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Neva Sockeye Stock Assessment, 2006 to 2008

Final Report for Study 06-601

Benjamin W. Van Alen
USDA Forest Service
Juneau Ranger District
8510 Mendenhall Loop Road
Juneau, Alaska 99801

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TABLE OF CONTENTS

	Page
LIST OF FIGURES	iii
LIST OF TABLES	iv
ABSTRACT	1
INTRODUCTION	2
OBJECTIVES	7
METHODS	7
Sockeye Escapement Assessment	7
Weir	7
Weir-to-Above-Weir Mark-Recapture Escapement Estimate	9
Age, Sex, and Length Sampling	12
Stream Temperature and Depth	12
RESULTS	13
Weir and Weir-to-Above-Weir Mark-Recapture Estimate of Total Escapement	13
2006	13
2007	18
2008	24
Run Timing	26
Age, Sex, and Length Composition	33
Stream Temperature and Depth	36
DISCUSSION	40
CONCLUSIONS	41
RECOMMENDATIONS	42
ACKNOWLEDGEMENTS	43
LITERATURE CITED	44

(Cover photo: Jerome Abbott and Elijah Sheakley, Hoonah Indian Association, in front of the Neva Creek weir, June 18, 2007.)

LIST OF FIGURES

Page

Figure 1. Map of northern Southeast Alaska showing the location of Neva Lake.2

Figure 2. Bathymetric map of Neva Lake showing 5 m depth contours and approximate locations of the two fixed sampling stations, the main inlet stream, the outlet, and the beach spawning study area. 3

Figure 3. Subsistence effort and harvest of sockeye salmon at Neva from 1985 to 2008 as reported on permits returned to ADF&G. (from ADF&G, Division of Commercial Fisheries database, October, 2009) 5

Figure 4. Weekly purse seine harvest of chum salmon in Excursion Inlet, Statistical Area 114-80, 1960 to 2008. (from ADF&G database) 6

Figure 5. Weekly purse seine harvest of sockeye salmon in Excursion Inlet, Statistical Area 114-80, 1960 to 2008. (from ADF&G database) 6

Figure 6. Jeremy Johnson (HIA) counts fish swimming through two pulled pickets on the Neva weir trap while Myron Murphy (HIA, obscured) dipnets sockeye salmon in the trap and passes them upstream through the "fish door" on the front of the trap after clipping their adipose fins, July 24, 2008. 8

Figure 7. "Video weir" used to guide salmon past underwater video cameras in the lower part of Neva Lake's main inlet stream, 2008. 9

Figure 8. Underwater cameras mounted on each side of a one-picket gap in the "video weir" for getting motion-detected video footage of salmon migrating into Neva Lake's main inlet stream, 2008. 10

Figure 9. First frame of a motion-detected video of a sockeye salmon migrating into Neva Lake's main inlet stream. 10

Figure 10. Average daily temperatures (°C w/ max and min range), and average June through September temperatures, in Neva Lake's main inlet stream, July 27, 2002 to October 21, 2009. 37

Figure 11. Average daily temperatures (°C w/ max and min range), and average June through September temperatures, at the outlet of Neva Lake, July 27, 2002 to October 21, 2009. 38

Figure 12. Temperature and depth of Neva Lake's main inlet stream, June 13, 2006 to April 21, 2008. 39

Figure 13. Temperature and depth at the outlet of Neva Lake, June 13, 2006 to October 21, 2009. 40

LIST OF TABLES

		Page
Table 1.	Weather and stream measurements and daily numbers of fish counted and finclipped at the Neva Creek weir, 2006.	15
Table 2.	Mark and recapture data for sockeye salmon marked at the Neva Creek weir, 2006.	17
Table 3.	Estimated escapement of sockeye salmon into Neva Lake, 2006.	18
Table 4.	Weather and stream measurements and daily numbers of fish counted and finclipped at the Neva Creek weir, 2007.	20
Table 5.	Mark and recapture data for sockeye salmon marked at the Neva Creek weir, 2007.	23
Table 6.	Estimated escapement of sockeye salmon into Neva Lake, 2007.	24
Table 7.	Weather and stream measurements and daily numbers of fish counted and finclipped at the Neva Creek weir, 2008.	27
Table 8.	Mark and recapture data and estimated escapement of sockeye salmon into Neva Lake, 2008.	29
Table 9.	Estimated daily escapement of adult and jack sockeye salmon into Neva Lake, June 4 to October 13, 2002 to 2005 and 2008.	30
Table 10.	Estimated cumulative daily escapement of adult and jack sockeye salmon into Neva Lake, June 4 to October 13, 2002 to 2005 and 2008.	32
Table 11.	Age and length composition, by sex, of sockeye salmon in the Neva Lake escapement, 2006.	34
Table 12.	Age and length composition, by sex, of sockeye salmon in the Neva Lake escapement, 2007.	34
Table 13.	Age and length composition, by sex, of sockeye salmon in the Neva Lake escapement, 2008.	35
Table 14.	Age composition of the sockeye salmon escapement into Neva Lake, 2002 through 2008.	36

ABSTRACT

The escapement of sockeye salmon into Neva Lake was 5,931 (CV=3%) fish in 2006, 5,993 (CV=5%) in 2007, and 2,823 (CV=7%) in 2008 based on weir counts and mark-recapture data. For comparison, the sockeye escapements were estimated to be 5,003, 11,393, 9,513, and 5,263 in 2002, 2003, 2004, and 2005. Averaged from 2002 to 2008, the midpoint of the run was August 5 and 80% of the run passes between July 5 and September 7. The main inlet stream spawners spawned mostly in August and September and the lake spawners spawned mostly in October and November. Age-1. fish dominated the escapements but higher proportions of age-2. fish in recent years suggest that parent year escapements were filling the lake's rearing capacity. The high (20%+), low (0%), high (20%+) cycle of jack abundance also suggests carrying capacity constraints following high escapement years. There has been a significant increase in subsistence fishing effort on Neva sockeye salmon in recent years.

Key words: Sockeye salmon, *Oncorhynchus nerka*, subsistence, Neva Lake escapement, weir, mark-recapture, age composition.

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INTRODUCTION

Sockeye salmon returns to Neva Lake (Alaska Department of Fish and Game, Division of Commercial Fisheries stream number 114-80-045) have long been an important subsistence resource for Tlingit families living in Hoonah and other areas of northern Southeast Alaska (de Laguna 1960; Schroeder and Kookesh 1990; Goldschmidt and Haas 1998; Ratner and Dizard 2005; Langdon 2006; Figure 1).

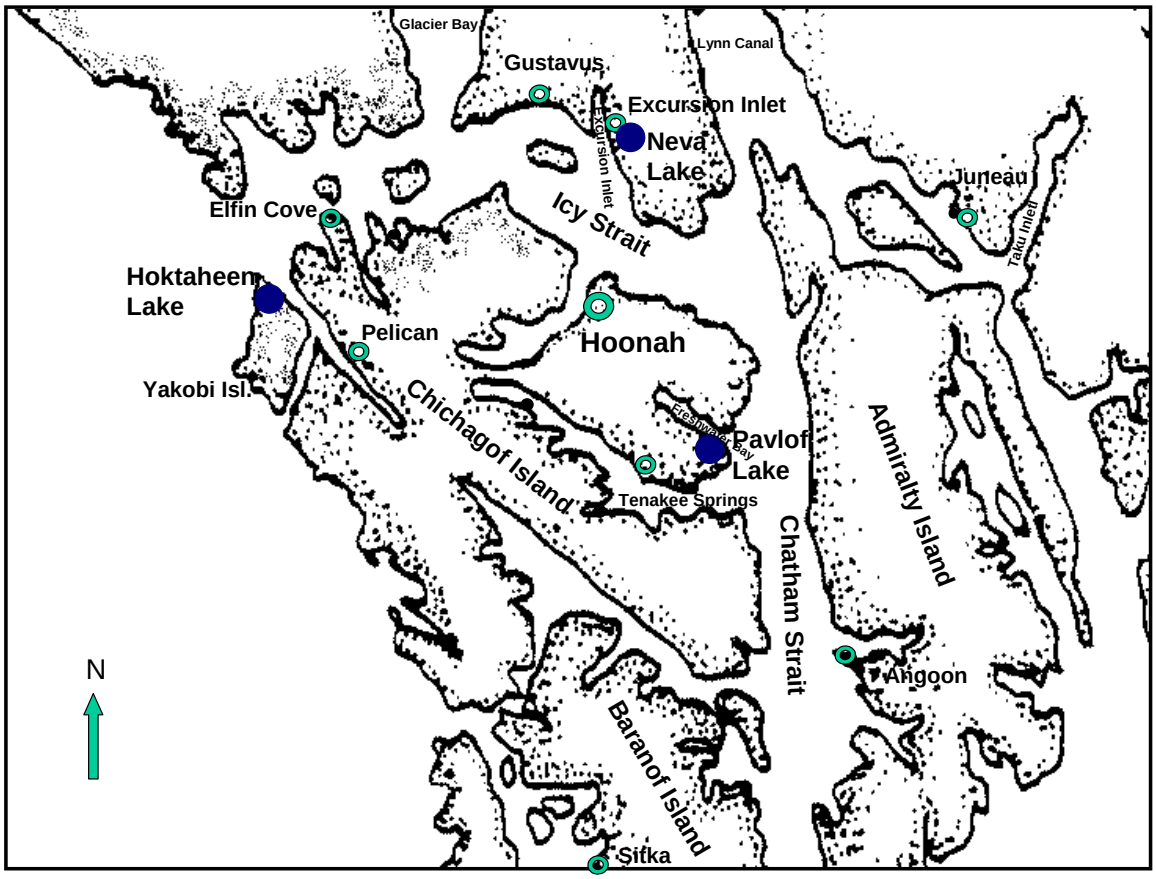

Figure 1. Map of northern Southeast Alaska showing the location of Neva Lake.

There was little known about the Neva sockeye run prior to 2002. From 2002 through 2008 the USDA Forest Service funded a weir/mark-recapture project to estimate the annual escapement and age composition of sockeye salmon in Neva Lake. Results from the 2002 season were reported in Van Alen (2004), for the 2003 season in Van Alen (2005), and for the 2004 and 2005 seasons in Van Alen (2008a). This paper summarizes results for 2006, 2007, and 2008.

This Neva sockeye stock assessment project is one of several sockeye stock assessment projects done in southeast Alaska since 2001 with support by the Forest Service and the U.S. Fish & Wildlife Service, Office of Subsistence Management, Fisheries Resource

Monitoring Program. Funding for these projects has been a fortunate consequence of the Federal government's 1999 assumption from the State of Alaska of the management of subsistence fisheries on Federal public lands. These projects usually involve cooperation among community Tribal associations, Alaska Department of Fish and Game (ADF&G), and the Forest Service. In this Neva Lake sockeye stock assessment project, the Hoonah Indian Association employs the field crew, ADF&G staff processes the scale (age), sex, and length data, and the Forest Service takes the lead in project planning, implementation, analysis, and reporting.

Neva Lake (outlet at 58˚24.332' N, 135˚24.632' W; NAD83/WGS84 datum) is located on the mainland on the east side of Excursion Inlet (Figures 1 and 2). The lake is about 2 km southeast of the unincorporated community of Excursion Inlet, about 22 km east of Gustavus, and about 40 km across Icy Strait from Hoonah. The lake lies at an elevation of 44 m, has a surface area of 36.1 ha, and a maximum depth of 19 m. There is one main inlet stream that flows into the northeast end of the lake. The outlet of Neva Lake (Neva Creek) flows from the northwest end of the lake about 1.2 km before entering the glacial South Creek which then flows about 1 km before entering Excursion Inlet on the south side of the cannery complex.

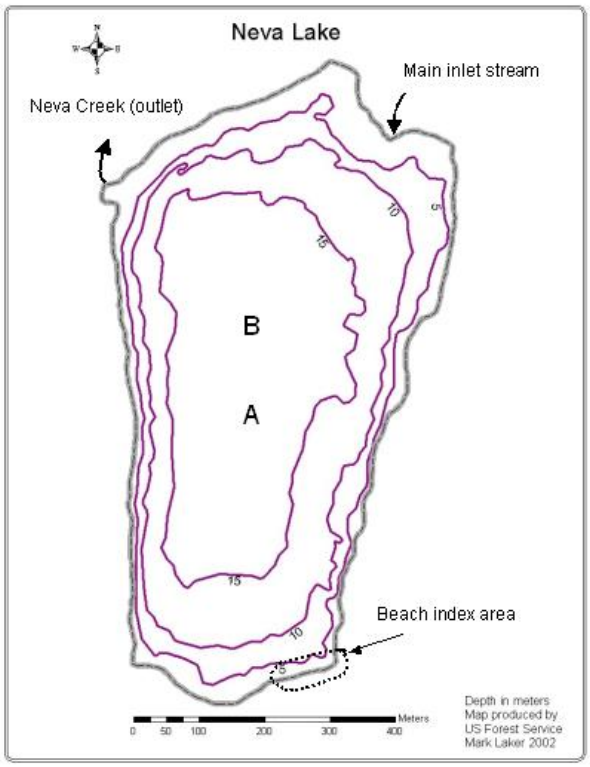

Figure 2. Bathymetric map of Neva Lake showing 5 m depth contours and approximate locations of the two fixed sampling stations, the main inlet stream, the outlet, and the beach spawning study area.

In 2006, 2007, and 2008, the Neva area was in the Federal subsistence customary and traditional use area for residents of the City of Hoonah and in Chichagof Island drainages on the east shore of Point Frederick from Garting Creek to Point Sophie. Effective April 1, 2009, the Federal subsistence customary and traditional use area was expanded to include residents of drainages flowing into Sections 12A, 13A and all of District 14 (Federal Register 50 CFR Part 100 and 36 CFR Part 242). The Neva area is in an area designated by the State as subsistence (5 AAC 01.716).

A permit is required to take salmon for subsistence or personal use in southeast Alaska. ADF&G, Commercial Fisheries Division, staff have issued these permits, one per household, and has maintained records of the permits issued and returned, and the reported harvest since 1984. The return of these permits is voluntary but information from unreturned permits is obtained prior to issuing new permits to a household. Beginning in 2002, the Forest Service has also had Federal Subsistence Fishing Permits available for rural residents living in this Customary and Traditional area. The State permits are valid for fishing in either fresh or marine waters while Federal permit are valid for fishing in freshwater only. The State and Federal regulations and permit conditions overlap to such a degree that only Federally qualified residents who wish to harvest sockeye salmon with rod and reel gear (no snagging) or before or after the State's June 1 to August 15 open season should need a Federal Permit. The designated fishermen provision on the Federal permit also allows the fishing for other households while the "proxy fishing" provision on the State permits only allows the fishing for those who are blind, disabled, or over 65.

Relatively few Federal subsistence fishing permits have been issued and there have only been three households reporting sockeye harvests from Neva Creek totaling 34 sockeye salmon in 2005 and 50 sockeye salmon in 2007. On the State subsistence fishing permits, no sockeye salmon were reported harvested at Neva prior to 1990. The effort and harvest has peaked every four years, 1992, 1996, 2000, 2004, and 2008 (Figure 3). There has been a significant increase in permits fished over these years (Spearman's Rho non-parametric trend test, $p\text{-value} < 0.05$, Conover 1980) and 2008 had the most permits fished (26) and highest sockeye harvest reported (601). Project personnel observed more subsistence sockeye taken in 2002, 2003, and 2005 than that reported on permits (Van Alen 2008a) so actual effort and harvest numbers might be higher (Ratner and Dizard 2005). Subsistence fishing for Neva sockeye salmon occurs both in saltwater, in the intertidal area at the outlet of South Creek, and in freshwater in South Creek and Neva Creek. A pool in the lower part of Neva Creek is a traditional site for taking sockeye salmon with a gaff (Langdon 2006). Most sport fishing for Neva sockeye salmon is done in the intertidal area.

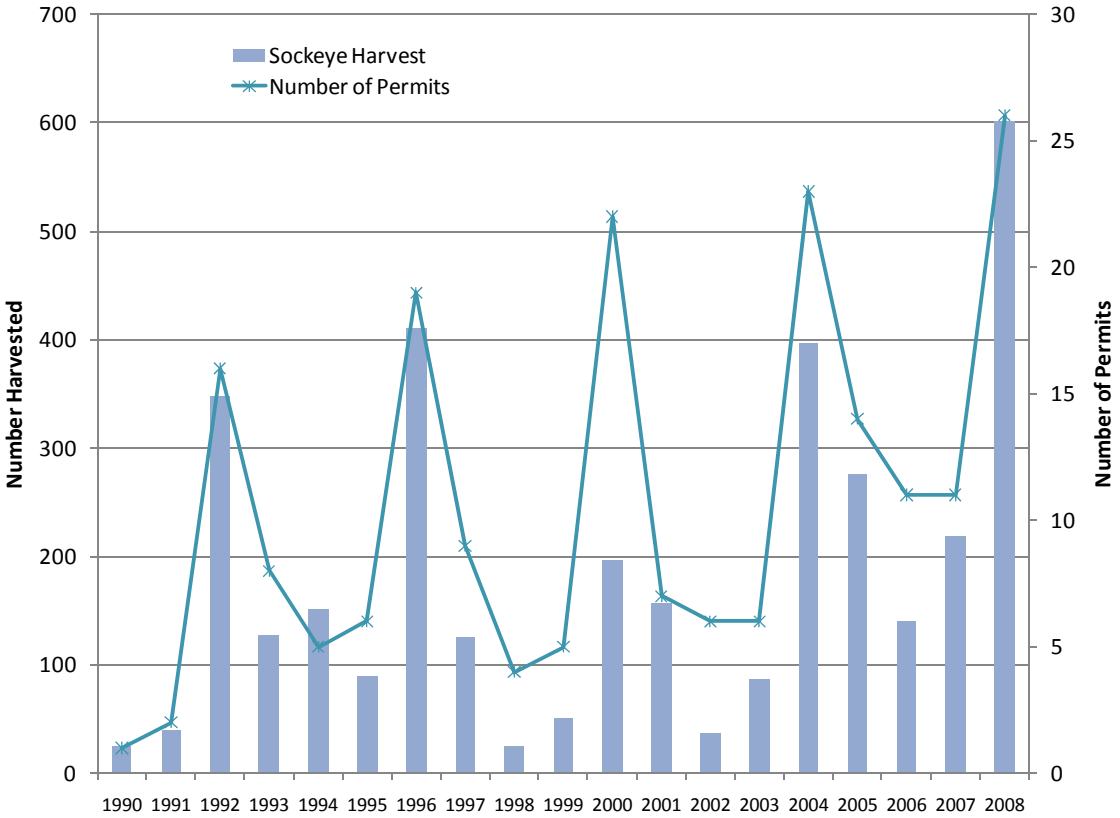

Figure 3. Subsistence effort and harvest of sockeye salmon at Neva from 1985 to 2008 as reported on permits returned to ADF&G. (from ADF&G, Division of Commercial Fisheries database, October, 2009)

Neva sockeye salmon are not targeted in commercial fisheries but some are likely caught in commercial purse seine openings in Excursion Inlet and Icy Strait (Figure 1). These fisheries also harvest sockeye salmon bound for Lynn Canal, Taku River, Chatham Strait, other northern inside systems. Seine openings in Excursion Inlet have been directed at fall run chum salmon returning to Excursion River. Returns and harvests of these fall chum salmon has declined dramatically since the early 1960s (Figure 4). There was a marked increase in sockeye harvest in the 1980s and 1990s when openings were advanced from September to August (Figure 5).

