State of Alaska
Department of Fish and Game
Division of Sport Fish

Nomination Form
Anadromous Waters Catalog

X

Region: Southeast (Region I)

USGS Quad(s): JUNB5

Anadromous Waters Catalog Number of Waterway: 114-80-10450-2004

Name of Waterway: Main Inlet Stream of Neva Lake

☐ USGS Name ☒ Local Name

☑ Addition ☐ Deletion ☐ Correction ☐ Backup Information

For Office Use

Nomination #	10-749		
Revision Year:	2011	Fisheries Scientist	10/26/10 Date
Revision to:	Atlas ____ Catalog ____ Both X	Habitat Operations Manager	10/26/10 Date
		AWC Project Biologist	7 Sept 10 Date
Revision Code:	B-1, A-1	Cartographer	11/12/10 Date

OBSERVATION INFORMATION

Species	Date(s) Observed	Spawning	Rearing	Present	Anadromous
Sockeye Salmon	2007, 2008	✓		✓	✓
Coho Salmon	2006, 2007, 2008			✓	✓
Chum Salmon	2007, 2008			✓	✓
Pink Salmon	2007, 2008				

IMPORTANT: Provide all supporting documentation that this water body is important for the spawning, rearing or migration of anadromous fish, including: number of fish and life stages observed; sampling methods, sampling duration and area sampled; copies of field notes; etc. Attach a copy of a map showing location of mouth and observed upper extent of each species, as well as other information such as: specific stream reaches observed as spawning or rearing habitat; locations, types, and heights of any barriers; etc.

Comments: This nomination is for the inclusion of the main inlet stream of Neva Lake in the Anadromous Waters Catalog. The US Forest Service, Hoonah Indian Association, and the Alaska Department of Fish and Game are cooperating on a sockeye salmon escapement monitoring project at the outlet of Neva Lake, where sockeye salmon pass to spawn either in the lake (the lifestage code should be changed for this lake) or in the main inlet stream. (Refer nom # 10-750)

Name of Observer (please print): Benjamin W. Van Alen

Signature: Benjamin W. Van Alen

Date: 8/30/2010

Agency: US Forest Service

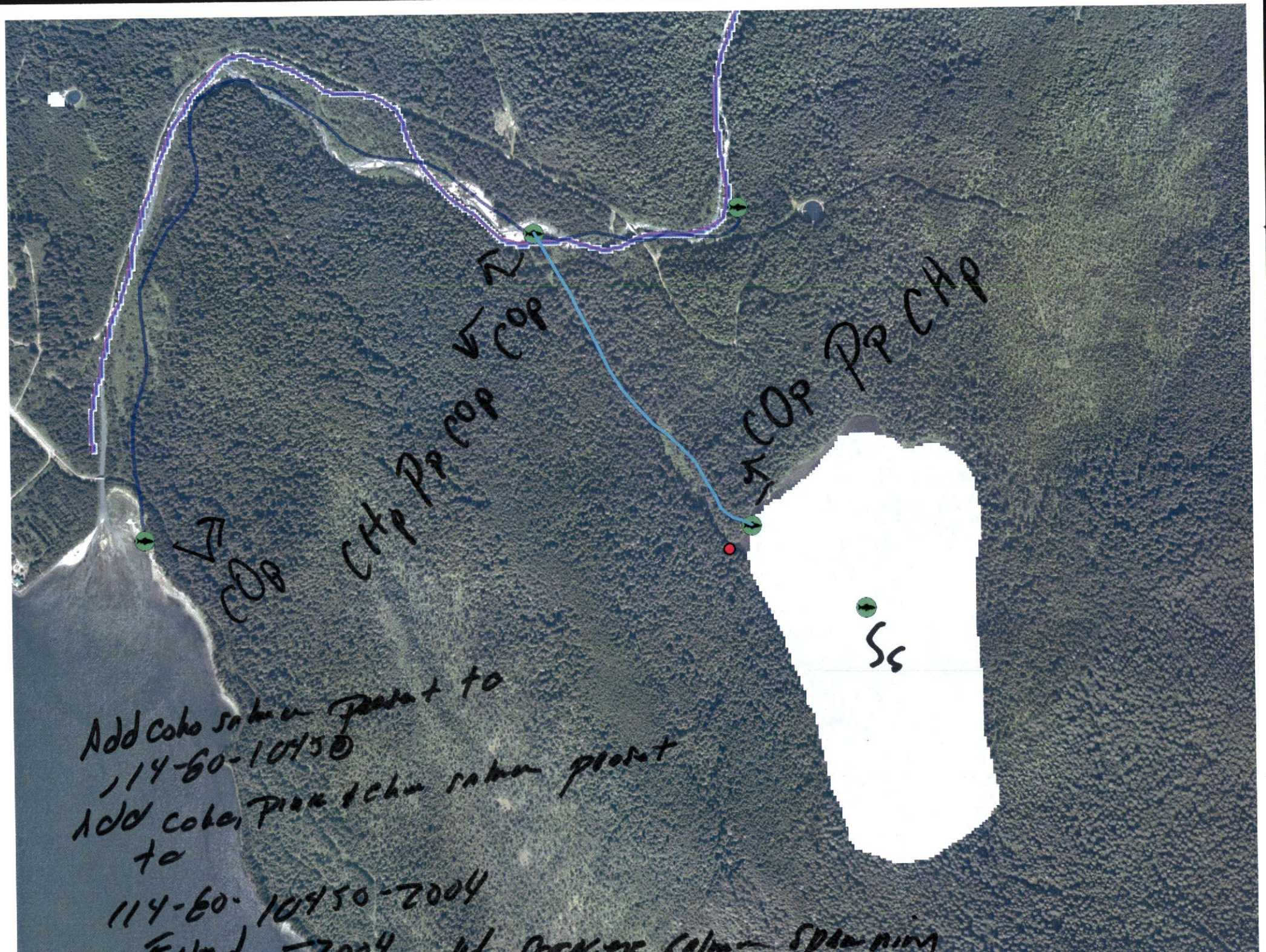
Address: 8510 Mendenhall Loop Road
Juneau, AK 99801

This certifies that in my best professional judgment and belief the above information is evidence that this waterbody should be included in or deleted from the Anadromous Waters Catalog.

Signature of Area Biologist: _____ Date: _____ Revision

02/08

Extend 114-80-10450-2004 w/ Sockeye Salmon spawning
~~Change~~ Add coho salmon present to 114-80-10450-
Add coho, pink, and chum salmon present to 114-80-10450-2004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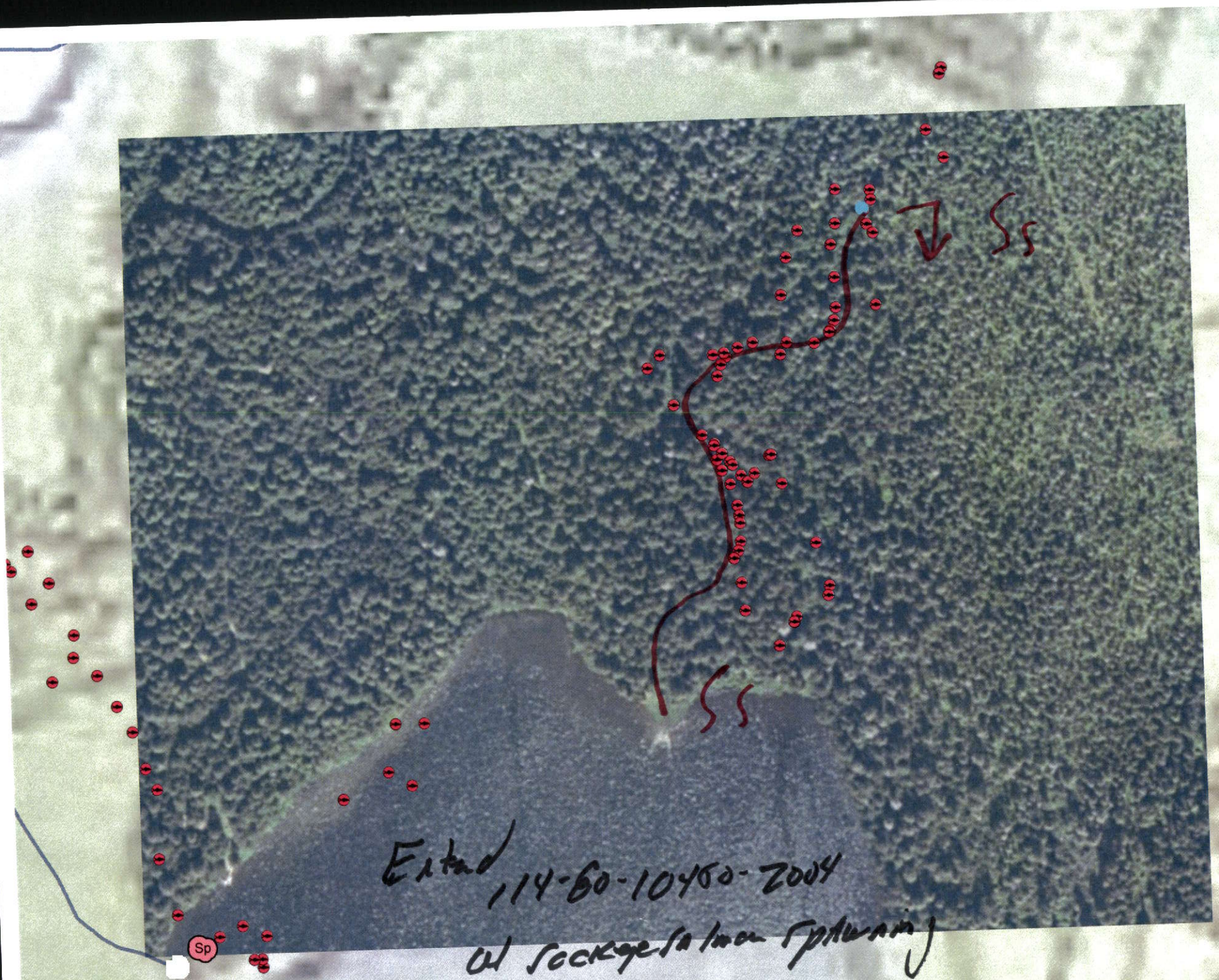


Extend 114-60-10460-2004
w/ sockeye salmon spawning

TO: J. Johnson, ADF & G Sport Fish Division Regional Office

FROM: Carol Mahara, USFS Subsistence Fisheries

DATE: August 30, 2010

SUBJECT: Anadromous Waters Catalog nominations

This nomination is for the inclusion of the main inlet stream of Neva Lake to the Anadromous Waters Catalog and for the update to the sockeye salmon life stage observation to include spawning for Neva Lake. The US Forest Service, Hoonah Indian Association, and the Alaska Department of Fish and Game have cooperated on a weir/mark-recapture project to estimate the annual escapement of sockeye salmon into Neva Lake. There are two main populations of sockeye salmon that enter the lake – an earlier running population that spawns in the main inlet stream and a latter running population of beach spawners.

Included are two topographic maps showing Neva Lake with the stream in question marked in pink. There is also a computer drawing showing the path recorded by Ben VanAlen's (USFS) GPS as he inspected the inlet stream.

Also included are the final reports from the cooperative stock assessment studies at Neva Lake. These reports provide detailed information about the project and explain the numbers of fish observed and the methods used to observe them. These reports also describe sockeye observations at the main inlet stream, and one report (Van Alen 2009) provides an image from a fish video clip of a sockeye salmon entering the stream (Figure 9, Page 10).

From June 4 to September 15, 2002, a total of 4,471 sockeye salmon (3,397 adults and 1,074 jacks) were physically counted at the weir on the outlet of Neva Lake. Of those fish counted, approximately 51% were marked with fin clips. On five occasions, sockeye salmon were examined for these marks in the main inlet stream and on four occasions in the beach spawning area. A total of 133 marked adults and 39 marked jacks were recovered during these sampling efforts, which allows for a combined escapement estimate of 4,951 sockeye salmon into Neva Lake (Van Alen 2004).

In 2003, the weir count totaled 11,099 sockeye salmon (9,248 adults and 1,851 jacks) from June 4 to October 9. Approximately 50% of the fish passed through the weir were marked with fin clips. Salmon were sampled for these clips in the main inlet stream on 14 occasions and in the beach index area on eight occasions. Of the fish sampled during these efforts, 669 fish in the main inlet stream and 739 fish from the beach spawning area (1,408 fish total) had fin clips from the weir. The optimum model for estimating escapement provides an estimate of 2,855 main inlet stream spawners and 8,538 beach spawners, for a total escapement of 11,393 sockeye salmon into the Neva Lake system (Van Alen 2005).

From June 16 to October 13, 2005, a total of 5,212 sockeye salmon (9,229 adults and 284 jacks) were counted at the weir. Of these fish, 22 percent of the adults and 28 percent of the jacks were marked

with fin clips throughout the season. Because of limited funds, there was only one spawning area recapture trip in 2005. During this trip, 19 percent of the adults (63 of 326) and 30 percent of the jacks (3 of 10) were found to have marks from the weir. This mark/recapture study allowed for an escapement estimate of 9,239 adult sockeye salmon, which is only 10 fish greater than the weir count. There was a greater difference between the weir counts and the estimated escapement for jack sockeye salmon (284 passed at the weir and 408 estimated using a Pooled Peterson estimate), but too few jacks were recaptured to be confident that they undercounted at the weir (Van Alen 2008).

The adult salmon weir was in place from June 13 to September 27, 2006. During this time, 3,454 sockeye salmon (3,221 adults and 233 jacks) were physically counted at the weir. Of these fish passed, 97% (3,352) were marked with fin clips. Adult and jack sockeye salmon were sampled for these marks on four occasions in the main inlet stream and on eight occasions on the beach spawning area. During these sampling efforts, 386 marked fish were recovered, which allowed for a total escapement estimate of 5,931 fish into Neva Lake (Van Alen 2009).

In 2007, the weir was in place from June 16 to October 8. During this time, 4,465 sockeye salmon (3754 adults and 711 jacks) were physically counted at the weir. Of these fish passed at the weir, 56% (2,521) were marked with fin clips. Salmon were sampled for these marks on four occasions in the main inlet stream and on three occasions in the beach spawning areas. A total of 220 marked fish were recovered during the recapture efforts. Using the pooled Peterson estimator, approximately 5,993 escaped into Neva Lake, which is 1,528 fish higher than the weir count (Van Alen 2009).

From June 16 to September 8, 2008, a total of 2,657 sockeye salmon (2,521 adults and 136 jacks) were physically counted at the weir. Project personnel adipose-clipped 29% (732) of the adult salmon and 36% (49) of the jacks passed at the weir. An underwater video camera was also installed to sample for marks on salmon entering the main inlet stream on August 26 and 27. Of the 732 fish marked at the weir, 201 were recovered during the sampling efforts. This mark/recapture effort provided an escapement estimate of 2,823 sockeye salmon into Neva Lake, which is 166 fish higher than the weir count (Van Alen 2009).

