7.71E+08
10	03/20/06	03/24/06	4,933	1.45%	339,884	8.58E+09
11	03/24/06	03/26/06	6,512	1.58%	412,032	1.32E+10
12	03/26/06	03/29/06	8,031	2.70%	297,570	4.51E+09
13	03/29/06	04/01/06	3,713	4.29%	86,572	3.81E+08
14	04/01/06	04/03/06	3,861	2.89%	133,591	9.64E+08
15	04/03/06	04/07/06	2,510	2.18%	115,232	9.11E+08
16	04/07/06	04/10/06	2,155	4.19%	51,451	1.47E+08
17	04/10/06	04/13/06	2,564	3.28%	78,095	2.81E+08
18	04/13/06	04/16/06	5,609	3.09%	181,358	1.45E+09
19	04/16/06	04/20/06	1,416	3.59%	39,459	1.17E+08
20	04/20/06	04/27/06	1,620	1.91%	84,645	5.87E+08
21	04/27/06	03/05/01	1,786	5.97%	29,916	4.15E+07
22	03/05/01	05/05/06	1,772	3.08%	57,543	1.71E+08
23	05/05/06	06/01/06	16,066	2.24%	716,588	2.37E+10
24	06/01/06	06/15/06	13,510	3.08%	439,075	2.07E+10
25	06/15/06	06/18/06	1,931	1.48%	130,343	1.70E+09
26	06/18/06	06/24/06	1,471	1.69%	87,209	6.81E+08
27	06/24/06	06/26/06	584	3.72%	15,658	3.23E+07
28	06/26/06	06/30/06	2,030	4.70%	43,164	1.05E+08
29	06/30/06	07/06/06	1,293	4.63%	27,960	3.36E+07
30	07/06/06	07/07/06	379	3.07%	12,365	1.45E+07
31	07/07/06	07/11/06	674	2.40%	28,140	6.78E+07
32	07/11/06	07/31/06	2,272	1.19%	191,416	4.10E+09
		Total	**142,779**		**6,220,041**	**1.32E+11**
					Standard Deviation	363,721
					C.V.	5.85%
					C.I. +/-	712,894

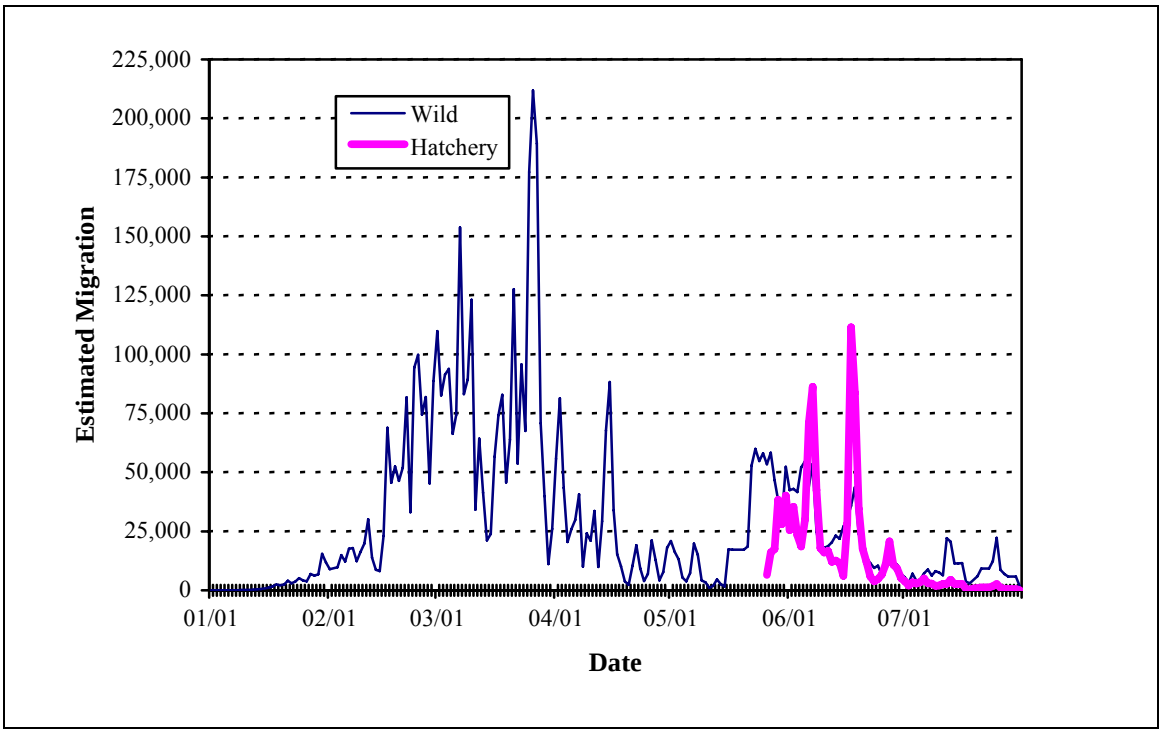

Figure 5. Estimated NOR and HOR Chinook 0+ migration past the Skagit River mainstem traps in 2006.

Table 13. Estimated catch and migration by strata for HOR Chinook 0+, Skagit River 2006

Strata	Date		Total Estimated Catch	Capture Rate	Migration	Variance
	Begin	End				
1	05/25/06	06/01/06	4,566	2.90%	159,541	1.35E+09
2	06/01/06	06/15/06	10,527	3.08%	342,128	1.26E+10
3	06/15/06	06/18/06	6,023	1.50%	406,553	1.71E+10
4	06/18/06	06/24/06	2,083	1.70%	123,492	1.40E+09
5	06/24/06	06/26/06	468	3.70%	12,569	1.80E+07
6	06/26/06	06/30/06	1,219	4.70%	25,920	3.58E+07
7	06/30/06	07/02/06	156	5.90%	2,639	5.20E+05
8	07/02/06	07/06/06	327	3.70%	8,894	7.04E+06
9	07/06/06	07/07/06	141	3.10%	4,600	1.96E+06
10	07/07/06	07/11/06	251	2.40%	10,479	9.14E+06
11	07/11/06	07/31/06	801	1.20%	67,484	5.32E+08
		Total	**26,562**		**1,164,300**	**3.30E+10**
					Standard Deviation	181,653
					C.V.	15.60%
					C.I. +/-	356,040

Chinook 0+ Migration Timing

As mentioned above, NOR Chinook 0+ were captured on the first night of trap operation, indicating that the migration was already under way. Extrapolation estimated that relatively few Chinook fry (0.12% of migration) had passed the trap before we started. Low catches in July indicated the Chinook migration was virtually over when trapping ceased on July 31. Migration from January

through mid-May accounted for 75% of the season total. Fifty-percent of the migration had passed the mainstem traps on March 25 (Figure 6), very near the observed long-term average. In the previous nine years that we have trapped throughout the entire migration (1997 through 2005), the median migration date has ranged from March 10 (1999) to May 2 (1998), with an average of March 27 (Figure 7).

Ad-marked HOR spring, summer and fall zero-age Chinook were released from three sites in the Skagit River basin: Marblemount Hatchery (R.M. 78), Countyline acclimation ponds (R.M. 89) and Baker River (R.M. 57) (Table 11, Figure 1). Baker River fall Chinook, released lowest in the watershed, had median migration timing to the traps of seven days (June 5 release), and took 56 days to completely migrate past the trap. Spring Chinook fry released further upriver at Marblemount Hatchery had median migration timing to the traps of three days (June 15 release), and took up to 47 days to emigrate. Ad-marked and tagged Chinook from Marblemount Hatchery were captured prior to the reported release date as some may have escaped early. Countyline summer Chinook, released earliest and highest in the watershed, had a median migration timing of eight days (May 23 release), and took 52 days to migrate past the mainstem traps (Figure 8). In addition to inherent stock differences, migration timing for HOR Chinook 0+ groups is potentially influenced by fish condition, size at release, flow, turbidity, release date, and release site.

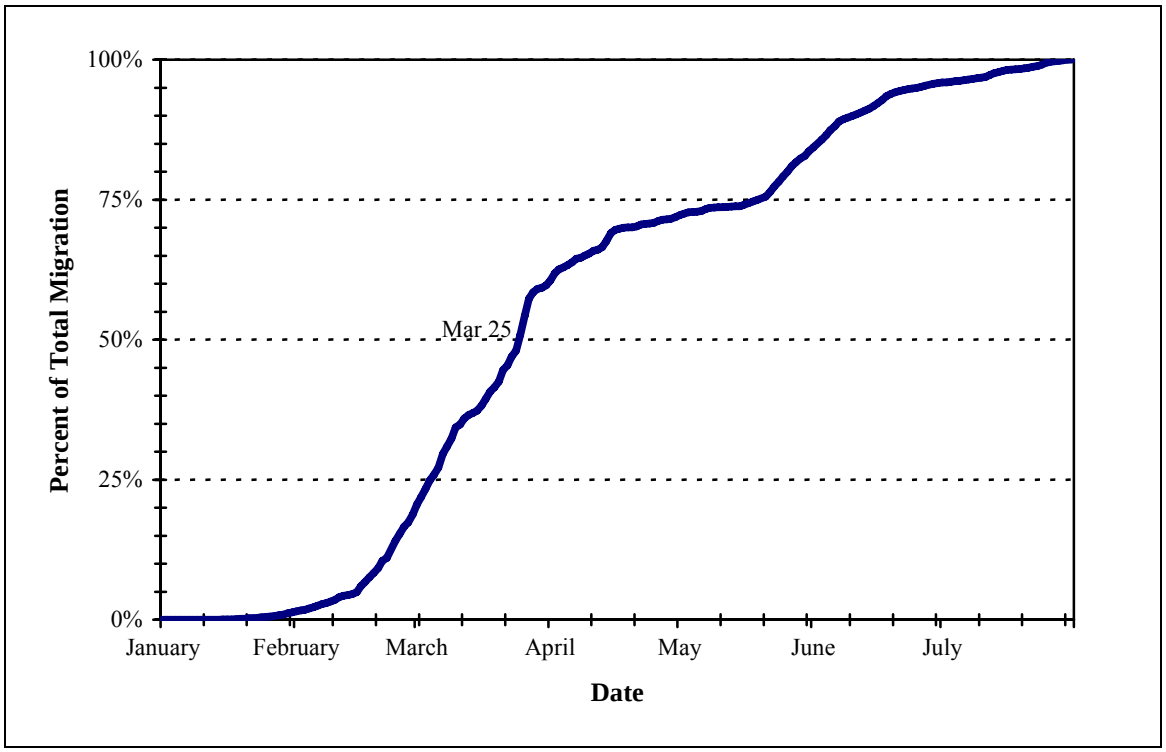

Figure 6. Migration timing of NOR Chinook 0+ past the Skagit River mainstem traps, 2006.

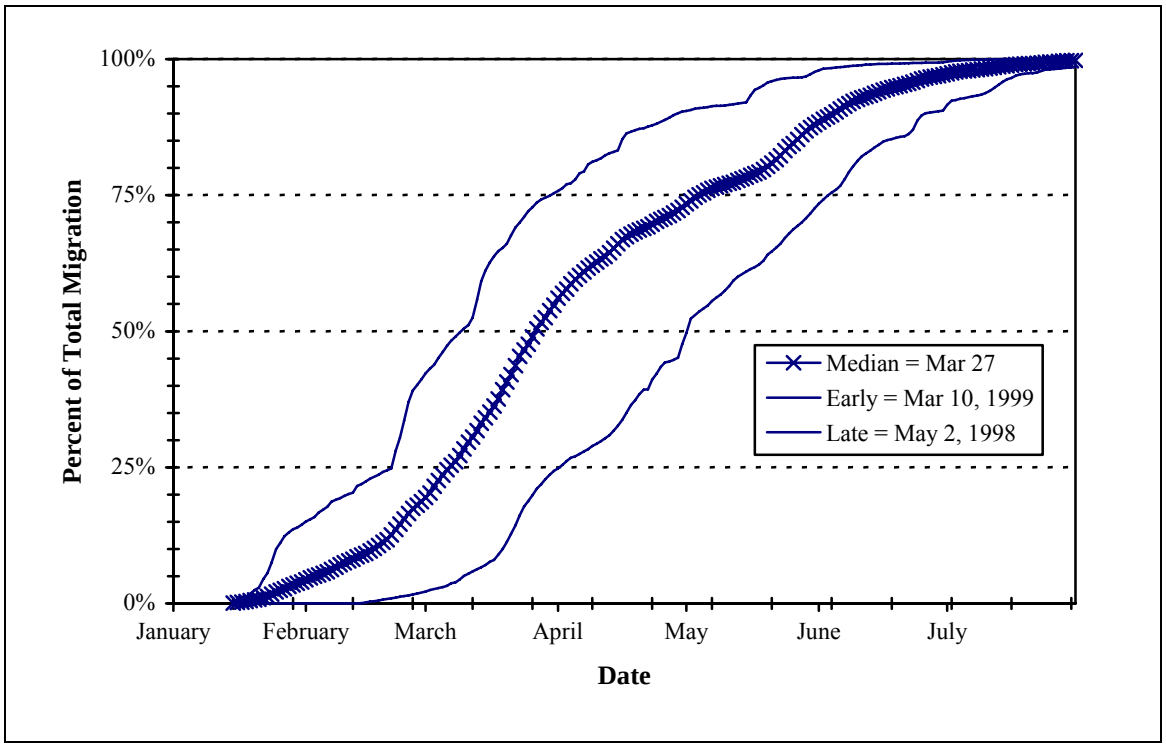

Figure 7. Migration timing variations of NOR Chinook 0+, Skagit River mainstem traps 1997-2006.