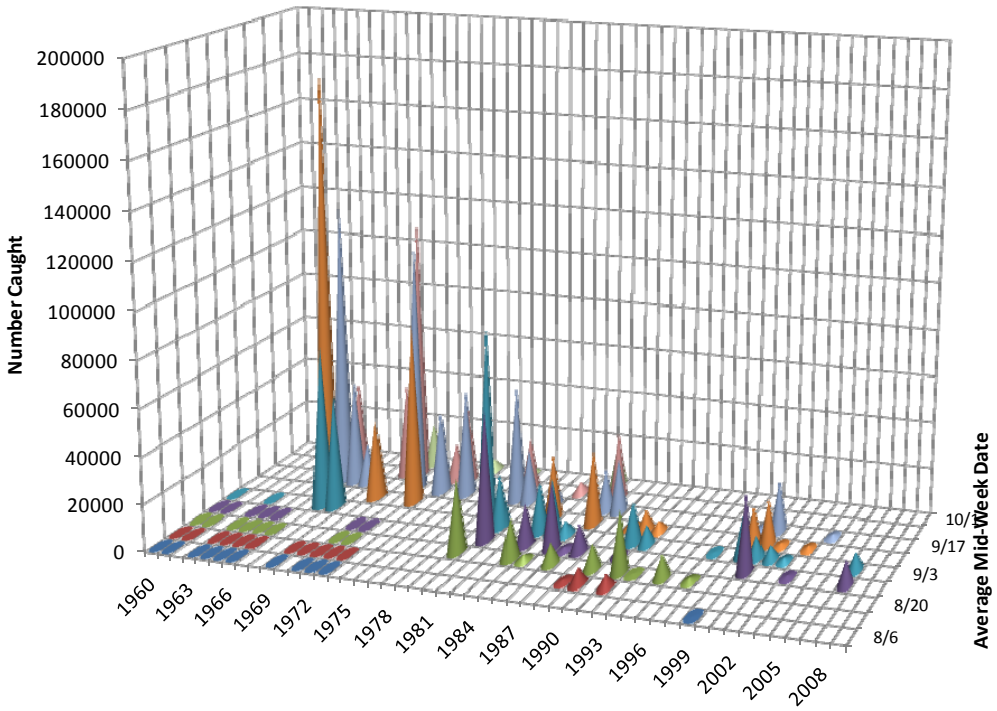

Figure 4. Weekly purse seine harvest of chum salmon in Excursion Inlet, Statistical Area 114-80, 1960 to 2008. (from ADF&G database)

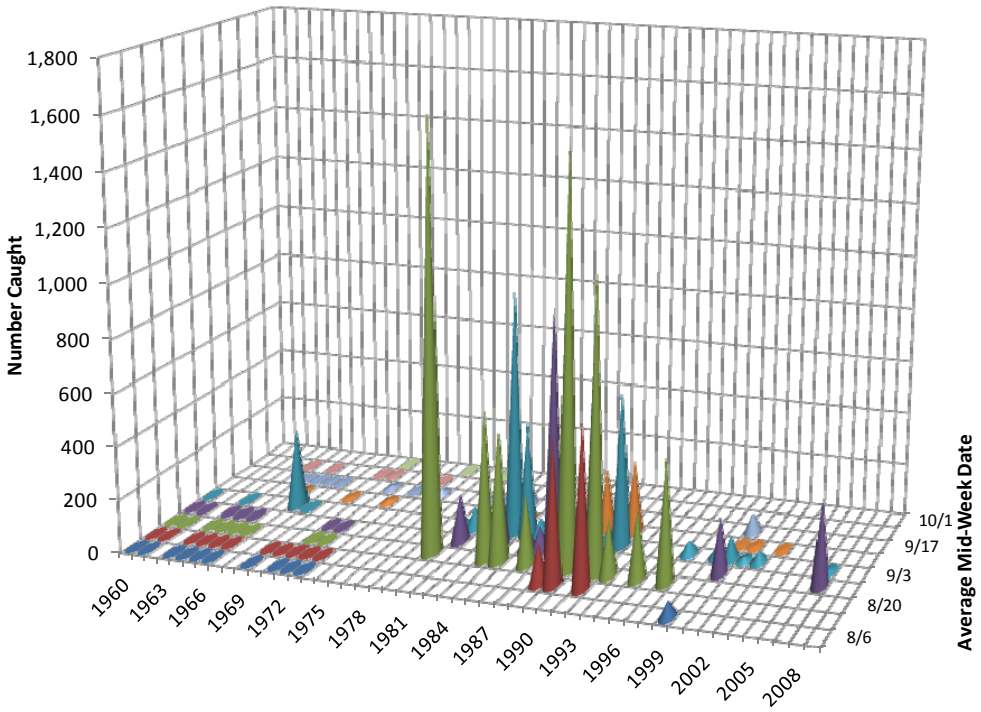

Figure 5. Weekly purse seine harvest of sockeye salmon in Excursion Inlet, Statistical Area 114-80, 1960 to 2008. (from ADF&G database)

OBJECTIVES

The project objectives were:

1) Estimate the total escapement of sockeye salmon into Neva Lake using a weir and mark-recapture so that the estimated coefficient of variation is less than 20 percent.
2) Estimate the age, length, and sex composition of the sockeye escapement into Neva Lake so that the estimated coefficient of variation for the proportion of the principal age class is less than 10 percent.

METHODS

Sockeye Escapement Assessment

In 2006, 2007, and 2008, the escapement of adult sockeye salmon into Neva Lake was estimated using the combination of a weir and mark-recapture. Validating weir counts with a companion mark-recapture study is to assure that Objective #1, the estimate of total escapement, is accurate. Only the fish observed at a weir are counted and fish could pass uncounted before or after the weir is operated, at times when the weir is not operational, or through known or unknown breaks in the weir (McGregor and Bergander 1993; Shaul 1994; Kelley and Josephson 1997; Kelley and Bachman 1999; Kelley and Bachman 2000; Lewis and Cartwright 2002; Conitz and Cartwright 2003). In both 2002 and 2003, a non-project person pulled pickets on the Neva Creek weir during peak passage days and the mark-recapture studies were needed to estimate the total escapement (Van Alen 2004 and 2005).

Weir

Upstream migrating salmon, trout, and char were counted as they swam or were dipnetted out of a trap mounted on the face of a channel and picket weir installed across Neva Creek. The weir was placed about 80 meters downstream from the lake (58°24.343'N, 135°24.672'W, NAD83/WGS84 datum) in the same location as it has been operated since 2002. The weir was operated continuously in 2006 from June 13 through September 27, in 2007 from June 16 to October 8, and in 2008 from June 16 to September 8. The weir trap was checked for fish early each morning and checked at other times during the day and evening as needed to minimize delays to their upstream migration. Separate counts were kept for adult and jack sockeye and coho salmon. Jacks were identified by their visual appearance and mid-eye-to-fork of tail length <400mm.

The weir and trap was constructed using an aluminum bipod and channel superstructure and 19.05 mm x 305 cm (¾ in x 10 ft) EMT conduit pickets (see Appendix A in Van Alen 2004 for weir and trap design specifications). The maximum gap between pickets in the weir and trap was 2.54 cm (each 8 ft channel had two 1-1/2" end holes and 52 1-1/8" picket holes). Filter fabric was laid bank-to-bank under the weir and trap to control erosion and sandbags were placed end-to-end around the upstream base of both.

Fish were passed upstream out of the trap through pulled pickets or through a "fish" door on the front or side of the trap (Figure 6). A short sand bag and picket diversion on the side of the trap provided an area of quiet water for stressed fish to recover. An aluminum fish-measuring trough and scale card/data holder were mounted on the side of the trap next to the fish door. A labeled array of hand tally counters (Figure 6) was used to initially record the number of adult and jack, marked and unmarked, salmon, trout, and char passed upstream. The weather (clear, partly cloudy, overcast, showers, rain), stream depth, and water and air temperature was recorded at a gauging station located about 20 meters above the weir each morning between 0800 and 0900 hour. All data was recorded on daily data forms.

Figure 6. Jeremy Johnson (HIA) counts fish swimming through two pulled pickets on the Neva weir trap while Myron Murphy (HIA, obscured) dipnets sockeye salmon in the trap and passes them upstream through the "fish door" on the front of the trap after clipping their adipose fins, July 24, 2008.

Weir-to-Above-Weir Mark-Recapture Escapement Estimate

The total escapement of sockeye salmon into Neva Lake was estimated by marking fish at the weir and sampling them for marks on the spawning grounds. The weir crew was instructed to mark a consistent proportion of the adult and jack sockeye that they counted through the weir throughout the season. Adults and jacks were to be marked at the same rate but separate counts were to be kept of the number marked and recaptured. The data forms had separate fields for recording mark and recapture data for adults and jacks.

Fish were examined for marks in the main inlet stream and beach spawning areas in August, September, and October. Dipnets were used to capture fish in the main inlet stream and a beach seine was used to capture fish in the lake.

In 2008, a short picket weir was installed across the lower part of the main inlet stream (Figure 7) and a solar powered mini-digital video recorder system (Appendix F, Van Alen 2008b) with two underwater cameras (Figure 8) was used to get motion-detected footage of the salmon migrating into the stream (Figure 9). Selected days of the video files were reviewed to get additional estimates of the number of marked (adipose-clipped) and unmarked salmon in the main inlet stream.

Figure 7. "Video weir" used to guide salmon past underwater video cameras in the lower part of Neva Lake's main inlet stream, 2008.

Figure 8. Underwater cameras mounted on each side of a one-picket gap in the "video weir" for getting motion-detected video footage of salmon migrating into Neva Lake's main inlet stream, 2008.

Figure 9. First frame of a motion-detected video of a sockeye salmon migrating into Neva Lake's main inlet stream.

Sampling effort was dependent on the number of recaptures and the proportion marked (Appendix C, Van Alen 2008b). If the observed proportion marked from a couple of sampling trips to a couple of locations is not less than the proportion marked at the weir then there is no indication that fish have passed through the weir uncounted and little need for additional recapture samples. A more extensive recapture effort would be needed if there is less than a 5% probability than the proportion of marked fish above the weir could equal or exceed that marked at the weir based on a one-tailed exact binomial test of goodness-of-fit (Sokal and Rohlf 1995). This test can be done using the Excel function "=BINOMDIST(number with marks, number examined for marks, proportion marked at the weir, TRUE)". The p-value returned is the probability that the observed proportion of marked fish above the weir is equal or greater than the expected proportion marked at the weir. A p-value <0.05 says that there is less than a 5% chance that the observed proportion equals or exceeds the expected proportion, that fish likely passed the weir uncounted, and that a mark-recapture study is needed to estimate the total escapement. The one-tailed test is used since only the fish that are seen at the weir are counted and if fish passed unnoticed then the proportion of marked fish in the lake could only be less than that marked at the weir.

In 2006 and 2007, a running average of 25% of the sockeye adults and jacks were to be marked at the weir, and in 2008, a running average of 33% of the adult and jack sockeye were to be marked at the weir. All marked fish were given an adipose fin clip. In 2006 and 2007, marked fish were also given a left axillary clip during the first third of the run, a left ventral clip during the middle third of the run, and a partial dorsal clip the last third of the run. The dates for each third of the run were the averages from the 2002 to 2005 weir counts and were start-of-run to July 28, July 29 to August 13, and August 14 to end-of-run (Van Alen 2008a). All marks were visible from the left side of the fish to avoid the confusion of left and right sides when marking and sampling (i.e., Heinl et al. 2008). These finclips involved severing the entire adipose fin, the entire left axillary fin, the lower two-thirds of the ventral fin, and cutting across the posterior base of the last four dorsal fin rays. Scissors were used to do the finclips. Most clips were done with the fish in a dipnet and the fish's head in the water. The marked fish were allowed to recover in an area of quiet water next to the trap and all sockeye released continued their upstream migration without delay.

Since the number of marked fish (*M*) will be known and the unknown variable will be how many fish need to be examined for marks (*C*) above the weir to get enough recaptures (*R*) we can use Chapman's (1952) "inverse sampling" formulas for unbiased estimates of the population size ($\hat{N}$) and variance ($Var(\hat{N})$) (Chapman 1952, Page 287-288), converted here to the notation of Ricker (1975):

Sampling with replacement, the formula for $\hat{N}$ is the same as for the simple Petersen (aka. Lincoln-Petersen) estimate, which is:

$$\hat{N} = \frac{M * C}{R} \qquad (1)$$

and, the unbiased (Chapman 1952, Seber 2002) estimate of variance is:

$$Var(\hat{N}) = \frac{CM^2(C-R)}{R^2(R+1)} \qquad (2)$$

In 2006 and 2007, partially stratified maximum likelihood Darroch estimates, and standard errors, were also calculated with the Stratified Population Analysis System (SPAS) freeware (Arnason et al. 1996). The SPAS software includes goodness-of-fit tests for "complete mixing" and "equal proportion" of marked fish among strata. If either or both of these tests are significant, at $P \leq 0.05$, bias with the stratified Darroch model might be less than for the pooled Peterson estimator. I used different pooling of release strata to examine the robustness of the Darroch abundance estimates and to help choose which estimate to use.

Age, Sex, and Length Sampling

Adult sockeye salmon were sampled at the weir for age (scales), sex, and length data following standard ADF&G sampling procedures (ADF&G 2001). Tweezers were used to pluck three scales from the preferred area on the left side of the each fish (INPFC 1963). Scales were mounted on gummed "scale cards" (Clutter and Whitesel 1956) and sex and length data recorded on optical scanner data forms. Mid-eye to fork-of-tail length was measured to the nearest half-centimeter by laying each fish on a fixed ruler in a "measuring trough".

Sampling was weighted by abundance by apportioning the season goal into weekly goals using the average weekly proportion of the escapement that passed through the weir in 2002, 2003, 2004, and 2005. Seasonal sampling goals were 610 fish in 2006 and 480 fish in 2007 and 2008.

Scales were aged at the ADF&G, Commercial Fisheries Division, Aging Lab in Juneau. Age classes are recorded in European notation where a period separates the number of fresh water and marine annuli (Koo 1962). Calculations of the average age and length compositions were not weighted by period escapement as was done in past years. However, since the weekly sampling effort was weighted by historical weekly proportions of the escapement the seasonal averages should be adequately weighted by abundance.

Stream Temperature and Depth

On July 27, 2002, temperature data loggers manufactured by the Onset Computer Corporation[1] were deployed to record water temperatures in the main inlet stream and outlet every four hours. These temperature data loggers were placed just below the stream bottom in 30cm long, 52mm I.D., aluminum pipes driven into the substrate. The

[1] Disclaimer: the use of trade names, manufacturers, or suppliers of commercial products in this report does not constitute endorsement or recommendation for use by the federal government.

logger in the outlet was positioned just upstream from the weir adjacent to the stream depth (staff) gauge at 58° 24.355'N, 135° 24.658'W. The logger in the inlet stream was located in the lower section of the creek at 58° 24.374'N, 135° 24.266'W.

One June 13, 2006, three pressure/temperature data loggers were also deployed in the main inlet stream and outlet to measure water depths and temperatures every four hours. The outlet logger was cabled under a large rock right at the outlet of the lake (58° 24.338'N, 135° 24.635'W) and the inlet logger was in a 30cm long, 38mm I.D., ABS plastic pipe driven into the stream bottom at 58° 24.383'N, 135° 24.243'W. A third logger was placed in the branches of a tree at the lake outlet at 58° 24.34'N 135° 24.661'W. The pressure readings from the loggers in the water were corrected for barometric pressure changes using the pressure readings from the logger in the tree using the "HOBOware"™ software made for the Onset Computer Corporation loggers.

RESULTS

Weir and Weir-to-Above-Weir Mark-Recapture Estimate of Total Escapement

2006

In 2006, the adult salmon weir was in place from 1600hr on June 13 to 1100hr on September 27 (Table 1). The weir count totaled 3,454 sockeye salmon – 3,221 adults and 233 jacks. The first sockeye salmon was counted through the weir on June 15 and there were still sockeye passing when the weir was pulled on September 27. Counts of other species totaled 466 coho salmon (including 44 jacks), 1,034 pink salmon, 1 chum salmon, 2 cutthroat trout, and 84 Dolly Varden char.

There were times when fish passed through the weir uncounted. I know that the weir was open from 0900hr on July 3 to 1645hr on July 5, four weir pickets were found up on July 18, and six weir pickets were found up on July 21. There were also nine days between September 6 and September 23 when the weir was operated but no records were kept. One or more crewmembers were also properly recording the number of fish they marked but not the number they didn't mark at times during the run. Lastly, there were probably a few sockeye that entered the lake after the weir was pulled on September 27. Thus, we know that more fish passed into the lake than were counted through the weir, that the total sockeye escapement estimate will need to come from the weir-to-above-weir mark-recapture study, and that daily estimates of escapement are not possible for 2006. No fresh dead (pre-spawn) salmon were observed at or near the weir in 2006 and there was no indication of any handling mortality associated with the counting, marking, and sampling of fish at the weir.

Project personnel finclipped 3,352 (97%) of the 3,454 sockeye counted through the weir with adipose clips and left axilary, left ventral, and dorsal clips (Table 2). The sampling plan was for a 25% marking rate but the crews' enthusiasm for marking was not

tempered inseason so the marking rate could be kept as consistent as possible throughout the run.