Attachments:

Nomination Forms for both the main inlet stream and Neva Lake

Topographic map from the Anadromous Waters Atlas on the ADF&G Sport Fish webpage

Topographic map showing Neva Lake

Computer drawing of a GPS route along the main inlet stream

The following four literatures cited:

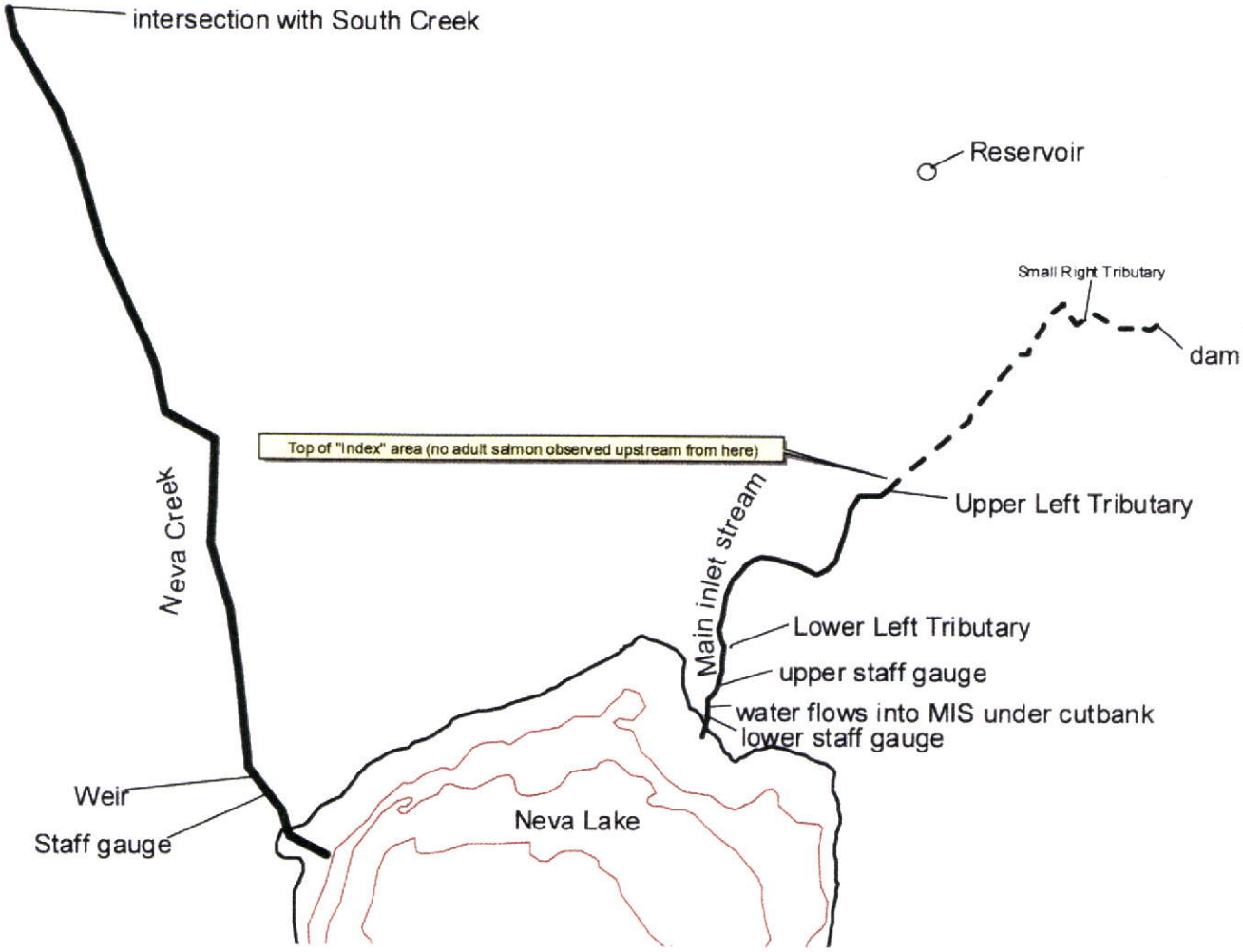
Van Alen, B.W. 2004. Neva, Pavlof, and Hoktaheen sockeye salmon stock assessment, 2002. Federal Subsistence Fishery Monitoring Program, Annual Project Report No. FIS 02-012-1. U.S. Fish and Wildlife Service, Office of Subsistence Management, Fishery Information Services Division, Anchorage, Alaska.

Van Alen, B.W. 2005. Neva, Pavlof, and Hoktaheen sockeye salmon stock assessment, 2003. Federal Subsistence Fishery Monitoring Program, Annual Project Report No. FIS 02-012-2. U.S. Fish and Wildlife Service, Office of Subsistence Management, Fishery Information Services Division, Anchorage, Alaska.

Van Alen, B.W. 2008. Neva, Pavlof, and Hoktaheen sockeye salmon stock assessment; 2002 to 2005. U.S. Fish and Wildlife Service, Office of Subsistence Management, Fishery Resource Monitoring Program, Final Report Study No. 02-012. Anchorage, Alaska.

Van Alen, B.W. 2009. Neva sockeye stock assessment; 2006 to 2008. U.S. Fish and Wildlife Service, Office of Subsistence Management, Fishery Resource Monitoring Program, Final Report Study No. 06-601. Anchorage Alaska.

Neva



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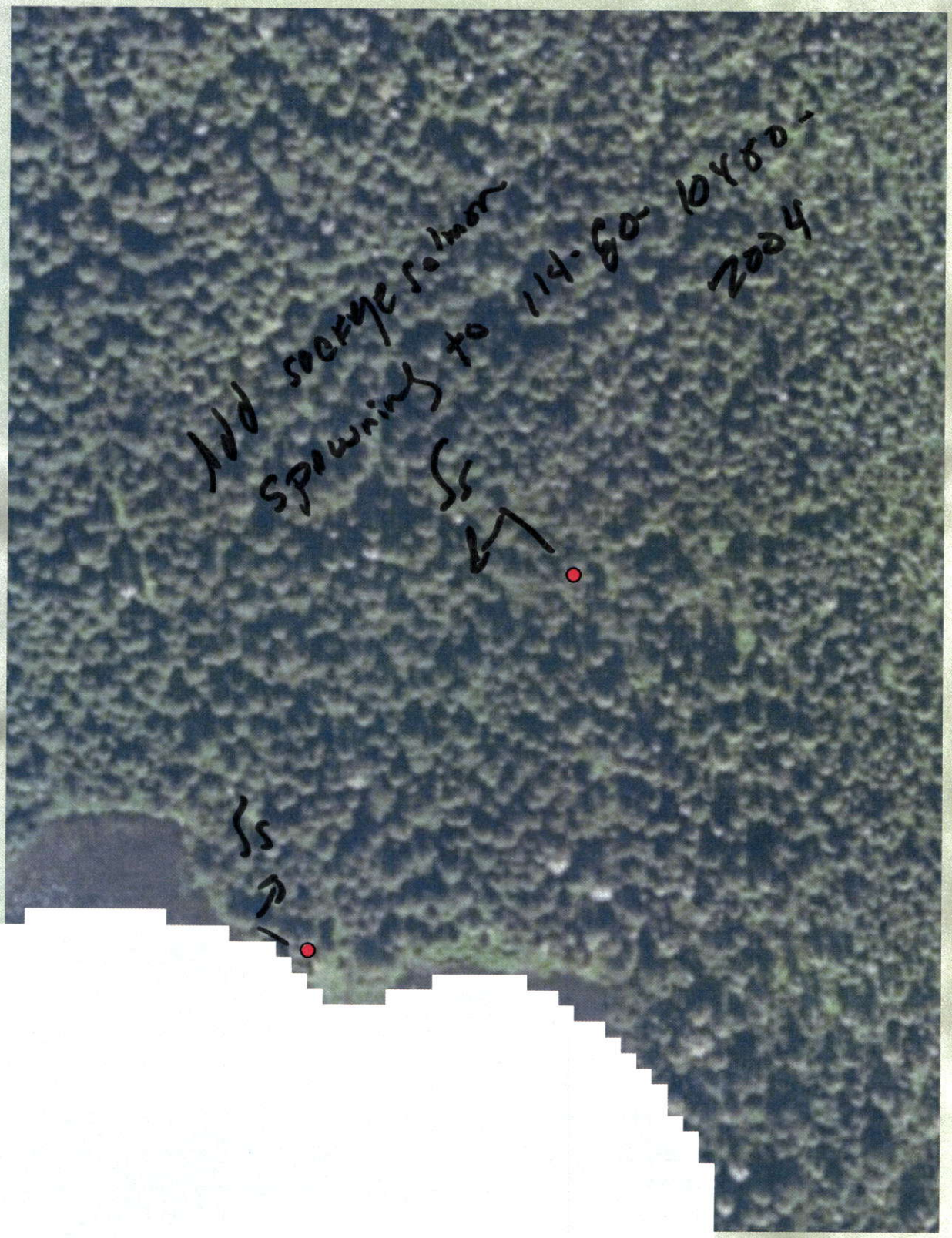
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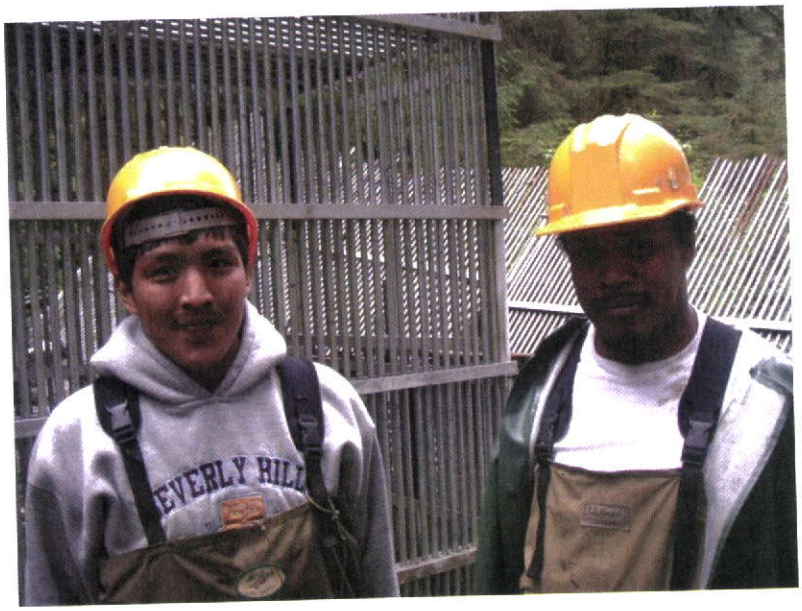
Office of Subsistence Management
Fisheries Resource Monitoring Program

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

November 2009

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

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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.

Citation: Van Alen, B. W. 2009. Neva sockeye stock assessment; 2006 to 2008. U.S. Fish and Wildlife Service, Office of Subsistence Management, Fishery Resource Monitoring Program, Final Report Study No. 06-601. Anchorage, Alaska.

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).

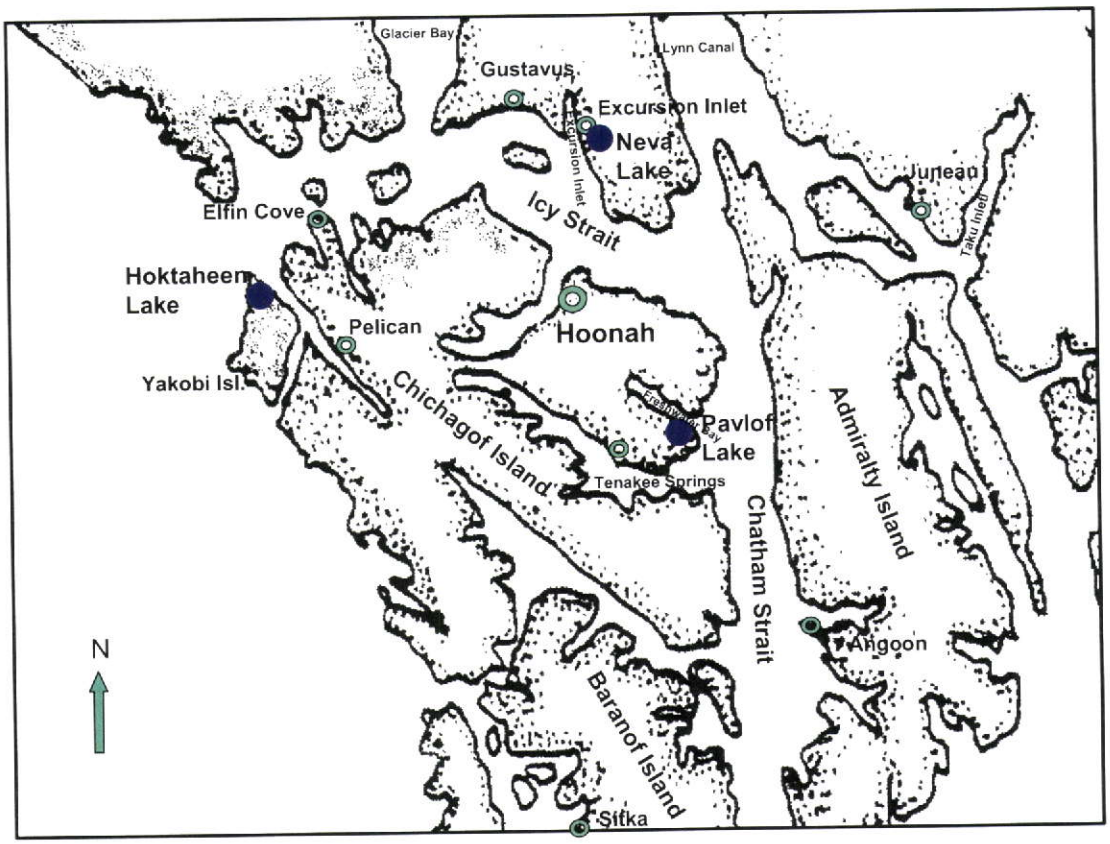

Figure 1. Map of northern Southeast Alaska showing the location of Neva Lake.

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.

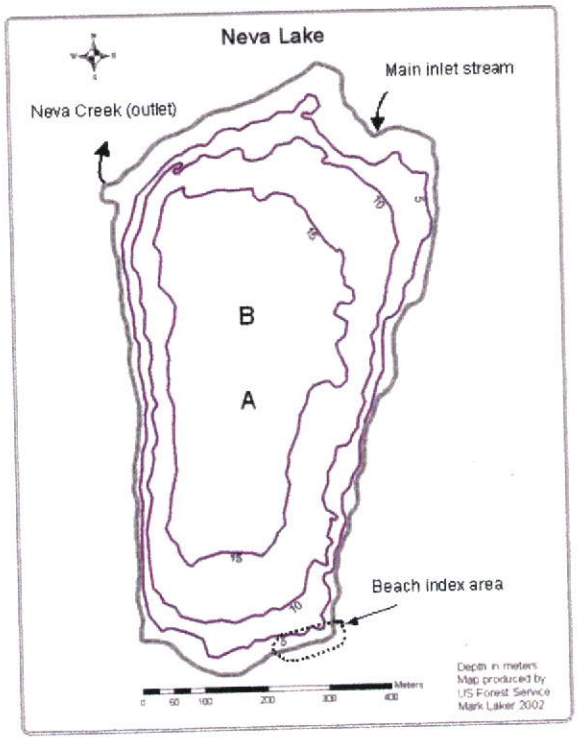

Figure 2. Bathymetric map of Neva Lake showing 5 m depth contours and approximate locations of the two fixed sampling stations, the main inlet stream, the outlet, and the beach spawning study area.

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-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.

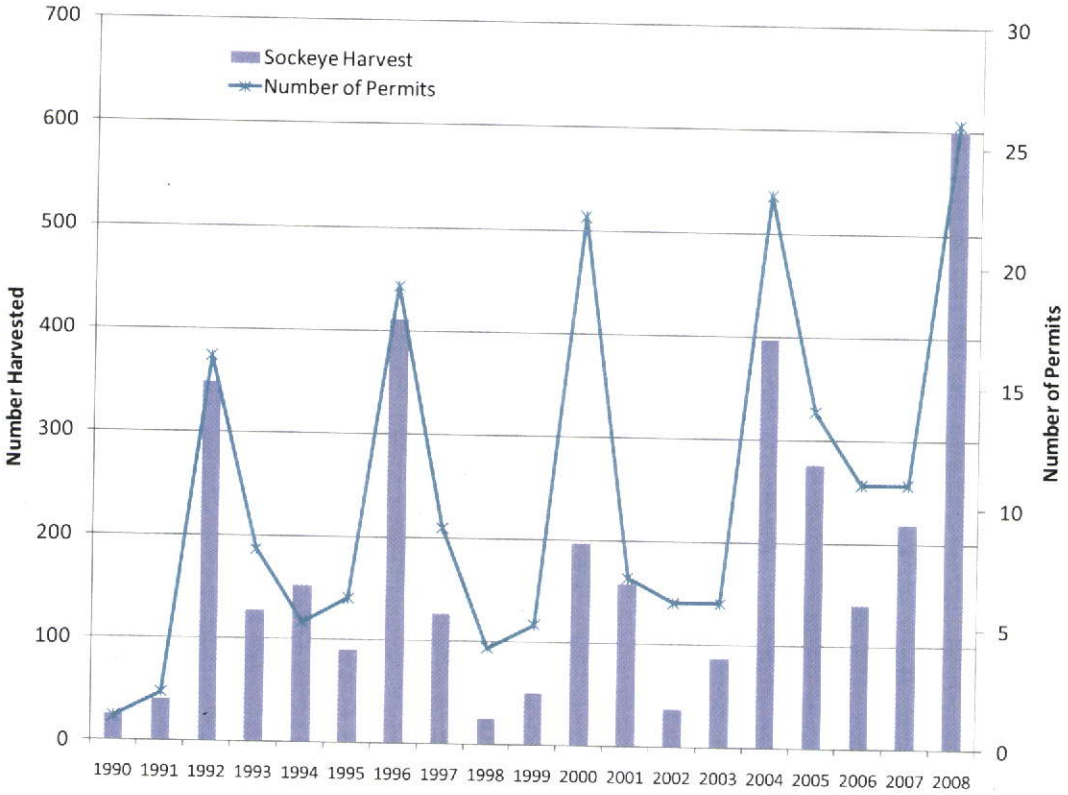

Figure 3. Subsistence effort and harvest of sockeye salmon at Neva from 1985 to 2008 as reported on permits returned to ADF&G. (from ADF&G, Division of Commercial Fisheries database, October, 2009)

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).