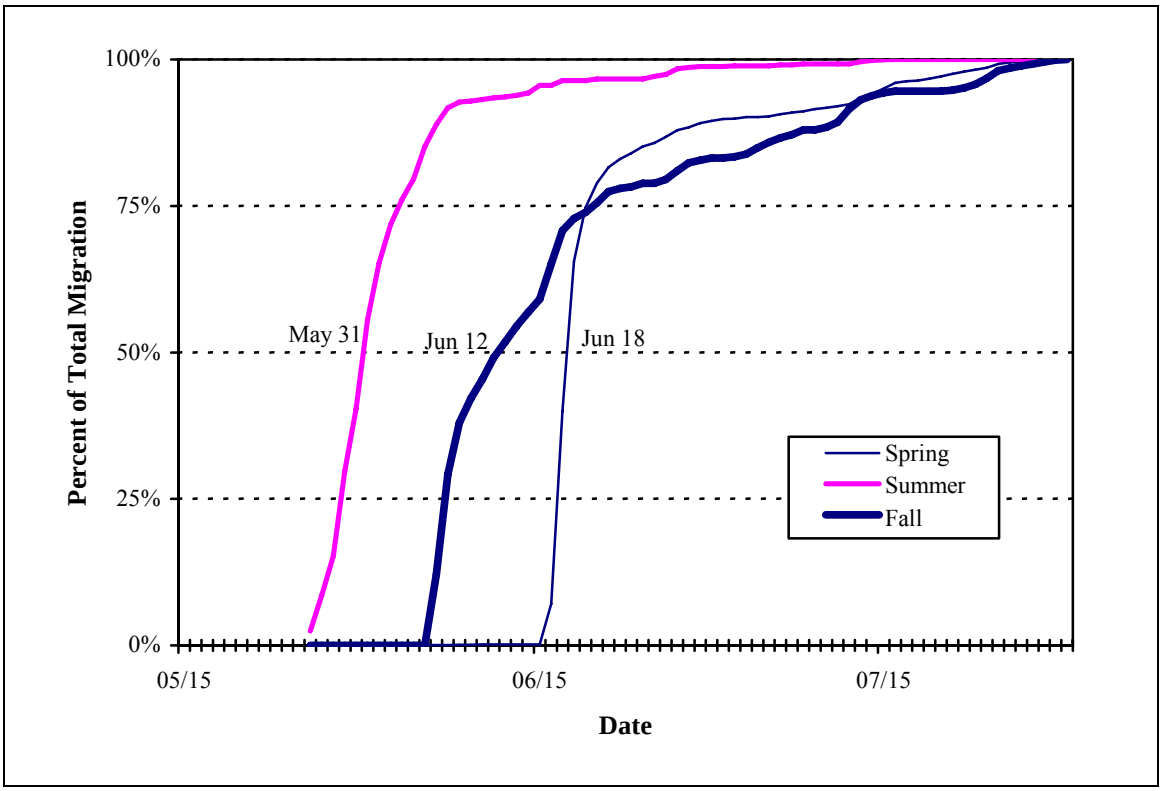

Figure 8. Estimated migration timing of three groups of HOR Chinook 0+ past the Skagit River mainstem traps, 2006.

Natural-Origin Chinook 0+ Size

Over the season, NOR Chinook 0+ captured in the traps increased in size from an average of 40 mm in late January, to 80 mm by the end of July (Table 14, Figure 9). The lower end of the weekly size range exceeded 40 mm in early May, and the week at which mean length reached 50 mm was also early May, which is comparable to previous years. Comparing mean Chinook fork lengths between the scoop and screw trap catches showed no significant difference (KS-test, α=0.05) (Figure 10).

Length Analysis and Size Selectivity

Moderate flows dominated winter and spring of the 2006 season. At lower velocities, larger smolts can avoid capture by swimming away from the trap entrance, and/or out of the traps. At higher flows this avoidance behavior is reduced. To assess this bias, each year we compare length distributions (fork length) of left ventral fin-clipped (LV-marked) coho smolts captured in the scoop and screw traps with that of the LV-marked smolts released from the Mannser Creek trap (KS test, $\alpha = 0.05$). The Mannser Creek weir captures all emigrants, regardless of size. The size comparison of coho captured at each site gives insight to the amount of size selectivity and how it might affect capture rates of NOR Chinook 0+.

The differences in the length distributions of LV-marked coho smolts recaptured in the scoop and screw traps were significant ($\alpha = 0.05$) relative to the size distribution at release. Marked smolts captured in the scoop and screw traps combined averaged 95.0 mm, while smolts released from Mannser Creek averaged 98.4 mm at release. In previous years, a significant difference has been observed when flows are generally lower than average, as occurred during much of the coho outmigration period in 2006.

These results show that the mainstem traps had a small degree of size selectivity that mildly effected recapture rates of NOR coho smolts. Capture rates of the smaller zero-age Chinook could also be biased for this reason but we suspect this affect to be minimal given the smaller sizes (season average 51.8 mm) of zero-age Chinook.

Table 14. Mean fork length (mm), standard deviation, range, sample size, and catch, by statistical week, of NOR Chinook 0+ in the Skagit River mainstem traps, 2006.

STAT WEEK			SCOOP TRAP						SCREW TRAP					
			Mean	s.d.	Range		n	Catch	Mean	s.d.	Range		n	Catch
No.	Begin	End			Min	Max					Min	Max		
4	01/16	01/22						139						117
5	01/23	01/29	41.5	1.89	39	47	21	611	40.3	2.30	36	46	22	206
6	01/30	02/05	40.0	1.48	37	44	29	921	40.3	1.90	36	43	30	438
7	02/06	02/12	39.9	1.64	37	44	40	1,926	39.8	3.71	20	44	40	1,196
8	02/13	02/19	40.1	1.75	37	46	30	2,761	40.6	1.61	36	44	30	1,069
9	02/20	02/26	40.8	1.72	37	45	40	5,438	40.9	3.01	36	55	40	2,882
10	02/27	03/05	41.4	2.70	37	51	30	5,906	41.4	2.03	38	48	30	3,544
11	03/06	03/12	40.4	1.23	38	43	20	6,718	40.4	1.60	37	43	20	3,704
12	03/13	03/19	42.3	2.67	39	51	20	3,666	40.7	1.42	38	43	20	2,365
13	03/20	03/26	40.7	1.45	37	44	40	5,909	41.1	1.60	38	45	40	4,146
14	03/27	04/02	41.1	1.63	37	44	40	6,968	41.7	2.43	38	51	40	4,932
15	04/03	04/09	41.3	1.34	38	45	50	2,909	42.1	2.98	37	53	50	2,153
16	04/10	04/16	41.6	2.28	37	50	30	4,742	42.7	2.96	40	52	30	2,814
17	04/17	04/23	41.9	2.81	37	48	20	1,042	43.3	3.09	38	50	20	564
18	04/24	04/30	44.6	6.31	40	70	30	1,254	47.4	9.07	38	76	30	702
19	05/01	05/07	50.3	5.92	39	68	50	1,159	48.8	7.05	39	63	40	526
20	05/08	05/14	55.0	8.55	41	75	29	412	57.8	4.80	49	67	25	115
21	05/15	05/21	55.6	6.42	48	67	10	122	54.4	9.08	44	68	10	56
22	05/22	05/28	58.9	9.14	44	85	60	2,004	58.3	7.10	48	81	60	1,627
23	05/29	06/04	58.1	7.12	41	77	80	1,764	56.4	5.18	45	69	70	1,532
24	06/05	06/11	56.2	8.81	40	108	81	1,570	57.2	6.59	43	77	80	1,813
25	06/12	06/18	60.2	6.61	44	84	60	1,027	59.2	6.44	47	74	60	1,205
26	06/19	06/25	64.1	7.22	47	78	50	563	63.6	8.28	47	84	50	468
27	06/26	07/02	66.0	8.25	44	82	40	726	68.5	6.36	58	86	40	732
28	07/03	07/09	72.4	7.57	56	87	40	486	69.5	6.68	54	83	40	408
29	07/10	07/16	69.2	10.01	52	90	20	297	71.6	6.77	58	86	20	226
30	07/17	07/23	79.6	6.04	73	93	10	115	81.4	9.43	67	99	10	59
31	07/24	07/30	79.5	10.27	59	95	10	320	82.5	14.32	66	112	10	165
32	07/31	08/06						18						3
Season Total					37	108	980	61,493			20	112	957	39,767

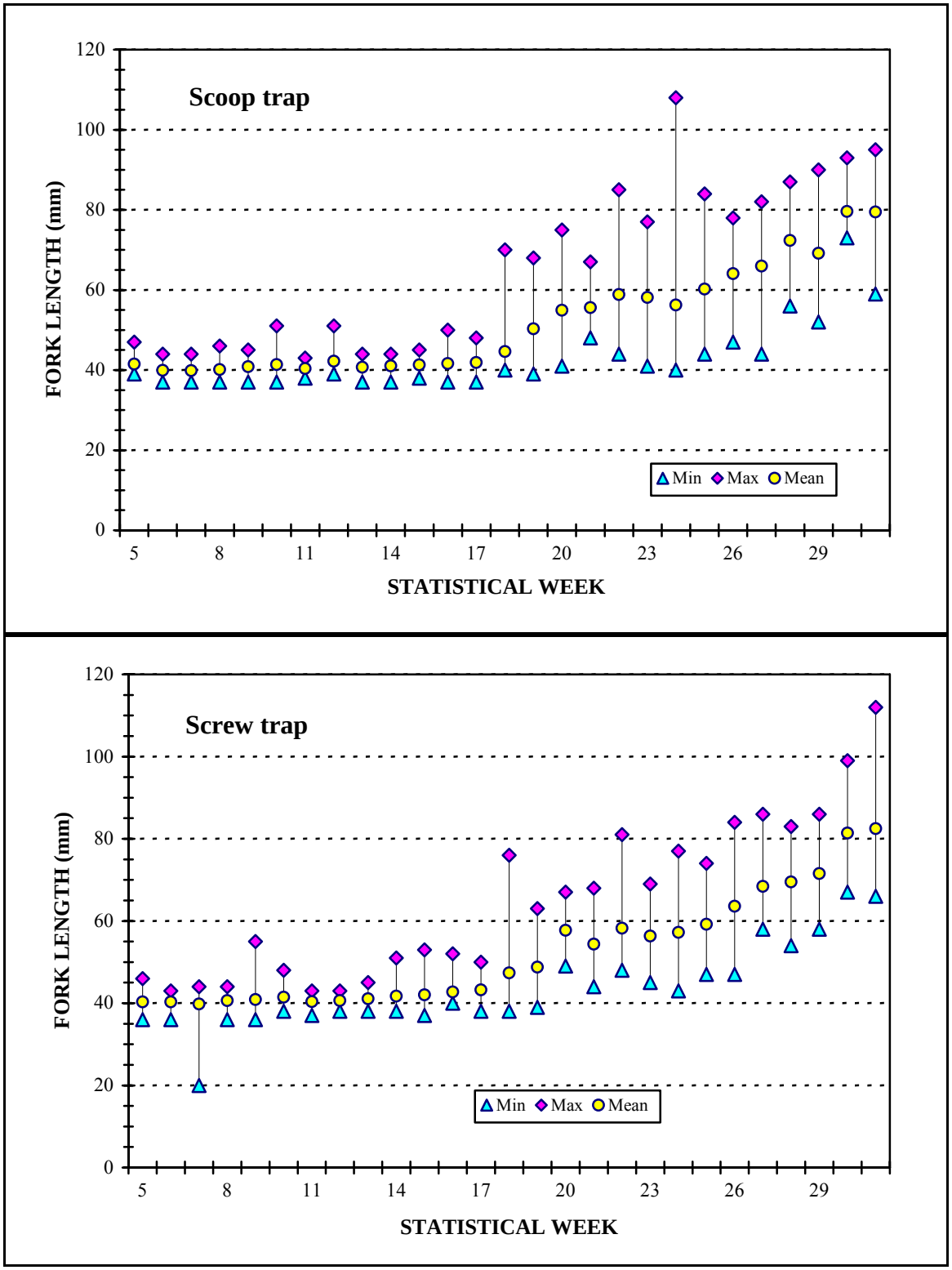

Figure 9. Weekly range and mean fork lengths of NOR Chinook 0+ measured at the Skagit River mainstem traps, 2006.

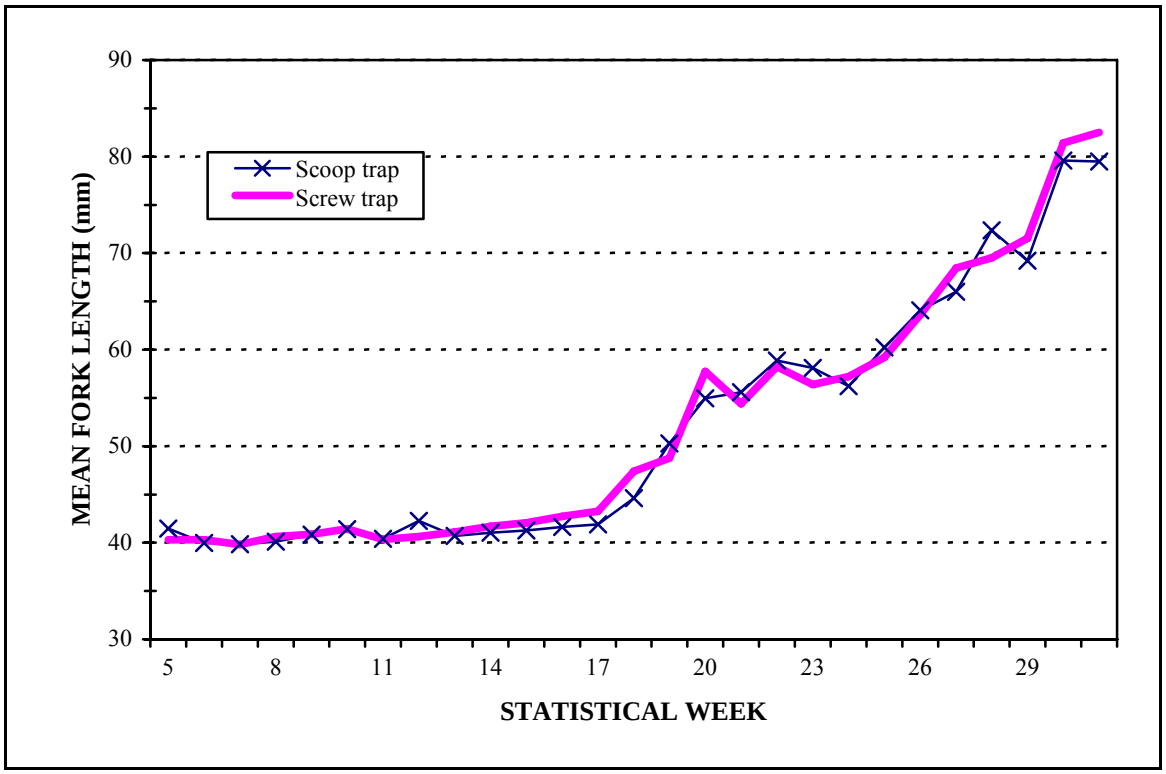

Figure 10. Comparison of mean size of Chinook 0+ in the scoop and screw traps, by statistical week, Skagit River 2006.