Adult and jack sockeye salmon were sampled for the proportion of marked fish in the main inlet stream on four different days and in beach spawning areas on eight different days. Unfortunately, separate counts of the number of adults and jacks sampled were only kept on four of the recapture days so I had to pool adults and jacks in the population estimate. Some fish were either only marked with an adipose clip or were recaptured with an adipose clip and not also examined for a left axillary, left ventral, or dorsal clip. Not knowing which release strata these fish belong to complicates calculations of a stratified abundance estimate.

Using the SPAS program (Arnason et al. 1996), both tests for complete mixing and equal proportions were significant for the stratified Darroch abundance estimator when the data was run using the three release strata and the 12 recovery strata. These tests were also both significant when the data was stratified into the three release strata and two recovery strata - main inlet stream and beach. I would normally estimate the escapement using the Darroch stratified estimator since both tests were significant but I choose to use the pooled Peterson estimator (Table 3) because the estimates differ by only 55 fish (pooled Peterson = 5,931, CV=3%, vs. Darroch 3 release x 12 recovery strata = 5,876, CV=4%), the Darroch 3 release x 2 recovery strata estimator had an unrealistically small estimate of 457 (CV=64%) spawners in the main inlet stream, and the above mentioned uncertainty regarding which release strata some recaptured fish should be placed in. We can expect the relatively high and consistent marking effort at the weir, relatively good time and area distribution of recovery sampling, and high numbers of recaptures to yield an accurate and precise Peterson estimate.

Thus, I estimate the total escapement of adult and jack sockeye salmon into Neva Lake in 2006 to be 5,931 (CV=3%) based on 3,352 marked, 683 examined for marks, and 386 recaptures (Table 3). This estimate is robust since a relatively high and consistent percent of the fish were marked in each of the 12 recapture days (57% average) and recaptures numbered 10 or more on each of these recovery days. Note that the observed proportion marked in each of the recovery days was always significantly less than that marked at the weir (Table 3).

Table 1. Weather and stream measurements and daily numbers of fish counted and finclipped at the Neva Creek weir, 2006.

Date	Weather	Water Level (cm)	Water Temp (°C)	Air Temp (°C)	Mark Used (Adipose + ?)	Sockeye Marked	Sockeye Unmarked	Jacks Marked	Jacks Unmarked	Adult Sockeye Count	Jack Sockeye Count	Total Sockeye Count	Adult Coho	Jack Coho	Total Coho Count	Pink	Chum	Cutthroat	Dolly Varden	Sculpin	Comments
13-Jun	Partly Cloudy																				Weir fish tight @ 1600hr
14-Jun	Clear	34.5	16.0	13.0	Left Axillary	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	
15-Jun	Overcast	35.0	17.0	14.0	Left Axillary	0	1	0	0	1	0	1	0	0	0	0	0	0	0	0	
16-Jun	Overcast	35.0	16.0	13.0	Left Axillary	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	
17-Jun	Overcast	34.4	16.0	14.0	Left Axillary	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	
18-Jun	Showers	34.0	15.0	12.0	Left Axillary	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	
19-Jun	Overcast	33.5	15.0	11.0	Left Axillary	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	
20-Jun	Overcast	33.5	15.0	11.0	Left Axillary	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	
21-Jun	Partly Cloudy	33.0	15.0	11.5	Left Axillary	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	
22-Jun	Showers	33.0	15.0	9.5	Left Axillary	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	
23-Jun	Overcast	32.5	14.0	10.0	Left Axillary	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	
24-Jun	Overcast	31.5	15.0	11.0	Left Axillary	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	
25-Jun	Rain	32.0	14.0	10.0	Left Axillary	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	
26-Jun	Partly Cloudy	33.5	14.0	10.0	Left Axillary	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	
27-Jun	Overcast	32.5	15.0	11.0	Left Axillary	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	
28-Jun	Showers	32.0	15.0	9.0	Left Axillary	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	
29-Jun	Rain	32.5	14.0	11.0	Left Axillary	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	
30-Jun	Overcast	32.5	14.0	11.0	Left Axillary	2	0	1	0	2	1	3	0	0	0	0	0	0	0	0	
1-Jul	Overcast	31.5	14.0	12.0	Left Axillary	9	0	1	0	9	1	10	0	0	0	0	0	0	0	0	
2-Jul	Partly Cloudy	30.5	15.0	13.0	Left Axillary	3	0	1	0	3	1	4	0	0	0	0	0	0	0	0	
3-Jul	Clear	31.0	15.0	11.0	Left Axillary	22	0	3	0	22	3	25	0	0	0	0	0	0	0	0	Fish could pass uncounted after 0900hr.
4-Jul					Left Axillary					0	0	0			0						Fish could pass uncounted all day.
5-Jul	Clear	30.0	14.0	12.0	Left Axillary					0	0	0			0						Fish could pass uncounted before 1645hr.
6-Jul	Overcast	28.0	16.0	15.0	Left Axillary	11	0	1	0	11	1	12	0	0	0	0	0	0	0	0	
7-Jul	Overcast	28.0	16.0	12.0	Left Axillary	3	0	2	0	3	2	5	0	0	0	0	0	0	0	0	
8-Jul	Overcast	28.0	18.0	13.0	Left Axillary	29	0	18	0	29	18	47	0	0	0	0	0	0	0	0	
9-Jul		28.0	15.0	12.0	Left Axillary	7	0	6	0	7	6	13	0	0	0	0	0	0	0	0	
10-Jul		29.0	14.0	12.0	Left Axillary	69	0	10	0	69	10	79	0	0	0	0	0	0	0	0	
11-Jul	Clear	29.0	17.0	15.0	Left Axillary	4	0	0	0	4	0	4	0	0	0	0	0	0	0	0	
12-Jul	Partly Cloudy	30.0	17.0	15.0	Left Axillary	9	0	0	0	9	0	9	0	0	0	0	0	0	0	0	Took apart beaver dam upstream. Lake level will probably drop a little.
13-Jul	Overcast	32.0	16.0	14.0	Left Axillary	4	0	1	0	4	1	5	0	0	0	0	0	0	0	0	
14-Jul	Overcast				Left Axillary	16	0	4	0	16	4	20	0	0	0	0	0	0	0	0	
15-Jul	Overcast	29.0	16.0	12.0	Left Axillary	20	0	2	0	20	2	22	0	0	0	0	0	0	2	0	
16-Jul	Overcast	28.0	16.0	12.0	Left Axillary	4	0	0	0	4	0	4	0	0	0	0	0	0	1	0	
17-Jul	Overcast	27.0	16.0	12.0	Left Axillary	4	0	0	0	4	0	4	0	0	0	0	0	0	2	0	
18-Jul	Overcast	26.5	16.0	12.0	Left Axillary	27	0	0	0	27	0	27	0	0	0	0	0	0	1	0	Found four pickets pulled at 1600hr. Fish could have passed uncounte
19-Jul	Partly Cloudy	26.0	15.0	11.5	Left Axillary	18	0	2	0	18	2	20	0	0	0	0	0	0	0	0	
20-Jul	Showers	26.0	16.0	13.0	Left Axillary	12	0	2	0	12	2	14	0	0	0	0	0	0	0	0	
21-Jul	Rain	26.5	11.0	13.0	Left Axillary	27	0	13	0	27	13	40	0	0	0	0	0	0	3	0	
22-Jul	Partly Cloudy	29.0	16.0	13.0	Left Axillary	4	0	0	0	4	0	4	0	0	0	0	0	0	2	0	Found six pickets pulled at 0830hr. Fish could have passed uncounte
23-Jul		29.0	17.0	14.0	Left Axillary	11	0	1	0	11	1	12	0	0	0	0	0	0	0	0	
24-Jul	Overcast	26.5	16.0	14.0	Left Axillary	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	Trap entrance tampered with before 0830hr.
25-Jul	Overcast	28.0	16.0	14.0	Left Axillary	135	0	5	0	135	5	140	0	0	0	0	0	0	5	0	
26-Jul	Showers	29.0	16.0	12.0	Left Axillary	181	0	8	0	181	8	189	0	0	0	0	0	0	0	0	
27-Jul	Showers	32.5	11.0	15.0	Left Axillary	80	0	20	0	80	20	100	2	0	2	4	0	0	0	0	
28-Jul	Partly Cloudy	31.5	17.0	15.0	Left Axillary	16	0	0	0	16	0	16	0	0	0	0	0	0	0	0	
29-Jul	Clear	31.0	17.0	14.0	Left Ventral	20	0	2	0	20	2	22	0	0	0	0	0	0	0	0	
30-Jul	Overcast	31.0	16.0	14.0	Left Ventral	4	0	2	0	4	2	6	0	0	0	1	0	0	0	0	
31-Jul	Overcast	30.0	16.0	18.0	Left Ventral	15	0	1	0	15	1	16	0	0	0	0	0	0	0	0	
1-Aug	Overcast	33.5	16.0	13.0	Left Ventral	35	0	4	0	35	4	39	0	0	0	1	0	0	0	0	
2-Aug	Overcast	32.0	16.0	13.0	Left Ventral	8	0	2	0	8	2	10	0	0	0	0	0	0	1	0	
3-Aug	Overcast	32.0	16.0	13.0	Left Ventral	36	0	4	0	36	4	40	0	0	0	1	0	0	0	0	
4-Aug		32.0	15.0	13.0	Left Ventral	17	0	3	0	17	3	20	0	0	0	0	0	0	0	0	
5-Aug	Rain	37.0	15.0	13.0	Left Ventral	123	6	12	0	129	12	141	2	0	2	12	0	0	0	0	
6-Aug	Overcast	36.0	17.0	15.0	Left Ventral	242	1	0	24	243	24	267	8	1	9	1	0	0	0	0	
7-Aug		37.0	16.0	14.0	Left Ventral	168	0	0	5	168	5	173	5	0	5	12	0	0	0	0	
8-Aug					Left Ventral	163	0	0	10	163	10	173	5	0	5	8	0	0	0	0	
9-Aug		42.5	15.0	14.0	Left Ventral	83	1	2	6	84	8	92	7	2	9	157	0	0	1	0	
10-Aug	Overcast	37.0	16.0	14.0	Left Ventral	48	0	0	1	48	1	49	5	0	5	25	0	0	1	0	

(continued)

Table 1. (page 2 of 2)

Date	Weather	Water Level (cm)	Water Temp (°C)	Air Temp (°C)	Mark Used (Adipose + ?)	Sockeye Marked	Sockeye Unmarked	Jacks Marked	Jacks Unmarked	Adult Sockeye Count	Jack Sockeye Count	Total Sockeye Count	Adult Coho	Jack Coho	Total Coho Count	Pink	Chum	Cutthroat	Dolly Varden	Sculpin	Comments
11-Aug	Overcast				Left Ventral	28	0	0	3	28	3	31	3	0	3	16	0	0	0	0	
12-Aug	Overcast	39.0	15.0	12.0	Left Ventral	61	0	5	0	61	5	66	3	0	3	11	0	0	0	0	
13-Aug	Showers	40.0	14.0	11.0	Left Ventral	78	0	1	0	78	1	79	1	0	1	24	0	0	0	0	
14-Aug	Overcast	40.0	15.0	12.0	Dorsal	29	0	0	0	29	0	29	0	0	0	40	0	0	0	0	
15-Aug	Showers				Dorsal	54	0	3	0	54	3	57	7	1	8	25	0	0	0	0	
16-Aug	Showers	39.0	14.0	12.0	Dorsal	30	0	4	0	30	4	34	4	0	4	33	0	0	1	0	
17-Aug	Rain	40.0	14.0	12.0	Dorsal	30	0	1	0	30	1	31	0	0	0	36	0	0	0	0	
18-Aug	Showers	40.0	14.0	12.0	Dorsal	85	0	3	0	85	3	88	26	0	26	67	0	0	0	0	
19-Aug	Overcast	41.0	14.0	12.0	Dorsal	61	0	3	0	61	3	64	31	4	35	65	0	0	1	0	
20-Aug	Overcast	40.0	14.0	12.0	Dorsal	18	0	1	0	18	1	19	15	1	16	51	0	0	1	0	
21-Aug	Overcast	40.0	14.0	12.0	Dorsal	47	0	2	0	47	2	49	5	0	5	18	0	0	0	0	
22-Aug	Overcast	39.0	15.0	12.0	Dorsal	45	0	1	0	45	1	46	4	0	4	40	0	0	0	0	
23-Aug	Showers	38.0	14.0	12.0	Dorsal	36	0	0	0	36	0	36	1	0	1	1	0	0	0	0	
24-Aug	Showers	38.0	14.0	12.0	Dorsal	39	0	2	0	39	2	41	0	0	0	20	0	0	0	0	
25-Aug	Showers	39.0	14.0	12.0	Dorsal	52	0	3	0	52	3	55	1	0	1	23	0	0	0	0	
26-Aug	Partly Cloudy	38.0	16.0	14.0	Dorsal	23	0	0	0	23	0	23	0	0	0	12	0	0	0	0	
27-Aug	Rain	35.5	13.0	12.0	Dorsal	65	2	1	0	67	1	68	3	0	3	7	0	0	0	0	
28-Aug	Overcast	39.0	15.0	12.0	Dorsal	39	0	2	0	39	2	41	0	0	0	22	0	0	0	0	
29-Aug	Overcast	38.5	15.0	13.0	Dorsal	26	0	0	0	26	0	26	7	0	7	16	0	0	0	0	
30-Aug	Partly Cloudy	39.0		16.0	Dorsal	20	0	0	2	20	2	22	8	0	8	16	0	0	0	0	
31-Aug	Rain	42.0	15.0	13.0	Dorsal	21	0	0	0	21	0	21	10	0	10	28	0	0	0	0	
1-Sep	Showers	44.0	13.0	11.0	Dorsal	46	0	0	3	46	3	49	5	0	5	41	0	0	0	0	
2-Sep	Partly Cloudy	53.0	13.0	15.0	Dorsal	89	15	0	0	104	0	104	57	2	59	14	0	0	1	0	
3-Sep	Overcast				Dorsal	53	1	0	2	54	2	56	38	0	38	55	0	0	1	0	
4-Sep	Overcast	50.5	13.0	12.0	Dorsal	148	13	0	4	161	4	165	38	1	39	52	0	0	5	0	
5-Sep	Partly Cloudy				Dorsal	16	0	0	0	16	0	16	18	1	19	16	0	0	0	0	
6-Sep	Rain				Dorsal	44	1	0	0	45	0	45	9	1	10	37	1	0	0	0	
7-Sep					Dorsal					0	0	0			0						Fish were passed and marked but no records were kept.
8-Sep					Dorsal					0	0	0			0						Fish were passed and marked but no records were kept.
9-Sep					Dorsal					0	0	0			0						Fish were passed and marked but no records were kept.
10-Sep					Dorsal					0	0	0			0						Fish were passed and marked but no records were kept.
11-Sep					Dorsal					0	0	0			0						Fish were passed and marked but no records were kept.
12-Sep	Rain				Dorsal	8	0	0	0	8	0	8	11	1	12	14	0	0	0	0	
13-Sep	Partly Cloudy	47.0	12.0	10.0	Dorsal	5	1	0	0	6	0	6	8	0	8	4	0	0	1	0	
14-Sep	Clear	47.0	12.0	10.0	Dorsal	10	0	2	0	10	2	12	3	2	5	1	0	0	1	0	
15-Sep	Clear	40.0	10.0	11.0	Dorsal	0	0	0	0	0	0	0	12	0	12	5	0	0	0	0	
16-Sep					Dorsal					0	0	0			0						Fish were passed and marked but no records were kept.
17-Sep					Dorsal					0	0	0			0						Fish were passed and marked but no records were kept.
18-Sep					Dorsal					0	0	0			0						Fish were passed and marked but no records were kept.
19-Sep	Partly Cloudy	36.0	11.0	10.0	Dorsal	11	0	2	0	11	2	13	7	2	9	0	0	0	17	0	
20-Sep		40.5	11.0	12.0	Dorsal	27	0	0	0	27	0	27	7	8	15	2	0	0	8	0	
21-Sep		41.0	11.0	11.0	Dorsal	10	0	0	0	10	0	10	1	2	3	0	0	0	3	0	
22-Sep					Dorsal					0	0	0			0						Fish were passed and marked but no records were kept.
23-Sep		43.5	11.0	11.0	Dorsal	32	0	1	0	32	1	33	14	8	22	0	0	1	13	0	
24-Sep		49.0	11.0	9.5	Dorsal	26	0	3	0	26	3	29	7	5	12	0	0	0	6	0	
25-Sep		55.5	11.0	9.5	Dorsal	56	0	0	0	56	0	56	12	1	13	0	0	0	2	0	
26-Sep	Showers	54.0	10.5	10.0	Dorsal	11	0	0	0	11	0	11	9	1	10	0	0	1	4	0	
27-Sep	Showers	54.0	10.5	11.0	Dorsal	11	0	0	0	11	0	11	3	0	3	0	0	0	0	0	1100hr weir pulled for season.
Total Number of Fish Counted, Marked, and Recorded on Da						3,179	42	173	60	3,221	233	3,454	422	44	466	1,034	1	2	84	0	

Table 2. Mark and recapture data for sockeye salmon marked at the Neva Creek weir, 2006.

Marking Data:

Location	Dates	Finclip	Sockeye Marked	Sockeye Unmarked	Jacks Marked	Jacks Unmarked	Total Adult & Jack Marked	Total Adult Weir Count	Total Jack Weir Count	Total Weir Count	Percent Adult Marked	Percent Jacks Marked	Percent Marked
Weir	6/13-7/28	Left Axillary	727	1	101	0	828	728	101	829	100%	100%	100%
Weir	7/29-8/13	Left Ventral	1,129	8	38	49	1,167	1,137	87	1,224	99%	44%	95%
Weir	8/14-9/27	Dorsal	1,323	33	34	11	1,357	1,356	45	1,401	98%	76%	97%
		Total	3,179	42	173	60	3,352	3,221	233	3,454	92%	74%	97%

Recapture Data:

Location	Date	Adults, Jacks, or Both	Unmarked	Adipose Only	Left Axillary	Left Ventral	Dorsal	Total Recaptures	Total New	Disregard	Total Caught	Percent Marked
MIS	8/28/2006	Both	34	0	5	7	0	12	46		46	26%
MIS	9/13/2006	Adults	39	5	9	20	8	42	81		81	52%
MIS	9/13/2006	Jacks	11	0	2	2	0	4	15		15	27%
MIS	9/13/2006	Both	50	5	11	22	8	46	96		96	48%
Lake	9/15/2006	Both	18	0	10	14	5	29	47		47	62%
Lake	9/16/2006	Both	28	0	25	23	15	63	91		91	69%
MIS	9/20/2006	Both	15	0	2	4	6	12	27	8	35	44%
MIS	9/21/2006	Both	16	2	1	4	3	10	26	10	36	38%
Lake	9/21/2006	Both	15	0	3	14	14	31	46	10	56	67%
Lake	9/23/2006	Both	19	0	4	16	15	35	54	22	76	65%
Lake	9/24/2006	Both	32	0	7	10	25	42	74	16	90	57%
Lake	9/25/2006	Both	19	0	4	5	15	24	43	11	54	56%
Lake	9/26/2006	Adults	14	0	7	30	17	54	68	34	102	79%
Lake	9/26/2006	Jacks	10	0	2	0	0	2	12	2	14	17%
Lake	9/26/2006	Both	24	0	9	30	17	56	80	36	116	70%
Lake	9/27/2006	Adults	7	0	0	12	12	24	31	44	75	77%
Lake	9/27/2006	Jacks	20	0	0	1	1	2	22	5	27	9%
Lake	9/27/2006	Both	27	0	0	13	13	26	53	49	102	49%
	Total	Adults	60	5	16	62	37	120	180	78	258	67%
		Jacks	41	0	4	3	1	8	49	7	56	16%
		Both	297	7	81	162	136	386	683	162	845	57%

Table 3. Estimated escapement of sockeye salmon into Neva Lake, 2006.