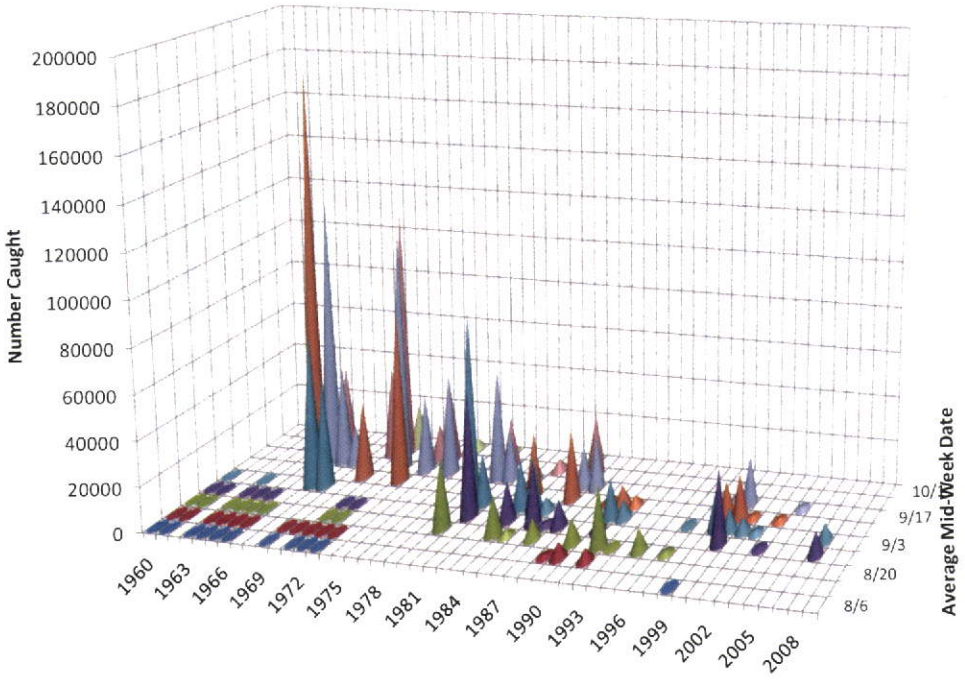

Figure 4. Weekly purse seine harvest of chum salmon in Excursion Inlet, Statistical Area 114-80, 1960 to 2008. (from ADF&G database)

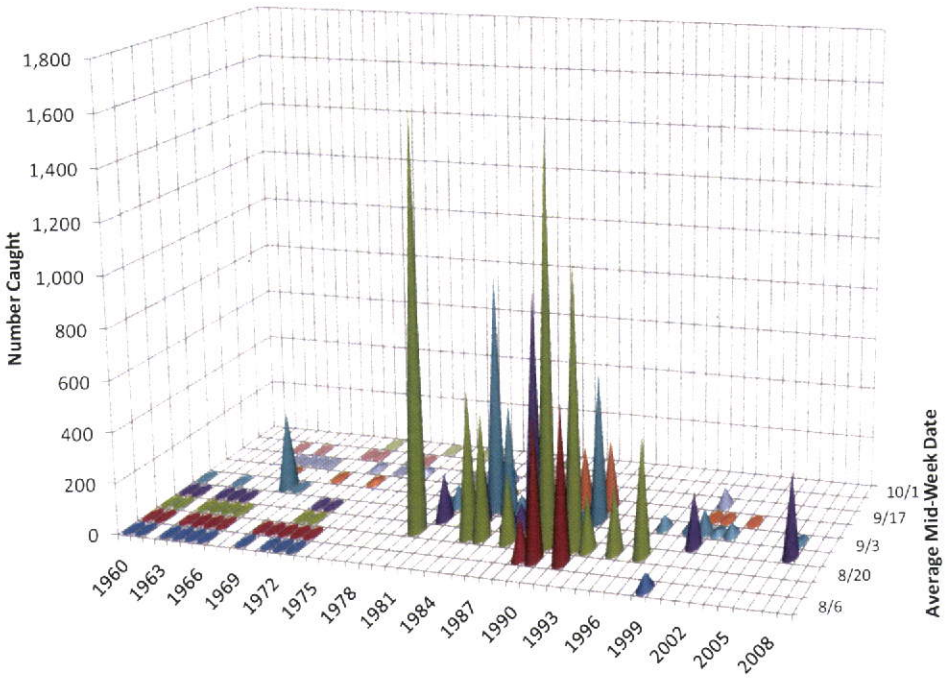

Figure 5. Weekly purse seine harvest of sockeye salmon in Excursion Inlet, Statistical Area 114-80, 1960 to 2008. (from ADF&G database)

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

[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.

stream bottom in 30cm long, 52mm I.D., aluminum pipes driven into the substrate. The 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 Tamp (°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																				
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	Weir fish tight @ 1600hr
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	26.0	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	Took apart beaver dam upstream. Lake level will probably drop a little.
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	
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	18.0	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	188	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	129	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	18	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	1,094	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 = $SE(\hat{N}) = \sqrt{(M^2 * C * (C-R)) / (R^2 * (R+1))}$

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 light @ 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 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 Fon						2,122	1,632	399	312	3,754	711	4,465	751	223	974	383	2	58	1,036	5	

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 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 fisl

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	2002	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).

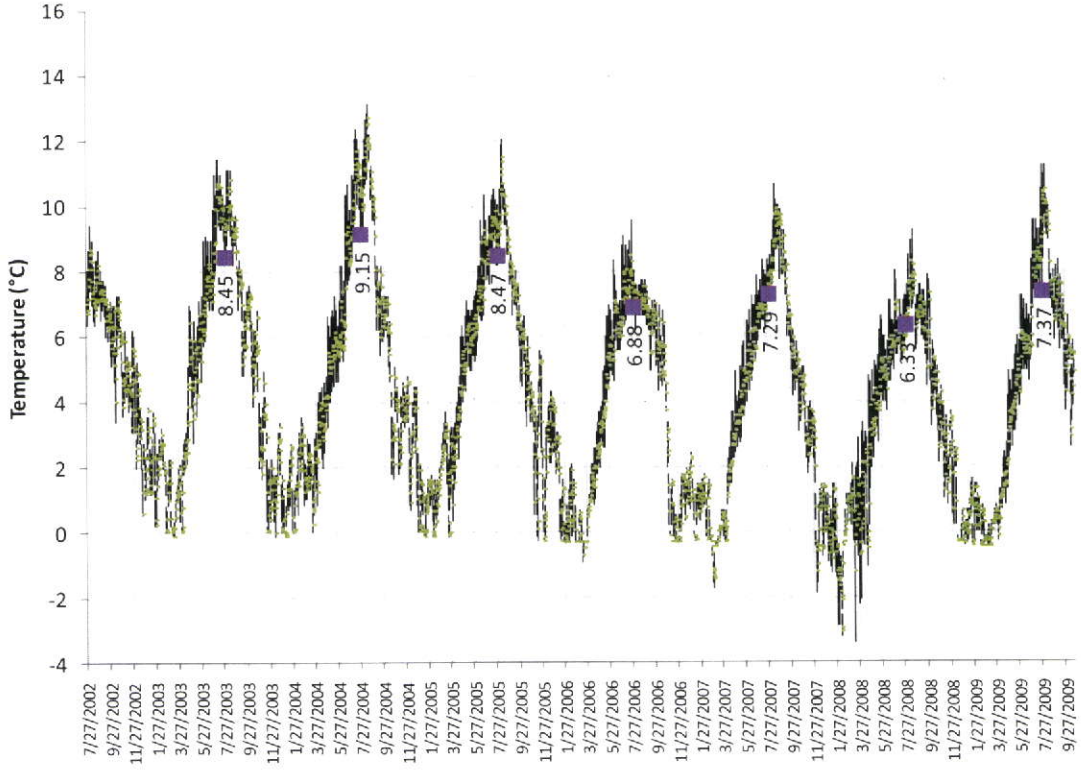

Figure 10. Average daily temperatures (°C w/ max and min range), and average June through September temperatures, in Neva Lake's main inlet stream, July 27, 2002 to October 21, 2009.

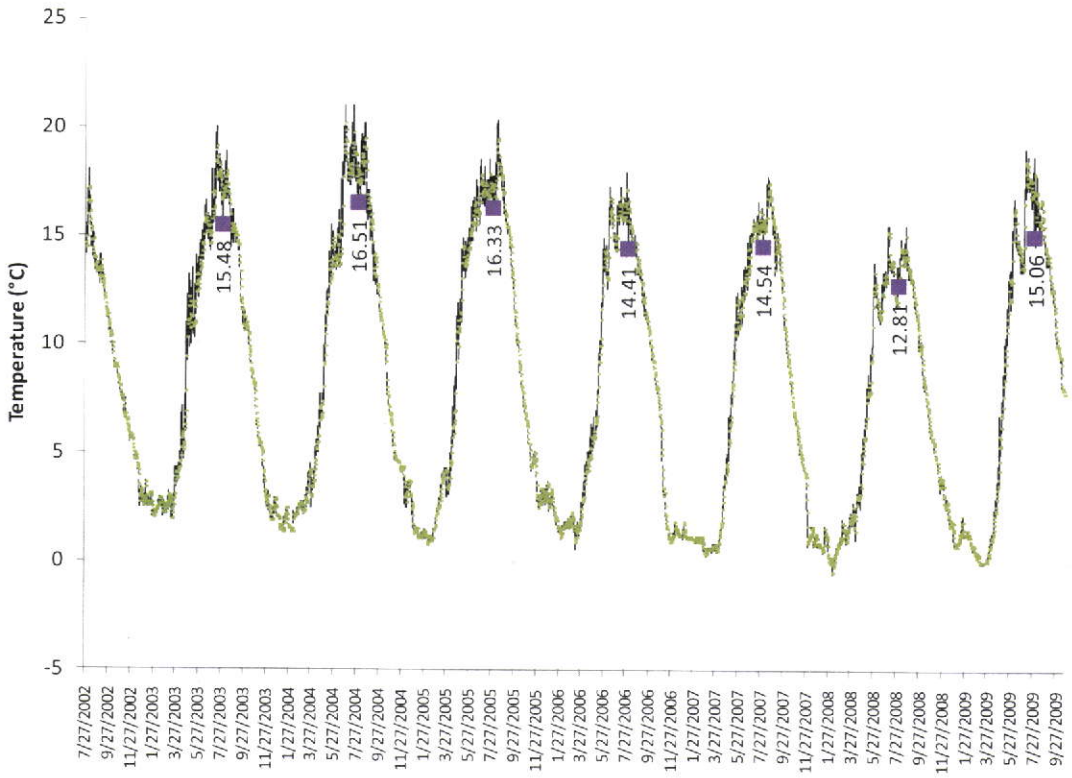

Figure 11. Average daily temperatures (°C w/ max and min range), and average June through September temperatures, at the outlet of Neva Lake, July 27, 2002 to October 21, 2009.

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.

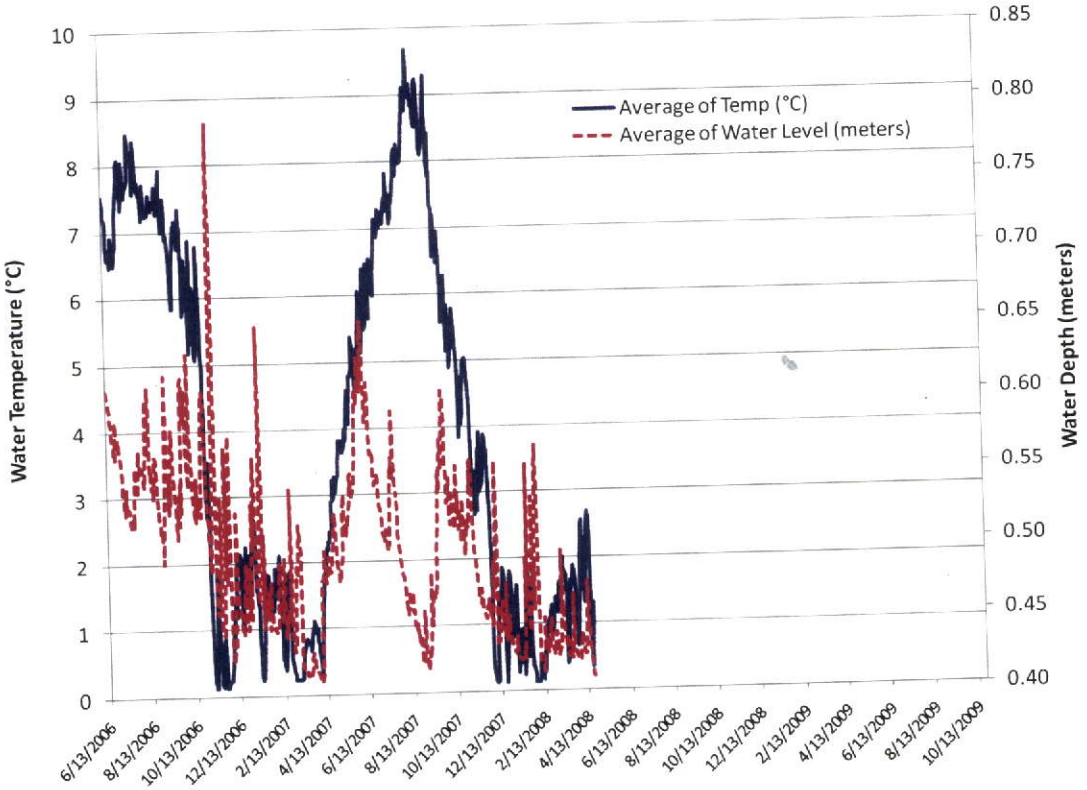

Figure 12. Temperature and depth of Neva Lake's main inlet stream, June 13, 2006 to April 21, 2008.