Egg-to-Migrant Survival

Relating our estimate of 6.2 million downstream-migrant Chinook 0+ to a potential deposition of 54.6 million eggs, results in an average survival-to-migration of 11.4%. This estimate of potential egg deposition (P.E.D.) is the product of 9,922 females and a fecundity of 5,500 eggs/female (Table 15).

This survival-to-migration rate is biased low because not all downstream-migrating Chinook are zero-age migrants; some 2005 brood Chinook will migrate in 2007 as yearlings, typically a very small proportion of the total run. For example, in 2006, we captured 93 NOR Chinook 1+ migrants. Comparing differences in capture rates between zero-age and yearling migrants suggest that Chinook yearlings made up about 0.3% of the 2004-brood out-migration. Undoubtedly there is a high mortality rate (80-90%) between zero-age and yearling life stages (WDFW unpublished data). Nevertheless, this still suggests that a very small percentage of the NOR Skagit Chinook production rears beyond the age-0 migrant stage in freshwater.

Table 15. Estimated freshwater survival (egg deposition to migration), by brood year, Skagit River naturally-produced Chinook 0+ (includes spring Chinook).

Brood Year (i)	Migr Year (i+1)	Estimated Escapement		PED @ 5,500[a] (millions)	NOR Smolts (millions)[b]	Survival to Migration	Peak Flow[c] Oct 22 – Feb 15	
		Total	Females (@45%)				cfs	Date
1989	1990	8,084	3,638	20.0	1.8	9.0%	88,200	12/05
1990	1991	18,303	8,236	45.3	0.5	1.2%	142,000	11/25
1991	1992	7,062	3,178	17.5	2.4	13.7%	40,100	02/01
1992	1993	8,334	3,750	20.6	3.0	14.4%	27,600	01/26
1993	1994	6,584	2,963	16.3	2.7	16.7%	32,100	12/11
1994	1995	6,019	2,709	14.9	1.5	10.2%	55,700	12/28
1995	1996	7,932	3,569	19.6	0.7	3.8%	132,000	11/30
1996	1997	11,664	5,249	28.9	4.5	15.6%	47,600	01/20
1997	1998	5,913	2,661	14.6	2.4	16.4%	35,600	11/01
1998	1999	15,695	7,063	38.8	6.4	16.5%	51,900	12/14
1999	2000	5,395	2,428	13.4	1.7	12.7%	76,800	11/13
2000	2001	17,951	8,078	44.4	6.0	13.5%	19,300	01/06
2001	2002	15,649	7,042	38.7	5.0	12.9%	73,700	01/08
2002	2003	20,656	9,295	51.1	5.5	10.8%	53,000	01/27
2003	2004	10,374	4,668	25.7	1.5	5.8%	110,000	10/22
2004	2005	[d]25,175	11,329	62.3	4.5	7.3%	66,700	12/11
2005	2006	[d]22,049	9,922	54.6	6.2	11.4%	57,400	01/11

[a] Personal communication, Pete Castle, WDFW.
[b] Prior to the 1996 brood, estimates were based on trapping during the coho migration period (April-June). Full-season trapping commenced in 1997.
[c] USGS mean daily flow at Mt Vernon.
[d] Personal communication, Brett Barkdull, WDFW

Coho

Mannser Creek

Over the season, a total of 18,145 NOR coho smolts were captured in the Mannser Creek smolt trap. A majority of this catch (17,873; 98.5%) was left ventral (LV) fin-clipped and released below the weir.

We installed the Mannser Creek weir on April 12. The first coho smolts were captured April 14 (6 smolts). Most of the migration (75%) occurred during May, with two peak catches of over one thousand coho smolts: the first peak (1,123 smolts) on May 6; the second peak (1,250 smolts) occurred on May 21. After this catches generally declined. On June 12, our last trap check, only 37 smolts were captured, indicating the migration was nearly over (Figure 11).

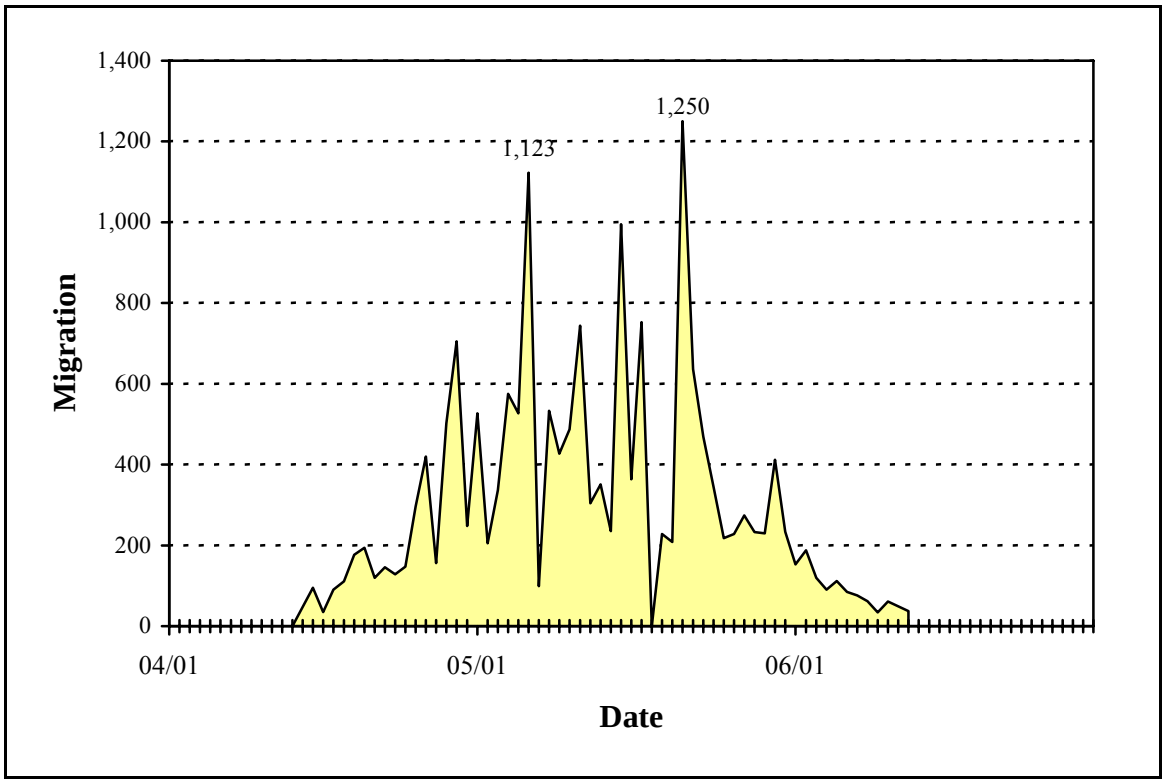

Figure 11. NOR coho smolt production from Mannser Creek in 2006.

Mainstem Traps

Catch

Flows were moderate throughout the 2006 season, with daily averages ranging from 7,820 to 38,700 cfs, very close to the long-term average flows during the coho migration period (April 15-June 15) of 18,686 cfs and 18,708 cfs, respectively. In mid-April and through May, runoff generally increased flows, with the highest flow occurring on May 19, at 38,700 cfs. These increased flows generally coincided with the coho migration (Figure 12). Flows then generally declined, and remained below the long-term average for the remainder of the trapping period.

High flows prevented trap operation for four days during the height of the coho migration. Missed catches during this period do not affect our production estimate, as the Mannser creek (LV) mark group provides a continuous sample. Because we use the modified Peterson estimate for coho production, we do not need to estimate missed catch.

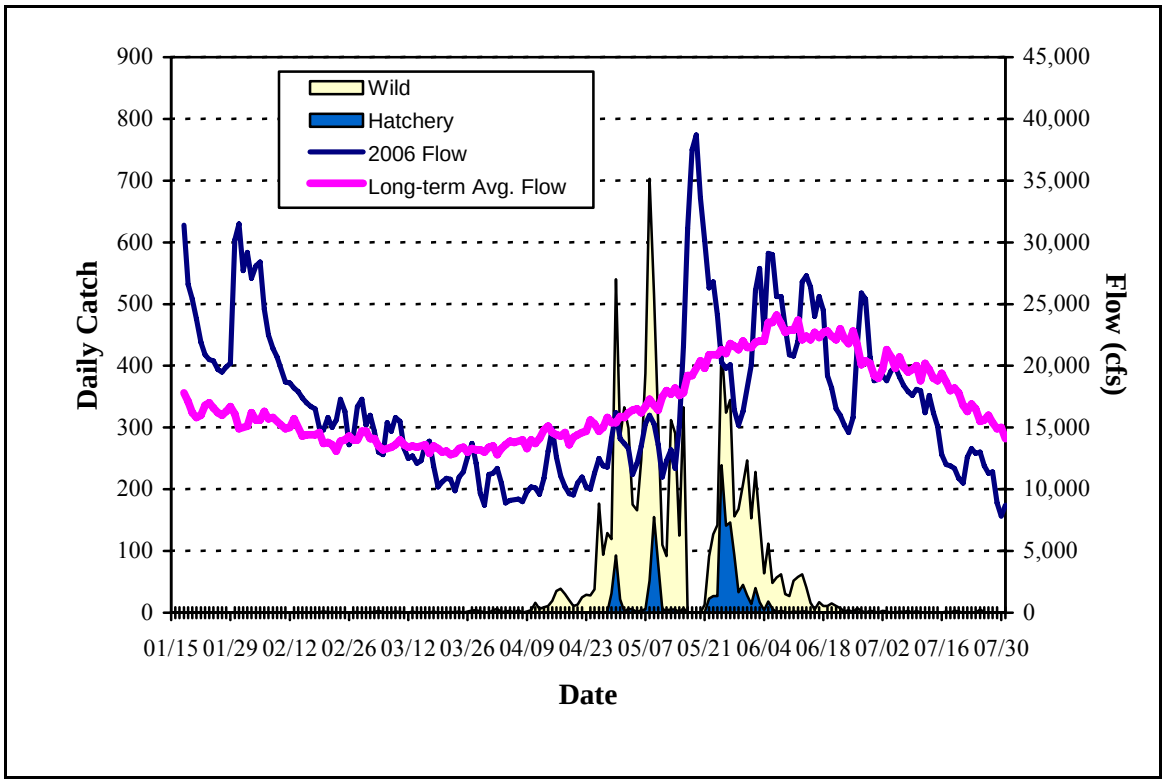

Figure 12. Daily NOR and HOR coho smolt catches in the Skagit River mainstem traps with 2006 daily mean stream flow and long-term average daily mean flows (USGS gauge#12200500, near Mt. Vernon).

Naturally-Produced Coho

We captured a total of 11,073 coho smolts in the mainstem traps (4,941 in the scoop and 6,132 in the screw trap). The coho smolt catch in 2006 consisted of 9,674 NOR smolts including 234 LV-marked smolts released from Mannser Creek (Table 16).

Table 16. Disposition of NOR and HOR coho smolts captured in the mainstem scoop and screw traps, Skagit River 2006

Gear	Natural-Origin			Hatchery					
	Unmk	LVs	Total	Admk	Admk/Brand	Unmk/CWT	Admk/CWT	Unmk	Total
Scoop Trap	4,464	112	4,576	315	5	15	30	0	365
Screw Trap	4,976	122	5,098	831	4	86	113	0	1,034
Total	9,440	234	9,674	1,146	9	101	143	0	1,399

NOR coho smolts first appeared in the traps in abundance in mid-April, and generally increased thereafter. Peak catch occurred on May 8, with 703 coho smolts captured. By May 10, we had captured 50% of the total catch. After this, the migration generally declined through late June and into July. The last NOR coho smolt was captured on July 26.

Hatchery Coho

A total of 1,399 2004-brood HOR coho smolts were captured over the season (Table 16). A majority of these HOR coho smolts were volitionally released by WDFW from Marblemount Hatchery on May 19. Puget Sound Energy (PSE) also released HOR coho smolts from April 12 through May 8 into the Baker River Basin. Catches of HOR coho peaked on May 25, with 239 smolts captured, and then declined (Figure 12).

A total of 257,500 HOR smolts were released from Marblemount Hatchery, which included three groups: ad-marked/CWT; unmarked/CWT; and ad-marked/untagged. In addition, PSE released 53,929 HOR coho: 15,538 smolts were released into Baker Lake and Lake Shannon, and 38,391 smolts were released into the Baker River near its confluence with the Skagit River (Table 17).

We visually identified HOR smolts captured in the mainstem traps, based on their appearance (body size and shape, fin condition, and coloration) and tag detections results. Also, all ad-marked smolts were identified as hatchery-origin. At the scoop and screw traps, we identified 360 and 1,034 smolts, respectively, as hatchery-origin (Table 16).

Table 17. Hatchery-produced coho smolts (2004 brood) released into the Skagit River in 2006.

Hatchery/Release Location	Stock	Release Date(s)	Tag Code	Coho Smolt Release Groups				
				Tagged (CWT)		Untagged		Total
				Admk	Unmk	Admk	Ad/Brand	Released
(PSE) Baker Lake/Lake Shannon[a]	Baker River	04/12-04/13	n/a				15,538	15,538
(PSE) Baker River @ Skagit[a]	Baker River	04/27/06	n/a			12,743		12,743
		05/07/06	n/a			12,810		12,810
		05/08/06	n/a			12,838		12,838
Skagit Hatchery (Marblemount)[b]	Skagit River	05/19/06				168,517		168,517
			63-30/99	47,505				47,505
			63-31/97		41,478			41,478
			Total	47,505	41,478	206,908	15,538	311,429

[a] Doug Bruland (PSE) pers comm
[b] Steve Stout (WDFW) pers comm

Length Analysis and Size Selectivity

Fork lengths of coho smolts that were LV-marked and released at Mannser Creek averaged 98.4 mm, larger than the LV-marked smolts recaptured in the mainstem traps (95.0 mm) (Table 18). We used the Kolmogorov-Smirnov (K-S) test to analyze fork length distributions of LV-marked smolts released at Mannser Creek compared to those recaptured in the mainstem traps. This test showed that length distributions from the two groups were significantly different (α=0.05), indicating some size selectivity.