		Total Adults and Jacks		
Marking Data:				
Location	Dates	Number Counted	Number Marked (M)	Expected Percent Marked
Weir	13-June to 27-Sept.	3,454	3,352	97%

Recapture Data:

Location	Dates	Number Examined (C)	Number Recaptured (R)	Observed Percent Marked	One-tailed Binomial Test P-value[a]
MIS	28-Aug	46	12	26%	0.00
MIS	13-Sep	96	46	48%	0.00
MIS	20-Sep	27	12	44%	0.00
MIS	21-Sep	26	10	38%	0.00
Lake	15-Sep	47	29	62%	0.00
Lake	16-Sep	91	63	69%	0.00
Lake	21-Sep	46	31	67%	0.00
Lake	23-Sep	54	35	65%	0.00
Lake	24-Sep	74	42	57%	0.00
Lake	25-Sep	43	24	56%	0.00
Lake	26-Sep	80	56	70%	0.00
Lake	27-Sep	53	26	49%	0.00
	Total	683	386	57%	0.00

Peterson Estimate[b]:

Number ($\hat{N}$)	S.E.	CV (%)
5,931	199	3%

[a] A p-value < 0.05 says that there is less than a 5% chance that the observed percent marked equals or exceeds the expected percent marked at the weir, that fish likely passed the weir uncounted, and that the mark-recapture study is needed to estimate the total escapement.

[b] Total escapement = $\hat{N} = M * C / R$

Standard Error = $S.E.(\hat{N}) = \sqrt{(M^2 * C * (C-R)) / (R^2 * (R+1))}$

Coefficient of Variation = $CV(\%) = (S.E(\hat{N}) / \hat{N}) * 100$

2007

In 2007, the adult salmon weir was in place from 1600hr on June 16 to the afternoon of October 8 (Table 4). The weir count totaled 4,465 sockeye salmon – 3,754 adults and 711 jacks. The first sockeye salmon was counted through the weir on June 26 and the last sockeye recorded through the weir was on October 6. Counts of other species totaled 974 coho salmon (including 233 jacks), 383 pink salmon, 2 chum salmon, 56 cutthroat trout, 1,036 Dolly Varden char, and 5 sculpin.

There were times when fish might have passed through the weir uncounted or unrecorded. We had reports of local citizens pulling pickets and passing fish that included 205 sockeye passed on July 9 and 113 sockeye passed on July 21. Weir personnel did not complete daily data forms on several days including the first 10 days of weir operation, the last two days of weir operations, and on August 19, August 27, and September 14. The 499 coho salmon counted through the weir on September 5 and 6 was an unusually high number for this date compared to other years and compared to other days in 2007. It is possible that many of these fish were actually sockeye salmon.

Unlike in 2006, there were no instances of finding pickets displaced or periods of time that the weir was opened and unattended. Like 2006, there were no observations of fresh dead (pre-spawn) salmon at or near the weir in 2007 or any indication of handling mortality associated with the counting, marking, and sampling of fish at the weir. Likewise, there were no observations or reports in 2007 of sockeye dying in Neva Creek due to low water and stressful migration conditions.

In 2007, project personnel finclipped 2,521 (56%) of the 4,465 sockeye counted through the weir with adipose clips and left axilary, left ventral, and dorsal clips (Table). The sampling plan was for a 25% marking rate but the crews' enthusiasm for marking was not tempered inseason so the marking rate could be kept as consistent as possible throughout the run. The marking rate was indeed kept fairly consistent through the run for both the adult and jack sockeye salmon (Table 5).

Adult and jack sockeye salmon were sampled for the proportion of marked fish in the main inlet stream on three different days and in beach spawning areas on three different days. Separate counts of the number of adults and jacks sampled were only recorded for one of these days so adults and jacks had to be pooled in the population estimate. The one-tailed Binomial test was significant for all but the first and last recovery days indicating that fish likely passed through the weir uncounted (Table 6).

Using the SPAS program (Arnason et al. 1996), the test for equal proportions was not significant for the stratified Darroch abundance estimator using the three release strata and six recovery strata. Given this, and the fact that a fairly high and consistent proportion of the fish were marked at the weir and in the recovery samples, I choose to estimate the total in-lake escapement using the pooled Peterson estimator. With M=2,521, C=523, and R=220 the Peterson estimate of escapement is 5,993 (CV=5%) sockeye salmon into Neva Lake (Table 6). For comparison, this Peterson estimate is 240 fish more that the 5,739 (CV=6%) Darroch estimate and 56 fish more than the 5,923 Schaefer estimate. It is also 1,528 fish higher than the 4,465 weir count. The daily weir counts might not represent the actual daily proportion of sockeye escaping into the lake but the estimate of the total escapement is reliable.

Table 4. Weather and stream measurements and daily numbers of fish counted and finclipped at the Neva Creek weir, 2007.

Date	Weather	Water Level (cm)	Water Temp (°C)	Air Temp (°C)	Mark Used (Adipose +)	Sockeye Marked	Sockeye Unmarked	Jacks Marked	Jacks Unmarked	Adult Sockeye Count	Jack Sockeye Count	Total Sockeye Count	Adult Coho	Jack Coho	Total Coho Count	Pink	Chum	Cutthroat	Dolly Varden	Sculpin	Comments
16-Jun																					Weir fish tight @ 1600hr
17-Jun																					missing daily data form
18-Jun																					missing daily data form
19-Jun																					missing daily data form
20-Jun																					missing daily data form
21-Jun																					missing daily data form
22-Jun																					missing daily data form
23-Jun																					missing daily data form
24-Jun																					missing daily data form
25-Jun																					missing daily data form
26-Jun	partly cloudy	35.5	14.0	13.0	Left Axillary	7	4	4	1	11	5	16	0	0	0	0	0	0	0	0	
27-Jun	overcast	41.5	14.0	13.0	Left Axillary	7	0	3	0	7	3	10	0	0	0	0	0	0	0	0	
28-Jun	partly cloudy	35.0	15.0	14.0	Left Axillary	10	0	4	0	10	4	14	0	0	0	0	0	0	0	0	
29-Jun	partly cloudy	35.5	15.0	14.0	Left Axillary	19	0	2	0	19	2	21	0	0	0	0	0	0	0	0	
30-Jun	partly cloudy	35.0	15.0	12.0	Left Axillary	14	0	8	0	14	8	22	0	0	0	0	0	0	0	0	
1-Jul	partly cloudy	33.5	17.0	15.0	Left Axillary	6	0	7	0	6	7	13	0	0	0	0	0	0	0	0	
2-Jul		32.5	15.0	14.0	Left Axillary	0	6	0	3	6	3	9	0	0	0	0	0	0	0	0	
3-Jul	overcast	31.0	16.0	14.0	Left Axillary	28	50	0	2	78	2	80	0	0	0	0	0	0	0	0	
4-Jul	rain	31.0	16.0	13.0	Left Axillary	0	10	0	1	10	1	11	0	0	0	0	0	0	0	0	
5-Jul		31.0	15.0	12.0	Left Axillary	0	76	0	6	76	6	82	0	0	0	0	0	0	0	0	
6-Jul	overcast	32.5	15.0	14.0	Left Axillary	18	18	5	1	36	6	42	0	0	0	0	0	0	0	0	
7-Jul	overcast	30.0	16.0	13.0	Left Axillary	14	0	4	0	14	4	18	0	0	0	0	0	0	0	0	
8-Jul	overcast	30.0	14.0	13.0	Left Axillary	27	23	1	2	50	3	53	0	0	0	0	0	0	0	0	
9-Jul		31.0	16.0	13.0	Left Axillary	0	205	0	0	205	0	205	0	0	0	0	0	0	0	0	205 sockeye reportedly passed
10-Jul	showers	30.0	15.0	12.0	Left Axillary	24	15	1	1	39	2	41	0	0	0	0	0	0	0	0	
11-Jul	showers	30.0	15.0	12.0	Left Axillary	88	69	3	4	157	7	164	0	0	0	0	0	0	0	0	
12-Jul		36.0	15.0	12.0	Left Axillary	74	0	9	0	74	9	83	0	0	0	0	0	0	0	0	
13-Jul		37.0	15.0	14.0	Left Axillary	130	0	8	0	130	8	138	0	0	0	0	0	0	0	0	
14-Jul		38.0	15.0	14.0	Left Axillary	32	0	12	0	32	12	44	0	0	0	0	0	0	0	0	
15-Jul		39.0	15.0	13.0	Left Axillary	103	49	24	9	152	33	185	0	0	0	0	0	0	0	0	
16-Jul	rain	41.5	16.0	13.0	Left Axillary	58	28	23	13	86	36	122	0	0	0	0	0	0	1	0	
17-Jul	overcast	44.0	14.0	13.0	Left Axillary	23	40	8	19	63	27	90	0	0	0	0	0	0	5	0	
18-Jul	overcast	39.0	14.0	13.0	Left Axillary	27	0	12	0	27	12	39	0	0	0	0	0	0	13	0	
19-Jul		39.0	16.0	14.0	Left Axillary	85	31	23	12	116	35	151	0	0	0	0	0	0	37	0	
20-Jul	showers	38.0	15.0	12.0	Left Axillary	41	0	23	0	41	23	64	0	0	0	0	0	0	16	0	
21-Jul		38.0	15.0	12.0	Left Axillary	0	137	0	15	137	15	152	0	0	0	0	0	0	55	0	113 sockeye reportedly passed
22-Jul	partly cloudy	36.5	16.0	15.0	Left Axillary	17	0	0	4	17	4	21	0	0	0	0	0	0	3	0	
23-Jul	partly cloudy	35.0	15.0	14.0	Left Axillary	0	30	0	18	30	18	48	0	0	0	0	0	0	2	0	
24-Jul		33.5	15.0	14.0	Left Axillary	0	0	0	0	0	0	0	0	0	0	0	0	0	4	0	
25-Jul		34.0	15.0	14.0	Left Axillary	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	
26-Jul	overcast	31.0	15.0	13.0	Left Axillary	0	23	0	4	23	4	27	0	0	0	0	0	0	0	0	
27-Jul		30.5	15.0	14.0	Left Axillary	29	0	2	0	29	2	31	0	0	0	0	0	0	0	0	
28-Jul	partly cloudy	30.0	15.0	14.0	Left Axillary	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	
29-Jul	partly cloudy	29.5	16.0	13.0	Left Ventral	41	20	19	0	61	19	80	0	0	0	0	1	0	1	0	
30-Jul	overcast				Left Ventral	20	39	0	23	59	23	82	0	0	0	0	0	0	0	0	
31-Jul		28.5	15.0	12.0	Left Ventral	34	91	6	27	125	33	158	0	0	0	0	0	0	3	0	
1-Aug					Left Ventral	10	0	4	0	10	4	14	0	0	0	0	0	0	2	0	
2-Aug	overcast	27.0	16.0	14.0	Left Ventral	46	0	29	0	46	29	75	0	0	0	0	0	1	0	0	
3-Aug	overcast	26.5	15.0	13.0	Left Ventral	0	23	0	5	23	5	28	0	0	0	0	0	0	0	0	

(continued)

Table 4. (page 2 of 3)

Date	Weather	Water Level (cm)	Water Temp (°C)	Air Temp (°C)	Mark Used (Adipose +)	Sockeye Marked	Sockeye Unmarked	Jacks Marked	Jacks Unmarked	Adult Sockeye Count	Jack Sockeye Count	Total Sockeye Count	Adult Coho	Jack Coho	Total Coho Count	Pink	Chum	Cutthroat	Dolly Varden	Sculpin	Comments
4-Aug	overcast	26.0	16.0	14.0	Left Ventral	27	0	0	17	27	17	44	0	0	0	0	0	0	2	0	
5-Aug	overcast	25.5	16.0	14.0	Left Ventral	1	0	0	4	1	4	5	0	0	0	0	0	0	2	0	
6-Aug	showers	25.5	15.0	18.0	Left Ventral	0	4	0	4	4	4	8	0	0	0	0	0	0	6	0	
7-Aug	overcast	26.0	15.0	13.0	Left Ventral	87	42	9	17	129	26	155	15	1	16	4	1	0	1	0	
8-Aug	overcast	26.0	16.0	13.0	Left Ventral	76	39	10	8	115	18	133	16	0	16	5	0	0	0	0	
9-Aug	overcast	26.5	16.0	14.0	Left Ventral	8	36	1	13	44	14	58	12	0	12	0	0	1	3	0	
10-Aug	partly cloudy	25.5	16.0	13.0	Left Ventral	12	1	7	0	13	7	20	0	0	0	0	0	0	0	0	
11-Aug	partly cloudy	24.5	18.0	19.0	Left Ventral	22	1	23	0	23	23	46	0	0	0	0	0	0	1	0	
12-Aug		24.0	18.0		Left Ventral	39	0	5	0	39	5	44	0	1	1	0	0	0	0	0	
13-Aug		24.5	16.0	13.0	Left Ventral	1	0	0	0	1	0	1	0	0	0	0	0	0	0	0	
14-Aug	clear	24.0	17.0	13.0	Left Ventral	0	13	0	6	13	6	19	0	0	0	0	0	0	1	0	
15-Aug		23.0	17.0	16.0	Left Ventral	6	0	0	4	6	4	10	0	3	3	0	0	0	6	0	
16-Aug	partly cloudy	22.0	17.0	15.0	Dorsal	19	6	0	5	25	5	30	0	0	0	0	0	0	0	0	
17-Aug					Dorsal	0	0	0	0	0	0	0	0	1	1	2	0	0	0	0	
18-Aug	overcast	20.0	16.0	14.0	Dorsal	10	0	5	0	10	5	15	1	0	1	0	0	0	2	0	
19-Aug					Dorsal																missing daily data form
20-Aug		18.5	17.0	14.0	Dorsal	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	
21-Aug	partly cloudy	20.0	17.0	14.0	Dorsal	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	
22-Aug	overcast	20.5	16.0	14.0	Dorsal	15	0	0	0	15	0	15	0	0	0	0	0	0	0	0	
23-Aug	overcast	20.0	16.0	14.0	Dorsal	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	
24-Aug	overcast	19.5	17.0	13.0	Dorsal	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	
25-Aug					Dorsal	25	0	9	0	25	9	34	1	2	3	1	0	0	0	0	
26-Aug	overcast	19.0	16.0	13.0	Dorsal	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	
27-Aug					Dorsal																missing daily data
28-Aug	clear	17.0	16.0	11.0	Dorsal	15	0	10	0	15	10	25	0	0	0	1	0	1	0	0	
29-Aug	overcast	14.5	16.0	14.0	Dorsal	0	9	0	4	9	4	13	1	0	1	8	0	0	0	0	
30-Aug		14.5	16.0	12.0	Dorsal	11	0	9	0	11	9	20	0	0	0	5	0	0	1	0	
31-Aug	rain	16.5	16.0	11.0	Dorsal	0	17	0	7	17	7	24	1	0	1	7	0	1	1	0	
1-Sep	showers	15.5	15.0	10.0	Dorsal	7	0	2	0	7	2	9	0	0	0	5	0	0	0	0	
2-Sep	partly cloudy	16.0	15.0	8.0	Dorsal	38	0	6	0	38	6	44	2	0	2	5	0	0	1	0	
3-Sep	clear	16.0	16.0	12.0	Dorsal	0	12	0	0	12	0	12	0	0	0	4	0	2	0	0	
4-Sep	showers	14.0	14.0	10.0	Dorsal	23	0	4	0	23	4	27	3	1	4	12	0	1	0	0	
5-Sep	showers	16.0	14.0	9.0	Dorsal	158	137	3	18	295	21	316	136	74	210	11	0	1	0	2	
6-Sep	showers	24.0	14.0	10.0	Dorsal	0	199	0	26	199	26	225	250	39	289	16	0	5	2	0	
7-Sep	showers	23.5	14.0	12.0	Dorsal	9	0	2	0	9	2	11	4	0	4	14	0	1	1	0	
8-Sep	rain	24.5	15.0	14.0	Dorsal	6	83	1	5	89	6	95	16	1	17	17	0	0	1	3	
9-Sep	rain	25.5	13.0	10.0	Dorsal	23	0	8	0	23	8	31	5	0	5	14	0	6	4	0	
10-Sep	rain	26.0	12.0	10.0	Dorsal	16	0	8	0	16	8	24	8	0	8	6	0	0	0	0	
11-Sep	rain	26.0	12.0	10.0	Dorsal	39	0	2	0	39	2	41	10	5	15	15	0	0	2	0	
12-Sep	rain	27.0	13.0	10.0	Dorsal	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	
13-Sep	partly cloudy	27.0	13.0	12.0	Dorsal	25	0	2	0	25	2	27	9	10	19	14	0	0	11	0	
14-Sep					Dorsal																missing daily data form
15-Sep	showers	34.0	14.0	9.0	Dorsal	20	0	4	0	20	4	24	30	6	36	6	0	0	19	0	

(continued)

Table 4. (page 3 of 3)