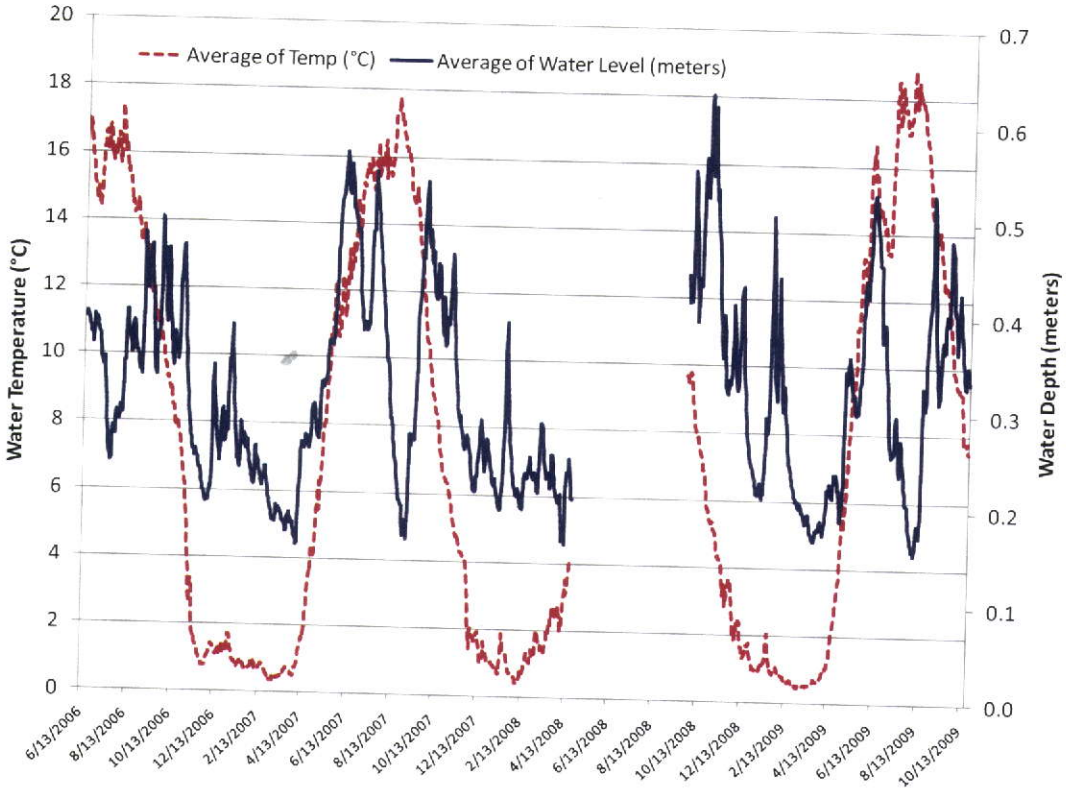

Figure 13. Temperature and depth at the outlet of Neva Lake, June 13, 2006 to October 21, 2009.

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).

ACKNOWLEDGEMENTS

This study is a cooperative effort among the Hoonah Indian Association, the Alaska Department of Fish and Game, and the Forest Service. Thanks to HIA's Johanna Dybdall and Forest Service's Cal Casipit for the help administering this multi-year project. It was a pleasure working with HIA's employees – Jerome Abbott, Jeremy Johnson, Myron Murphy, and Elijah Sheakley. Their enjoyment with work on this weir project was obvious and contributed to safe and productive field seasons.

Thanks to Iris Frank at ADF&G for aging and tabulating our scale, sex, and length samples. Thanks to Forest Service volunteer Brett Van Alen and Forest Service employees Chad Hood and Pete Schneider for their help on this project. Special thanks to Thomas Mills, Sr. and his family for their interest and assistance with this project too. The cooperation of Ocean Beauty's Mike Forbush and Bruce Gordon with accommodations and other logistics at Excursion Inlet was also most appreciated.

Thanks to the Forest Service, the Southeast Subsistence Regional Advisory Council and the Federal Subsistence Board for associating the importance of this sockeye system with the funding needed to keep this important subsistence resource and fishery healthy. Finally, we wish to thank the area residents who rely on the wise stewardship and customary and traditional use of Neva sockeye salmon.

The Forest Service, through the U.S. Fish and Wildlife Service, Office of Subsistence Management, provided $89,151 in funding support for this three year, 2006, 2007, and 2008, project through the Fisheries Resource Monitoring Program, under contract number

06-601. The Hoonah Indian Associated received $66,151 of the funds to employ the field personnel, and ADF&G received $6,000 to cover scale aging and archiving costs. This report was submitted as the final report to U.S. Fish and Wildlife Service, Office of Subsistence Management, Subsistence Fisheries Monitoring Program for project number 06-601.

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U.S. Fish and Wildlife Service
Office of Subsistence Management
Fisheries Resource Monitoring Program

Neva, Pavlof, and Hoktaheen Sockeye Salmon Stock Assessment, 2003

Annual Report for Study FIS02-012-2

This report has been prepared to assess project progress. Review comments may not be addressed in this report, but will be incorporated into the final report for this project.

Benjamin W. Van Alen
USDA Forest Service
Juneau Ranger District
8465 Old Dairy Road
Juneau, Alaska 99801

October 2005

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ABSTRACT

Sockeye salmon (*Oncorhynchus nerka*) returns to Neva, Pavlof, and Hoktaheen Lakes have long been an important subsistence resource for Tlingit families living in Hoonah and other areas of northern Southeast Alaska. This annual report summarizes the sockeye stock assessment project findings from the second year, 2003, of a three-year cooperative Hoonah Indian Association, Alaska Department of Fish and Game, and U.S. Forest Service study. This project uses a weir and mark-recapture methods to estimate the sockeye escapement into Neva Lake, a fishpass trap and mark-recapture to estimate the sockeye escapement into Pavlof Lake, and mark-recapture to index the sockeye escapement in Hoktaheen Lake. Age, sex, and length data and limnology data were also collected to help assess the status of these stocks.

The Neva sockeye escapement was 11,393 (CV = 2%) – 9,468 adults and 1,925 jacks – based on weir counts and a weir-to-spawning area mark-recapture study. Sockeye migrated into the lake from June 22 through October 8 and the midpoint of the run was on August 6th. The early running fish spawned in the main inlet stream and the later running fish were beach spawners. Inlet stream spawners totaled about 3,000. Ninety-five percent of the Neva sockeye escapement was age-1.- and 17% were jacks (age -.1). The observed subsistence harvest was 278 sockeye salmon and sport harvest was 53.

The Pavlof sockeye escapement was 1,474 (CV = 2%). The run extended from June 15 to August 12 with a midpoint of July 7. Sixty-nine percent of the sockeye salmon used the fishpass to migrate into the lake. A radio tagging study confirmed that the sockeye spawn in the lower part of the main inlet stream from late-July to mid-August. Age-1.3 fish dominated the escapement.

Three thousand four hundred (CV = 3%) sockeye salmon spawned in upper Hoktaheen Lake's main inlet stream. Just over 300 sockeye spawned in the upper section of the stream connecting the upper and lower lakes. Few spawning sockeye were observed outside of these two index areas. Age-1.3 fish dominated the escapement.

The dominant macrozooplankton was *Daphnia* sp. in Neva Lake, *Bosmina* sp. in Pavlof, and *Cyclops* sp. in Hoktaheen. The weighted "seasonal" biomass of zooplankton was 562, 13, and 463 mg m^{-2}, respectively, in Neva, Pavlof, and Hoktaheen Lakes and euphotic zone depths were 10.6, 6.2, and 3.9.

Key Words: Sockeye salmon, *Oncorhynchus nerka*, Neva, Pavlof, Hoktaheen, escapement, mark-recapture, age composition, limnology.

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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), Pavlof Lake (112-50-010), and Hoktaheen Lake (113-94-003) 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; Figure 1). Household subsistence surveys done in Hoonah in 1996 found that 86% of the families used salmon and 65% used sockeye salmon (Table 1).

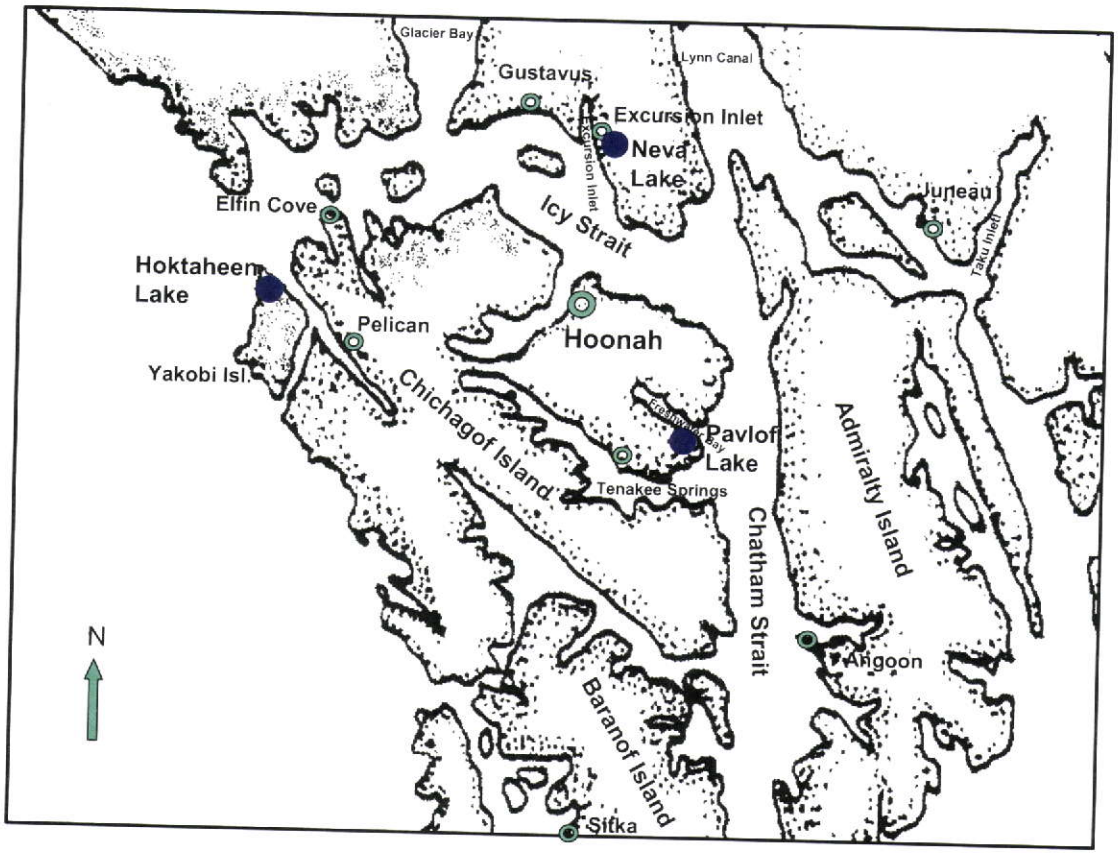

Figure 1. Map of northern Southeast Alaska showing the location of Neva, Pavlof, and Hoktaheen Lakes.

Table 1. Subsistence use and harvest of salmon by households in Hoonah. (ADF&G, Division of Subsistence, Community Profile Database, 2003).

	Sockeye Salmon		All Salmon	
Year	Percent Households Using	Percent Households Harvesting	Percent Households Using	Percent Households Harvesting
1985	32%	17%	86%	55%
1987	38%	29%	92%	69%
1996	65%	43%	86%	74%

Unfortunately, little is known about the health of these sockeye runs. Management has had to rely on infrequent and imprecise aerial survey counts and subsistence harvest reports to assess run sizes and trends. I am not aware of any prior studies that estimated or indexed the sockeye escapement into these lakes. We do not know if escapements are at levels that would maximize returns and harvests. We do not know if management is too conservative and if subsistence harvests limits could be liberalized, or, if these runs are depressed and need rebuilding from over harvesting that occurred with the onset of commercial fishing in the late-1800s and early-1900s (Bean 1891; Moser 1899; Rich and Ball 1933; Cooley 1963; Van Alen 2000). Most importantly, we do not know if escapements are trending downward and if management actions are needed to protect these important subsistence resources.

This project estimates sockeye escapements into Neva and Pavlof Lakes, indexes the sockeye escapement into Hoktaheen Lake, and collects associated biological and limnological data needed to assess the current status of these important subsistence stocks. Mark-recapture methods are used to estimate the relative and/or absolute sockeye escapement in all lakes. This information is needed to estimate escapement goals and understand the current status of these runs (Geiger et al. 2003).

This report covers the second season (2003) of a joint Hoonah Indian Association (HIA)/U.S. Forest Service (USFS)/Alaska Department of Fish and Game (ADF&G) study into the status of Neva, Pavlof, and Hoktaheen sockeye salmon. Results from the 2002 season were reported in Van Alen (2004). The stock assessment of sockeye salmon in Hoktaheen Lake was part of an Organized Village of Kake and ADF&G project in 2001 (Conitz and Cartwright 2002a) but was included in this project since Hoktaheen is in the traditional fishing area of the Hoonah people. Project personnel also worked this season with personnel from the Angoon Community Association to estimate the escapement of sockeye salmon in Kook Lake's main inlet stream and these results will be presented in an ADF&G report.

This Neva, Pavlof, and Hoktaheen Sockeye Salmon Project is one of eight new projects, initiated in 2001 and funded through the U.S. Fish & Wildlife Service Fisheries Resource Monitoring Program, to assess significant subsistence sockeye runs in southeast Alaska (Conitz and Cartwright 2002a, 2002b, 2002c; Conitz et al. 2002; Lewis and Cartwright 2002a, 2002b, 2002c). 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 all involve cooperation among community Tribal associations, ADF&G, and USFS.

There is also a Federal Office of Subsistence Management-funded, cooperative HIA and ADF&G, Division of Subsistence, project currently studying the historic and contemporary subsistence use by the people of Hoonah. Results from both these studies will help us assure the adequacy of these runs for meeting escapement and customary and traditional subsistence needs.

BACKGROUND

Neva

Neva Lake (58°24.219' N, 135°24.258' W; NAD27 datum) is located on the mainland on the east side of Excursion Inlet (Figure 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.

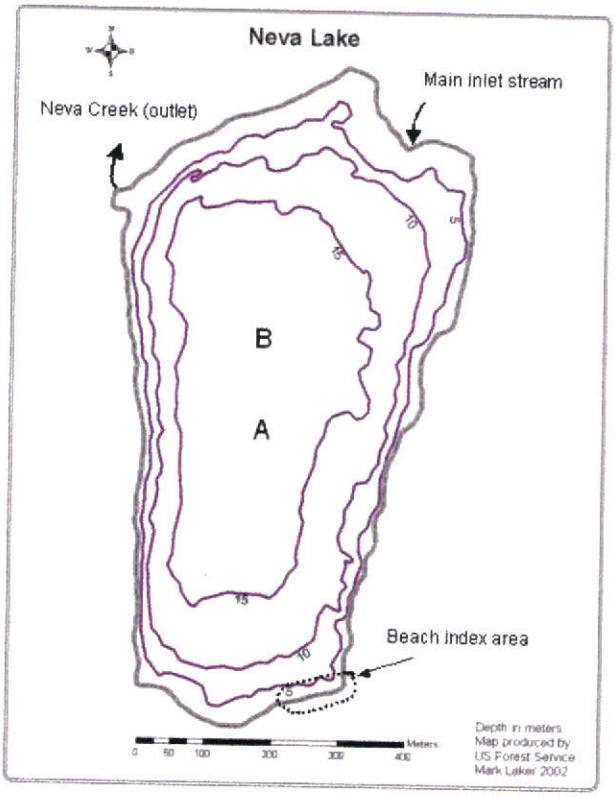

Figure 2. Bathymetric map of Neva Lake showing 5 m depth contours and approximate locations of the two fixed sampling stations, the main inlet stream, the outlet, and the beach spawning index area.

Neva Lake is in the traditional lands used for subsistence harvesting and gathering by the Huna Tlingit (Schroeder and Kookesh 1990). There used to be a village of Wooshkeetaan clan people in Excursion Inlet near the present cannery site (Goldschmidt and Haas 1998). Villagers would fish for "a good run of sockeye" salmon returning to Neva Lake and there were several smokehouses in the area. Stone barriers are still evident in Neva Creek that were built to impede the upstream migration of salmon.

A salmon cannery began operation in Excursion Inlet in 1918. The location and ownership of the cannery has changed several times over the years (Galginaitis 2003). During World War II, between August 1942 and November 1943, over 3,000 civilian and U.S. Army workers constructed a barge terminal at Excursion Inlet as a potential resupply port for the Aleutian campaign (Cohen 1988). The $17 million port was never needed and from July 1945 to January 1946 the Army used about 700 German prisoners of war to dismantle and salvage as much as possible. A dam, reservoir, and water distribution system is still used by the cannery today. This water system diverts water out of Neva Lake's main inlet stream. Neva Lake is accessible by road from the cannery.

The State currently holds title to the land surrounding Neva Lake and outlet, and the cannery site is privately owned, but the majority of the watershed is on National Forest System Land. The State has subdivided and sold land along the eastern shore of Excursion Inlet and there are now about 80 cabins/homes and a sport fishing lodge in the area that are mostly used for summer recreation. Unguided clients from sport fish lodges often target salmon at the mouth of South Creek.