Comparison of the length distributions between unmarked smolts captured in the scoop versus the screw trap showed that these two samples had similar distributions (K-S α=0.05). This indicates there was no size selectivity between the two traps. Similarly, we found no difference in length distributions of the recaptured LV-marked fish between the scoop and screw traps (K-S α=0.05).

Mean fork lengths of unmarked NOR coho smolts captured in the mainstem traps averaged 93.8 mm (92.3 mm and 95.4 mm in the scoop and screw traps, respectively), smaller than the LV-marked smolts recaptured in the mainstem traps (95.0 mm)(Table 18). A two-sample t-test shows that mean fork lengths of unmarked and LV-marked smolts were not significantly different (α=0.05). The total

mean size of NOR coho captured in the mainstem traps, including the LV-marked fish, was 94.0 mm. This combined mean best represents average size of NOR fish for entire watershed.

Table 18. Summary statistics for fork length data (mm) sampled from NOR coho smolts captured in the scoop, screw (mainstem Skagit) and Mannser Creek traps, 2006

Mark Group	Trap	Mean	S.D.	Min.	Max	Number Sampled	Catch	Percent Sampled
LV Marked	Mannser (release site)	98.4	10.17	66	155	1,801	18,145	9.9%
	Scoop (recapture)	94.2	8.39	77	121	112	112	100.0%
	Screw (recapture)	95.7	8.20	78	118	122	122	100.0%
Unmarked	Scoop	92.3	10.01	63	138	407	4,464	9.1%
	Screw	95.4	12.98	61	154	396	4976	8.0%

Mark-Recapture Rates

Naturally-Produced Coho

In total 17,873 NOR coho smolts were LV-marked and released from the Mannser Creek weir. In the mainstem scoop and screw traps, we captured 9,674 NOR coho smolts, 234 of which were LV-marks recaptured from Mannser Creek. The incidence of LV-marked smolts in the total NOR smolt catch was estimated at 2.42%, with a recapture rate (number recaptured /number released) of the Mannser Creek marked coho at 1.31% (Table 19).

Hatchery Groups

A total of 311,429 HOR coho smolts were released into the Skagit River in 2006: 257,500 smolts by WDFW from the Marblemount Hatchery and 53,929 smolts by PSE in the Baker River watershed (Table 17). The combined recapture rate of these HOR smolts was 0.45%, three times lower than the recapture rate of NOR Mannser Creek marked coho (Table 19).

Table 19. Estimated capture rates of NOR and HOR coho smolts at the Skagit River Traps in 2006.

Stock	Number Released	Scoop		Screw		Total	
		Number Recap	Catch Rate	Number Recap	Catch Rate	Number Recap	Catch Rate
Wild Mannser Creek (LV marked)	17,873	112	0.6%	122	0.7%	234	1.3%
Marblemount/ Baker Hatcheries (WDFW/ PSE)	311,429	365	0.1%	1,034	0.3%	1,399	0.4%

Naturally-Produced Coho Smolt Production

Subtracting the HOR smolt catch from our mainstem coho smolt catch estimates that we captured 9,674 NOR coho smolts (u). This catch includes 234 LV-marked smolts (m) from 17,873 LV-

marked smolts released (M) from Mannser Creek. The Mannser Creek marked smolts provide the basis for our coho smolt estimate. Application of the Chapman's modification of a Peterson population estimate yields a coho production (U) of 735,876 smolts past the mainstem traps. Confidence intervals (95%) around this estimate range from 643,748 to 828,004 (Table 20). This estimate assumes that all of the LV-marked NOR coho smolts survived to pass the mainstem traps during the season.

Table 20. Estimation of NOR coho smolt production, Skagit River 2006.

	Number	Formula
Total mainstem trap catches	11,073	
Marblemount/Baker River Hatchery	-1,399	
Wild coho captured (u)	**9,674**	
LVs recaptured (m)	234	$N = \frac{(M+1)(u+1)}{(m+1)}$
LVs released (M)	17,873	
Total production (U)	**735,876**	
Variance (Var)	2.21E+09	$Var = \frac{(M+1)(u+1)(M-m)(u-m)}{(m+1)^2(m+2)}$
Standard Deviation (sd)	47,004	
Coefficient of Var (CV)	6.39%	CV = sd/U
Confindence Interval (CI)	92,128	CI = +/- 1.96(sd)
Estimated coho production		
Skagit River	735,876	
Upper CI (95%)	828,004	
Lower CI (95%)	643,748	

Other Species

In addition to Chinook 0+ and coho smolts, we captured numerous other salmonids, including Chinook yearlings, coho fry, sockeye fry and smolts, pink and chum fry, HOR and NOR steelhead smolts and adults, cutthroat smolts and adults, trout fry and parr, and Dolly Varden/bull trout (native char) smolts (Table 2). Spring 2006 was a pink salmon outmigration year, as the adults spawn in fall on odd-numbered years. Pink salmon fry were the most abundant downstream-migrant that we captured during the 2006 trapping season, with a total of 306,895 pink fry captured between the scoop and screw traps. On April 15, we had a very large daily catch of juvenile pink salmon in the mainstem traps of 104,184 fry (Figure 13). This was during a period of gradual flow increase. The high water that occurred in mid-May pushed out most of the remaining pink and chum fry and the migration was virtually finished at this point.

After Chinook 0+, chum fry were the third most prevalent catch of the 2006 season, with 79,036 fry captured (Figure 13).

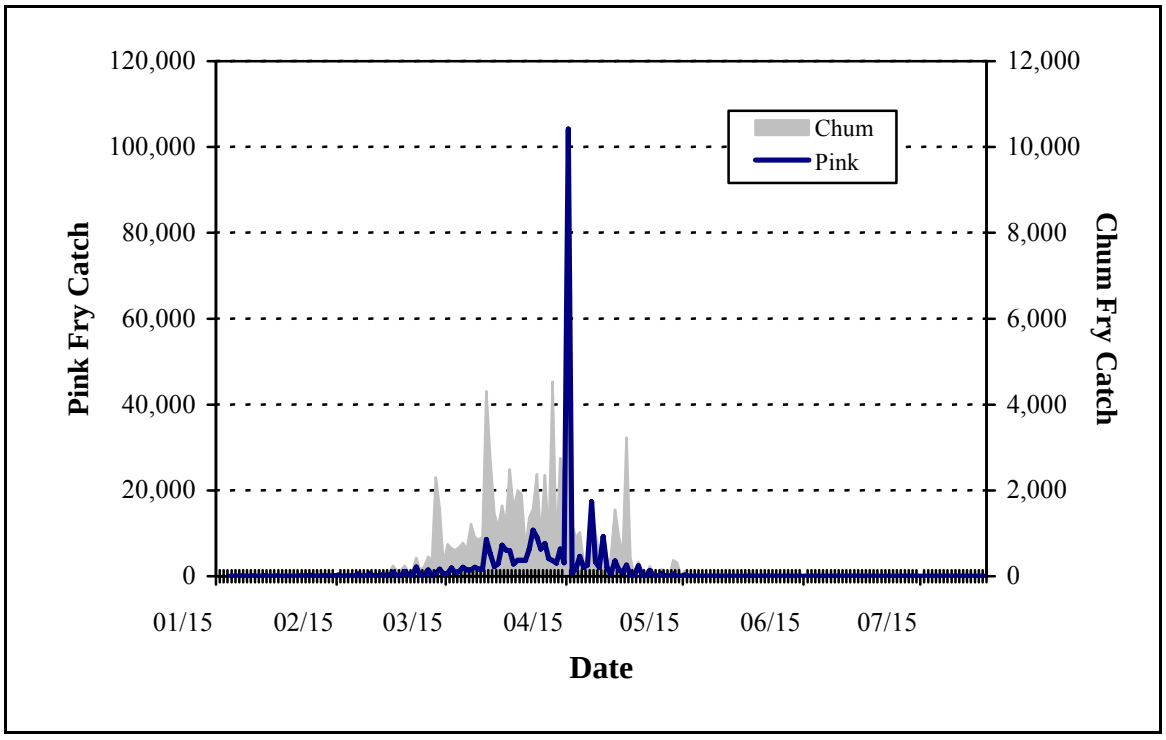

Figure 13. Pink and chum salmon fry catches in the Skagit River mainstem traps, 2006.

Steelhead smolts are captured to some degree in our mainstem traps. Due to their larger size and stronger swimming ability, steelhead smolts are more difficult to catch in such large rivers as the Skagit, because they are better able to avoid the gear compared to other species. In addition, steelhead demonstrate more variable life histories than coho or Chinook, and smolt age must be considered when relating their numbers to a specific cohort. Nevertheless, we enumerate all species captured at the trap, as these catches provide insight on general abundance and also provide samples for genetic analysis, virology and acoustic tagging projects for WDFW and other agencies.

A total of 329 NOR steelhead smolts were captured in the mainstem scoop and screw traps. We measured fork lengths on a random sample, and they averaged 161 mm over the season. We captured 90 native char smolts, which had an average fork length of 125 mm. Catch totals for all other salmonids are listed in Table 2.

Assumptions

Chinook 0+

Every estimate relies on a set of assumptions. We know that trap efficiency varies over time, and assume it is the end product of smolt abundance and environmental conditions. To minimize problems associated with using a small number of trap efficiency tests to represent catch rates over a variety of conditions, we elected to use a stratified mark-recapture approach, releasing many smaller groups of NOR Chinook 0+ across different flow levels throughout the duration of the trapping season. This stratified approach better represents the variability of trap efficiency throughout the season, as it is a product of environmental conditions and fish abundance, which are never constant. In addition, we made the following assumptions to estimate the numbers of NOR Chinook 0+ migrating from the Skagit River in 2006.

1. **Catch Expansion**. Expansion of catch to the standard of continuous trap operation involved estimating fish passing the traps on the nights and daytime periods that we did not fish.

2. **Trap Efficiency**. Trap efficiency is estimated by stratifying mark-recapture data over the duration of the trapping season. Inherent in the stratified mark-recapture approach is the assumption that trap efficiency during the daytime is identical to that during the night hours within each strata.

   Basic assumptions for every trap calibration group of marked fish include:
   a. The number passing the gear is known (survival from release to the trap is 100%);
   b. All marked fish captured are identified and enumerated; and
   c. Instantaneous trap efficiency is not a function of light.

3. **Equal Probability of Capture**. Marked fish are captured within hours of release, but are used to estimate efficiency over a longer period (few days). We assume the probability of capture remains constant over this longer period.

Discussion of Assumptions

Although direct assessment of the above assumptions is not possible, we have some intuition as to how important they are and in which direction some of them may be violated. These beliefs and their effects on our estimate of the zero-age Chinook production from the Skagit River follows:

Assumption #1: Catch Projection
We have no reason to believe that the catch projections using expansions of the day/night ratios for the daylight periods not fished are biased. We believe that the catch projection for the season is a reasonable estimate of the numbers of NOR zero-age Chinook that we would have caught in both traps had they operated continuously from January 18 to July 31.

Assumption #2a: 100% Survival of Calibration Fish
It is unlikely that all of the calibration fish in each group survived to pass the trap. For calibration tests involving the release of marked Chinook, however, we expect high survival to the traps given the short distance from the release site to the traps (about one mile) and condensed recovery time.

Assumption # 2b: Complete Identification/enumeration of All Marked Fish Captured
We are confident that virtually every marked fish captured was identified and recorded. The 2006 trapping crew was comprised of trained and dedicated scientific technicians with many years of experience at this site. Consequently, we don't consider this to be a significant potential bias.

Assumption #2c: Trap Efficiency Is Not Affected by Light
If this assumption is not correct, then it is likely that efficiency during the day is lower relative to the night rate; if a difference exists, trap avoidance enhanced by daylight is the likely reason. Another factor that would contribute to lower capture rates during the daylight could be any shifting in the migration path to deeper water as a function of light.

In an attempt to measure trap efficiency during the day and night, in Spring 1999, we released paired groups of hatchery Chinook. As we expected, however, these fish did not pass the gear within their release strata (catches occurred primarily at night), so these tests provided no insight into this potential problem. If these hatchery calibration groups have the same diel migration behavior as NOR fish, then different capture rates for day and night would not constitute a source of bias.

Assumption #3: Equal Probably of Capture
The stratified mark-recapture design used reduces the period that a mark group represents unmarked fish over a few days. While the accuracy of any one efficiency experiment is variable, we expect the error about the true efficiency is reduced to near zero given the large number of final efficiency strata used (32).

Conclusion

As in previous years, we conclude that the critical assumption for producing unbiased estimates of NOR Chinook 0+ production is the estimate of trap efficiency. Bias in the production estimate results largely from variation in this critical parameter. Trap efficiency in 2006 was estimated by releasing many groups (49 release groups) of marked Chinook 0+ and stratifying this data into 32 groups. These stratified groups better represent how trap efficiency is affected by environmental conditions.

Our trap efficiencies for NOR release groups ranged from a low of 1.2% to a high of 6% across the strata. Application of these stratified efficiency data to the expanded catch data estimates that 6.2 million NOR Chinook 0+ passed the traps in the Skagit River in 2006. If this production estimate is biased, we believe that it is high, because it is unlikely that all marked Chinook survived to pass the traps. Therefore, actual capture rates may be somewhat higher than what is projected by using mark groups.

Coho Smolts

The coho smolt migration estimate is achieved by marking 100% of migrants from Mannser Creek, a tributary to the Skagit River. Since the Mannser trap operated for the duration of the coho migration, it provides a known continuous mark group enabling us to forgo expanding coho smolt catches at the mainstem traps to the standard of continuous trapping as we do with Chinook. An equal proportion of marked fish from Mannser to total unmark coho catch would be caught regardless if we fished the

traps 24 hours a day for the entire migration or just a portion of the time. This approach also relies on assumptions.