Date	Weather	Water Level (cm)	Water Temp (°C)	Air Temp (°C)	Mark Used (Adipose +)	Sockeye Marked	Sockeye Unmarked	Jacks Marked	Jacks Unmarked	Adult Sockeye Count	Jack Sockeye Count	Total Sockeye Count	Adult Coho	Jack Coho	Total Coho Count	Pink	Chum	Cutthroat	Dolly Varden	Sculpin	Comments
16-Sep	rain	33.5	14.0	10.0	Dorsal	0	18	0	4	18	4	22	9	0	9	3	0	0	3	0	
17-Sep		39.0	14.0	10.0	Dorsal	9	0	3	0	9	3	12	15	2	17	1	0	1	2	0	
18-Sep	rain	42.5	14.0	10.0	Dorsal	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	
19-Sep	rain	39.5	10.0	10.0	Dorsal	15	0	4	0	15	4	19	11	6	17	7	0	0	24	0	
20-Sep	showers	43.0	14.0	10.0	Dorsal	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	
21-Sep	showers	45.0	14.0	10.0	Dorsal	39	0	1	0	39	1	40	19	4	23	21	0	2	62	0	
22-Sep	partly cloudy	44.5	13.0	10.0	Dorsal	29	3	0	0	32	0	32	28	4	32	17	0	0	37	0	
23-Sep	rain	44.0	12.0	9.0	Dorsal	21	0	3	0	21	3	24	3	1	4	3	0	0	32	0	
24-Sep	showers	48.0	13.0	11.0	Dorsal	22	0	3	0	22	3	25	19	9	28	40	0	1	75	0	
25-Sep	rain	50.5	12.0	10.0	Dorsal	51	0	2	0	51	2	53	30	4	34	57	0	0	72	0	
26-Sep	rain	53.0	11.0	8.0	Dorsal	40	24	2	0	64	2	66	24	2	26	12	0	0	73	0	
27-Sep	overcast	52.5	12.0	9.0	Dorsal	23	0	2	0	23	2	25	10	6	16	28	0	1	92	0	
28-Sep	partly cloudy	49.5	11.0	6.0	Dorsal	16	0	0	0	16	0	16	17	7	24	6	0	2	62	0	
29-Sep	overcast	49.5	10.0	7.0	Dorsal	12	0	0	0	12	0	12	12	8	20	6	0	4	83	0	
30-Sep	overcast	47.5	11.0	8.0	Dorsal	20	0	0	0	20	0	20	4	3	7	6	0	5	37	0	
1-Oct	rain	48.0	11.0	8.0	Dorsal	10	0	1	0	10	1	11	4	4	8	3	0	1	21	0	
2-Oct	overcast	49.0	10.0	7.0	Dorsal	5	0	0	0	5	0	5	0	0	0	0	0	0	1	0	
3-Oct	partly cloudy	50.0	10.0	8.0	Dorsal	14	0	1	0	14	1	15	16	5	21	1	0	1	24	0	
4-Oct	clear	47.0	10.0	6.0	Dorsal	9	0	2	0	9	2	11	1	4	5	0	0	4	42	0	
5-Oct	overcast	47.5	8.0	7.0	Dorsal	5	0	1	0	5	1	6	3	4	7	0	0	11	21	0	
6-Oct		49.5	9.0	6.0	Dorsal	12	1	0	0	13	0	13	6	6	12	0	0	3	64	0	
7-Oct					Dorsal																missing daily data form
8-Oct					Dorsal																missing daily data, weir pulled PM
Total Counted, Marked, and Recorded on Daily Weir Data For						2,122	1,632	399	312	3,754	711	4,465	751	223	974	383	2	56	1,036	5	

Table 5. Mark and recapture data for sockeye salmon marked at the Neva Creek weir, 2007.

Marking Data:

Location	Dates	Finclip	Sockeye Marked	Sockeye Unmarked	Jacks Marked	Jacks Unmarked	Total Adult & Jack Marked	Total Adult Weir Count	Total Jack Weir Count	Total Weir Count	Percent Adults Marked	Percent Jacks Marked	Percent Marked
Weir	6/16-7/28	Left Axillary	881	814	186	115	1,067	1,695	301	1,996	52%	62%	53%
Weir	7/29-8/15	Left Ventral	430	309	113	128	543	739	241	980	58%	47%	55%
Weir	8/16-10/8	Dorsal	811	509	100	69	911	1,320	169	1,489	61%	59%	61%
		Total	2,122	1,632	399	312	2,521	3,754	711	4,465	57%	56%	56%

Recapture Data:

Location	Date	Adults, Jacks, or Both	Unmarked	Left Axillary	Left Ventral	Dorsal	Total Recaptures	Total New	Disregard	Total Caught	Percent Marked
MIS	8/10	Both	27	28	0	0	28	55	0	55	51%
MIS	9/20	Both	33	6	10	6	22	55	0	55	40%
MIS	9/23	Both	70	20	20	10	50	120	0	120	42%
Lake	10/2	Both	62	3	13	21	37	99	0	99	37%
Lake	10/3	Both	79	4	15	33	52	131	49	180	40%
Lake	10/7	Both	32	5	10	16	31	63	45	108	49%
		Totals	303	66	68	86	220	523	94	617	42%

Table 6. Estimated escapement of sockeye salmon into Neva Lake, 2007.

		Total Adults and Jacks			
Marking Data:					
Location	Dates	Number Counted	Number Marked (M)	Expected Percent Marked	
Weir	16-June to 8-Oct.	4,465	2,521	56%	
Recapture Data:					
Location	Dates	Number Examined (C)	Number Recaptured (R)	Observed Percent Marked	One-tailed Binomial Test P-value[a]
MIS	10-Aug	55	28	51%	0.24
MIS	20-Sep	55	22	40%	0.01
MIS	23-Sep	120	50	42%	0.00
Lake	2-Oct	99	37	37%	0.00
Lake	3-Oct	131	52	40%	0.00
Lake	7-Oct	63	31	49%	0.15
	Total	523	220	42%	0.00
Peterson Estimate[b]:					
		Number ($\hat{N}$)	S.E.	CV (%)	
		5,993	307	5%	

[a] A p-value < 0.05 says that there is less than a 5% chance that the observed percent marked equals or exceeds the expected percent marked at the weir, that fish likely passed the weir uncounted, and that the mark-recapture study is needed to estimate the total escapement.

[b] Total escapement = $\hat{N} = M * C / R$

Standard Error = $S.E.(\hat{N}) = \sqrt{(M^2 * C * (C-R)) / (R^2 * (R+1))}$

Coefficient of Variation = $CV(\%) = (S.E(\hat{N}) / \hat{N}) * 100$

2008

In 2008, the adult salmon weir was in place from 1800hr on June 16 to the afternoon of September 8 (Table 7). The weir count totaled 2,657 sockeye salmon – 2,521 adults and 136 jacks. The first sockeye salmon was counted through the weir on June 29 and the last sockeye recorded through the weir was on September 4. Counts of other species totaled 40 coho salmon (including 1 jack), 70 pink salmon, 16 chum salmon, 1 cutthroat trout, and 77 Dolly Varden char.

Unlike in 2006 and 2007, there were no times when fish were known to have passed through the weir uncounted or unrecorded in 2008 although some sockeye salmon certainly entered the lake after the weir was pulled on September 8. Daily data forms were not completed from June 17 to 23, June 25 and 26, August 6, 9, 10, and 11, August

23, and September 6, 7, and 8 but he operators reported that data forms were not completed because no fish were counted through the weir on these days.

In 2008, there were no observations of fresh dead (pre-spawn) salmon at or near the weir or any indication of handling mortality associated with the counting, marking, and sampling of fish at the weir. Likewise, there were no observations or reports in 2008 of unusual numbers of sockeye dying in Neva Creek or the main inlet stream due stressful migration conditions of low and warm water.

In 2008, project personnel adipose-clipped 732 (29%) of the adult sockeye salmon and 49 (36%) of the jack sockeye salmon counted through the weir (Tables 7 and 8). The sampling plan was for a running average of 33% of the adults and jacks to be marked. The marking rate for adult sockeye salmon was higher in early June but was kept close to 30% for the rest of the summer. The marking rate for jacks was a little more variable probably because so few were counted.

Live adult and jack sockeye salmon were sampled for the proportion of marked fish in the main inlet stream on three different days and in beach spawning areas on three different days. Whole, fresh dead, adult sockeye salmon were also sampled for adipose-clips on two of these days. Separate counts of the number of adults and jacks sampled were recorded each day.

An underwater video camera and mini-digital video recorder system (Figures 7, 8, and 9; Appendix F, Van Alen 2008b) was used to sample for marked and unmarked sockeye salmon entering Neva Lake's main inlet stream on August 26 and 27. The video from the left (river left) camera was reviewed for these days to help fill-in the sampling coverage between the August 16 and September 4 trips. The motion-detected footage was relatively quick and easy to review and the slight down-looking angle of the camera and 30 frames-per-second recording speed worked quite well for determining if each sockeye swimming into the main inlet stream was adipose-clipped or not. Sockeye salmon were only "sampled" for adipose-clips if their adipose fin area was clearly visible and this was the case for nearly all the fish that swam past the camera.

The Peterson estimate of the adult sockeye salmon escapement into Neva Lake in 2008 is 2,655 (CV=6%) with M=732, C=729, and R=201 (Table 8). The Peterson estimate of the jack sockeye salmon escapement into Neva Lake in 2008 is 168 (CV=32%) with M=49, C=24, and R=7 (Table 8). Summed together, the total escapement of adult and jack sockeye salmon into Neva Lake is 2,823 (CV=7%) which is four fish less than the Peterson estimate for adults and jacks combined of 2,827 (CV=6%; Table 8). It is also 166 fish higher than the 2,657 weir count. I assume that these 166 fish likely entered the lake after September 8 and I use the estimated daily proportions from an all year (2002, 2003, 2004, 2005, and 2008) EM algorithm missing values fill-in (McLachlan and Krishnan 1977) to estimate the daily passage through October 13 (Table 9). The estimated total escapement would be 143 fish higher if the strait weir counts and EM fill-in numbers for the dates the weir was not operated from June 4 to October 13 were used instead. Nevertheless, I choose the slightly more conservative estimate of 2,823

(CV=7%) as the best estimate of sockeye escapement into Neva Lake in 2008. Note that only the one-tailed Binomial test for the last recovery trip was close to significant which suggests that weir counts were accurate but fish did enter the lake after the weir was pulled (Table 8).

Run Timing

Averaged from 2002 to 2008, 80% of the sockeye salmon entered Neva Lake between July 5 and September 8 and the mid-point of the run was on August 5 (Table 10). The run timing was latest in 2004 and earliest in 2008.

Table 7. Weather and stream measurements and daily numbers of fish counted and finclipped at the Neva Creek weir, 2008.

Date	Weather	Water Level (cm)	Water Temp (°C)	Air Temp (°C)	Adult Sockeye Marked	Adult Sockeye Unmarked	Cum. Percent Adults Marked	Jack Sockeye Marked	Jack Sockeye Unmarked	Cum. Percent Jacks Marked	Adult Sockeye Count	Jack Sockeye Count	Total Sockeye Count	Adult Coho	Jack Coho	Total Coho Count	Pink	Chum	Cutthroat	Dolly Varden	Comments
16-Jun	partly cloudy				0	0		0	0		0	0	0	0	0	0	0	0	0	0	Weir fish tight @ 18:00hr.
17-Jun					0	0		0	0		0	0	0	0	0	0	0	0	0	0	no data form
18-Jun					0	0		0	0		0	0	0	0	0	0	0	0	0	0	no data form
19-Jun					0	0		0	0		0	0	0	0	0	0	0	0	0	0	no data form
20-Jun					0	0		0	0		0	0	0	0	0	0	0	0	0	0	no data form
21-Jun					0	0		0	0		0	0	0	0	0	0	0	0	0	0	no data form
22-Jun					0	0		0	0		0	0	0	0	0	0	0	0	0	0	no data form
23-Jun					0	0		0	0		0	0	0	0	0	0	0	0	0	0	no data form
24-Jun	rain	34.0			0	0		0	0		0	0	0	0	0	0	0	0	0	0	
25-Jun					0	0		0	0		0	0	0	0	0	0	0	0	0	0	no data form
26-Jun					0	0		0	0		0	0	0	0	0	0	0	0	0	0	no data form
27-Jun	partly cloudy	32.0	13.0		0	0		0	0		0	0	0	0	0	0	0	0	0	0	
28-Jun	overcast	35.5	14.0		0	0		0	0		0	0	0	0	0	0	0	0	0	0	
29-Jun		35.0	13.0	10.0	3	1	75%	0	0		4	0	4	0	0	0	0	0	0	0	
30-Jun	overcast	34.5	14.0	13.0	0	0	75%	0	0		0	0	0	0	0	0	0	0	0	0	
1-Jul		36.0	13.0	10.0	0	0	75%	0	0		0	0	0	0	0	0	0	0	0	0	
2-Jul	clear	36.5	15.0	13.0	15	0	95%	0	0		15	0	15	0	0	0	0	0	0	0	
3-Jul	overcast	35.0	16.0	15.0	11	0	97%	0	0		11	0	11	0	0	0	0	0	0	0	
4-Jul	overcast	35.0	16.0	15.0	54	82	50%	0	1	0%	136	1	137	0	0	0	0	0	0	0	
5-Jul	overcast	36.0	15.0	16.0	16	62	41%	0	0	0%	78	0	78	0	0	0	0	0	0	0	
6-Jul		36.0	15.0	11.0	40	110	35%	0	1	0%	150	1	151	0	0	0	0	0	0	0	
7-Jul		35.5	14.0	12.0	45	58	37%	0	8	0%	103	8	111	0	0	0	0	0	0	0	
8-Jul	showers	37.0	15.0	13.0	55	42	40%	0	0	0%	97	0	97	0	0	0	0	0	0	0	
9-Jul	partly cloudy	35.5	14.0	13.0	32	21	42%	0	2	0%	53	2	55	0	0	0	0	0	0	0	
10-Jul	partly cloudy	34.0	14.0	11.5	35	0	45%	3	0	20%	35	3	38	0	0	0	0	0	0	1	
11-Jul	overcast	32.0	14.0	12.0	8	1	45%	1	0	25%	9	1	10	0	0	0	0	0	0	0	
12-Jul	rain	32.5	13.0	10.0	0	18	44%	0	2	22%	18	2	20	0	0	0	0	0	0	0	
13-Jul	overcast	31.0	14.0	12.0	9	37	43%	1	1	25%	46	2	48	0	0	0	0	0	0	0	
14-Jul		31.5	14.0	13.0	0	15	42%	0	2	23%	15	2	17	0	0	0	0	0	0	0	wolf prints around weir
15-Jul					0	0	42%	0	0	23%	0	0	0	0	0	0	0	0	0	0	
16-Jul					0	0	42%	0	0	23%	0	0	0	0	0	0	0	0	0	0	
17-Jul	rain	35.5	14.0	12.0	0	306	30%	0	7	17%	306	7	313	0	0	0	0	0	0	0	
18-Jul	rain	41.0	14.0	11.0	0	121	27%	0	10	13%	121	10	131	0	0	0	0	0	0	1	
19-Jul	partly cloudy	58.0	12.0	10.0	37	100	27%	2	7	15%	137	9	146	0	0	0	0	0	0	0	
20-Jul		52.0	13.0	10.0	25	36	28%	2	3	17%	61	5	66	0	0	0	0	0	0	0	
21-Jul	overcast	48.0	13.0	10.0	0	22	27%	0	0	17%	22	0	22	0	0	0	0	0	0	0	
22-Jul	overcast				40	0	29%	0	0	17%	40	0	40	0	0	0	0	0	0	0	
23-Jul	overcast	41.0	12.0	10.0	17	24	30%	1	0	19%	41	1	42	0	0	0	0	0	0	7	
24-Jul	showers	41.0	12.0	11.0	21	53	29%	0	1	18%	74	1	75	0	0	0	0	0	0	18	
25-Jul		42.0	12.0	10.0	6	0	30%	1	1	19%	6	2	8	0	0	0	0	0	0	0	UW cameras installed upstream from weir
26-Jul		48.0	12.0	10.0	13	30	30%	8	0	29%	43	8	51	0	0	0	0	0	0	0	
27-Jul		47.0	12.0	9.0	10	15	30%	2	1	31%	25	3	28	0	0	0	0	0	0	16	
28-Jul	overcast				10	4	30%	0	2	30%	14	2	16	0	0	0	1	0	0	0	
29-Jul		50.0	12.0	10.0	10	5	31%	0	0	30%	15	0	15	0	0	0	0	0	0	5	
30-Jul		47.5	14.0	13.0	20	0	31%	0	0	30%	20	0	20	0	0	0	0	1	0	1	
31-Jul		45.5	13.0	11.0	0	21	31%	0	2	29%	21	2	23	0	0	0	0	0	0	2	

(continued)

Table 7. (page 2 of 2)