This area is in the Federal subsistence customary and traditional use area for residents in the Hoonah area (Federal Register 50 CFR Part 100 and 36 CFR Part 242) and 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, returned, and the reported harvest since 1984. The return of these permits is voluntary. No sockeye salmon were reported harvested at Neva prior to 1990 and the peak effort (22 permits) and harvest (411 sockeye salmon) was in 1996 (Figure 3). Subsistence and personal use fishing for Neva sockeye salmon occurs both in saltwater, at the mouth 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.

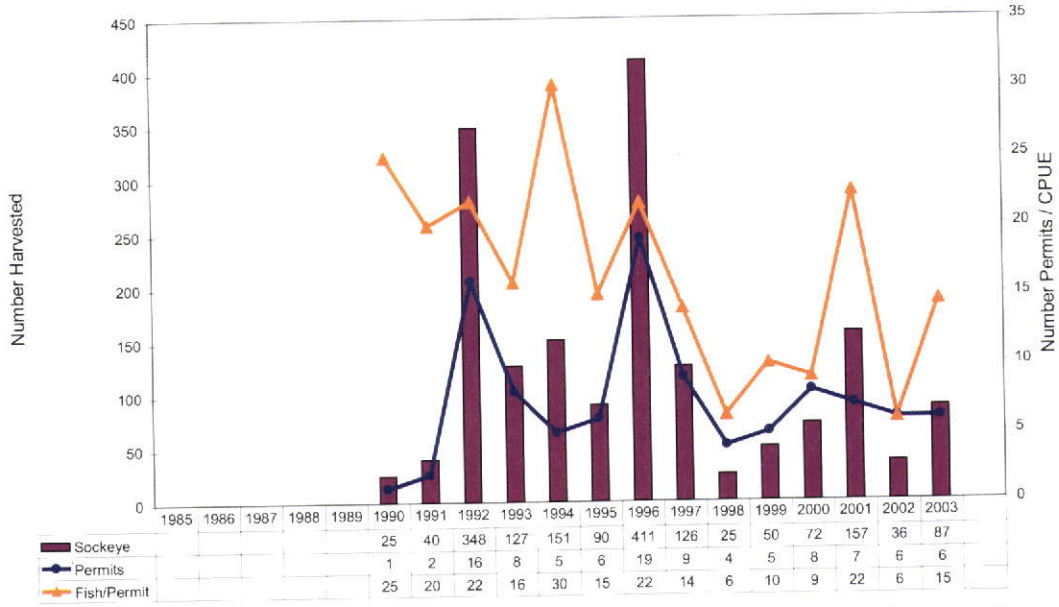

Figure 3. Subsistence/personal use effort and harvest of sockeye salmon at Neva from 1985 to 2003 as reported on permits returned to ADF&G (ADF&G, Division of Commercial Fisheries database, May, 2005).

Neva sockeye salmon would primarily be harvested in commercial fisheries in Excursion Inlet and Icy Strait. These fisheries also harvest sockeye salmon bound for Lynn Canal, Taku River, Chatham Strait, and other northern inside systems. Rich and Ball (1933) reported no harvests of sockeye salmon in Excursion Inlet prior to 1914 and annual harvests of zero to 50,722 sockeye salmon in Excursion Inlet from 1914 to 1927 (Table 2). Beach

seines, purse seines, gillnets, and traps fishing on passing stocks in Icy Strait harvested hundreds of thousands of sockeye salmon annually through 1927 (Rich and Ball 1933; Table 2). Commercial harvest estimates for Icy Strait and Excursion Inlet from 1928 to statehood (1959) are not available. Traps were outlawed in 1959; however, the purse seine fishing effort remained high in Icy Strait into the early 1970s (Table 3). The annual sockeye harvest has ranged between zero and 2,584 fish in Excursion Inlet since 1960 (Table 3). Seine openings in Excursion Inlet have not been directed at Neva sockeye salmon and it is likely that many of the sockeye harvested there were bound for other systems.

The ADF&G, Division of Sport Fish, estimates sport effort, catch, and harvest from an annual statewide mail survey (Mills and Howe 1992). Twelve or more responses are needed for estimates to be useable. There have been too few responses to estimate effort or harvests of salmon in the Neva Lake system but the sport fish harvest of sockeye salmon in the entire Excursion Inlet area (excluding Excursion River) has averaged only 34 fish from 1984 to 1999 (Table 4). There has been an increasing trend in sport effort and harvest in both the Excursion Inlet area (Table 4) and the Glacier Bay Area that includes Excursion Inlet (Table 5).

Aerial and foot escapement surveys have been conducted by ADF&G, Commercial Fisheries Division, intermittently since 1960. These surveys are primarily geared to indexing pink and chum salmon escapements. They should not be considered a reliable estimate or index of sockeye abundance without further study. Survey locations, dates, and observers are not standardized (Bevan 1961; Jones *et al.* 1998) and usually only a small fraction of the escapement is visible due to the forest canopy, dark water, and the natural dispersal of fish within a system. Nevertheless, counts as high as 1,250 sockeye salmon have been made in Neva Lake in recent years (Table 6).

Table 2. Historic commercial harvest of sockeye salmon in Icy Strait, and Hoktaheen Cove and Excursion Inlet (Neva), and Northern Chatham Strait, and Freshwater Bay (Pavlof), 1889 to 1927 (Rich and Ball, 1933).

Year	Icy Strait[a]	Hoktaheen Cove	Excursion Inlet	Northern Chatham Strait[b]	Freshwater Bay
1889	51,600				
1890	144,000			4,902	
1891	91,200				
1892				21,875	
1893					
1894					
1895				4,260	
1896				36,969	
1897				566	
1898					
1899					
1900	151,901			194,200	25,000
1901	96,547			131,055	
1902	218,084			128,080	
1903	236,167			241,175	
1904	432,262			199,200	
1905	584,275	8,279		93,664	
1906	375,459	11,348		177,200	
1907	511,265	7,000		121,394	
1908	661,140	10,677		256,619	
1909	626,511	10,391		304,351	
1910	609,802	9,896		150,892	
1911	635,726	7,196		158,956	
1912	818,162	7,197		248,964	1,000
1913	686,268	5,344		208,937	
1914	1,304,877	7,686	3	223,738	
1915	768,068	8,301		241,763	
1916	679,561			127,681	560
1917	712,770		6,036	270,713	179
1918	827,768	2,519	61	242,056	
1919	822,679	5,463	385	205,552	808
1920	608,953	3,218	50,722	173,875	
1921	271,138			91,406	
1922	425,725	653	390	103,996	
1923	518,006	5,266	78	86,297	30
1924	552,789	2,310	2,382	121,589	
1925	525,391	2,335	3,039	153,412	
1926	523,110	1,834	546	140,680	
1927	345,635	2,021	2,469	102,367	
Spearman's rho non-parametric trend test (Conover 1980):					
rho	0.46	-0.85	0.35	0.22	-0.83
P-value	0.01	0.00	0.30	0.21	0.04
N	31	20	11	33	6

[a] The beach seine, purse seine, gillnet, and traps in the Icy Strait District primarily targeted passing stocks. Hoktaheen and Excursion Inlet (Neva) are in this district.

[b] The Northern Chatham Strait area includes the beach seine, purse seine, gillnet, and trap harvests north of Pt. Gardner and Takatz Bay. Freshwater Bay (Pavlof) is in this district.

Table 3. Commercial purse seine effort and harvest of sockeye salmon in waters adjacent to Neva Lake (Icy Strait and Excursion Inlet), Pavlof Lake (Upper Chatham Strait and Freshwater Bay), and Hoktaheen Lake (Hoktaheen Cove), 1960 to 2003 (from ADF&G, Division of Commercial Fisheries, Alexander Database, May, 2005).

	Icy Strait (Dist. 114)		Excursion Inlet (Dist. 114-80)		Upper Chatham (Dist. 112)		Freshwater Bay (Dist. 112-50)		Hoktaheen Cove (Dist. 113-94)	
Year	Sockeye Harvest	Boat-Days	Sockeye Harvest	Boat-Days	Sockeye Harvest	Boat-Days	Sockeye Harvest	Boat-Days	Sockeye Harvest	Boat-Days
1960	136,796	1,552			12,399	236	1,046	58		
1961	213,619	2,965			45,493	726	69	15		
1962	136,712	1,208			11,148	160	114			
1963	201,535	5,440			24,268	1,312	18	4		
1964	204,304	4,162	9		34,225	1,282				
1965	280,730	4,682	1		48,756	1,383	15			
1966	216,858	2,747	12		28,737	1,363	3			
1967	160,019	3,113	306		15,891	525	17			
1968	230,741	3,004	2		41,874	3,213	448		1,073	
1969	231,624	3,627			29,563	1,610				
1970	163,224	4,384	4	190	49,598	4,844	14	27	149	6
1971	88,758	3,188	3	232	18,533	1,728			315	36
1972	96,853	3,374	13	220	33,761	2,651	528	48	8	3
1973	130,805	1,714	10	102	32,118	620			205	4
1974	20,594	656	2	184	23,639	858				
1975	2,391	226	0	110						
1976	21	303	21	303						
1977										
1978					1,261	434				
1979	3	53	2	52	1,577	261	8	4		
1980	1,792	216	1,685	198	1,300	662				
1981	10,638	596	266	238	17,188	602				
1982	234	119			26,524	3,408				
1983	2,333	135	85	28	25,979	1,001				
1984	6,882	190	1,876	138	22,208	1,548				
1985	3,638	253	919	26	37,140	2,448				
1986	1,479	69	168	35	8,391	2,181				
1987	3,793	307	396	156	44,989	1,486				
1988	1,244	135	952	73	3,927	642				
1989	6,111	164	151	2	48,985	1,653				
1990	4,161	110	2,348	52	17,477	873				
1991	4,307	208	1,153	31	40,289	2,735				
1992	6,454	180	2,584	65	54,403	1,869				
1993	9,806	249	216	1	81,676	2,989				
1994	10,536	412			76,582	4,044				
1995	264	8	264	8	20,387	2,799	1,576	54		
1996					37,482	3,102				
1997	5,123	259	518	5	25,946	2,528	1,582	46		
1998					30,820	2,546				
1999	17,301	893	105	24	55,942	3,725				
2000	1,111	99	376	77	30,594	2,538				
2001	43,739	443			64,427	1,777				
2002	4,592	262	46		24,751	1,761				
2003	11,973	288	3		68,316	1,945				

Table 4. Sport fish effort and harvest in Excursion Inlet and Neva Lake, 1984 to 2002 (from ADF&G, Division of Sport Fish, Statewide Harvest Database, 2005).

Year	Number of Anglers	Number of Trips	Days Fished	Coho Harvest	Sockeye Harvest	Number of Responses
1984	12	55	33	59	0	1
1985	163	130	121	50	0	3
1986	204	681	706	45	11	6
1987	225	449	444	44	110	6
1988	402	2,135	1,893	54	0	5
1989	290	273	321	152	28	10
1990	232	249	443	0	21	9
1991	724	1,252	3,164	176	0	19
1992	660	1,383	1,420	97	66	29
1993	588	1,042	1,062	163	0	24
1994	1,166	1,428	2,496	1,053	74	42
1995	1,113	1,419	3,042	290	34	40
1996	613	1,197	1,633	620	0	34
1997	1,170	1,921	2,867	840	50	52
1998	1,005	1,955	2,720	924	124	49
1999	1,257	1,675	3,357	2,762	32	51
2000	365	901	1,415	916	0	15
2001	277	234	616	1,098	0	12
2002	378	410	1,546	4,080	0	21
2003						
Average	571	989	1,542	706	29	23
Spearman's rho rank correlation trend test:						
r_s =	0.57	0.32	0.54	0.89	0.03	0.71
P =	0.01	0.18	0.02	0.00	0.89	0.00
n =	19	19	19	19	19	19

Table 5. Sport fish harvest and effort in the Sitka area (on and around Baranof and Chichagof Islands) and Glacier Bay areas, 1977 to 2002 (from ADF&G, Division of Sport Fish, Statewide Harvest Database, 2005).

		Sitka Area (includes Pavlof)[a]:					Glacier Bay Area (includes Excursion Inlet and Neva):				
Watertype	Year	Number of Anglers	Number of Trips	Days Fished	Coho Harvest	Sockeye Harvest	Number of Anglers	Number of Trips	Days Fished	Coho Harvest	Sockeye Harvest
Freshwater	1977			6,927	261	192			1,362	0	6
	1978			5,303	176	56			129	0	0
	1979			3,946	154	36			79	0	0
	1980			5,510	326	69			143	9	43
	1981			3,844	184	0			196	11	22
	1982			5,663	146	0			17	0	0
	1983			4,998	336	76			253	0	0
	1984	2,720	2,938	4,258	255	102	208	429	535	124	78
	1985	2,941	4,670	4,680	348	0	291	747	433	12	0
	1986	2,809	3,942	4,587	115	38	646	805	651	167	11
	1987	2,582	4,826	5,611	42	14	428	673	1,845	88	143
	1988	3,089	4,112	5,077	308	1,092	682	1,176	1,009	837	419
	1989	2,424	4,017	5,154	261	214	511	1,023	887	559	0
	1990	2,826	3,676	4,404	87	120	598	813	1,371	495	0
	1991	3,026	3,610	6,970	390	323	997	1,995	2,335	780	48
	1992	3,535	5,066	6,674	461	0	559	1,706	2,029	349	164
	1993	3,148	6,142	9,444	925	177	627	1,640	1,912	212	142
	1994	3,031	5,776	7,789	389	151	627	1,788	2,114	669	0
	1995	3,251	4,273	7,718	937	77	866	2,808	4,071	846	219
	1996	2,355	3,324	4,426	479	252	369	877	903	154	99
	1997	3,309	4,840	7,123	828	547	1,173	1,931	3,087	815	271
	1998	2,822	3,075	5,298	823	259	804	598	1,187	129	81
	1999	3,268	5,051	8,368	1,196	637	666	1,118	1,351	197	0
	2000	1,748	4,178	6,289	324	212	1,026	2,257	3,249	749	244
	2001	1,369	3,163	4,733	137	133	1,111	2,905	3,503	1,668	108
	2002	1,644	2,457	4,395	396	82	962	2,315	3,173	1,356	0
	2003										
Spearman's rho rank correlation trend test:											
	r_s =	-0.15	-0.09	0.26	0.53	0.52	0.69	0.65	0.78	0.81	0.36
	P =	0.55	0.71	0.19	0.01	0.01	0.00	0.00	0.00	0.00	0.07
	n =	19	19	26	26	26	19	19	26	26	26
Saltwater	1977			30,817	2,855	620			3,013	744	231
	1978			27,638	2,188	268			1,529	880	169
	1979			36,564	1,554	754			2,563	227	0
	1980			33,172	1,876	1,326			2,299	207	17
	1981			34,650	3,122	594			2,242	562	22
	1982			37,686	3,741	628			2,747	1,163	0
	1983			39,160	4,312	306			3,237	619	41
	1984	9,367	28,715	35,791	2,389	533	941	1,411	2,848	247	0
	1985	12,429	32,650	31,935	3,332	210	1,876	3,407	3,468	324	0
	1986	13,733	32,786	35,173	3,962	328	2,380	2,973	3,213	224	0
	1987	14,005	38,882	39,972	2,673	433	2,716	4,023	5,333	956	121
	1988	16,736	36,028	43,603	2,437	2,055	2,445	7,395	8,267	508	91
	1989	17,618	44,824	54,076	8,030	1,934	4,144	5,612	8,008	1,817	216
	1990	22,612	46,777	57,502	7,721	1,224	3,483	5,013	6,486	1,251	21
	1991	23,009	44,672	61,223	11,084	487	7,318	12,145	19,630	4,873	84
	1992	29,824	55,978	71,607	8,706	434	5,221	9,072	13,250	1,158	215
	1993	28,460	52,358	65,500	13,593	949	6,017	9,394	13,142	2,508	172
	1994	40,327	67,455	100,204	42,489	1,987	8,220	9,401	16,105	6,142	93
	1995	37,258	62,777	93,420	15,677	1,502	9,224	13,343	21,243	2,130	477
	1996	32,219	41,539	60,556	35,413	2,789	6,266	9,224	13,533	4,513	228
	1997	34,501	53,446	81,442	37,125	2,962	8,890	12,763	20,083	5,140	264
	1998	37,305	46,188	72,136	50,645	3,522	6,812	8,368	13,071	3,652	99
	1999	34,042	55,906	96,789	75,050	6,929	7,955	11,361	21,556	11,793	85
	2000	22,190	50,067	84,602	39,182	2,170	8,115	21,355	38,126	12,522	172
	2001	24,502	50,642	87,657	83,377	1,829	8,415	18,499	38,963	25,250	146
	2002	21,856	39,122	63,361	39,809	1,206	7,394	14,631	28,506	29,636	544
	2003										
Spearman's rho rank correlation trend test:											
	r_s =	0.64	0.57	0.89	0.91	0.65	0.84	0.88	0.94	0.86	0.52
	P =	0.00	0.01	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.01
	n =	19	19	26	26	26	19	19	26	26	26

[a]The Sitka Area included all of Baranof and Chichagof/Yakobi Island (Hoktaheen) prior to 2000. Starting in 2000, the sport effort and harvest in the Northern part of Chichagof Island and Yakobi Island is included with the Glacier Bay Area.