1. **Closed Population**. No fish migrating in from other systems (upstream).

2. **Mark Group Representation**. The mark group must be composed of a representative sample of coho (size, migration timing) from the entire Skagit system and have an equal chance of being captured for both marking and recapture at the mainstem traps.

3. **Basic Assumptions**.
    a. All fish in mark groups must be marked clearly, enumerated correctly before release, and all marks must be noticed and properly enumerated upon recapture;
    b. Marking does not affect catch ability; and
    c. The number of marks passing the gear is known (survival from release to the trap is 100%) and fish do not lose marks

Assumption #1: Closed Population
Coho have a very defined migration period as observed on many systems in Washington State (Seiler et al 2005). Coho smolts are active downstream-migrants and it is assumed that no smolts would be migrating up the Skagit River from other systems.

Assumption #2: Mark Group Representation
We technically violate this assumption in that we only mark the fish that emigrate from Mannser Creek and not from the rest of the Skagit system. However, timing of the Mannser Creek mark group is nearly identical in timing to the rest of the Skagit coho, and these fish mix thoroughly with the unmarked migrants in the 18 miles between the Mannser Creek and the mainstem Skagit traps. The coho migration from Mannser Creek is not fully made up from progeny of coho that spawned in Mannser Creek. Lower Mannser is low gradient, off-channel (off of mainstem Skagit) rearing habitat. Coho parr migrate into Mannser Creek to rear and escape high water events on the mainstem Skagit. We therefore believe that the Mannser mark group to be a fairly good representation of coho from the entire system. Fork length averages for coho released from Mannser are slightly larger (98.4 mm) than the average lengths of unmarked coho captured at the mainstem traps (93.8 mm). This is the result of slight size selectivity observed this year at the mainstem trap sites. The average size of Mannser creek marked fish captured at the mainstem traps was 95.0 mm, slightly larger but not significantly different (t-test, $\alpha = 0.05$) than 93.8 mm average size of unmarked NOR coho smolts (Length Analysis and Size Selectivity).

Assumption #3a: Complete identification/enumeration of all fish marked and recaptured
We are confident that virtually every marked fish was handled and clipped according to procedure, and were properly identified and recorded upon recapture by our trained, experienced trapping crew. As with the Chinook estimate, we don't consider this potential bias to be significant.

Assumption #3b: Catchability
Mannser Creek coho were anesthetized and marked with a left ventral (LV) fin-clip, and were allowed to recover fully before release. It is believed this clipping and handling had very little impact on fish survival and swimming performance.

Assumption #3c: Number of marks passing the gear is known

It is highly unlikely that all the Mannser Creek mark group survived to pass or be captured in the mainstem traps. Therefore it is probable that our estimate is biased high.

Conclusion

We believe our coho production estimate to be biased slightly high, based on some of the preceding assumptions. Length analysis for LV-marked coho released at Mannser Creek and recaptured at the mainstream traps showed a slight, but significant difference ($\alpha = 0.05$) in length distributions from release to recapture. This indicates that the mainstem traps were less efficient at capturing larger migrants. This is a violation of Assumption #2, as the mark group does not have an equal chance of being recaptured. Also it is highly unlikely that 100% of our Mannser Creek mark group survived to pass or be captured in the mainstem traps (Assumption #3c), as these sites are 18 R.M. apart. It is believed, however, that the in-river survival rate for coho smolts are very high, based on previous studies (Seiler et. al 2004, p 101).

Discussion

Chinook Production

The 2005 spawning escapement was estimated at 22,049 adult Chinook (Barkdull pers comm.), the second highest that has been estimated since we started our trapping operations on the Skagit River in 1990. Over the years we have developed a strong relationship with incubation flow (November 1 through January 31) and egg-to-migrant survival (r^2=0.79)(Figure 14). The peak flow event for this 2005 brood Chinook was late during this critical period and fairly benign (57,400 cfs on January 11). These moderate rearing/incubation flows combined with the moderate flows throughout the trapping period translated into a high egg-to-migrant survival (11.4%) and large catches of Chinook 0+. During the 2006 trapping season we captured a total of 101,260 NOR Chinook 0+. This the largest catch total we have observed since we extended trapping season to specifically target Chinook 0+ in 1997.

With these favorable trapping conditions and large catches, we were able to increase the number of NOR Chinook mark groups to better calibrate trap efficiencies across a broader range of environmental conditions. A total of 49 groups of NOR Chinook 0+ were released beginning on February 14, with our last group being released on July 19. In total, 17,973 fish were marked and released, and of which 464 marked Chinook were recovered. This results in a season average trap efficiency of 2.6% for NOR Chinook. We stratified this data into 32 strata, which were applied to the expanded catch total to estimate Skagit System production. The estimate of 6.2 million NOR Chinook 0+ (CV = 5.85%, CI +/- 712,894) (Table 12) is the second highest production that we have estimated from the Skagit River (Table 15).

We are very confident with this production estimate as it closely fits the egg-to-migrant survival relationship that we have developed. Also, our increased number of NOR Chinook trap calibration groups has tightened our estimate to more accurately reflect how changes in flows and environmental conditions affect trap efficiency.

The 2006 outmigration of hatchery-produced Chinook 0+ experienced above average flow conditions during their release period, and as a result, experienced high survival past the mainstem traps. We believe that HOR Chinook are less likely to residualize when released during high flows, and spend less time exposed to in-river predation as they will migrate more quickly downstream. We used NOR Chinook efficiency data to estimate capture efficiencies for HOR Chinook groups. Using this efficiency data resulted in an estimated HOR Chinook production of just over 1.1 million (Table 13). This estimates relies on the same assumptions as the NOR Chinook 0+ estimate, and we therefore believe it is biased high.

We also assume that HOR Chinook had the same capture rate as NOR Chinook, which has been shown to be not necessarily true. On June 12, we released paired NOR and hatchery mark groups, to compare capture rates. The HOR mark-release group was recaptured at 5.88%, while the NOR mark group was recaptured at 3.08%. Although this is only one test, it demonstrates that our assumption may not be valid.

Because hatchery releases only total 677,882 fish, we believe the primary value of our estimate is that it indicates that in-river survival of these HOR groups was very good.

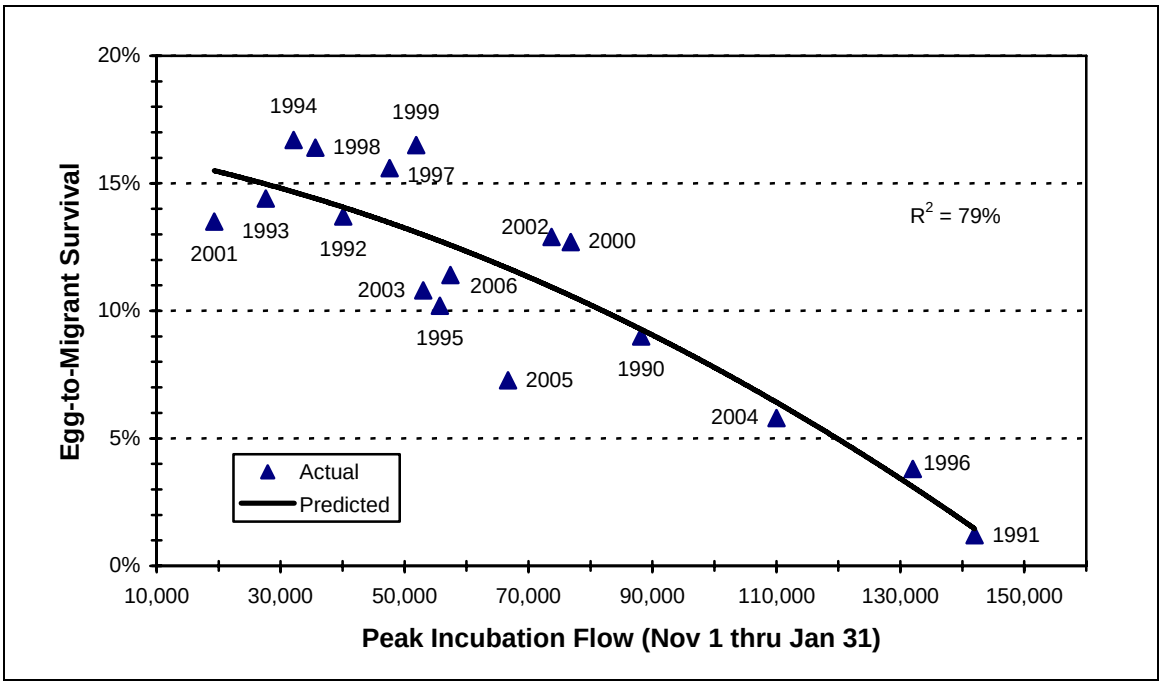

Figure 14. NOR Chinook 0+ egg-to-migrant survival and peak incubation flow, migration years 1990-2006, Skagit River

Coho Production

An estimated 735,876 NOR coho smolts were produced from the Skagit River in 2006. This is well below the average even-numbered year production (1,270,259 fry) based on estimates from 1990-2004. Over the past 16 years, we have observed a pattern that even-numbered year coho smolt productions are larger than in those occurring in odd-numbered years. We hypothesize that this is the result of a positive interaction between coho parr rearing and pink salmon, which generally only spawn in odd-numbered years.

The coho production estimate was made from smolts that were LV-marked at Mannser Creek and recaptured at the mainstem traps. Mannser was chosen as our index stream for marking of coho smolts to estimate production because of the large number of fish that it produces, the ease of trapping, mid-river location and its reputation for rearing juvenile coho from other areas of the river. Other upstream tributaries were trapped in the past for the purpose of ventral marking coho smolts but the recapture rates from these other locations show a significant, two- to four-fold difference lower than those marked at the Mannser Creek trap. We doubt that the difference in survival between these upriver tributaries and Mannser could be so different, and this could be due to a number of factors as discussed in Seiler et al 2005 (p114-115). In Spring 2001, we stopped marking coho smolts from the upper basin tributaries, given low recovery rates observed in 1999-2000, and Mannser Creek provided the basis for our coho smolt estimate.

In 2006 we recaptured 234 LV-marked coho smolts in the mainstem traps, out of a total of 17,873 smolts marked and released from Mannser Creek (Table 20). This yielded a capture rate of 1.3% (Table 19). This recapture rate is similar to the long-term average observed on recaptures of ventral

fin-clipped NOR coho over the previous 16 years (1990-2005 average = 1.33%). We believe the capture rate in 2006 was a result of very moderate flows throughout the migration period.

Recommendations

The following recommendations, compiled from the previous years' work, are listed so that we can assess the progress made during the 2006 season. As noted in last year's report, these measures include actions that we may reasonably and cost-effectively implement within the current scope and funding level of our trapping program in the lower Skagit River.

1. We will continue to assess the relationship of flow, turbidity, and migration rates;
2. Increase the number of Chinook 0+ calibration groups to assess recapture rates at various flow levels, including more paired releases of HOR and NOR calibration groups if HOR fish are to be used; and
3. Conduct pilot Chinook 0+ releases early in the season, supplemented with dye-marked chum or pink fry to assess recapture rates.

Progress:

1. **Accomplished**. We continued to look at the relationships between flow, turbidity and migration rates, and in 2006, used a relationship between flows and d:n catch rate ratios to predict missed catches.
2. **Accomplished**. We dramatically increased the number NOR Chinook 0+ trap calibration groups and released a total of 49 groups over the season at various flow levels. We only released one paired NOR and HOR calibration group, as we focused more on trap efficiencies for NOR fish.
3. **Accomplished**. Catches of NOR Chinook 0+ were high enough during the 2006 season that we were able to begin our trap calibration releases early in the migration (February 14).

Recommendations for 2007

Our study plan for the 2007 season includes continuing all of the above recommendations:

1. Continue to assess the relationship of flow, turbidity, and migration rates;
2. Continue with the increased number of marked NOR Chinook release groups to assess recapture rates at various flow levels throughout the season;
3. When possible, conduct paired releases of HOR and NOR Chinook groups to test the assumption of similar capture rates;
4. Explore options for estimating Chinook 1+ production;

5. Given the proposed listing of Puget Sound steelhead, consider developing new approaches for estimating NOR steelhead production; and

6. Continue estimating production for NOR coho smolts from the Skagit River by using smolt captured at the Mannser Creek trap site.

Appendix A: Variance of total unmarked smolt numbers, when the number of unmarked smolts, is estimated.

Kristen Ryding
WDFW Biometrician

Appendix A. Variance of total unmarked smolt numbers, $\hat{U}_i$, when the number of unmarked smolts, $\hat{u}_i$ is estimated. by Kristen Ryding, WDFW Biometrician.

The estimator for $\hat{U}_i$ is,

$$\hat{U}_i = \frac{\hat{u}_i\left(M_i+1\right)}{\left(m_i+1\right)}$$

the estimated variance of $\hat{U}_i$, $Var\left(U_i\right)$ is as follows,

$$Var\left(\hat{U}_i\right) = Var\left(\hat{u}_i\right)\left(\frac{\left(M_i+1\right)\left(M_i m_i+3M_i+2\right)}{\left(m_i+1\right)^2\left(m_i+2\right)}\right)+Var\left(\hat{U}_i\middle|E\left(\hat{u}\right)\right)$$

$$\text{where } Var\left(\hat{U}_i\middle|E\left(\hat{u}\right)\right) = \frac{\left(M_i+1\right)\left(M_i-m_i\right)E\left(\hat{u}_i\right)\left(E\left(\hat{u}_i\right)+m_i+1\right)}{\left(m_i+1\right)^2\left(m_i+2\right)},$$

$E\left(\hat{u}_i\right)$ = the expected value of $\hat{u}_i$ either in terms of the estimator (equation for $\hat{u}_i$) or just substitute in the estimated value and, $Var\left(\hat{u}_i\right)$ depends on the sampling method used to estimate $\hat{u}_i$.