Date	Weather	Water Level (cm)	Water Temp (°C)	Air Temp (°C)	Adult Sockeye Marked	Adult Sockeye Unmarked	Cum. Percent Adults Marked	Jack Sockeye Marked	Jack Sockeye Unmarked	Cum. Percent Jacks Marked	Adult Sockeye Count	Jack Sockeye Count	Total Sockeye Count	Adult Coho	Jack Coho	Total Coho Count	Pink	Chum	Cutthroat	Dolly Varden	Comments
1-Aug	overcast	43.0	13.0	11.0	10	3	31%	0	1	29%	13	1	14	0	0	0	0	0	0	0	
2-Aug	overcast	41.0	13.0	13.0	10	8	32%	0	5	27%	18	5	23	0	0	0	0	0	0	2	
3-Aug	overcast	38.5	13.0	13.0	10	25	32%	5	1	31%	35	6	41	2		2	0	0	0	2	
4-Aug	overcast	37.5	13.0	11.0	0	11	31%	0	6	29%	11	6	17	0	0	0	0	0	0	2	
5-Aug		36.0	13.0	13.0	0	2	31%	0	2	28%	2	2	4	0	0	0	0	0	0	0	
6-Aug					0	0	31%	0	0	28%	0	0	0	0	0	0	0	0	0	0	no data form
7-Aug	overcast				0	0	31%	0	0	28%	0	0	0	0	0	0	0	0	0	6	
8-Aug	partly cloudy				0	0	31%	0	0	28%	0	0	0	0	0	0	0	0	0	0	
9-Aug					0	0	31%	0	0	28%	0	0	0	0	0	0	0	0	0	0	no data form
10-Aug					0	0	31%	0	0	28%	0	0	0	0	0	0	0	0	0	0	no data form
11-Aug					0	0	31%	0	0	28%	0	0	0	0	0	0	0	0	0	0	no data form
12-Aug	rain	31.0	14.0	14.0	0	213	28%	0	3	27%	213	3	216	0	0	0	0	0	1	2	
13-Aug					10	107	27%	0	8	25%	117	8	125	1	0	1	0	5	0	4	
14-Aug	showers	30.5	13.0	13.0	30	89	27%	0	6	24%	119	6	125	0	0	0	4	4	0	0	
15-Aug		32.5	15.0	14.0	10	6	27%	0	0	24%	16	0	16	0	1	1	0	0	0	0	UW cameras installed lower MIS
16-Aug		30.0	14.0		6	6	27%	1	0	25%	12	1	13	0	0	0	10	0	0	1	
17-Aug	overcast	29.5	14.0	12.0	7	0	27%	0	0	25%	7	0	7	0	0	0	2	0	0	0	
18-Aug	clear	27.5	15.0	14.0	0	14	27%	0	0	25%	14	0	14	0	0	0	3	0	0	0	
19-Aug	overcast	27.0	16.0	16.0	0	0	27%	0	0	25%	0	0	0	0	0	0	0	0	0	0	
20-Aug	overcast	28.0	16.0	16.0	0	0	27%	0	0	25%	0	0	0	0	0	0	0	0	0	0	
21-Aug					21	0	28%	6	0	28%	21	6	27	0	0	0	5	0	0	0	UW camera installed at beach spawning are
22-Aug	rain	27.5	14.0	11.0	0	7	28%	0	0	28%	7	0	7	0	0	0	10	0	0	0	
23-Aug					0	0	28%	0	0	28%	0	0	0	0	0	0	0	0	0	0	no data form
24-Aug	overcast	36.0	14.0	10.0	18	62	28%	7	0	33%	80	7	87	7	0	7	8	0	0	0	
25-Aug	showers	37.0	13.0	10.5	27	0	28%	6	0	36%	27	6	33	13	0	13	23	0	0	4	
26-Aug	overcast	37.5	13.0	11.0	0	0	28%	0	0	36%	0	0	0	0	0	0	0	0	0	0	
27-Aug	partly cloudy	36.0	13.0	11.0	0	0	28%	0	0	36%	0	0	0	0	0	0	0	0	0	0	
28-Aug	overcast	35.5	13.0	11.0	20	16	29%	2	0	37%	36	2	38	13	0	13	2	0	0	1	
29-Aug	overcast				0	0	29%	0	0	37%	0	0	0	0	0	0	0	0	0	0	
30-Aug		32.0	13.0	10.0	5	23	29%	0	0	37%	28	0	28	2	0	2	0	6	0	0	
31-Aug		32.0	13.0	10.0	0	0	29%	0	0	37%	0	0	0	0	0	0	0	0	0	0	
1-Sep	rain				0	9	29%	0	4	36%	9	4	13	1	0	1	0	0	0	0	
2-Sep	overcast				7	0	29%	0	0	36%	7	0	7	1	0	1	0	0	0	2	
3-Sep	rain				0	0	29%	0	0	36%	0	0	0	0	0	0	0	0	0	0	
4-Sep	rain	28.5	13.0	11.0	9	4	29%	1	0	36%	13	1	14	0	0	0	2	0	0	0	
5-Sep	rain				0	0	29%	0	0	36%	0	0	0	0	0	0	0	0	0	0	
6-Sep					0	0	29%	0	0	36%	0	0	0	0	0	0	0	0	0	0	no data form
7-Sep					0	0	29%	0	0	36%	0	0	0	0	0	0	0	0	0	0	no data form
8-Sep					0	0	29%	0	0	36%	0	0	0	0	0	0	0	0	0	0	no data form, weir pulled
Totals					732	1,789		49	87		2,521	136	2,657	40	1	41	70	16	1	77	

Table 8. Mark and recapture data and estimated escapement of sockeye salmon into Neva Lake, 2008.

		Adults			Jacks			Total Adults and Jacks			
Marking Data:											
Location	Dates	Number Counted	Number Marked (M)	Expected Percent Marked	Number Counted	Number Marked (M)	Expected Percent Marked	Number Counted	Number Marked (M)	Expected Percent Marked	
Weir	16-June to 7-Sep	2,521	732	29%	136	49	36%	2,657	781	29%	
Recapture Data:											
Location	Dates	Number Examined (C)	Number Recaptured (R)	Observed Percent Marked	Number Examined (C)	Number Recaptured (R)	Observed Percent Marked	Number Examined (C)	Number Recaptured (R)	Observed Percent Marked	One-tailed Binomial Test P-value[a]
MIS	16-Aug Live	55	15	27%	2	0	0%	57	15	26%	0.36
MIS	16-Aug Dead	15	4	27%	0	0		15	4	27%	0.54
MIS	26-Aug Live	120	35	29%	0	0		120	35	29%	0.52
MIS	27-Aug Live	285	76	27%	0	0		285	76	27%	0.17
MIS	4-Sep Live	134	40	30%	11	3	27%	145	43	30%	0.57
MIS	4-Sep Dead	23	7	30%	0	0		23	7	30%	0.64
Beach	5-Sep Live	57	17	30%	9	4	44%	66	21	32%	0.72
Beach	26-Sep Live	40	7	18%	2	0	0%	42	7	17%	0.05
	Total	729	201	28%	24	7	29%	753	208	28%	0.15
Peterson Estimate[b]:											
		Number ($\hat{N}$)	S.E.	CV (%)	Number ($\hat{N}$)	S.E.	CV (%)	Number ($\hat{N}$)	S.E.	CV (%)	
		2,655	159	6%	168	50	30%	2,827	166	6%	

[a] A p-value < 0.05 says that there is less than a 5% chance that the observed percent marked equals or exceeds the expected percent marked at the weir, that fish likely passed the weir uncounted, and that the mark-recapture study is needed to estimate the total escapement.

[b] Total escapement = $\hat{N} = M * C / R$

Standard Error = $S.E.(\hat{N}) = \sqrt{(M^2 * C * (C - R)) / (R^2 * (R + 1))}$

Coefficient of Variation = $CV(\%) = (S.E(\hat{N}) / \hat{N}) * 100$

Table 9. Estimated daily escapement of adult and jack sockeye salmon into Neva Lake, June 4 to October 13, 2002 to 2005 and 2008.

	2002			2003			2004			2005			2008		
Date	Adults	Jacks	Total	Adults	Jacks	Total	Adults	Jacks	Total	Adults	Jacks	Total	Adults	Jacks	Total
6/4	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
6/5	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
6/6	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
6/7	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
6/8	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
6/9	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
6/10	1	0	1	0	0	0	0	0	0	0	0	0	0	0	0
6/11	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
6/12	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
6/13	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
6/14	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
6/15	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
6/16	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
6/17	1	0	1	0	0	0	0	0	0	0	0	0	0	0	0
6/18	2	0	2	0	0	0	0	0	0	0	0	0	0	0	0
6/19	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
6/20	1	0	1	0	0	0	0	0	0	0	0	0	0	0	0
6/21	0	0	0	0	0	0	22	0	22	0	0	0	0	0	0
6/22	1	0	1	1	0	1	0	0	0	0	0	0	0	0	0
6/23	1	0	1	4	1	5	0	0	0	0	0	0	0	0	0
6/24	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
6/25	0	0	0	5	1	6	147	2	149	0	0	0	0	0	0
6/26	1	0	1	2	0	2	17	0	17	48	1	49	0	0	0
6/27	62	0	62	0	0	0	22	0	22	18	0	18	0	0	0
6/28	35	0	35	0	0	0	39	1	40	26	1	27	0	0	0
6/29	0	0	0	4	2	6	1	0	1	42	2	44	4	0	4
6/30	31	0	31	1	1	2	4	0	4	61	5	66	0	0	0
7/1	188	0	188	0	0	0	4	0	4	32	2	34	0	0	0
7/2	333	7	340	15	11	26	0	0	0	29	2	31	15	0	15
7/3	203	3	206	29	14	43	77	0	77	56	4	60	11	0	11
7/4	28	0	28	63	36	99	221	4	225	18	5	23	136	1	137
7/5	83	1	84	21	11	32	87	2	89	0	0	0	78	0	78
7/6	12	0	12	2	4	6	62	1	63	0	0	0	150	1	151
7/7	11	3	14	0	3	3	2	0	2	18	0	18	103	8	111
7/8	8	0	8	0	0	0	0	0	0	0	0	0	97	0	97
7/9	18	3	21	0	0	0	0	0	0	22	5	27	53	2	55
7/10	8	0	8	0	0	0	0	0	0	6	3	9	35	3	38
7/11	11	0	11	0	0	0	0	0	0	1	1	2	9	1	10
7/12	9	2	11	0	0	0	0	0	0	60	5	65	18	2	20
7/13	0	4	4	0	0	0	0	0	0	4	0	4	46	2	48
7/14	28	9	37	8	11	19	0	0	0	2	0	2	15	2	17
7/15	22	18	40	1	2	3	0	0	0	2	0	2	0	0	0
7/16	11	10	21	0	0	0	0	0	0	0	0	0	0	0	0
7/17	4	6	10	0	0	0	0	0	0	1165	20	1185	306	7	313
7/18	28	15	43	359	137	496	0	0	0	87	18	105	121	10	131
7/19	35	17	52	225	136	361	0	1	1	74	14	88	137	9	146
7/20	1	4	5	21	24	45	0	0	0	58	3	61	61	5	66
7/21	0	2	2	914	221	1135	0	0	0	49	0	49	22	0	22
7/22	13	18	31	61	31	92	0	2	2	6	1	7	40	0	40
7/23	1	3	4	3	4	7	0	0	0	0	0	0	41	1	42
7/24	190	49	239	0	0	0	0	3	3	10	0	10	74	1	75
7/25	79	24	103	1	0	1	448	26	474	56	1	57	6	2	8
7/26	247	26	273	2	4	6	105	6	111	0	0	0	43	8	51
7/27	81	13	94	1	3	4	23	1	24	230	9	239	25	3	28
7/28	94	16	110	49	18	67	1383	19	1402	141	5	146	14	2	16
7/29	25	14	39	1758	156	1914	254	2	256	35	3	38	15	0	15
7/30	15	8	23	217	14	231	198	1	199	55	2	57	20	0	20
7/31	25	24	49	59	17	76	57	3	60	40	1	41	21	2	23
8/1	49	47	96	122	20	142	33	1	34	52	7	59	13	1	14
8/2	12	13	25	170	22	192	28	1	29	42	5	47	18	5	23
8/3	3	5	8	8	1	9	20	1	21	49	1	50	35	6	41
8/4	3	14	17	4	7	11	4	1	5	92	2	94	11	6	17
8/5	32	32	64	333	34	367	39	5	44	5	0	5	2	2	4
8/6	3	4	7	112	13	125	24	5	29	94	3	97	0	0	0
8/7	10	13	23	71	8	79	6	1	7	67	3	70	0	0	0
8/8	297	64	361	279	32	311	0	0	0	81	3	84	0	0	0
8/9	176	30	206	91	12	103	1	0	1	74	4	78	0	0	0
8/10	92	54	146	4	3	7	504	18	522	33	8	41	0	0	0
8/11	74	42	116	4	0	4	1619	14	1633	30	3	33	0	0	0
8/12	177	29	206	195	29	224	194	3	197	23	2	25	213	3	216
8/13	25	12	37	131	12	143	185	13	198	11	2	13	117	8	125
8/14	26	9	35	580	73	653	94	1	95	40	3	43	119	6	125
8/15	38	42	80	632	84	716	25	1	26	40	2	42	16	0	16
8/16	26	15	41	201	32	233	20	4	24	60	1	61	12	1	13
8/17	33	19	52	67	17	84	38	3	41	0	0	0	7	0	7
8/18	54	20	74	6	2	8	48	5	53	0	0	0	14	0	14
8/19	24	21	45	2	1	3	15	1	16	55	2	57	0	0	0
8/20	22	18	40	3	3	6	60	4	64	65	0	65	0	0	0
8/21	31	25	56	40	8	48	3	1	4	65	0	65	21	6	27

(continued)

Table 9. (page 2 of 2).

	2002			2003			2004			2005			2008		
Date	Adults	Jacks	Total	Adults	Jacks	Total	Adults	Jacks	Total	Adults	Jacks	Total	Adults	Jacks	Total
8/22	54	25	79	58	25	83	21	4	25	131	2	133	7	0	7
8/23	39	8	47	48	19	67	9	2	11	113	11	124	0	0	0
8/24	15	14	29	13	4	17	5	0	5	28	1	29	80	7	87
8/25	20	20	40	47	17	64	2	0	2	0	0	0	27	6	33
8/26	16	11	27	54	13	67	0	2	2	50	2	52	0	0	0
8/27	19	16	35	29	16	45	361	18	379	50	0	50	0	0	0
8/28	28	12	40	36	14	50	128	5	133	85	8	93	36	2	38
8/29	17	10	27	10	5	15	29	1	30	60	1	61	0	0	0
8/30	30	16.5	46.5	524	97	621	10	0	10	47	0	47	28	0	28
8/31	43	23	66	138	35	173	8	1	9	113	7	120	0	0	0
9/1	16	10	26	292	98	390	2	0	2	55	1	56	9	4	13
9/2	45	35	80	514	53	567	0	0	0	27	4	31	7	0	7
9/3	13	14	27	81	28	109	338	10	348	35	1	36	0	0	0
9/4	22	9	31	34	15	49	324	10	334	30	3	33	13	1	14
9/5	18.8	9	27.8	39	18	57	97	7	104	39	0	39	0	0	0
9/6	15.6	9	24.6	41	14	55	81	0	81	89	2	91	0	0	0
9/7	12.4	9	21.4	36	13	49	48	1	49	109	2	111	0	0	0
9/8	9.2	9	18.2	49	20	69	37	0	37	0	0	0	0	0	0
9/9	6	9	15	53	23	76	35	3	38	0	0	0	5.3	1.3	6.6
9/10	28	7	35	21	17	38	23	0	23	190	7	197	12.1	2.9	15.0
9/11	0	5	5	18	7	25	14	0	14	45	1	46	3.7	0.9	4.6
9/12	5	0	5	17	7	24	67	5	72	17	5	22	5.1	1.2	6.3
9/13	4	9	13	62	13	75	444	12	456	46	1	47	24.4	5.8	30.2
9/14	3	0	3	38	10	48	257	5	262	17	0	17	13.6	3.3	16.9
9/15	1	11	12	25	6	31	139	4	143	0	0	0	7.7	1.8	9.5
9/16	9.0	2.8	11.9	7	4	11	47	4	51	0	0	0	3.0	0.7	3.8
9/17	14.3	4.4	18.7	9	7	16	61	0	61	19	2	21	4.8	1.2	6.0
9/18	9.6	3.0	12.6	2	2	4	21	6	27	32	3	35	3.2	0.8	4.0
9/19	8.2	2.5	10.7	3	4	7	31	6	37	12	0	12	2.8	0.7	3.4
9/20	5.4	1.7	7.1	7	6	13	10	2	12	8	4	12	1.8	0.4	2.3
9/21	23.2	7.2	30.4	31	8	39	105	2	107	11	2	13	7.8	1.9	9.7
9/22	18.7	5.8	24.5	14	3	17	72	5	77	34	0	34	6.3	1.5	7.8
9/23	21.6	6.7	28.3	0	2	2	113	1	114	28	4	32	7.3	1.7	9.0
9/24	11.1	3.4	14.5	14	3	17	43	4	47	11	1	12	3.7	0.9	4.6
9/25	26.1	8.1	34.2	139	13	152	13	1	14	10	3	13	8.8	2.1	10.9
9/26	4.0	1.2	5.3	15	1	16	6	0	6	5.3	0.3	5.5	1.4	0.3	1.7
9/27	13.7	4.2	17.9	32	2	34	38	3	41	18.0	0.9	18.9	4.6	1.1	5.7
9/28	3.5	1.1	4.5	13	3	16	3	0	3	4.6	0.2	4.8	1.2	0.3	1.4
9/29	4.7	1.5	6.2	8	4	12	13	1	14	6.2	0.3	6.5	1.6	0.4	2.0
9/30	2.4	0.7	3.1	2	1	3	10	0	10	3.1	0.2	3.3	0.8	0.2	1.0
10/1	1.3	0.4	1.7	2	0	2	5	0	5	1.7	0.1	1.8	0.4	0.1	0.5
10/2	1.6	0.5	2.2	5	0	5	4	0	4	2.2	0.1	2.3	0.6	0.1	0.7
10/3	0.0	0.0	0.0	0	0	0	0	0	0	0.0	0.0	0.0	0.0	0.0	0.0
10/4	1.6	0.5	2.2	2	0	2	6	1	7	2.2	0.1	2.3	0.6	0.1	0.7
10/5	1.3	0.4	1.7	3	0	3	4	0	4	1.7	0.1	1.8	0.4	0.1	0.5
10/6	0.5	0.2	0.7	0	0	0	3	0	3	0.7	0.0	0.8	0.2	0.0	0.2
10/7	0.7	0.2	1.0	0	0	0	3	1	4	1.0	0.0	1.0	0.2	0.1	0.3
10/8	0.4	0.1	0.5	2	0	2	0	0	0	0.5	0.0	0.5	0.1	0.0	0.2
10/9	0.0	0.0	0.0	0	0	0	0	0	0	0.0	0.0	0.0	0.0	0.0	0.0
10/10	0.7	0.2	1.0	0	0	0	4	0	4	1.0	0.0	1.0	0.2	0.1	0.3
10/11	0.0	0.0	0.0	0	0	0	0	0	0	0.0	0.0	0.0	0.0	0.0	0.0
10/12	0.2	0.1	0.2	0	0	0	1	0	1	0.2	0.0	0.3	0.1	0.0	0.1
10/13	0.2	0.1	0.2	0	0	0	1	0	1	0.2	0.0	0.3	0.1	0.0	0.1
Total	**3,818**	**1,185**	**5,003**	**9,468**	**1,925**	**11,393**	**9,229**	**284**	**9,513**	**5,018**	**244**	**5,263**	**2,655**	**168**	**2,823**
Weir Count	3,397	1,074	4,656	9,248	1,851	11,099	9,229	284	9,513	4,970	242	5,212	2,521	136	2,657
Difference	421	111	347	220	74	294	0	0	0	48	2	51	134	32	166

Shaded cells with whole numbers entries are the estimated best guess and shaded cells with values to one decimal place are interpolated (see below).

Notes for 2002:

The 5,003 total is the Pooled Peterson estimate for adults and jacks (CV=5%); one or both tests for complete mixings or equal proportions were NOT significant, this model should be best. The recapture went through Nov 13, which is a month after the last fish was marked at the weir, so this mark-recap. estimate is good for the whole run and the BEST total estimate.