Table 6. Peak aerial, foot, or boat counts of sockeye salmon at Neva, Pavlof, and Hoktaheen, 1960 to 2003 (from ADF&G, Division of Commercial Fisheries, Alexander Database, January 2005).

	Neva Creek		Pavlof River		Hokatheen Cove	
Year	Number Counted	Number of Surveys	Number Counted	Number of Surveys	Number Counted	Number of Surveys
1960						
1961						
1962			200	1		
1963			300	1		
1964			850	1		
1965						
1966			2,500	3	3,000	1
1967			4,000	1		
1968			2,500	5		
1969			3,300	4	2,000	2
1970					1,500	2
1971						
1972						
1973					0	1
1974					500	2
1975						
1976						
1977						
1978					1,500	1
1979					500	1
1980						
1981						
1982			800	1		
1983			200	2		
1984			170	4		
1985			150	2		
1986			0	1		
1987			0	2		
1988	100	1	200	5		
1989	140	2				
1990	470	3	100	3		
1991	300	2	300	6		
1992	0	1				
1993	0	1	300	4		
1994	0	2	800	5		
1995	250	1	100	2		
1996	610	2	400	3		
1997	50	4	400	2		
1998	123	10	620	2	2	3
1999	810	4	350	5		
2000	215	4	40	3	150	2
2001	1,250	4	200	4	404	3
2002	100	2	300	2	745	3
2003	150	1	100	2		
					150	2

Pavlof

Pavlof Lake (57°50.605' N, 135°02.672' W) is located on the northeast side of Chichagof Island (Figure 1). Pavlof Lake empties directly into Pavlof Harbor on the southeast side of Freshwater Bay. There is a short 4 m falls on the outlet. Pavlof Harbor is about 48 km by boat from Hoonah and Angoon and 24 km from Tenakee Springs. Pavlof Lake has a surface area of 36.6 ha, a maximum depth of 8 m, a mean depth of 2.3 m, a volume of 860,000 m^3, and an elevation of 5 m (Figure 4; Barto and Cook 1999). This small, shallow lake has an extensive growth of lily pads (*Nuphar* spp.) and other aquatic vegetation. The small lake does little to buffer rainfall or snowmelt events and there is a wide range in daily stream flows, particularly in the fall (Figure 5).

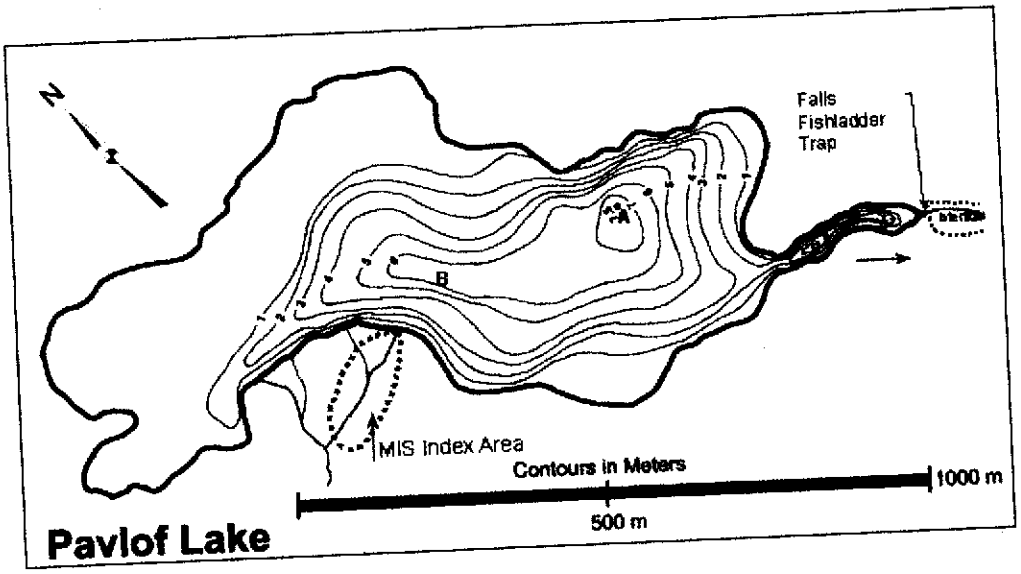

Figure 4. Bathymetric map of Pavlof Lake showing 1 m depth contours and locations of the two fixed sampling stations, the index area in the main inlet stream, and the fish pass and trap at the outlet of the lake (from ADF&G).

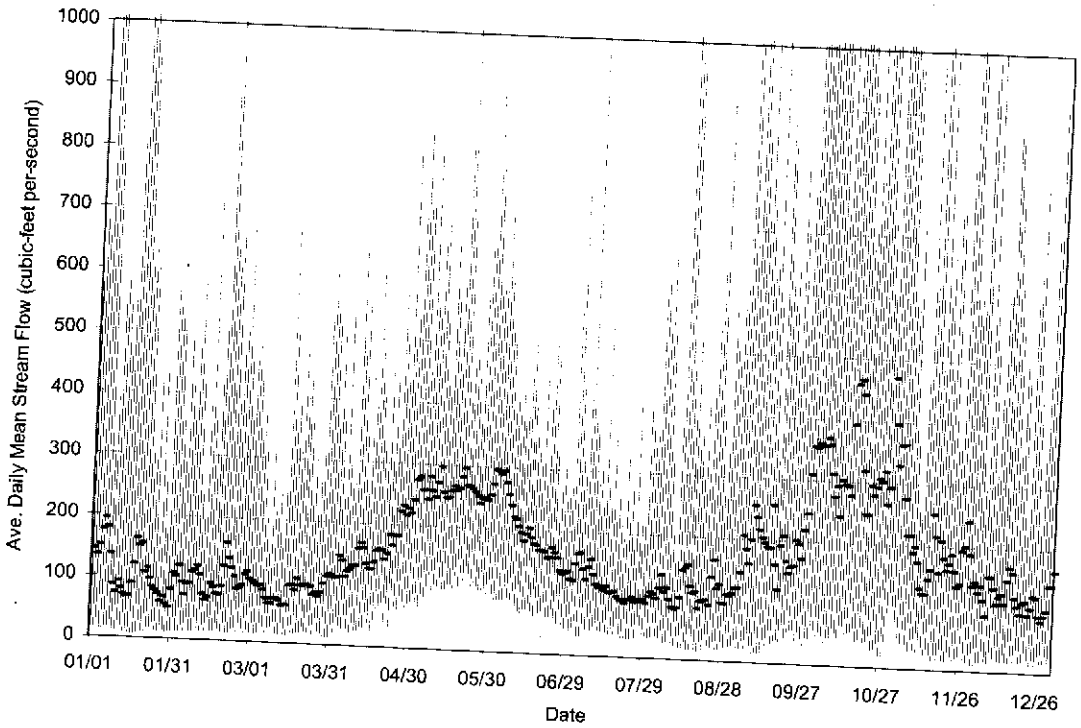

Figure 5. Average daily mean stream flow (cubic-feet per-second) and minimum and maximum (truncated at 1,000 from peaks up to 3,370) daily measurements for Pavlof River, June 1, 1957 to September 30, 1981. (From USGS)

The Pavlof Harbor area is in the traditional territory of Wooshkeetaan clan members associated with Angoon, Auk (Juneau), and Tenakee (Goldschmidt and Haas 1998). Goldschmidt and Haas reported that Wooshkeetan people from Angoon had lived for a time in a small village near Pavlof Harbor called Asaank'ˊi and that a smoke house was located below the waterfall at the outlet of Pavlof Lake. De Laguna (1960) interviewed an elderly man in Angoon who also collaborated Goldschmidt and Haas's report. He said when he was a small boy there were two "Wuckitan" lineage houses in a small village about a mile east of "the sockeye stream in Freshwater Bay". De Laguna (1960) clarifies that this territory originally belonged to an independent division of the Wuckitan, the Freshwater Bay branch, and that they subsequently "inherited rights at Angoon when the Kootznahoo branch of this sib became extinct." A picture of a Tlingit man gaffing salmon in 1901 in a Freshwater Bay creek (believed to be Pavlof Creek with the waterfall in the background) is shown on Page 107 in the book "The Tlingit Indians" by Emmons (1991).

Shroeder and Kookesh (1990) report that a cannery was operated in Pavlof Harbor in 1889 and 1919-1923. The waterfall was incorporated into cannery operations. The Federal Works Progress Administration constructed a concrete fish ladder with 14 step pools on the left side (looking downstream) of the falls in 1935. Prior to the construction of this fish ladder it is believed that the cascading falls at the outlet of the lake was a partial

barrier to upstream migrating salmon (Barto and Cook 1999). The USFS installed an aluminum "Alaskan steep pass" inside the concrete fish ladder in 1986. The USFS also installed an "Alaskan steep pass" fishpass on a waterfall in the main inlet tributary in 1987. The intent of this upper fishpass is to provide coho salmon with better access to upriver spawning and rearing habitat.

The State of Alaska currently holds title to the land around the lake and outlet but the majority of the watershed is on National Forest System Lands. Large portions of the watershed were clearcut logged in years 1977 to 1981, 1987 and 1988, and 1991 to 1993. Roads now traverse the watershed and provide vehicle access with Hoonah. The area immediately around the lake and outlet has not been logged and it is not possible to drive to the lake or outlet.

Barto and Cook (1999) conducted a limnology and fisheries investigation of Pavlof Lake in 1997. Their study evaluated rearing conditions for sockeye salmon and applied empirical sockeye production models developed by Koenings and Burkett (1987) to identify potential management or enhancement strategies for optimizing sockeye production. They concluded that the lake's sockeye carrying capacity was relatively small, that sockeye production was near capacity, and that coho production might be compromised if the lake was fertilized in an attempt to boost sockeye production.

Coho salmon spawners from Pavlof were a brood source for an ADF&G, Fisheries Rehabilitation Enhancement and Development Division's, effort to boost recreational sport fishing opportunities in the Juneau area. Between 1987 and 1996, 109 coho salmon adults were killed during egg take operations in late-September in the upper reaches of the main inlet stream. These eggs were incubated in Juneau and the fry released into Juneau area streams.

The Pavlof area is not in either a Federal or State customary and traditional use area. Subsistence use data ranked the Pavlof Lake area as high use by residents of Tenakee Springs and middle use by residents of Hoonah and Angoon (ADF&G, Subsistence Division, Tongass Land Management Plan Revision, 1996). Pavlof has not been listed on the annual subsistence/personal use permits issued by ADF&G and sockeye harvests have only been reported in two years (Figure 6).

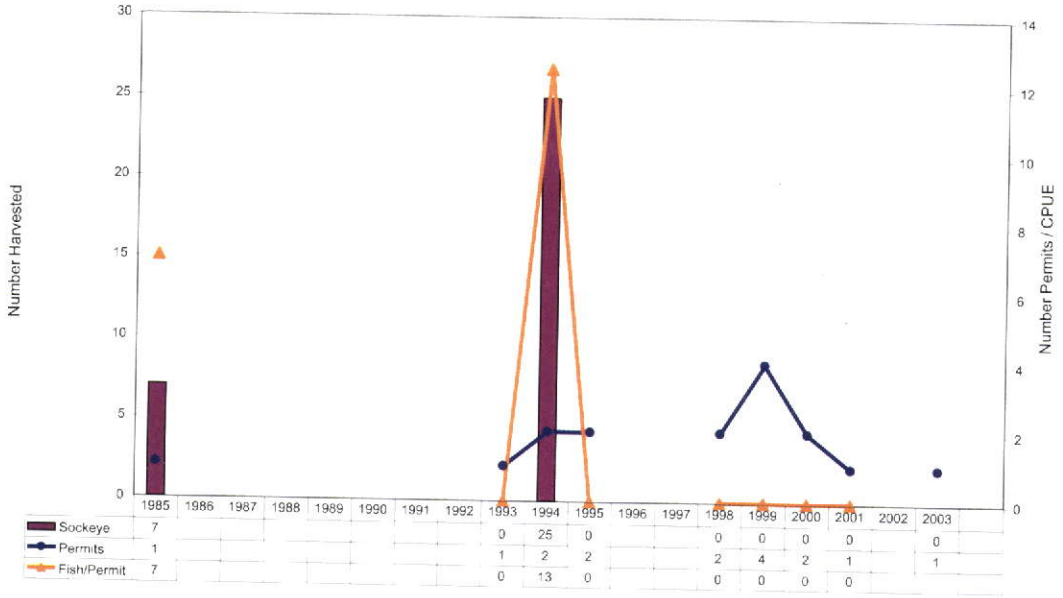

Figure 6. Subsistence/personal use effort and harvest of sockeye salmon at Pavlof from 1985 to 2003 as reported on permits returned to ADF&G (ADF&G, Division of Commercial Fisheries, Alexander Database, May, 2005).

Sockeye salmon returning to Pavlof Lake would be harvested in Icy Strait and Chatham Strait area fisheries. Rich and Ball (1933) reported six years of sockeye harvested in Freshwater Bay starting with 25,000 harvested in 1900 and ending with 30 in 1923 (Table 2). Sockeye harvests in Freshwater Bay since statehood (1959) are between zero and 1,582 fish (Table 3). These seine openings target pink salmon.

Pavlof Harbor is a popular anchorage for pleasure boaters and sport fishing for trout and salmon is also popular in the area. However, the sport harvest of sockeye salmon in the Pavlof area is small. Only nine sockeye salmon were reported harvested in the Pavlof Lake, Pavlof Bay, Freshwater Bay area from 1977 to 1999 (ADF&G, Division of Sport Fish, Statewide Harvest Survey database, 2002). The saltwater sport effort and harvests are trending upward in the area (Table 5).

Aerial and foot escapement surveys since 1980 have usually counted around 200 sockeye salmon in the Pavlof River (Table 6). The run timing of sockeye and pink salmon overlaps and the tannin stained water makes counting fish difficult.

Hoktaheen

Hoktaheen Lake (58°03.236' N, 136°30.381' W) is located on the northwest side of Yakobi Island, about 25 km from the community of Pelican (Figure 1). The lake is at

about 51 m in elevation and drains a watershed area of about 20 km^2. It has a surface area of 67 ha, an average depth of about 20 m, and a maximum depth of about 50 m (Conitz and Cartwright 2002a; Figure 7). There are two lakes in the Hoktaheen Lake system. A short, 0.5 km, stream connects the larger, upper lake to the lower lake. The outlet of the smaller lake flows about 2 km to Hoktaheen Cove on the Gulf of Alaska.