Derivation:

Ignoring the subscript i for simplicity, the derivation of the variance estimator is based on the following unconditional variance expression,

$$Var\left(\hat{U}\right) = Var\left(E\left(\hat{U}\middle|u\right)\right)+E\left(Var\left(\hat{U}\middle|u\right)\right).$$

The expected value and variance $\hat{U}$ given u is as before, respectively,

$$E\left(\hat{U}_i\middle|u\right) = \frac{u_i\left(M_i+1\right)}{\left(m_i+1\right)} \text{ and,}$$

$$Var\left(\hat{U}\middle|u\right) = \frac{u\left(u+m+1\right)\left(M+1\right)\left(M-m\right)}{\left(m+1\right)^2\left(m+2\right)}.$$

Substituting in $\hat{u}$ for u gives the following,

$$Var\left(\hat{U}\right) = Var\left(\frac{\hat{u}\left(M+1\right)}{\left(m+1\right)}\right)+E\left[\frac{\left(M+1\right)\left(M-m\right)\hat{u}\left(\hat{u}+m+1\right)}{\left(m+1\right)^2\left(m+2\right)}\right]$$

$$Var\left(\hat{U}\right) = \left(\frac{\left(M+1\right)}{\left(m+1\right)}\right)^2 Var\left(\hat{u}\right)+\frac{\left(M+1\right)\left(M-m\right)}{\left(m+1\right)^2\left(m+2\right)}\left[E\left(\hat{u}^2\right)+E\left(\hat{u}\right)\left(m+1\right)\right]$$

Note that,

$$E\left(\hat{u}^2\right) = Var\left(\hat{u}\right) + \left(E\hat{u}\right)^2$$

Substituting in this value for $E\left(\hat{u}^2\right)$,

$$Var\left(\hat{U}\right) = \left(\frac{(M+1)}{(m+1)}\right)^2 Var\left(\hat{u}\right) + \frac{(M+1)(M-m)}{(m+1)^2(m+2)}\left[Var\left(\hat{u}\right) + \left(E\left(\hat{u}\right)\right)^2 + E\left(\hat{u}\right)(m+1)\right]$$

$$= \left(\frac{(M+1)}{(m+1)}\right)^2 Var\left(\hat{u}\right) + \frac{(M+1)(M-m)}{(m+1)^2(m+2)}\left[Var\left(\hat{u}\right) + E\left(\hat{u}\right)\left[E\left(\hat{u}\right) + m + 1\right]\right]$$

$$Var\left(\hat{U}\right) = \left(\frac{(M+1)}{(m+1)}\right)^2 Var\left(\hat{u}\right) + \frac{(M+1)(M-m)}{(m+1)^2(m+2)} Var\left(\hat{u}\right) + \frac{(M+1)(M-m)E\left(\hat{u}\right)\left[E\left(\hat{u}\right) + m + 1\right]}{(m+1)^2(m+2)}$$

$$Var\left(\hat{U}\right) = Var\left(\hat{u}\right)\left(\frac{(M+1)^2}{(m+1)^2} + \frac{(M+1)(M-m)}{(m+1)^2(m+2)}\right) + \frac{(M+1)(M-m)E\left(\hat{u}\right)\left[E\left(\hat{u}\right) + m + 1\right]}{(m+1)^2(m+2)}$$

$$Var\left(\hat{U}\right) = Var\left(\hat{u}\right)\left(\frac{(M+1)^2}{(m+1)^2} + \frac{(M+1)(M-m)}{(m+1)^2(m+2)}\right) + Var\left(\hat{U}\middle|E\left(\hat{u}\right)\right)$$

$$Var\left(\hat{U}\right) = \frac{(M+1)}{(m+1)^2} Var\left(\hat{u}\right)\left(\frac{(M+1)(m+2)}{(m+2)} + \frac{(M-m)}{(m+2)}\right) + Var\left(\hat{U}\middle|E\left(\hat{u}\right)\right)$$

$$Var\left(\hat{U}\right) = \frac{(M+1)}{(m+1)^2} Var\left(\hat{u}\right)\left(\frac{Mm + 2M + m + 2 + M - m}{(m+2)}\right) + Var\left(\hat{U}\middle|E\left(\hat{u}\right)\right)$$

$$Var\left(\hat{U}\right) = Var\left(\hat{u}\right)\left(\frac{(M+1)(Mm + 3M + 2)}{(m+1)^2(m+2)}\right) + Var\left(\hat{U}\middle|E\left(\hat{u}\right)\right)$$

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Appendix B and C: Daily Catches in the Mainstem Skagit River Scoop and Screw Traps, 2006

Appendix B: Total daily catches, by species and age, in the Skagit River mainstem scoop trap, 2006.

Date	HOURS		CHINOOK		Chum	COHO		Pink	Sock	TROUT			Unmarked		
	Fished	Out	0+	1+		0+	1+			Parr	Sthd	Cutt	Chin0	Coho1	Sthd1
01/18	8.00	0.25	7	0	1	0	0	1	0	0	0	0	7	0	0
01/19	15.25	8.75	20	1	2	0	0	5	0	0	0	0	20	0	0
01/20	14.00	10.00	33	0	4	0	0	10	0	0	0	0	33	0	0
01/21	23.42	0.58	66	1	9	0	0	18	0	0	0	0	66	0	0
01/22	14.17	9.83	38	1	2	0	0	11	0	0	0	0	38	0	0
01/23	14.00	10.00	52	0	0	0	0	12	0	1	0	0	52	0	0
01/24	23.67	0.33	110	1	2	0	0	50	0	0	0	0	110	0	0
01/25	14.00	10.00	62	0	0	0	0	9	0	0	0	0	62	0	0
01/26	14.50	9.50	72	1	1	0	0	10	0	0	0	0	72	0	0
01/27	22.67	1.33	140	0	3	0	0	96	0	0	0	0	140	0	0
01/28	14.17	9.83	99	0	5	0	0	12	0	0	0	0	99	0	0
01/29	14.33	9.67	128	0	6	0	0	16	0	0	0	0	128	0	0
01/30	9.25	0.25	130	0	4	0	0	15	0	0	0	0	130	0	0
01/31	6.50	32.00	54	0	3	0	0	6	0	0	0	0	54	0	0
02/01	14.00	10.00	120	0	8	0	0	14	0	0	0	0	120	0	0
02/02	23.67	0.33	186	0	9	0	0	19	0	0	0	0	186	0	0
02/03	14.00	10.00	141	0	6	0	0	12	0	0	0	0	141	0	0
02/04	13.75	10.25	159	0	2	0	0	18	0	0	0	0	159	0	0
02/05	11.75	12.25	119	0	3	0	0	23	0	0	0	0	119	0	0
02/06	23.58	0.42	339	0	5	0	0	44	0	0	0	0	339	0	0
02/07	14.25	9.75	170	0	3	0	0	14	0	0	0	0	170	0	0
02/08	23.58	0.42	250	0	3	0	0	137	0	0	0	0	250	0	0
02/09	14.00	10.00	226	1	3	0	0	19	0	0	0	0	226	0	0
02/10	13.83	10.17	305	0	5	0	0	14	0	0	0	0	305	0	0
02/11	23.58	0.42	474	0	7	0	0	94	0	0	1	0	474	0	1
02/12	13.75	10.25	152	0	1	0	0	29	0	0	0	0	152	0	0
02/13	14.00	10.00	105	0	1	0	0	31	0	1	0	0	105	0	0
02/14	14.25	9.75	158	0	2	0	0	29	1	0	0	0	158	0	0
02/15	23.50	0.50	625	0	8	0	0	194	1	0	0	0	625	0	0
02/16	23.67	0.33	558	0	10	0	0	21	0	0	0	0	558	0	0
02/17	23.67	0.33	513	0	3	0	0	57	0	0	0	0	513	0	0
02/18	14.17	9.83	501	1	1	0	0	26	1	0	0	0	501	0	0
02/19	14.25	9.75	435	0	5	0	0	34	0	0	0	0	435	0	0
02/20	23.67	0.33	740	1	17	0	1	361	1	1	0	0	740	1	0
02/21	13.75	10.25	583	0	11	0	1	26	0	0	0	0	583	1	0
02/22	13.75	10.25	334	0	9	0	0	20	0	0	0	0	334	0	0
02/23	23.50	0.50	1,267	0	29	0	1	514	0	0	0	0	1,267	1	0
02/24	13.50	10.50	798	1	9	0	0	74	0	0	0	0	798	0	0
02/25	13.42	10.58	796	1	6	0	1	61	0	0	0	0	796	1	0
02/26	23.67	0.33	905	1	43	0	0	250	0	0	0	0	905	0	0
02/27	13.92	10.08	526	0	59	0	0	131	0	1	0	0	526	0	0
02/28	13.50	10.50	846	1	64	0	0	66	0	0	0	0	846	0	0
03/01	23.67	0.33	1,184	1	131	0	0	709	0	0	0	0	1,184	0	0
03/02	13.00	11.00	798	0	96	0	0	86	0	0	0	0	798	0	0
03/03	13.00	11.00	815	0	95	0	0	115	1	0	0	0	815	0	0
03/04	23.67	0.33	1,195	1	124	0	0	785	0	0	0	0	1,195	0	0
03/05	13.00	11.00	650	0	78	0	1	233	1	0	0	0	650	1	0
03/06	13.00	11.00	870	1	106	0	0	292	0	0	0	0	870	0	0
03/07	23.58	0.42	1,538	0	216	0	0	1,126	0	0	0	0	1,538	0	0
03/08	12.83	11.17	755	1	124	0	1	214	0	0	0	0	755	1	0
03/09	12.00	12.00	774	0	132	0	1	178	0	0	0	0	774	1	0
03/10	23.58	0.42	1,235	1	332	0	1	889	0	1	0	0	1,235	1	0

Table continued on next page

Appendix B: Total daily catches, by species and age, in the Skagit River mainstem scoop trap, 2006 (cont'd).

Date	HOURS		CHINOOK		Chum	COHO		Pink	Sock	TROUT			Unmarked		
	Fished	Out	0+	1+		0+	1+			Parr	Sthd	Cutt	Chin0	Coho1	Sthd1
03/11	12.50	11.50	700	0	880	0	0	274	0	0	0	0	700	0	0
03/12	12.50	11.50	872	0	1,333	0	1	431	0	0	0	0	872	1	0
03/13	23.58	0.42	642	0	659	0	1	871	0	0	0	0	642	1	0
03/14	12.50	11.50	297	1	274	0	0	403	0	0	0	0	297	0	0
03/15	12.00	12.00	348	0	307	0	0	410	0	0	0	0	348	0	0
03/16	23.50	0.50	583	1	394	0	0	858	0	0	0	0	583	0	0
03/17	12.00	12.00	604	1	429	0	0	574	1	0	0	0	604	0	0
03/18	11.75	12.25	559	0	406	0	1	669	0	0	0	0	559	1	0
03/19	23.67	0.33	530	0	498	0	0	1,599	0	0	1	0	530	0	1
03/20	12.00	12.00	730	0	494	0	0	839	0	0	0	0	730	0	0
03/21	12.00	12.00	694	0	445	0	0	808	0	0	0	0	694	0	0
03/22	23.58	0.42	632	0	593	0	1	1,449	0	0	0	0	632	1	0
03/23	11.50	12.50	604	0	526	1	1	939	0	0	0	0	604	1	0
03/24	11.50	12.50	731	0	1,005	0	1	1,642	0	1	0	0	731	1	0
03/25	23.58	0.42	1,609	0	2,149	0	0	4,440	0	0	0	0	1,609	0	0
03/26	11.75	12.25	1,802	0	1,196	0	1	2,246	0	0	0	0	1,802	1	0
03/27	11.50	12.50	1,663	0	604	0	1	1,223	0	1	0	0	1,663	1	0
03/28	23.58	0.42	1,021	0	751	0	1	2,687	0	0	0	0	1,021	1	0
03/29	11.50	12.50	435	0	755	0	1	3,274	0	0	0	0	435	1	0
03/30	11.50	12.50	306	0	613	0	0	2,544	0	0	0	0	306	0	0
03/31	23.67	0.33	820	0	1,304	0	1	2,667	0	0	0	0	820	1	0
04/01	11.50	12.50	994	0	845	0	2	1,648	0	0	0	0	994	2	0
04/02	11.50	12.50	853	0	918	1	1	1,798	1	0	1	0	853	1	1
04/03	23.67	0.33	576	0	893	0	1	2,575	0	1	0	0	576	1	0
04/04	11.25	12.75	280	0	622	0	2	3,643	0	1	0	0	280	2	0
04/05	11.25	12.75	301	0	769	0	1	4,850	0	1	0	0	301	1	0
04/06	23.50	0.50	411	1	1,037	0	1	6,086	0	0	0	0	411	1	0
04/07	10.75	13.25	398	0	1,040	1	2	5,618	0	0	0	0	398	2	0
04/08	11.00	13.00	278	0	554	0	0	3,941	0	0	0	0	278	0	0
04/09	23.50	0.50	573	0	1,083	0	2	3,578	0	0	0	0	573	2	0
04/10	10.75	13.25	446	0	1,227	2	5	2,762	0	0	0	0	446	5	0
04/11	10.75	13.25	437	0	1,874	1	7	2,836	0	1	0	0	437	7	0
04/12	10.50	13.50	232	0	471	0	4	2,519	0	2	0	0	232	4	0
04/13	23.58	0.42	743	0	1,636	1	6	3,516	0	2	0	0	743	6	0
04/14	10.75	13.25	910	0	1,107	11	7	1,362	1	1	0	1	910	7	0
04/15	22.25	1.75	1,448	114	3,696	41	7	57,863	1	1	0	0	1,448	7	0
04/16	10.50	13.50	505	33	851	21	12	888	1	0	0	0	505	12	0
04/17	10.50	13.50	248	8	406	7	18	1,195	0	1	0	0	248	18	0
04/18	23.50	0.50	181	5	498	10	14	2,541	0	0	0	0	181	14	0
04/19	10.50	13.50	63	1	202	4	5	1,116	0	2	0	0	63	5	0
04/20	10.50	13.50	51	0	246	3	4	3,017	0	1	0	0	51	4	0
04/21	23.25	0.75	137	0	842	3	10	7,894	0	1	0	0	137	10	0
04/22	10.25	13.75	178	0	537	0	16	1,908	0	1	0	0	178	16	0
04/23	10.25	13.75	91	0	256	1	16	1,270	0	1	1	0	91	16	1
04/24	23.67	0.33	44	0	372	0	17	6,230	0	2	0	0	44	17	0
04/25	9.75	14.25	125	6	259	0	61	952	3	1	3	0	125	61	3

Table continued on next page

Appendix B: Total daily catches, by species and age, in the Skagit River mainstem scoop trap, 2006 (cont'd).