I had previously reported in Van Alen (2004) and Van Alen (2005) that the escapement of sockeye salmon into Neva Lake in 2002 was 53 fish less at 4,951.

The missing values on 8/30 and 9/5-9/8 were linerally interpolated. The EM algorithm was used to fill-in the missing values after 9/15 using the 2002-2005 data block after adjusting the estimated escapement of adults that passed through the weir uncounted on 7/3 (Van Alen 2004) down by 33 fish so the season total equals 5,003.

Notes for 2003:

The total of 11,393 is unchanged from Van Alen (2005). I assume that no sockeye passed after the weir was pulled on 10/9 (the EM Algorithm would have increased this number by 7 fis

Notes for 2004:

Based on early season weir counts, I assume that no sockeye passed before the weir was operational on 6/16. The EM algorithm would have estimated an escapement of one fish.

Notes for 2005:

Based on early season weir counts, I assume that no sockeye passed before the weir was operational on 6/20. The EM algorighm would have estimated an escapement of three fish. The EM algorithm increases the total weir count by 51 fish that probably passed after the weir was pulled on 9/25.

Notes for 2008:

The 2,823 total is the sum of the Peterson mark-recapture estimate of 2,655 adults (SE=159, CV=6%) and 168 jacks (SE=50, CV=30%) which is 4 fish less than the 2,827 pooled adult and jack (SE=167, CV=6%) estimate. This 2,823 total is 166 fish more than the weir count and I assume that these fish passed after the weir was pulled. I used the estimated daily proportions from an all-year EM fill-in to estimate the daily passage of these fish.

Table 10. Estimated cumulative daily escapement of adult and jack sockeye salmon into Neva Lake, June 4 to October 13, 2002 to 2005 and 2008.

Date	2,002	2003	2004	2005	2008	Average
6/4	0.000	0.000	0.000	0.000	0.000	0.000
6/5	0.000	0.000	0.000	0.000	0.000	0.000
6/6	0.000	0.000	0.000	0.000	0.000	0.000
6/7	0.000	0.000	0.000	0.000	0.000	0.000
6/8	0.000	0.000	0.000	0.000	0.000	0.000
6/9	0.000	0.000	0.000	0.000	0.000	0.000
6/10	0.000	0.000	0.000	0.000	0.000	0.000
6/11	0.000	0.000	0.000	0.000	0.000	0.000
6/12	0.000	0.000	0.000	0.000	0.000	0.000
6/13	0.000	0.000	0.000	0.000	0.000	0.000
6/14	0.000	0.000	0.000	0.000	0.000	0.000
6/15	0.000	0.000	0.000	0.000	0.000	0.000
6/16	0.000	0.000	0.000	0.000	0.000	0.000
6/17	0.000	0.000	0.000	0.000	0.000	0.000
6/18	0.001	0.000	0.000	0.000	0.000	0.000
6/19	0.001	0.000	0.000	0.000	0.000	0.000
6/20	0.001	0.000	0.000	0.000	0.000	0.000
6/21	0.001	0.000	0.002	0.000	0.000	0.001
6/22	0.001	0.000	0.002	0.000	0.000	0.001
6/23	0.001	0.001	0.002	0.000	0.000	0.001
6/24	0.001	0.001	0.002	0.000	0.000	0.001
6/25	0.001	0.001	0.018	0.000	0.000	0.004
6/26	0.002	0.001	0.020	0.009	0.000	0.006
6/27	0.014	0.001	0.022	0.013	0.000	0.010
6/28	0.021	0.001	0.026	0.018	0.000	0.013
6/29	0.021	0.002	0.026	0.026	0.001	0.015
6/30	0.027	0.002	0.027	0.039	0.001	0.019
7/1	0.065	0.002	0.027	0.045	0.001	0.028
7/2	0.133	0.004	0.027	0.051	0.007	0.044
7/3	0.174	0.008	0.035	0.063	0.011	0.058
7/4	0.180	0.017	0.059	0.067	0.059	0.076
7/5	0.196	0.019	0.068	0.067	0.087	0.088
7/6	0.199	0.020	0.075	0.067	0.140	0.100
7/7	0.201	0.020	0.075	0.070	0.180	0.109
7/8	0.203	0.020	0.075	0.070	0.214	0.117
7/9	0.207	0.020	0.075	0.075	0.233	0.122
7/10	0.209	0.020	0.075	0.077	0.247	0.126
7/11	0.211	0.020	0.075	0.078	0.250	0.127
7/12	0.213	0.020	0.075	0.090	0.258	0.131
7/13	0.214	0.020	0.075	0.091	0.275	0.135
7/14	0.221	0.022	0.075	0.091	0.281	0.138
7/15	0.229	0.022	0.075	0.091	0.281	0.140
7/16	0.234	0.022	0.075	0.091	0.281	0.141
7/17	0.236	0.022	0.075	0.317	0.391	0.208
7/18	0.244	0.066	0.075	0.337	0.438	0.232
7/19	0.255	0.097	0.075	0.353	0.490	0.254
7/20	0.256	0.101	0.075	0.365	0.513	0.262
7/21	0.256	0.201	0.075	0.374	0.521	0.285
7/22	0.262	0.209	0.075	0.375	0.535	0.291
7/23	0.263	0.210	0.075	0.375	0.550	0.295
7/24	0.311	0.210	0.076	0.377	0.576	0.310
7/25	0.331	0.210	0.126	0.388	0.579	0.327
7/26	0.386	0.210	0.137	0.388	0.597	0.344
7/27	0.405	0.211	0.140	0.434	0.607	0.359
7/28	0.427	0.217	0.287	0.461	0.613	0.401
7/29	0.435	0.385	0.314	0.469	0.618	0.444
7/30	0.439	0.405	0.335	0.479	0.625	0.457
7/31	0.449	0.411	0.341	0.487	0.633	0.464
8/1	0.468	0.424	0.345	0.498	0.638	0.475
8/2	0.473	0.441	0.348	0.507	0.646	0.483
8/3	0.475	0.442	0.350	0.517	0.661	0.489
8/4	0.478	0.443	0.351	0.535	0.667	0.495
8/5	0.491	0.475	0.355	0.536	0.668	0.505

(continued)

Table 10. (page 2 of 2).

Date	2,002	2003	2004	2005	2008	Average
8/6	0.492	0.486	0.358	0.554	0.668	0.512
8/7	0.497	0.493	0.359	0.567	0.668	0.517
8/8	0.569	0.520	0.359	0.583	0.668	0.540
8/9	0.610	0.529	0.359	0.598	0.668	0.553
8/10	0.639	0.530	0.414	0.606	0.668	0.572
8/11	0.663	0.530	0.586	0.612	0.668	0.612
8/12	0.704	0.550	0.606	0.617	0.745	0.644
8/13	0.711	0.562	0.627	0.619	0.789	0.662
8/14	0.718	0.620	0.637	0.628	0.834	0.687
8/15	0.734	0.682	0.640	0.636	0.839	0.706
8/16	0.742	0.703	0.642	0.647	0.844	0.716
8/17	0.753	0.710	0.647	0.647	0.846	0.721
8/18	0.768	0.711	0.652	0.647	0.851	0.726
8/19	0.777	0.711	0.654	0.658	0.851	0.730
8/20	0.785	0.712	0.661	0.670	0.851	0.736
8/21	0.796	0.716	0.661	0.683	0.861	0.743
8/22	0.812	0.723	0.664	0.708	0.863	0.754
8/23	0.821	0.729	0.665	0.732	0.863	0.762
8/24	0.827	0.731	0.666	0.737	0.894	0.771
8/25	0.835	0.736	0.666	0.737	0.906	0.776
8/26	0.840	0.742	0.666	0.747	0.906	0.780
8/27	0.847	0.746	0.706	0.756	0.906	0.792
8/28	0.855	0.750	0.720	0.774	0.919	0.804
8/29	0.861	0.752	0.723	0.786	0.919	0.808
8/30	0.870	0.806	0.724	0.795	0.929	0.825
8/31	0.883	0.821	0.725	0.817	0.929	0.835
9/1	0.888	0.856	0.725	0.828	0.934	0.846
9/2	0.904	0.905	0.725	0.834	0.936	0.861
9/3	0.910	0.915	0.762	0.841	0.936	0.873
9/4	0.916	0.919	0.797	0.847	0.941	0.884
9/5	0.921	0.924	0.808	0.854	0.941	0.890
9/6	0.926	0.929	0.816	0.872	0.941	0.897
9/7	0.931	0.933	0.821	0.893	0.941	0.904
9/8	0.934	0.939	0.825	0.893	0.941	0.907
9/9	0.937	0.946	0.829	0.893	0.944	0.910
9/10	0.944	0.949	0.832	0.930	0.949	0.921
9/11	0.945	0.952	0.833	0.939	0.950	0.924
9/12	0.946	0.954	0.841	0.943	0.953	0.927
9/13	0.949	0.960	0.889	0.952	0.963	0.943
9/14	0.949	0.965	0.916	0.955	0.969	0.951
9/15	0.952	0.967	0.931	0.955	0.973	0.956
9/16	0.954	0.968	0.937	0.955	0.974	0.958
9/17	0.958	0.970	0.943	0.959	0.976	0.961
9/18	0.960	0.970	0.946	0.966	0.978	0.964
9/19	0.963	0.971	0.950	0.968	0.979	0.966
9/20	0.964	0.972	0.951	0.971	0.980	0.967
9/21	0.970	0.975	0.962	0.973	0.983	0.973
9/22	0.975	0.977	0.970	0.980	0.986	0.977
9/23	0.981	0.977	0.982	0.986	0.989	0.983
9/24	0.983	0.978	0.987	0.988	0.991	0.986
9/25	0.990	0.992	0.989	0.990	0.995	0.991
9/26	0.991	0.993	0.989	0.991	0.995	0.992
9/27	0.995	0.996	0.994	0.995	0.997	0.995
9/28	0.996	0.997	0.994	0.996	0.998	0.996
9/29	0.997	0.999	0.995	0.997	0.998	0.997
9/30	0.998	0.999	0.997	0.998	0.999	0.998
10/1	0.998	0.999	0.997	0.998	0.999	0.998
10/2	0.999	0.999	0.997	0.999	0.999	0.999
10/3	0.999	0.999	0.997	0.999	0.999	0.999
10/4	0.999	1.000	0.998	0.999	0.999	0.999
10/5	0.999	1.000	0.999	0.999	1.000	0.999
10/6	0.999	1.000	0.999	0.999	1.000	0.999
10/7	1.000	1.000	0.999	1.000	1.000	1.000
10/8	1.000	1.000	0.999	1.000	1.000	1.000
10/9	1.000	1.000	0.999	1.000	1.000	1.000
10/10	1.000	1.000	1.000	1.000	1.000	1.000
10/11	1.000	1.000	1.000	1.000	1.000	1.000
10/12	1.000	1.000	1.000	1.000	1.000	1.000
10/13	1.000	1.000	1.000	1.000	1.000	1.000

The boxes and lines delineate the median, second and third quartiles, and 80% fish passage dates.

Age, Sex, and Length Composition

In 2006, based on a sample of 205 fish with ageable scales, 70 percent of the Neva sockeye escapement were age-1.-, fish and 30 percent were age-2.- (Table 11). Age-1.2 fish comprised 19%, age-1.3 fish comprised 51%, and age-2.2 fish comprised 28%. There were no jacks (age-.1) sampled. The sex composition was 54% males. The average mid-eye-to-fork length was 515 mm for the age-1.2 fish, 548 mm for the age-1.3 fish, and 510 for the age-2.2 fish (Table 11).

Table 11. Age and length composition, by sex, of sockeye salmon in the Neva Lake escapement, 2006.

	Brood Year and Age Class				
	2002	2001	2000	1999	
	1.2	1.3	2.2	2.3	Total
Male					
Sample Size	20	62	26	2	110
Percent	9.8%	30.2%	12.7%	1.0%	53.7%
SE	2.1%	3.2%	2.3%	0.7%	3.5%
Ave. Length	514	556	519	540	539
SE	7.4	2.8	6.4	20.0	3.1
Female					
Sample Size	19	42	32	2	95
Percent	9.3%	20.5%	15.6%	1.0%	46.3%
SE	2.0%	2.8%	2.5%	0.7%	3.5%
Ave. Length	516	536	503	540	521
SE	6.6	4.5	4.4	0.0	3.2
All Fish					
Sample Size	39	104	58	4	205
Percent	19.0%	50.7%	28.3%	2.0%	100.0%
SE	2.7%	3.5%	3.2%	1.0%	
Ave. Length	515	548	510	540	530
SE	4.9	2.6	3.9	8.2	2.3

In 2007, based on a sample of 115 fish with ageable scales, 87 percent of the Neva sockeye escapement were age-1.- fish (Table 12). Jacks aged-1.1 and 2.1 comprised 21%, age-1.2 61%, and age-1.3 16%. The sex composition was 60% males. The average mid-eye-to-fork length was 350 mm for the age-1.1 fish, 508 mm for the age-1.2 fish, and 565 mm for the age-1.3 fish (Table 12).

Table 12. Age and length composition, by sex, of sockeye salmon in the Neva Lake escapement, 2007.

	Brood Year and Age Class					
	2004	2003	2002	2003	2001	
	1.1	1.2	1.3	2.1	2.3	Total
Male						
Sample Size	17	34	8	7	3	69
Percent	14.8%	29.6%	7.0%	6.1%	2.6%	60.0%
SE	3.3%	4.3%	2.4%	2.2%	1.5%	4.6%
Ave. Length	350	506	570	372	578	464
SE	3.1	4.6	4.2	9.0	13.0	10.3
Female						
Sample Size		36	10			46
Percent		31.3%	8.7%			40.0%
SE		4.3%	2.6%			4.6%
Ave. Length		510	561			521
SE		3.6	4.0			4.3
All Fish						
Sample Size	17	70	18	7	3	115
Percent	14.8%	60.9%	15.7%	6.1%	2.6%	100.0%
SE	3.3%	4.6%	3.4%	2.2%	1.5%	
Ave. Length	350	508	565	372	578	487
SE	3.1	2.9	3.0	9.0	13.0	6.9

In 2008, based on a sample of 360 fish with ageable scales, 89 percent of the Neva sockeye escapement were age-1.-, fish (Table 13). Jacks aged-1.1 and 2.1 comprised 9%, age-1.2 58%, and age-1.3 25%. The sex composition was 53% males. The average mid-eye-to-fork length was 375 mm for the age-1.1 fish, 496 mm for the age-1.2 fish, and 562 mm for the age-1.3 fish (Table 13).

Table 13. Age and length composition, by sex, of sockeye salmon in the Neva Lake escapement, 2008.

	Brood Year and Age Class							
	2005	2004	2003	2002	2004	2003	2002	
	1.1	1.2	1.3	1.4	2.1	2.2	2.3	Total
Male								
Sample Size	21	107	38		12	14		192
Percent	5.8%	29.7%	10.6%		3.3%	3.9%		53.3%
SE	1.2%	2.4%	1.6%		0.9%	1.0%		2.6%
Ave. Length	375	499	567		406	496		492
SE	12.5	3.4	4.5		14.2	9.2		4.9
Female								
Sample Size		102	51	1		11	3	168
Percent		28.3%	14.2%	0.3%		3.1%	0.8%	46.7%
SE		2.4%	1.8%	0.3%		0.9%	0.5%	2.6%
Ave. Length		493	557	520		503	528	514
SE		3.2	3.5					3.2
All Fish								
Sample Size	21	209	89	1	12	25	3	360
Percent	5.8%	58.1%	24.7%	0.3%	3.3%	6.9%	0.8%	100.0%
SE	1.2%	2.6%	2.3%	0.3%	0.9%	1.3%	0.5%	
Ave. Length	375	496	562	520	406	499	528	503
SE	12.5	2.3	2.8		14.2	5.4	21.3	3.1

Looking at age compositions from 2002 to 2008, we see that age-1.- fish have dominated the escapements (Table 14) with age-1.2 and 1.3 fish usually the most abundant. However, age-2.- fish were 15% of the escapement in 2005 and 30% of the escapement in 2006. The relatively high proportion of age-.1 fish in 2002 and 2003 contributed to the higher proportions of two-ocean fish and three-ocean fish in subsequent years. When the age-.1 fish are most abundant the age-2. fish are least abundant.

Table 14. Age composition of the sockeye salmon escapement into Neva Lake, 2002 through 2008.

		Age								
Year	Sample Size	0.1	1.1	1.2	2.1	1.3	2.2	1.4	2.3	Total
2002	606	0%	22%	45%	0%	28%	4%	0%	0%	100%
2003	1,054		20%	71%	2%	5%	2%		1%	100%
2004	480		10%	70%	0%	16%	4%			100%
2005	444		3%	43%	2%	40%	11%		2%	100%
2006	205			19%		51%	28%		2%	100%
2007	115		15%	61%	6%	16%			3%	100%
2008	360		6%	58%	3%	25%	7%	0%	1%	100%

Stream Temperature and Depth

In the main inlet stream, the average June through September stream temperature varied from a high of 9.15°C in 2004 to a low of 6.33°C in 2008 (Figure 10). Likewise, at the

lake outlet, the average June through September temperatures ranged from a high of 16.51°C in 2004 to a low of 12.81°C in 2008 (Figure 11).