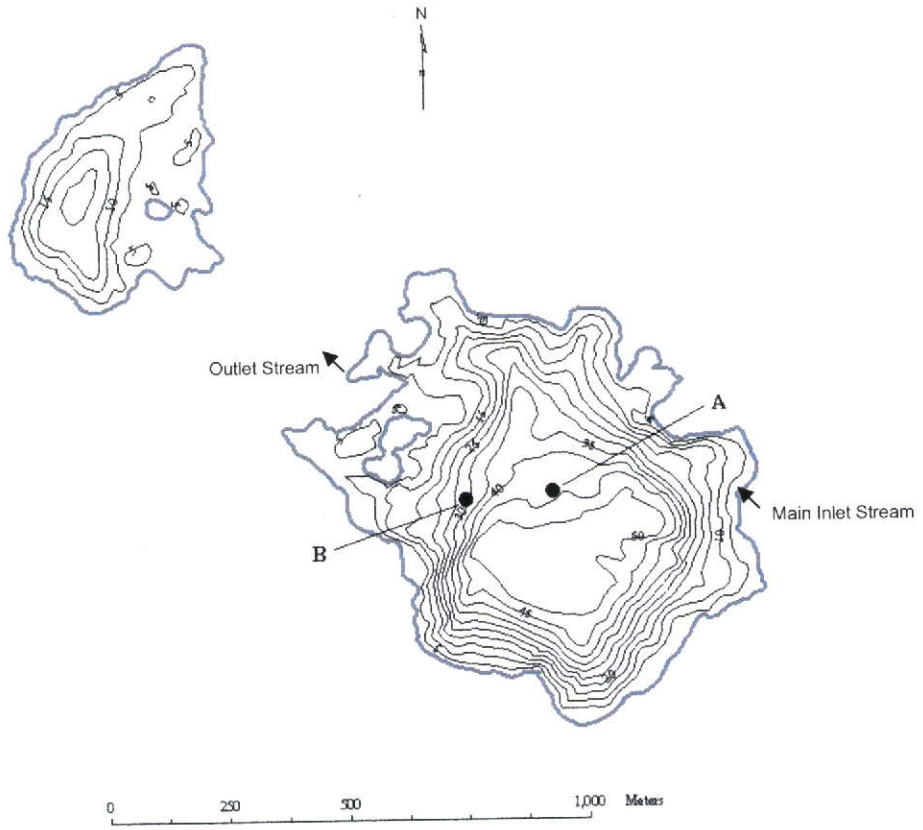

Figure 7. Bathymetric map of Hoktaheen Lakes with 5 m depth contours, location of limnology sampling stations A and B, and locations of the Main Inlet Stream and outlet.

The Hoktaheen Lake system on Yakobi Island is within the traditional subsistence harvesting and gathering area claimed by the Hoonah people. Goldschmidt and Hass (1946) believed that the Hoktaheen Cove area belonged to the T'akdeintaan clan. They reported that "Hoktaheen Creek is a good sockeye stream" and that smokehouses were located there. The summer camps and smoke houses are now gone but subsistence fishers from Hoonah, Pelican, and Elfin Cove continue to make day or overnight trips to Hoktaheen Cove. Travel is often by skiff and weather and sea conditions must be good for safe boating.

Hoktaheen Lake is in the West Chichagof Yakobi Wilderness Area. The entire watershed is on National Forest land.

The reported subsistence harvest of sockeye salmon at Hoktaheen peaked at 1,720 fish in 1997 (Figure 8). Harvests vary with effort and the fish-per-permit, a rough indicator of annual abundances, is variable but steady. The public has expressed concern about aggressive fishing and possible overharvest in the Hoktaheen subsistence and personal use fisheries (Conitz and Cartwright 2002a).

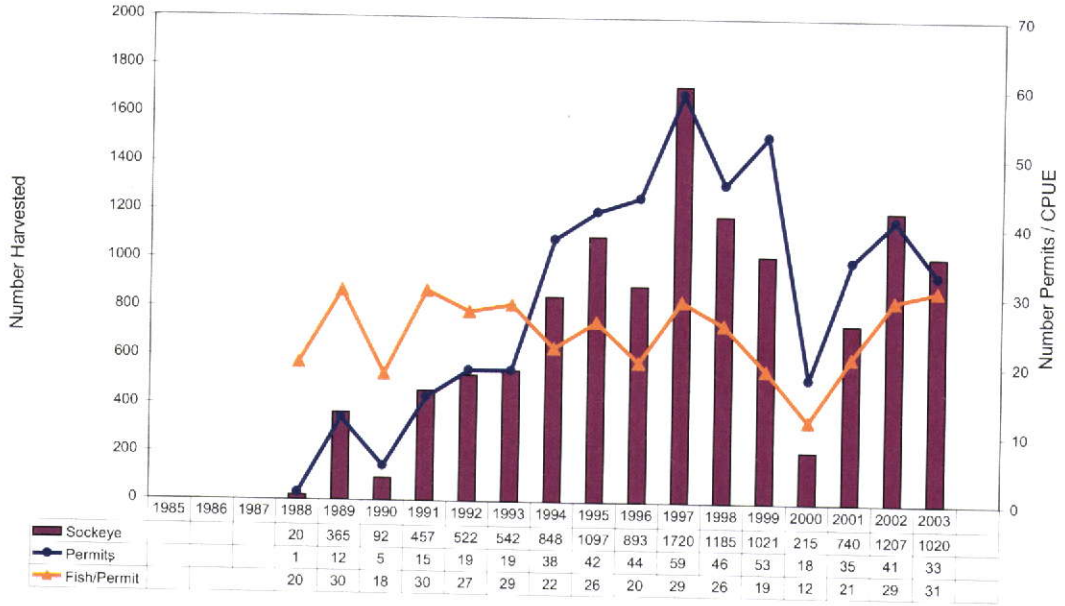

Figure 8. Subsistence/personal use effort and harvest of sockeye salmon at Hoktaheen from 1985 to 2003 as reported on permits returned to ADF&G (ADF&G, Division of Commercial Fisheries database, 2005).

The historical commercial harvests of sockeye salmon in Hoktaheen Cove decreased significantly (Spearman's rho rank correlation trend test, at $\rho = 0.05$; Conover 1980) from around 10,000 fish a year in years 1905 to 1910 to around 2,000 fish a year by 1927 (Rich and Ball 1933; Table 2). We don't know what the sockeye harvest was from then to statehood but less than 1,800 have been harvested since statehood and the last time Hoktaheen Cove was open to seining was in 1973 (Table 3). There have not been seine fisheries operating in the immediate vicinity of Hoktaheen Cove in recent years, but those at the mouth of Lisianski Inlet, in Icy Straits, and southward along the outside Chichagof Island coast may incidentally harvest some sockeye salmon returning to Hoktaheen Lake.

The sport harvest of sockeye salmon from Hoktaheen is unknown; the ADF&G, Division of Sport Fish Division's statewide harvest survey has received less than three responses a year from those fishing in the Hoktaheen area. However, the area around Hoktaheen

Cove has become increasingly popular for sport fishing since the late 1980s (Conitz and Cartwright 2002a).

Escapement surveys have only been done in a few years at Hoktaheen. These aerial surveys have been directed at indexing escapements of pink salmon and no surveys were flown in the 1980s and early 1990s. Recent counts have been in the hundreds and historical counts were in the thousands (Table 6).

OBJECTIVES

The project objectives for 2003 were:

1) Use an outlet weir/trap and mark-recapture methods to estimate the annual escapement of sockeye salmon into Neva and Pavlof Lakes such that the estimated coefficient of variation is less than 10%.

2) Use mark-recapture methods to index the number of sockeye spawning in Neva, Pavlof, and Hoktaheen Lake's main inlet streams, Neva Lake's beach spawning area, and upper Hoktaheen Lake's outlet stream such that the estimated coefficient of variation is less than 20%.

3) Estimate the age, length, and sex composition of the sockeye escapements into Neva, Pavlof, and Hoktaheen Lakes such that the estimated coefficient of variation is less than 10%.

4) Collect baseline data on in-lake productivity of Neva, Pavlof, and Hoktaheen Lakes using established ADF&G limnological sampling procedures which may include zooplankton sampling and vertical sub-surface temperature, dissolved oxygen, and light intensity measurements.

5) Describe the distribution of spawning sockeye salmon in the Pavlof Lake system using radio tags.

METHODS

Adult Sockeye Escapement Assessment

Neva

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 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 2002a; Conitz and Cartwright 2003b). In 2002, a non-project person pulled pickets on the weir during a peak passage day and the mark-recapture study was needed to estimate the total escapement (Van Alen 2004).

Independent mark-recapture studies were also done to index the abundance of sockeye spawning in Neva Lake's main inlet stream (MIS) and beach spawning "index" areas. Visual counts of sockeye in, and out, of the MIS and beach index areas were also made in conjunction with these mark-recapture trips. These survey counts and mark-recapture estimates might prove to be a good predictor of the total escapement but three or more years of paired observations are needed to develop expansion factors (Heinl et al. 2000).

Weir.

Upstream migrating adult salmon, trout, and char were counted as they were passed upstream out of a trap mounted on the face of a weir installed across Neva Creek. The weir was placed about 80 meters downstream from the lake. The weir was operated continuously from June 4 through October 9. The weir trap was checked for fish early each morning and checked at other times during the day and evening as needed to pass fish without delaying their upstream migration. Separate counts were kept for adult and jack sockeye and coho salmon. Jacks were identified by their visual appearance.

The weir 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 design specifications). Seven bipods were used to support the 16.5 m wide weir. Upstream migrating salmon, trout, and char were counted and sampled from a 152.5 x 244 x 244 cm (5 x 8 x 8 ft), bear proof, trap attached to the front of the weir. The maximum gap between pickets in the weir and trap was 2.54 cm. 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 in the side of the trap and into quiet water created with a short sand bag and picket diversion. A plastic fish tub, 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 was used to initially record the number of adult and jack, marked and unmarked, salmon, trout, and char passed upstream. Five mL of a 20:80, Clove oil:ethyl alcohol (Everclear), mix in 40+ L fresh river water was used to lightly anesthetize the sockeye or coho salmon that were marked or scale sampled (Anderson et al. 1997).

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. Recording thermometers (Onset Computer Corporation, "Optic StowAway Temp" loggers[1]) were also deployed on July 27, 2002 at the weir gauging station and in the lower part of the main inlet stream. These thermographs were placed about three inches below the streambed in short aluminum pipes. They recorded the temperature every four hours at 0000, 0400, 0800, 1200, 1600, and 2000 hour. Two additional thermographs were deployed at depths of 1 m and 13 m at Station A on May 23, 2002.

Weir-to-Spawning Ground Mark-Recapture Escapement Estimate.

The total escapement of sockeye salmon into Neva Lake was also estimated by marking fish at the weir and sampling them for marks on the spawning grounds. A running average of half (50%) of the sockeye salmon counted through the weir each day were marked with an adipose fin clip and either a left axillary clip for the first third of the run, a left ventral clip for the middle third of the run, or a dorsal clip for the last third of the run. The dates for each third of the run were approximated as start-of-run to July 27, July 28 to August 10, and August 11 to end-of-run based on each third of the 2002 run. These finclips involved severing the entire adipose fin, the entire 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'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.

Eleven recapture "trips" on 20 different days were then made between August 11 and October 29 to examine sockeye salmon for marks in the main inlet stream (MIS) and beach spawning areas. Fish were captured in the MIS using dip nets and in the beach study areas with a 21 m long by 3.66 m deep beach seine with 3.81 cm square mesh of No. 9 knotted Nylon web. Hand punches were used to give an opercule mark to all fish examined so fish were only sampled once (i.e., sampled without replacement). The opercule marking was also part of a separate "spawning area mark-recapture" study that I describe in the next section. Again, counts were kept of the number of adult and jack sockeye salmon marked and examined for marks.

Partially stratified maximum likelihood Darroch estimates, and standard errors, were calculated with the Stratified Population Analysis System (SPAS) software (Arnason et

[1] Product names used in this report are included for scientific completeness but do not constitute product endorsement.

al. 1995). The SPAS software also computes Darroch, Schaefer, and Pooled Peterson estimates as described in Seber (1982). The Darroch model is probably the best estimator for this type of 2-sample mark-recapture data that is stratified by both date of marking and location and date of recapture (Schaefer 1951; Seber 1982). The Darroch model provides abundance estimates for the MIS and beach recovery strata when the number of recovery strata is less than or equal to the three release strata. When the number of recovery strata exceed the number of release strata only the number in each release strata are estimated. 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 will probably be less than for the pooled Peterson estimator and the use of the Darroch model is indicated. The chi-square test statistic was used to test the hypothesis of equal probability of marked fish when pooling recovery strata (Bernard and Hansen 1992). Separate analyses were completed for adults, jacks, and adults and jacks combined. I used different combinations of pooled or dropped release strata, and comparisons with Schaefer, pooled Peterson, and independent Jolly-Seber estimates (see "Stream and Beach Mark-Recapture Escapement Indexing" section below) to examine the robustness of the Darroch abundance estimates.

Stream and Beach Mark-Recapture Escapement Indexing.

Mark and recapture trips were made to index jack and adult sockeye salmon in both the main inlet stream (MIS) and the beach "index" areas. The stream "index area" was between the lake and 58°24.561' N, 135°23.967' W. All the sockeye observed in the MIS stayed within the study area except for a few that eventually moved into two small side tributaries when water levels increased late in the season (Figure 9). The stream gradient is steeper and boulders and bedrock dominate the substrate upstream from the index area. The beach study area included two small (one set) beach spawning areas on the Southeast side of the lake between about 58°23.981' N, 135°24.246' W and 58°23.949' N, 135°24.348' W. We assume that the sockeye spawning in the MIS and beach study areas are separate populations given their geographic and temporal separation. In 2002 there was no sockeye that were marked in the MIS and recovered or marked on the beach and recovered in the MIS.

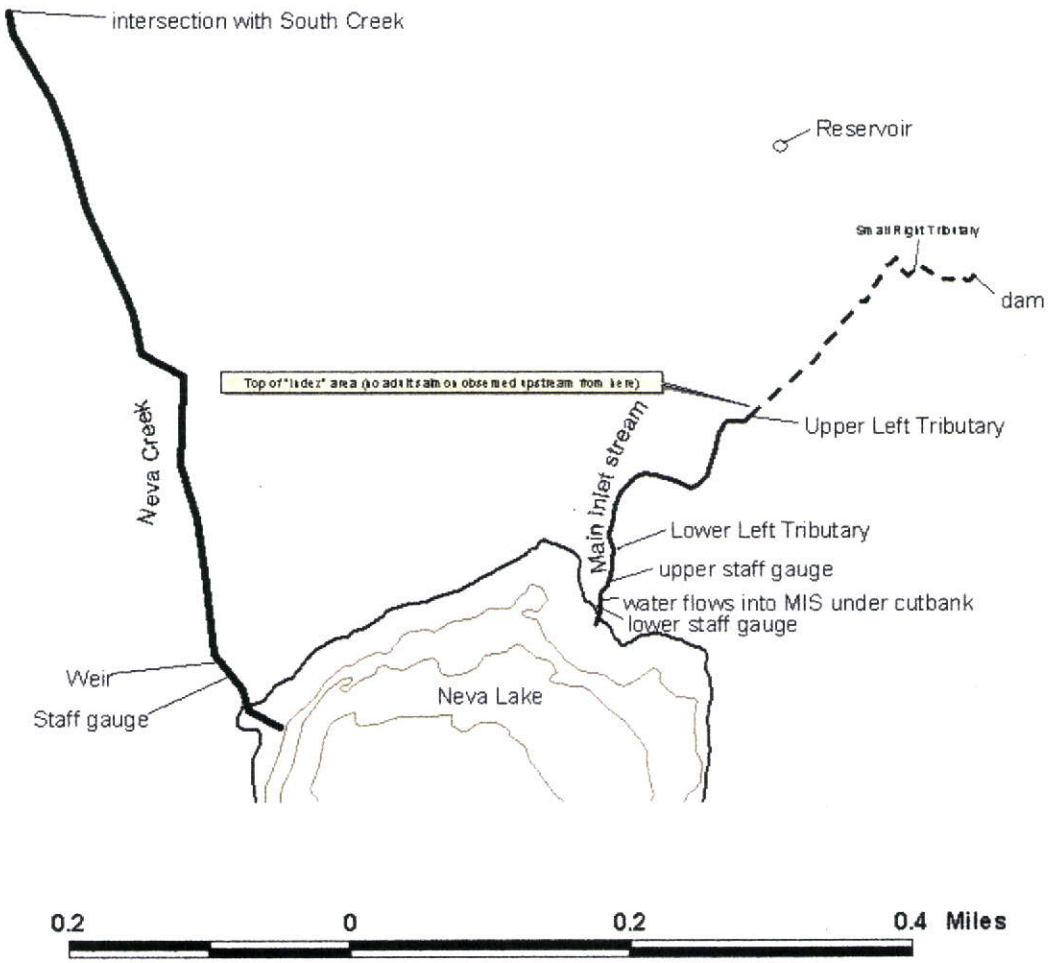

Figure 9. Map of the North end of Neva Lake showing the main inlet stream and Neva Creek.