Date	HOURS		CHINOOK		Chum	COHO		Pink	Sock	TROUT			Unmarked		
	Fished	Out	0+	1+		0+	1+			Parr	Sthd	Cutt	Chin0	Coho1	Sthd1
04/26	6.00	18.00	106	3	200	2	49	347	2	0	1	0	106	49	1
04/27	23.50	0.50	153	0	867	4	65	2,384	1	1	0	0	153	65	0
04/28	10.00	14.00	128	1	457	3	91	874	0	0	0	0	128	84	0
04/29	9.75	14.25	250	2	390	7	182	512	1	1	2	0	250	156	2
04/30	19.50	4.50	552	1	1,334	12	251	1,536	1	0	3	0	552	218	3
05/01	9.67	14.33	261	1	196	6	139	145	0	0	0	0	261	134	0
05/02	9.50	14.50	207	2	44	0	171	75	2	1	1	0	207	169	1
05/03	23.50	0.50	201	1	182	1	152	1,558	2	1	1	0	201	149	1
05/04	9.50	14.50	63	0	29	1	113	90	1	0	0	0	63	112	0
05/05	9.50	14.50	45	0	47	0	77	61	0	0	1	0	45	75	1
05/06	23.50	0.50	137	0	139	1	116	763	3	1	0	0	137	114	0
05/07	9.50	14.50	194	1	19	0	290	27	3	1	3	1	194	277	2
05/08	9.50	14.50	137	0	6	0	369	4	0	1	4	1	137	329	0
05/09	23.00	1.00	56	0	106	0	246	431	0	0	1	0	56	204	0
05/10	9.50	14.50	30	0	6	0	124	6	0	2	1	0	30	108	1
05/11	9.00	15.00	13	0	42	0	53	8	0	1	0	0	13	52	0
05/12	23.50	0.50	38	1	235	0	98	318	1	1	0	0	38	98	0
05/13	9.00	15.00	46	0	121	0	180	3	1	0	1	0	46	178	1
05/14	8.75	15.25	25	0	8	1	144	2	1	2	1	1	25	143	1
05/15	23.50	0.50	63	0	56	0	145	149	0	1	0	1	63	144	0
05/16	2.00	0.00	30	0	3	0	66	1	0	0	0	0	30	66	0
05/21	2.25	139.00	27	0	1	0	13	0	0	0	1	0	27	13	0
05/22	4.00	19.75	87	1	1	3	37	0	1	0	2	0	87	33	1
05/23	4.00	20.00	109	0	2	6	57	0	0	0	3	0	109	47	2
05/24	9.25	15.75	288	1	1	2	129	1	2	0	4	0	288	108	2
05/25	8.25	15.75	305	0	1	5	180	0	2	0	6	0	297	144	3
05/26	8.75	15.25	402	1	1	7	141	0	0	0	1	0	330	122	0
05/27	23.50	0.50	917	0	2	6	159	4	0	0	0	1	720	124	0
05/28	8.00	16.00	430	0	2	1	51	2	0	0	1	0	256	47	1
05/29	8.50	15.50	659	0	2	0	84	0	0	0	1	1	266	82	0
05/30	23.67	0.33	918	0	13	0	116	0	0	1	0	0	443	111	0
05/31	8.25	15.75	569	1	15	0	86	0	0	0	0	0	269	82	0
06/01	8.00	16.00	379	0	23	1	74	1	1	0	1	0	192	69	1
06/02	8.00	16.00	431	0	5	2	94	2	0	0	1	0	228	83	1
06/03	7.50	16.50	283	0	2	2	46	0	0	0	1	1	163	44	0
06/04	7.50	16.50	336	0	1	2	37	0	0	0	2	2	229	35	2
06/05	11.00	13.00	533	0	1	3	43	0	0	1	2	1	317	39	2
06/06	7.75	16.25	551	0	0	1	24	0	0	1	0	1	169	23	0
06/07	8.00	16.00	787	0	0	0	19	0	2	0	0	0	264	19	0
06/08	23.58	0.42	847	0	1	1	22	0	1	1	0	0	326	22	0
06/09	8.00	16.00	174	0	1	0	14	0	0	0	0	0	74	13	0
06/10	8.00	16.00	190	0	1	0	14	0	0	0	0	0	97	14	0
06/11	23.75	0.25	422	1	3	0	23	0	0	0	0	0	244	22	0
06/12	8.00	16.00	174	0	0	0	23	0	0	0	0	1	107	23	0
06/13	8.00	16.00	177	1	0	1	20	0	0	0	0	0	113	20	0
06/14	23.50	0.50	425	1	1	3	12	0	0	0	0	0	306	12	0
06/15	8.75	15.25	135	0	1	2	3	0	0	0	0	0	98	3	0

Note: The unmarked coho 1+ does not include fish marked at Mannser Creek or Baker Dam.

Table continued on next page

Appendix B: Total daily catches, by species and age, in the Skagit River mainstem scoop trap, 2006 (cont'd).

Date	HOURS		CHINOOK		Chum	COHO		Pink	Sock	TROUT			Unmarked		
	Fished	Out	0+	1+		0+	1+			Parr	Sthd	Cutt	Chin0	Coho1	Sthd1
06/16	9.00	15.00	302	0	0	1	4	0	0	1	0	0	77	4	0
06/17	23.58	0.42	1,629	0	1	0	8	0	0	0	0	0	225	8	0
06/18	8.00	16.00	538	0	0	0	4	0	0	0	0	0	95	4	0
06/19	8.00	16.00	290	0	1	0	4	0	0	0	0	0	77	4	0
06/20	23.75	0.25	395	0	1	0	8	0	0	0	0	1	164	8	0
06/22	8.00	16.00	111	0	2	2	3	0	0	1	0	0	59	3	0
06/23	23.50	0.50	150	0	2	2	1	0	0	0	0	0	86	1	0
06/24	8.25	15.75	103	0	2	0	0	0	0	2	0	1	52	0	0
06/25	8.00	16.00	136	0	3	1	2	0	0	2	0	2	69	2	0
06/26	14.50	9.50	198	0	2	1	2	0	0	0	0	0	93	2	0
06/27	8.25	15.75	194	0	2	1	0	0	1	0	0	0	94	0	0
06/28	7.50	16.50	140	0	2	0	0	0	0	0	0	0	81	0	0
06/29	23.50	0.50	339	0	7	0	3	0	0	0	0	0	240	3	0
06/30	8.00	16.00	114	0	2	0	1	0	0	0	0	0	80	1	0
07/01	8.25	15.75	83	0	2	0	2	0	0	1	0	0	56	1	0
07/02	23.83	0.17	112	0	1	1	2	0	0	0	0	0	82	2	0
07/03	8.00	16.00	96	0	1	0	0	0	0	0	0	0	73	0	0
07/04	5.50	0.00	47	0	1	0	0	0	1	1	0	0	38	0	0
07/05	2.50	40.00	35	0	0	0	0	0	0	0	0	0	24	0	0
07/06	23.50	0.50	213	0	0	1	0	0	0	0	0	0	137	0	0
07/07	8.17	15.83	96	0	0	0	1	0	0	0	0	0	68	1	0
07/08	23.50	0.50	131	0	0	0	2	0	1	0	0	0	89	2	0
07/09	8.25	15.75	57	1	0	0	0	0	0	0	0	0	43	0	0
07/10	8.25	15.75	60	0	0	0	0	0	0	0	0	0	41	0	0
07/11	23.58	0.42	124	0	0	1	0	0	0	0	0	0	84	0	0
07/12	8.00	16.00	106	0	0	0	0	0	0	0	0	0	75	0	0
07/13	5.50	0.00	129	0	0	0	0	0	0	0	0	0	86	0	0
07/16	2.25	88.25	6	0	0	0	0	0	0	0	0	0	5	0	0
07/17	23.50	0.50	33	0	0	0	1	0	0	0	0	0	24	1	0
07/18	8.50	15.50	28	0	1	0	0	0	0	0	0	0	21	0	0
07/19	23.50	0.50	52	0	0	0	3	0	0	0	0	0	36	3	0
07/20	6.00	0.00	42	0	0	1	1	0	0	0	0	0	29	1	0
07/23	2.50	87.50	27	0	0	0	0	0	0	0	0	0	22	0	0
07/24	21.00	3.00	131	0	1	1	1	0	0	0	0	0	107	1	0
07/25	8.50	15.50	118	0	1	0	3	0	0	0	0	0	96	3	0
07/26	23.58	0.42	89	0	0	1	1	0	0	0	0	0	69	1	0
07/27	6.00	0.00	28	0	0	0	0	0	0	0	0	0	26	0	0
07/30	2.75	87.25	7	0	0	0	0	0	0	0	0	0	3	0	0
07/31	6.00	0.00	15	0	0	0	0	0	0	0	0	0	15	0	0
	2,603.67	2,042.58	69,787	209	44,269	209	4,941	178,987	45	53	53	17	61,493	4,576	36

Note: The unmarked coho 1+ does not include fish marked at Mannser Creek or Baker Dam.

Appendix C: Total daily catches, by species and age, in the Skagit River mainstem screw trap, 2006

Date	HOURS		CHINOOK		Chum	COHO		Pink	Sock	TROUT			Unmarked		
	Fished	Out	0+	1+		0+	1+			Parr	Sthd	Cutt	Chin0	Coho1	Sthd1
01/18	8.00	0.25	14	0	1	0	0	3	0	0	0	0	14	0	0
01/19	15.08	8.92	21	0	1	0	0	7	0	0	0	0	21	0	0
01/20	14.08	9.92	16	0	4	0	0	11	0	0	0	0	16	0	0
01/21	23.75	0.25	52	0	2	0	0	19	0	0	0	0	52	0	0
01/22	14.17	9.83	25	0	1	0	0	4	0	0	0	0	25	0	0
01/23	14.00	10.00	15	1	1	0	0	0	0	1	0	0	15	0	0
01/24	23.83	0.17	57	0	2	0	0	14	0	0	1	0	57	0	1
01/25	14.00	10.00	14	0	0	0	0	3	0	0	1	0	14	0	1
01/26	14.50	9.50	23	1	0	0	0	4	0	0	0	0	23	0	0
01/27	23.25	0.75	62	1	3	0	0	36	1	0	0	0	62	0	0
01/28	14.17	9.83	19	0	1	0	0	4	0	0	0	0	19	0	0
01/29	14.25	9.75	58	0	3	0	0	8	1	0	0	0	58	0	0
01/30	9.25	0.25	87	0	2	0	0	9	0	0	0	0	87	0	0
01/31	6.50	32.00	18	0	0	0	0	0	0	0	0	0	18	0	0
02/01	14.00	10.00	35	1	2	0	0	5	1	0	0	0	35	0	0
02/02	24.00	0.00	92	1	4	0	0	17	0	1	0	0	92	0	0
02/03	14.00	10.00	66	0	1	0	0	12	0	0	0	0	66	0	0
02/04	13.75	10.25	59	1	1	0	0	10	0	0	0	0	59	0	0
02/05	11.75	12.25	57	0	2	0	0	13	0	0	0	0	57	0	0
02/06	24.00	0.00	259	0	3	0	0	42	0	0	0	0	259	0	0
02/07	14.17	9.83	142	0	1	0	0	16	0	1	0	0	142	0	0
02/08	23.58	0.42	143	0	3	0	0	94	1	0	0	0	143	0	0
02/09	14.17	9.83	103	1	2	0	0	11	0	0	0	0	103	0	0
02/10	13.75	10.25	138	1	2	0	0	9	0	0	0	0	138	0	0
02/11	24.00	0.00	317	1	2	0	0	81	0	1	0	0	317	0	0
02/12	13.75	10.25	92	1	1	0	0	32	0	0	0	0	92	0	0
02/13	14.00	10.00	62	0	1	0	0	35	0	0	0	0	62	0	0
02/14	14.25	9.75	55	0	1	0	1	15	1	0	0	0	55	1	0
02/15	24.00	0.00	296	0	1	0	0	98	2	0	1	0	296	0	1
02/16	13.67	10.33	183	0	0	0	0	8	1	1	0	0	183	0	0
02/17	23.75	0.25	244	2	1	0	0	21	0	0	0	0	244	0	0
02/18	13.83	10.17	131	0	2	0	0	5	0	0	0	0	131	0	0
02/19	14.08	9.92	180	0	5	0	1	9	0	0	0	0	180	1	0
02/20	23.83	0.17	346	0	13	0	1	143	1	0	0	0	346	1	0
02/21	13.75	10.25	211	0	5	0	0	10	0	0	0	0	211	0	0
02/22	13.75	10.25	217	0	6	0	1	21	0	0	0	1	217	1	0
02/23	23.67	0.33	875	0	31	0	0	161	1	0	0	0	875	0	0
02/24	13.50	10.50	392	0	9	0	0	17	0	0	0	0	392	0	0
02/25	13.50	10.50	337	0	6	0	0	28	0	0	0	0	337	0	0
02/26	24.00	0.00	497	0	27	0	0	104	0	0	0	0	497	0	0
02/27	13.67	10.33	352	0	24	0	1	56	0	0	0	1	352	1	0
02/28	13.42	10.58	601	1	44	0	1	38	0	0	0	0	601	1	0
03/01	24.00	0.00	813	0	86	0	0	253	0	0	0	0	813	0	0
03/02	13.00	11.00	448	0	32	0	0	30	0	0	0	0	448	0	0
03/03	13.00	11.00	406	0	32	0	1	38	0	0	0	0	406	1	0
03/04	24.00	0.00	683	0	110	0	2	408	0	0	0	0	683	2	0
03/05	13.00	11.00	286	1	32	0	1	105	0	0	0	0	286	1	0
03/06	13.00	11.00	530	0	76	0	1	121	0	0	0	0	530	1	0
03/07	24.00	0.00	925	1	158	0	0	921	0	0	0	0	925	0	0
03/08	13.00	11.00	313	0	60	0	0	51	1	0	1	0	313	0	1
03/09	12.00	12.00	407	1	82	0	0	33	0	0	0	1	407	0	0
03/10	24.00	0.00	684	0	185	0	0	654	1	0	0	0	684	0	0

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Appendix C: Total daily catches, by species and age, in the Skagit River mainstem screw trap, 2006 cont'd).