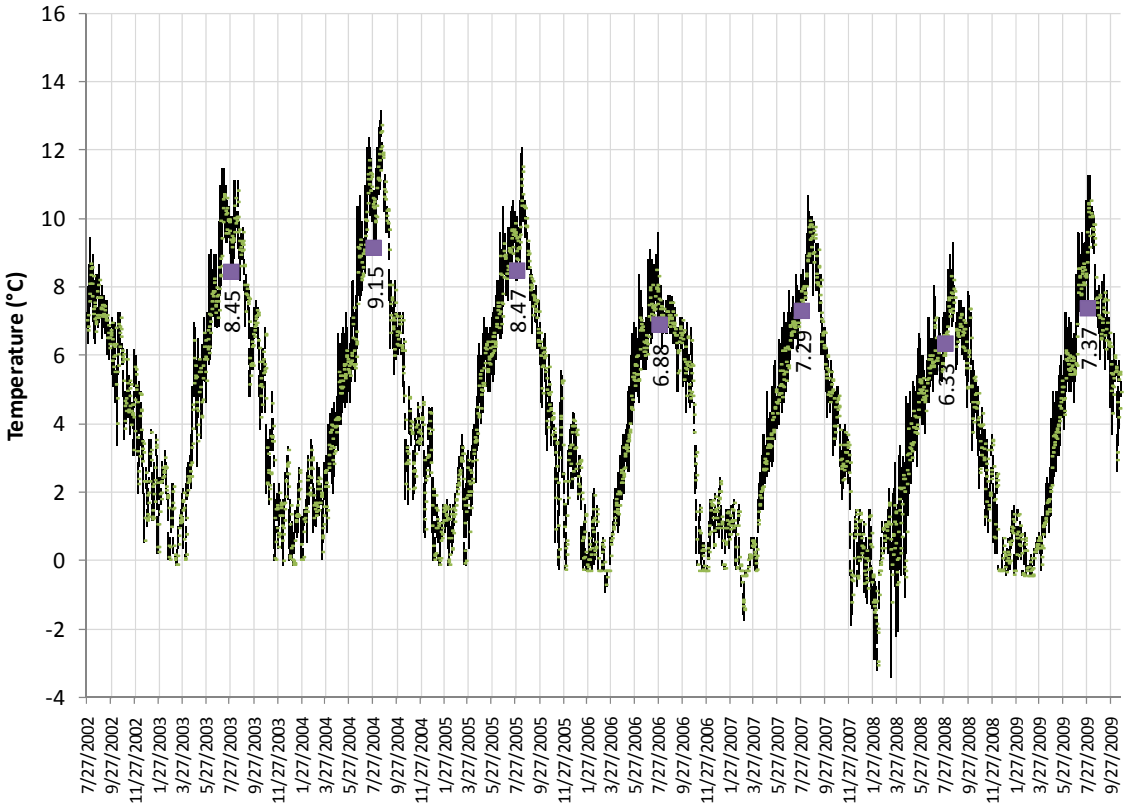

Figure 10. Average daily temperatures (°C w/ max and min range), and average June through September temperatures, in Neva Lake's main inlet stream, July 27, 2002 to October 21, 2009.

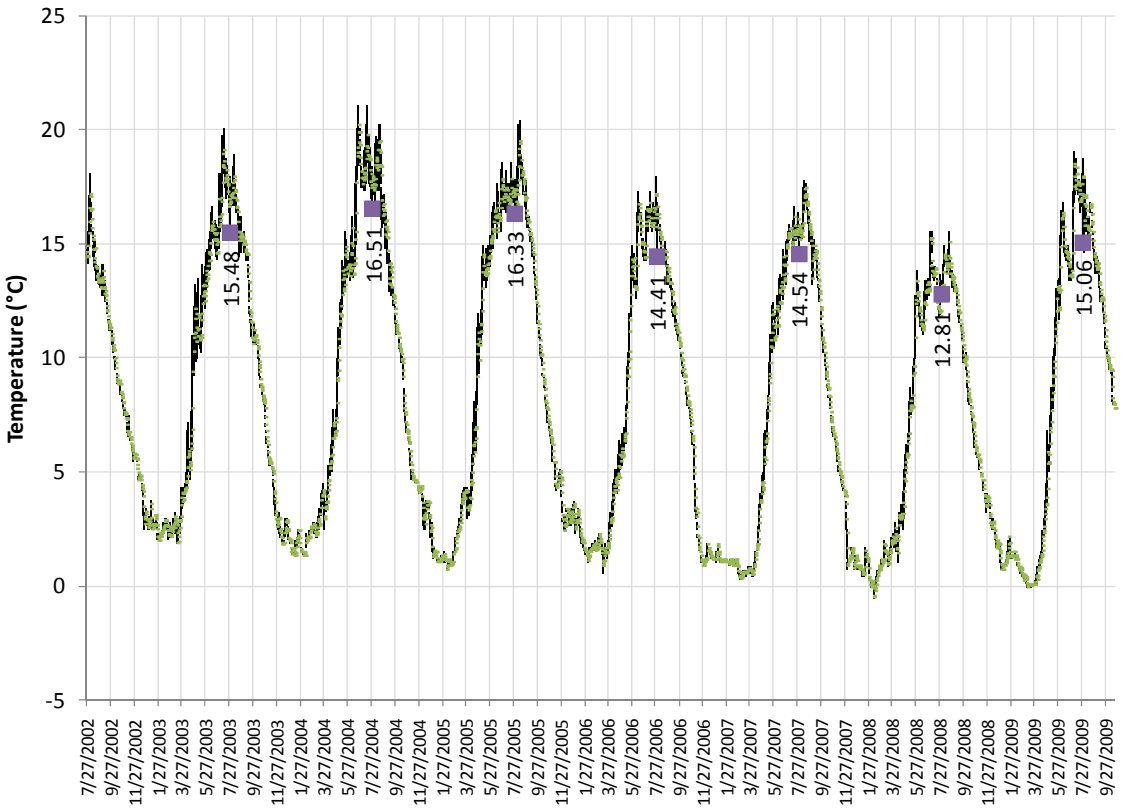

Figure 11. Average daily temperatures (°C w/ max and min range), and average June through September temperatures, at the outlet of Neva Lake, July 27, 2002 to October 21, 2009.

During the summer months, the depth and temperature data loggers recorded the highest water temperatures when the water depths were the lowest in both the main inlet stream (Figure 12) and the outlet (Figure 13). The barometric pressure-calibrated readings from these depth/temperature data loggers are charted for the main inlet stream for the period from June 13, 2006 to April 21, 2008 (Figure 12). The barometric pressure-calibrated readings from the outlet data logger are plotted from June 13, 2006 to October 21, 2009 (Figure 13). The readings between April 21, 2008 and September 26, 2008 were downloaded from both loggers but lost during a computer upgrade. On October 21, 2009, I was able to download the logger in the outlet but unable to find the logger in the main inlet stream. Over time the stream has eroded the stream bed behind the logger and filled-in the stream bed over the logger. Hopefully, the logger is still in the standpipe at this location but a more extensive search, possibly with a metal detector, will be needed to recover it if it is still there.

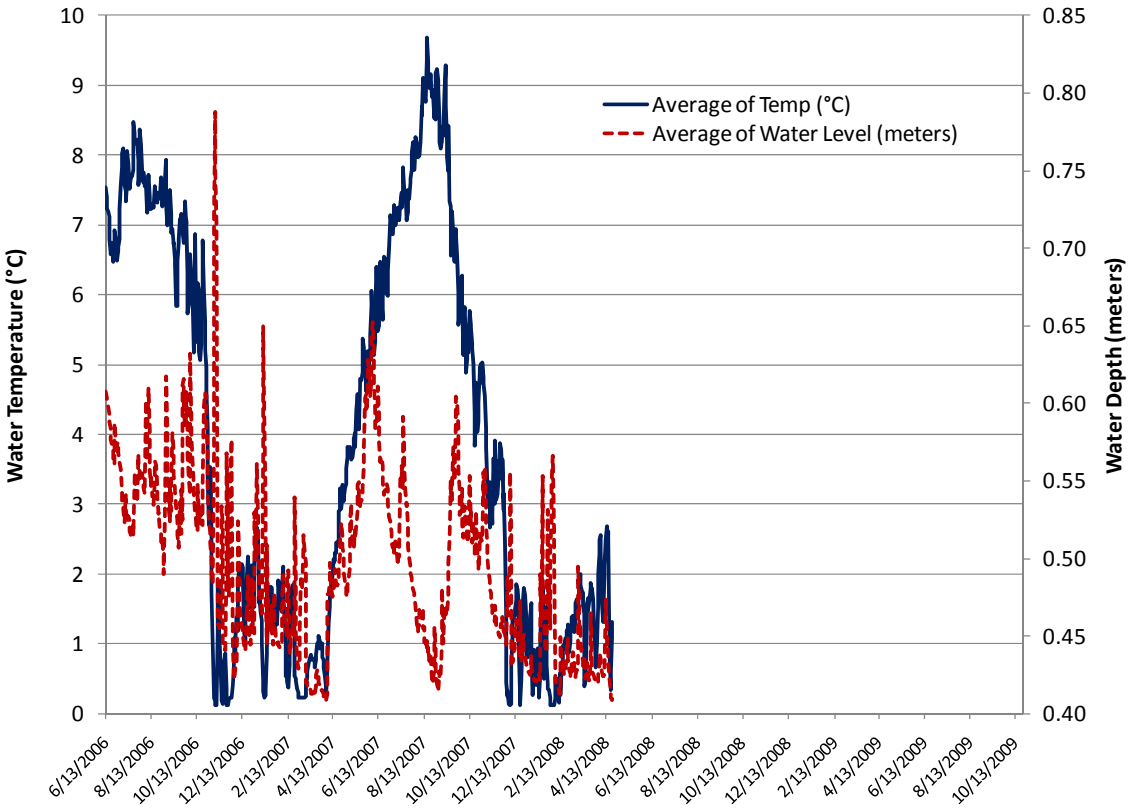

Figure 12. Temperature and depth of Neva Lake's main inlet stream, June 13, 2006 to April 21, 2008.

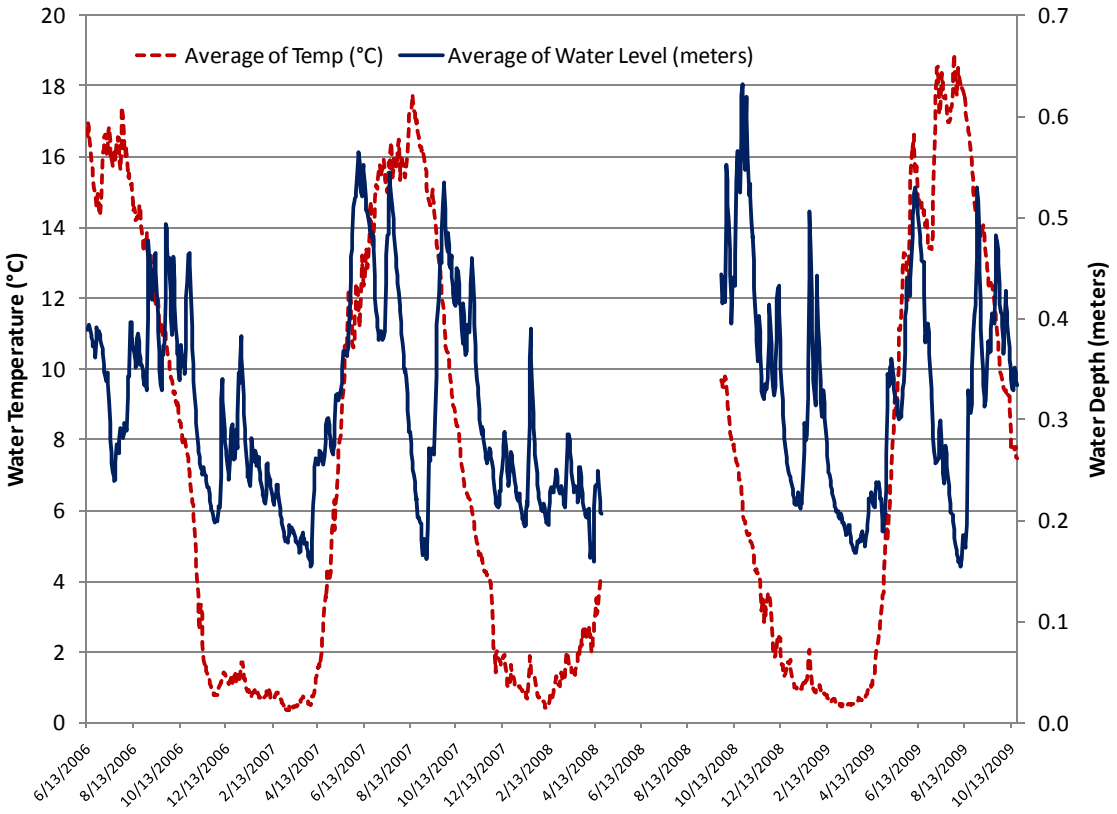

Figure 13. Temperature and depth at the outlet of Neva Lake, June 13, 2006 to October 21, 2009.

DISCUSSION

The Neva sockeye run has been larger than expected for such a small 36.1 ha lake with escapements of 5,003 in 2002, 11,393 in 2003, 9,513 in 2004, 5,263 in 2005, 5,931 in 2006, 5,993 in 2007, and 2,823 in 2008. Factors reflecting the health of the run includes the prolonged, late-June to early-October, duration of the escapement into the lake, and the healthy mix of early-running inlet stream spawning and of late-running lake spawning populations. The increased proportion of age-2.- fish in the past four years suggests that the parent year escapements, and resultant fry production, was pushing the lake's capacity for juveniles to attain the threshold size to smolt after their first year of rearing in the lake. The distribution of ocean age-.1, .2, and .3 fish in the escapements promotes, and reflects, the viability of the stock.

Alaska Department of Fish and Game managers recognized the good health of the Neva sockeye run and increased daily and annual subsistence/personal use harvest limits from 10 fish in 2002 to 25 fish in 2003 and then to 40 fish in 2004. Subsistence fishing was also extended through August 15 in 2004 from the June 1 to July 31 season dates provided in past years. This liberalization in harvest limits and season, and the issuance of Federal subsistence salmon fishing permits in 2003, has resulted in an increasing trend

in subsistence fishing effort (Figure 3). The greater the effort, and harvest, the more important this stock status and trend project information will be.

The migration of sockeye salmon into the lake is timed with increases in stream flow (Van Alen 2008a) and, during the summer/fall migration period, the water levels tended to decline into September and water temperatures were the highest when the water was the lowest (Figures 12 and 13). Shallow, warm, poorly oxygenated water contributed to the die-off of the 130 adult sockeye salmon observed in Neva Creek on August 13, 2004 and 100 or more sockeye salmon on August 14 and 15, 2005 (Van Alen 2008a). Die-offs of migrating, unspawned, sockeye salmon were not observed in 2006, 2007, or 2008 possibly because stream temperatures were cooler (Figures 10 and 11). Nevertheless, average daily outlet stream temperatures often exceed 15°C in June, July, and August in all years but 2008 (Figure 11). Bjornn and Reiser (1991) reported that the preferred migration temperatures for sockeye salmon are between 7.2 and 15.6 °C. McCullough (1999) reported the upper thermal tolerance for spawning sockeye salmon to be 14.4 to 16.1 °C. The water temperatures in the main inlet stream never averaged more than 13°C (Figure 10) but tended to be highest in August and September when the water was the lowest and the sockeye salmon were actively spawning or trying to spawn.

The watershed is relatively undeveloped but the fish processing plant's diversion of water out of the main inlet stream might exacerbate low flow conditions, and migration delays and fish die-offs, during summers with little snow pack and precipitation. Beginning in 2005, the fish processing plant's diversion of water out of Neva Lake's main inlet stream was moderated following renewal of the plant's water right by the State of Alaska, Department of Natural Resources.

CONCLUSIONS

1. Sockeye salmon runs to Neva Lake has long been an important subsistence resource for Tlingit families living in Hoonah and other areas of northern Southeast Alaska.

2. This report summarizes the sockeye stock assessment project findings from a cooperative Hoonah Indian Association, Alaska Department of Fish and Game, and Forest Service study. This project used a weir and mark-recapture methods to estimate the sockeye escapement into Neva Lake in 2006, 2007, and 2008. Age, sex, and length data was also collected to help assess stock status. This is the final report for Fisheries Resource Monitoring Program study 06-601. Reports summarizing project findings for 2002 to 2005 are reported in Van Alen 2004, 2005, and 2008.

3. The escapement of sockeye salmon into Neva Lake was 5,931 (CV=3%) fish in 2006, 5,993 (CV=5%) in 2007, and 2,823 (CV=7%) in 2008 based on weir counts and mark-recapture data. For comparison, the sockeye escapements were estimated to be 5,003, 11,393, 9,513, and 5,263 in 2002, 2003, 2004, and 2005.

4. Averaged from 2002 to 2008, the midpoint of the run was August 5 and 80% of the run passes between July 5 and September 8.

5. The early running sockeye spawn in the main inlet stream in August and September and the later running fish spawn in the lake in October and November.

6. Age-1. fish have dominated the escapements but the increased proportion of age-2.- fish the last four years suggests that some juveniles were not attaining the threshold size to smolt after a year rearing in the lake because parent year escapements were meeting and exceeding the lake's rearing capacity for sockeye juveniles.

7. There has been an increase in subsistence effort on Neva sockeye salmon in recent years and the number of permits fished and sockeye harvest in 2008 was the highest on record. There will be an increased need to monitor and maintain the distribution and abundance of escapements if subsistence, sport, or commercial harvests increase.

8. The migration and spawning success of Neva sockeye would be compromised if the fish processing plant taps too much water out of Neva Lake's main inlet stream during low flow periods in July, August, and September.

RECOMMENDATIONS

I recommend using an underwater video system to count the escapement of salmon into Neva Lake in future years (see Appendix F in Van Alen 2008b). The extended timing of the migration of sockeye salmon into Neva Lake and the extended timing of their spawning in the main inlet stream and lake makes it difficult to assess annual escapements without the aid of a weir project (Van Alen 2008a). Using the weir as a platform to trap, mark, and count upstream migrants works well but the natural upstream migration of salmon is disrupted to some degree by the weir and our handling of the fish. Most salmon seek to migrate upstream from dusk to dawn and we only pass fish between dawn and dusk. On occasion, when there is a "push" of fish at the weir, they could be efficiently counted through pulled pickets but most fish are passed upstream out of the weir trap which they had entered hours before. During high potential fish migration periods the weir crew must close the trap at night to reduce the risk of fish overcrowding and dying in the trap. It is likely that some fish try for days to migrate through the weir.

Predators like bears, wolves, otters, and eagles are attracted to the concentration of fish below the weir. The weir-related delays in migration of salmon into the lake might also make them more vulnerable to subsistence or sport fishers. Weir-related delays in migration increases their risk of injury or death from low water, warm water, and poorly oxygenated water. These conditions often exist during low flow periods during the summer.

Motion-detected video of the fish swimming into Neva Lake could be obtained when the fish swim, on their own, past video cameras. Picket weirs could be used to funnel the fish past cameras mounted in video chutes. Escapement counts would be validated if they were the same between independent weir/camera locations. The only fish that would need to be physically handled would be the fish sampled for age, sex, size, and genetic data.

Weir operations would be smoother and more reliable if project personnel lived on-site instead of commuting back-and-forth from their accommodations in Excursion Inlet. This would be best accomplished by housing the crew on a floating wall tent anchored off the outlet of Neva Lake. A floating wall tent camp worked well for the salmon stock assessment projects at Pavlof Lake (Van Alen 2004) and Kook Lake (Van Alen 2008b).

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