Date	HOURS		CHINOOK		Chum	COHO		Pink	Sock	TROUT			Unmarked		
	Fished	Out	0+	1+		0+	1+			Parr	Sthd	Cutt	Chin0	Coho1	Sthd1
03/11	12.50	11.50	366	0	329	0	1	138	0	0	0	0	366	1	0
03/12	12.50	11.50	493	0	581	0	0	148	1	0	0	0	493	0	0
03/13	23.75	0.25	404	0	429	0	0	754	0	0	0	0	404	0	0
03/14	12.50	11.50	231	0	221	0	0	214	0	0	0	0	231	0	0
03/15	12.00	12.00	277	0	263	0	0	358	0	0	0	0	277	0	0
03/16	24.00	0.00	387	0	371	0	0	1,032	0	0	0	0	387	0	0
03/17	12.00	12.00	345	0	209	0	0	359	0	0	0	0	345	0	0
03/18	11.75	12.25	337	1	194	0	1	261	0	0	0	0	337	1	0
03/19	24.00	0.00	413	0	307	0	0	830	0	0	0	0	413	0	0
03/20	12.00	12.00	477	0	397	0	0	661	0	0	1	0	477	0	1
03/21	12.00	12.00	421	0	363	0	1	573	0	0	0	0	421	1	0
03/22	24.00	0.00	473	0	561	0	0	838	0	1	0	0	473	0	0
03/23	11.50	12.50	359	0	357	0	0	744	0	0	0	1	359	0	0
03/24	11.50	12.50	523	0	842	0	1	1,579	0	0	0	0	523	1	0
03/25	24.00	0.00	1,249	0	2,070	0	0	4,247	0	0	0	0	1,249	0	0
03/26	11.75	12.25	1,174	0	986	0	2	1,661	0	2	0	0	1,174	2	0
03/27	11.50	12.50	1,026	0	497	0	2	894	0	1	1	0	1,026	2	1
03/28	24.00	0.00	645	0	824	0	2	2,660	1	0	1	0	645	2	1
03/29	11.50	12.50	312	0	677	0	1	3,434	0	1	1	0	312	1	1
03/30	11.50	12.50	254	0	535	0	1	2,759	0	0	0	0	254	1	0
03/31	24.00	0.00	790	0	1,399	0	1	2,535	0	0	0	0	790	1	0
04/01	11.50	12.50	755	0	849	0	3	1,486	2	0	0	0	755	3	0
04/02	11.50	12.50	586	0	798	0	2	1,438	2	1	0	1	586	2	0
04/03	23.83	0.17	452	0	669	0	0	1,438	1	0	0	0	452	0	0
04/04	11.25	12.75	176	0	287	0	1	1,039	0	1	1	0	176	1	1
04/05	11.25	12.75	223	0	508	0	1	2,548	0	1	1	0	223	1	1
04/06	24.00	0.00	352	0	1,005	0	0	4,636	0	0	0	0	352	0	0
04/07	10.75	13.25	275	0	755	0	1	2,425	0	1	1	0	275	1	1
04/08	11.00	13.00	174	0	429	0	0	2,510	0	1	0	0	174	0	0
04/09	23.75	0.25	462	0	1,150	0	1	3,138	0	0	0	0	462	1	0
04/10	10.75	13.25	323	0	985	0	4	1,182	0	0	0	0	323	4	0
04/11	10.75	13.25	278	0	1,177	0	5	636	0	0	0	1	278	5	0
04/12	10.50	13.50	130	0	280	1	3	937	0	0	0	0	130	3	0
04/13	23.75	0.25	506	0	1,394	0	4	2,389	0	0	0	1	506	4	0
04/14	10.75	13.25	540	2	665	3	6	864	1	0	0	1	540	6	0
04/15	22.17	1.83	753	64	2,881	7	16	46,301	1	1	3	4	753	16	3
04/16	10.50	13.50	221	36	344	2	27	353	0	1	2	4	221	27	2
04/17	10.50	13.50	135	6	388	1	19	735	0	2	3	0	135	19	3
04/18	23.75	0.25	107	3	413	1	12	2,008	0	2	1	0	107	12	1
04/19	10.50	13.50	34	0	97	1	11	1,171	0	1	1	0	34	11	1
04/20	10.50	13.50	37	0	196	2	8	3,382	0	1	0	0	37	8	0
04/21	23.25	0.75	116	0	857	3	8	5,998	0	0	1	0	116	8	1
04/22	10.25	13.75	61	0	285	1	10	923	0	0	3	0	61	10	3
04/23	10.25	13.75	30	0	187	1	13	645	0	1	1	1	30	13	1
04/24	24.00	0.00	25	0	298	0	16	3,168	0	1	0	0	25	15	0
04/25	9.75	14.25	84	5	190	1	77	606	2	1	5	1	84	77	5

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Appendix C: Total daily catches, by species and age, in the Skagit River mainstem screw trap, 2006 cont'd).

Date	HOURS		CHINOOK		Chum	COHO		Pink	Sock	TROUT			Unmarked		
	Fished	Out	0+	1+		0+	1+			Parr	Sthd	Cutt	Chin0	Coho1	Sthd1
04/26	6.00	18.00	61	2	139	2	50	152	1	0	3	0	61	50	3
04/27	24.00	0.00	83	0	851	2	40	1,440	0	2	2	0	83	40	2
04/28	10.00	14.00	49	1	306	0	51	435	0	2	4	1	49	44	4
04/29	9.75	14.25	113	1	277	3	143	184	2	2	10	2	112	116	10
04/30	19.25	4.75	315	0	1,657	4	265	1,045	1	2	16	1	315	232	16
05/01	9.67	14.33	95	0	94	2	176	31	0	2	14	2	95	167	12
05/02	9.50	14.50	107	0	37	1	149	19	0	2	9	1	107	147	8
05/03	23.67	0.33	105	0	136	3	105	921	1	0	4	1	105	102	4
05/04	9.50	14.50	41	1	30	1	64	81	2	2	2	0	41	62	0
05/05	9.50	14.50	30	0	17	1	114	33	3	2	9	0	30	113	3
05/06	24.00	0.00	73	1	56	1	192	524	1	1	18	1	73	190	3
05/07	9.50	14.50	49	0	13	0	240	17	1	1	57	1	49	231	9
05/08	9.50	14.50	25	0	2	0	355	2	1	0	103	1	25	304	19
05/09	22.50	1.50	28	0	60	0	321	211	0	1	58	2	28	237	10
05/10	9.25	14.75	9	0	1	0	161	2	2	1	20	3	9	125	3
05/11	9.00	15.00	8	0	25	0	53	2	1	0	15	3	8	50	0
05/12	24.00	0.00	18	0	188	0	81	198	1	2	24	2	18	76	4
05/13	9.00	15.00	12	0	83	0	127	2	1	1	36	2	12	124	8
05/14	8.75	15.25	7	0	6	0	87	2	0	0	34	2	7	85	7
05/15	24.00	0.00	37	1	71	0	146	118	2	0	19	2	37	141	3
05/16	2.00	0.00	16	0	0	0	67	0	1	0	5	0	16	65	2
05/22	4.00	161.00	110	0	3	0	77	0	2	0	47	2	110	58	3
05/23	4.00	20.00	113	4	3	2	97	1	2	0	36	0	113	80	9
05/24	9.25	15.75	280	0	3	0	278	0	2	0	54	2	280	188	11
05/25	8.25	15.75	216	0	1	0	400	1	1	0	84	5	213	236	15
05/26	9.00	15.00	241	0	0	2	293	0	1	0	61	5	187	181	17
05/27	23.00	1.00	732	0	3	3	295	0	0	0	37	7	562	190	11
05/28	8.00	16.00	379	0	1	4	183	1	0	1	16	8	227	113	5
05/29	8.50	15.50	448	0	4	2	133	0	0	0	12	6	192	97	5
05/30	23.67	0.33	605	1	8	1	152	1	0	0	13	8	307	118	7
05/31	8.25	15.75	478	0	12	0	151	0	0	0	10	8	226	132	7
06/01	8.00	16.00	342	0	22	0	121	0	0	0	10	6	175	103	7
06/02	8.00	16.00	408	1	1	1	145	2	1	0	14	3	198	123	11
06/03	7.50	16.50	331	0	1	0	86	1	1	0	6	2	202	76	5
06/04	7.50	16.50	416	1	1	2	47	0	1	0	5	1	292	40	5
06/05	10.50	13.50	606	0	1	5	65	0	1	0	5	1	364	56	4
06/06	7.67	16.33	608	0	1	1	32	0	0	1	2	1	209	28	2
06/07	7.75	16.25	744	0	1	0	34	0	1	0	2	1	268	32	0
06/08	23.83	0.17	803	1	0	0	38	0	2	0	3	2	366	36	2
06/09	8.00	16.00	231	0	0	0	16	0	0	0	1	3	103	16	0
06/10	8.00	16.00	233	0	1	0	18	0	0	1	0	3	110	18	0
06/11	24.00	0.00	536	0	2	0	37	0	0	0	1	5	301	36	1
06/12	8.00	16.00	209	1	3	0	37	0	1	0	2	4	118	35	2
06/13	8.00	16.00	221	0	1	0	33	0	1	0	1	3	130	32	1
06/14	23.67	0.33	530	0	0	0	27	0	2	1	1	1	358	25	1
06/15	8.75	15.25	124	0	1	1	10	0	0	0	1	0	82	10	1

Note: The unmarked coho 1+ does not include fish marked at Mannser Creek or Baker Dam.

Table continued on next page

Appendix C: Total daily catches, by species and age, in the Skagit River mainstem screw trap, 2006 cont'd).

Date	HOURS		CHINOOK		Chum	COHO		Pink	Sock	TROUT			Unmarked		
	Fished	Out	0+	1+		0+	1+			Parr	Sthd	Cutt	Chin0	Coho1	Sthd1
06/16	9.00	15.00	313	0	0	0	2	0	0	0	0	2	89	2	0
06/17	24.00	0.00	1,819	0	2	0	9	0	0	0	0	2	303	9	0
06/18	8.00	16.00	679	0	2	0	7	0	0	0	0	0	120	7	0
06/19	8.00	16.00	334	1	2	0	8	0	1	1	0	3	85	8	0
06/20	23.75	0.25	347	0	6	0	6	0	0	1	0	5	129	6	0
06/21	8.00	16.00	132	0	3	1	8	0	0	1	0	0	51	8	0
06/22	8.00	16.00	73	0	0	0	2	0	0	0	0	2	36	2	0
06/23	23.75	0.25	108	0	2	0	2	0	0	0	0	2	69	2	0
06/24	8.25	15.75	80	0	3	0	3	0	0	0	0	2	46	3	0
06/25	8.00	16.00	104	0	5	1	1	0	0	0	0	4	54	1	0
06/26	14.75	9.25	234	0	4	0	4	0	0	1	0	4	116	4	0
06/27	8.25	15.75	268	0	2	1	2	0	1	0	0	2	124	2	0
06/28	7.50	16.50	149	0	4	1	0	0	1	0	0	1	84	0	0
06/29	24.00	0.00	344	0	13	1	1	0	1	0	0	1	222	1	0
06/30	8.00	16.00	93	0	5	0	0	0	0	0	0	0	54	0	0
07/01	8.25	15.75	79	0	4	0	0	0	1	0	0	0	51	0	0
07/02	24.00	0.00	96	0	2	0	1	0	0	0	0	0	71	1	0
07/03	8.00	16.00	87	0	3	1	1	0	0	0	0	1	62	1	0
07/04	5.50	0.00	60	0	1	1	0	0	1	0	0	0	40	0	0
07/05	2.50	40.00	36	0	0	0	1	0	0	0	0	0	26	1	0
07/06	24.00	0.00	168	0	1	0	2	0	0	0	0	1	123	1	0
07/07	8.17	15.83	63	0	1	0	1	0	0	0	0	0	46	1	0
07/08	24.00	0.00	82	0	3	0	0	0	0	0	0	0	56	0	0
07/09	8.25	15.75	60	0	2	0	1	0	0	0	0	0	45	1	0
07/10	8.25	15.75	50	0	0	0	2	0	0	0	0	0	38	2	0
07/11	23.75	0.25	87	0	0	0	0	0	1	0	0	1	59	0	0
07/12	8.00	16.00	76	0	0	0	0	0	0	0	0	1	56	0	0
07/13	5.50	0.00	89	0	0	0	1	0	1	0	0	1	63	1	0
07/16	2.50	88.00	7	0	0	0	0	0	0	0	0	0	5	0	0
07/17	24.00	0.00	22	0	0	0	1	0	0	0	0	1	16	1	0
07/18	8.50	15.50	11	0	0	0	0	0	0	0	0	0	9	0	0
07/19	24.00	0.00	23	0	0	0	0	0	0	0	0	0	18	0	0
07/20	6.00	0.00	13	0	0	0	1	0	0	0	0	0	11	1	0
07/23	2.50	87.50	17	0	0	0	0	0	0	0	0	0	11	0	0
07/24	21.00	3.00	79	0	0	0	0	0	1	1	0	0	53	0	0
07/25	8.50	15.50	86	0	0	0	1	0	0	1	0	1	60	1	0
07/26	23.83	0.17	34	0	1	0	0	0	0	0	0	0	24	0	0
07/27	6.00	0.00	17	0	0	0	0	0	0	0	0	0	17	0	0
07/30	2.75	87.25	1	0	0	0	0	0	0	0	0	0	1	0	0
07/31	6.00	0.00	2	0	0	0	0	0	0	0	0	0	2	0	0
	2,604.83	2,041.42	47,896	150	34,767	75	6,132	127,908	72	59	917	169	39,767	5,098	293

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