All sockeye captured on both the marking (day 1) and recapture (day 2) days were given that trip's mark – a left opercule punch unique for that trip. Round, square, heart, rectangle, and triangle punch shapes were used. All sockeye captured on the day 2 were also given that trip's right opercule punch to facilitate sampling without replacement. Records were kept, for jacks and adults, of the number of sockeye salmon with and without opercule marks. The following instructions were printed on the back of the data form:

Key to Spawning Mark-Recapture Sampling:

On Day One:

IF	Then	and Record
fish has the current trip's left opercule punch	Disregard	nothing
fish has no left opercule punch	mark with the current trip's left opercule punch	"New (no opercule mark)"
fish has only left opercule punch(es) from earlier trip(s)	mark with the current trip's left opercule punch	recapture in appropriate column

On Day Two:

IF	Then	and Record
fish has the current trip's right opercule punch	Disregard	nothing
fish has no left opercule punch	mark with the current trip's left **and** right opercule punch	"New (no opercule mark)"
fish has only left opercule punch(es) from earlier trip(s)	mark with the current trip's left **and** right opercule punch	recapture in appropriate column
fish has current trip's left opercule punch w/ or w/o punch(es) from earlier trip(s)	mark with the current trip's right opercule punch	recapture of current trips mark

All sampling was done without replacement by disregarding a fish with that trips left opercule punch on day 1 and disregarding a fish with that trips right opercule punch on day 2. Data for both the "Weir Mark-Recapture" and "Spawning Mark-Recapture" sampling was recorded on the same data form (Appendix A).

A two-sample Peterson estimate was calculated for each trip and used in a modified Jolly-Seber (Schwarz et al. 1993) estimator for multiple mark-recaptures in an open population (J. Blick, ADF&G, personal communication 1998; Cook 1998; Crabtree 2001; Conitz and Cartwright 2003a). The "Blick-modified" Jolly-Seber estimator requires three or more recovery events and recaptures of fish marked from an earlier trip (Seber 1982). The notation and formulas used to calculate the Blick-modified Jolly-Seber estimates are provided in the column headings of Table 12 and the parametric bootstrap method used to calculate standard errors is detailed in Conitz and Cartwright (2005).

Seven trips were completed in the MIS index area from August 11 to October 5 and four trips were completed in the beach index area from October 3 to October 29.

Visual Survey Counts.

Foot and boat surveys were conducted in conjunction with the MIS and beach mark-recapture trips. Each observer had hand tally counters and kept their own counts of live sockeye salmon. In the MIS study area there were times when each observer counted live

sockeye salmon when walking upstream and then when walking downstream. In the lake, each observer counted live sockeye salmon in, and out of, the beach study area from a skiff that was slowly motored around the perimeter of the lake. Each observer's counts were recorded separately and when averaged they provide an estimate of what proportion of all the sockeye observed are in the study area(s). Separate counts were not made for adult and jack sockeye salmon.

Foot surveys were also done periodically through the summer to count the number of live sockeye and coho salmon in Neva Creek from the weir to the confluence with South Creek. We also kept counts of the number of coho salmon observed in the MIS and lake.

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). Approximately every seventh jack or adult sockeye salmon was systematically sampled through the course of the run. 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 length was measured to the nearest millimeter by laying each fish on a fixed ruler in a "measuring trough". 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).

After the scales were aged, the scale samples were stratified by age and week as described by Conitz and Cartwright (2003a). Let n be the total number of samples aged, n_k be the number of samples in stratum k, and N be the estimated escapement. The proportion of each stratum k was calculated by

$$\hat{p}_k = \frac{n_k}{n} \tag{1}$$

The estimated standard error was derived from the binomial formula with correction for finite population size (Thompson 1992, p. 35-36):

$$SE(\hat{p}_k) = \sqrt{\left(1 - \frac{n}{N}\right)\frac{\hat{p}_k(1-\hat{p}_k)}{n-1}} \tag{2}$$

The estimated mean length and associated standard error for stratum k were calculated as the sample mean of a simple random sample (Thompson 1992, p. 42-43):

$$\bar{y}_k = \frac{1}{n_k}\sum_{i=1}^{n_k} y_{ki}\text{, and } SE(\bar{y}_k) = \sqrt{\frac{1}{n_k}}\sqrt{\left(\frac{1}{n_k - 1}\right)\sum_{i=1}^{n_k}(y_{ki} - \bar{y}_i)^2} \tag{3}$$

Harvest Monitoring.

We made a special effort this season to estimate the subsistence/personal use and sport fishing effort and harvest in the Neva Creek and South Creek area. From June 23 to July 31 and from August 11 to 28 a project employee talked with all individuals and groups observed fishing in the area. Basic harvest, and effort data was recorded on a daily data form (Appendix A.3.). The weir operators route to and from the weir site, two or more times a day, also enabled routine monitoring of fishing activities in and off the mouth of South Creek. Fishing activities in Neva Creek were monitored during routine foot surveys of the creek (see the "Visual Survey Counts" section above) and by occasional visits to the traditional fishing site in the lower part of the creek. An effort was made to get harvest and effort information by speaking directly with the participants but this was not always possible.

Pavlof

The original project plan was to index the annual escapement of Pavlof sockeye salmon by marking and recapturing them on the spawning ground. Plans were expanded in 2002 and 2003 to also estimate the total escapement by marking fish as they enter the lake through a trap installed at the top the existing fishpass and recapturing them on the spawning grounds. We assumed that sockeye migrate into Pavlof Lake both up the fish ladder and up the falls so the trap count was not anticipated to be the total escapement estimate.

This was the second season of fishery technician work for the Hoonah Indian Association crew working at Pavlof Lake. Project activities continued to focus on camp and field safety and procedures, how to capture, handle, and sample fish, and basic record keeping. The crew lived in a floating wall tent anchored near the outlet of Pavlof Lake (see Appendix B of Van Alen 2004 for the technical design specifications).

Recording thermometers were deployed on July 29, 2002 at the top of the fish pass, at the lower end of the MIS, and at 1m and 6m depths at limnological sampling Station A (Figure 4). They were programmed to record the temperature every four hours at 0000, 0400, 0800, 1200, 1600, and 2000 hour.

Trap-to-Spawning Ground Mark-Recapture Estimate.

Upstream migrating salmon were captured and counted as they were passed upstream of a trap installed at the top of the outlet fishpass. Separate counts were not made for adults and jacks. Trapped sockeye (and coho) salmon were marked with an adipose fin clip. The trap was in place from June 12 to August 28.

The aluminum channel and picket trap design was the same as used at the Neva weir. Salmon that ascended the fish pass were led through a "V" channel and picket entrance

into the trap. The trap and V-entrance were on bedrock and sand bags were placed end-to-end around the outside of both.

The crew did boat surveys around the lake and foot surveys up the main inlet stream in 2002 and 2003 and only found sockeye spawning in the lower part of the main inlet stream. The lower approximately 300 meters of the main inlet stream, and fish schooled immediately off the mouth of the MIS, was designated the MIS study area again this season. The upper end of the study area was at 57°50.468' N, 135°03.211' where there was a logjam extending across the river. Both left and right forks of the main inlet stream are included in the MIS study area but water only flows out the left fork at high water levels. A few sockeye salmon were observed immediately upstream of the MIS study area but the highest concentration of fish was clearly within the study area.

Five, two-day, mark-recapture, trips were done between July 25 and August 20 to examine sockeye salmon for marks in the MIS study area. A 21 m long by 3.66 m deep beach seine with 3.81 cm square mesh and No. 9 knotted Nylon web was used to catch the sockeye salmon. in a sequence of sets from upstream to downstream. Hand punches were used to give an opercule mark to all fish examined as part of the "Stream Mark-Recapture Escapement Indexing" study (see below). These opercule marks enabled us to "sample without replacement". A pooled Peterson model was used to estimate the total escapement.

Stream Mark-Recapture Escapement Indexing.

"Stream mark and recapture" trips were done in conjunction with the "trap to spawning ground" mark and recapture trips described above. Thus, five, two-day, mark-recapture trips were done in the MIS index area between July 25 and August 20.

All sockeye captured on both the marking (day 1) and recapture (day 2) days were given a unique opercule punch for that "trip". All sockeye captured on the day 2 were also given an opercule punch. Records were kept of the number of new fish marked on both days and the number of day 1 recaptures on day 2. All sampling was done without replacement by disregarding a fish with that trips' left opercule punch on day 1 and disregarding a fish with that trips' right opercule punch on day 2. I used the modified Jolly-Seber method described for Neva Lake to estimate the total number of sockeye spawning in the MIS index area.

Visual Survey Counts.

Foot surveys were conducted in conjunction with the MIS mark-recapture indexing trips. The number of live sockeye salmon in the MIS index area were made on July 13, 21, 25, 31, August 5 and 26. Unfortunately, no counts were made during the August 12-13 or August 19-20 trips. Each observer made their own counts during two passes of the MIS index area - one walking upstream and one walking downstream. Sockeye were schooled off the mouth of the MIS in July but we were unable to count them due to poor water clarity, glare, and the way they moved in and out of view. No attempt was made to count

sockeye salmon outside of the MIS index area since no sockeye were observed spawning anywhere in the lake or lake outlet and it took too much time to count the few sockeye spawning upstream of the index reach.

Age, Sex, and Length Sampling.

Adult sockeye salmon were sampled at the trap for age (scales), sex, and length data. The sampling plan called for the crew to sample every third sockeye salmon they passed upstream of the trap. Sampling, processing, and analysis procedures were the same as described above for the Neva Lake samples.

Radio Tagging.

Sixteen sockeye salmon and eight coho salmon were radio tagged at the outlet trap in 2003. The study design called for radio tagging approximately one out of every 60 sockeye passed through the weir. The radio tags (transmitters) were manufactured by Advanced Telemetry Systems. The Model F1845 transmitters were bottle shaped, weighed 24 g, and were 51 mm long and 20 mm in diameter with a 30.5 cm long wire antenna. Their pulse rate was 65 min^{-1}. Inserting these "esophageal" transmitters involved threading the antenna through a 3 x 20 cm plastic tube and using this tube to gently push the transmitter through the fish's mouth and into the stomach. The antenna was left sticking out of the mouth. Tagged fish were measured for mid-eye-to-fork length then tagged and released quickly to minimize handling stress. Tagged fish were watched till they swam out of sight above the trap for any evidence of tag loss or handling mortality. Tracking of radio tagged fish was done on foot in conjunction with the mark-recapture studies in July and August and from a fixed wing survey on September 26, 2003.

Hoktaheen

Field studies in 2001 (Conitz and Cartwright 2002a) and 2002 (Van Alen 2004) found sockeye spawning in an inlet stream on the East side of the upper (larger) lake (58°03.379' N, 136°30.973' W) and in the upper section of the stream that connects the two lakes. Spawning was observed in the inlet stream the first three weeks in September and in the outlet stream the last two weeks in September. Based on this information we planned our fieldwork for the month of September.

Stream Mark-Recapture Escapement Indexing.

Project personnel camped at upper Hoktaheen Lake from September 3 to 28, 2003. They completed six mark-recapture "trips" to the upper Hoktaheen Lake's MIS "index area" (this stream flows into the north west side of the lake). Three trips were attempted to the outlet index area but stormy weather and high water prevented completing the third trips recovery day. The MIS index area included sockeye schooling immediately off the mouth of the stream and extended upstream to a bedrock section of the stream at

58°03.897' N, 136°30.951' W. Few sockeye were observed spawning above this MIS index area. The index study area in the outlet stream extended from the outlet of the upper lake at 58°03.370' N, 136°30.939' W downstream about 0.2 km. Again few sockeye salmon were observed spawning downstream from the index area. Dip nets were used to capture sockeye salmon in the MIS and a 21 m long by 3.66 m deep beach seine with 3.81 cm square mesh of No. 9 knotted Nylon web was used to capture sockeye off the mouth of the MIS and in the outlet.

All sockeye captured on both the marking and recapture days were given a uniquely shaped opercule punch. All sockeye captured during the recapture day(s) were also given a right opercule punch. Records were kept of the number of new fish marked on both days and the number of day 1 recaptures on day 2. All sampling was done without replacement by disregarding a fish with that trips' mark on the marking day and disregarding a fish with that trips' right opercule punch on the recapture day(s).

Simple Peterson estimates were calculated for each day that fish were examined for marks. The abundance of sockeye salmon was estimated on September 5, 6, 7, and 18 in the MIS index area and on September 7 and 18 in the outlet index area.

Visual Survey Counts.

Foot and boat surveys were conducted in conjunction with the mark-recapture indexing trips. Counting procedures were the same as those used at Neva Lake.

Age, Sex, and Length Sampling.

Adult sockeye salmon were sampled for age (scales), sex, and length data from both the MIS and outlet study areas. The sampling, processing, and analysis procedures were the same as described above for the Neva Lake samples.

Limnology Sampling

Limnology sampling was done on the following dates in each lake:

Neva Lake	Pavlof Lake	Hoktaheen Lake
6/4	6/11	7/11
8/20	7/25	9/6
10/6	8/26	
10/28	10/30	

Two buoy and anchor sampling stations, "Station A" and "Station B", were setup over the deepest part of each lake (Table 7). Zooplankton samples were taken at both stations and physical data at Station A.

Table 7. Latitude and longitude coordinates for the limnological sampling stations in Neva, Pavlof, and Hoktaheen Lakes, 2002.

Lake	Station A	Station B
Neva	58°24.219' N, 135°24.258' W	58°24.270' N, 135°24.290' W
Pavlof	57°50.605' N, 135°02.672' W	57°50.629' N, 135°02.921' W
Hoktaheen	58°03.236' N, 136°30.381' W	58°03.292' N, 136°30.630' W

Light, Temperature, and Dissolved Oxygen Profiles

The subsurface light intensity was measured at 0.5-meter intervals from just below (5 cm) the surface down to one percent of the surface light reading using a Licor LI-250 submarine photometer. Readings were in μmol s^{-1} m^{-2}. The vertical light extinction coefficient (K_d) and euphotic zone depth (EZD) was calculated following procedures described by Conitz and Cartwright (2002a). The vertical light extinction coefficient (K_d) was calculated as the slope of the light intensity (natural log of percent subsurface light) versus depth. The euphotic zone depth (EZD) was calculated as EZD = $4.6205/K_d$ and is defined as the part of the lake where photosynthesis is possible. Water transparency was also measured with a 20 cm diameter Secchi disk (Koenings *et al.* 1987).

All vertical temperature and dissolved oxygen (DO) measurements were made with a Yellow Springs Instruments Model 58 DO meter and probe. The Model 58 DO meter was calibrated each trip by taking the average value of two 30 ml Winker titrations from a water sample collected at 1 m (Koenings *et al.* 1987). Readings were taken at one-meter intervals down to 20 meters then at five-meter intervals to within 2 m of the bottom or 50 meters, whichever is less. Dissolved oxygen (DO) readings were in mg L^{-1} and temperature readings were in °C. The mg L^{-1} DO readings were converted to percent O_2 saturation using the following formula:

$$\%O_2 saturation = (DO/(0.004399 * temp^2 - 0.381784 + 14.571252)) * 100 \qquad (4)$$

The parameters in this equation were computed from data presented in Table 6.1 of Wetzel and Likens (2000). This regression of the solubility of O_2 on temperature had a correlation coefficient of 0.9998. No adjustment was made for altitude (barometric pressure) since Neva, Pavlof, and Hoktaheen Lakes are all at relatively low elevations of 44, 5, and 51 meters, respectively.

Zooplankton Composition and Density

A vertical zooplankton tow was made at both stations each trip. A 0.5 m diameter, 153 um mesh, 1:3 conical net was used. Vertical tows were pulled from 2 m from the bottom of the lake at 0.5 m sec^{-1}. Specimens were preserved in neutralized 10% formalin (Koenings *et al.* 1987). Zooplankton samples were analyzed at the ADF&G Commercial

Fisheries Division Limnology Laboratory in Soldotna, Alaska. The identification to genus or species, enumeration, and density and biomass estimates were done as described by Conitz *et al.* 2002 and Koenings *et al.* 1987). The zooplankton density (individuals per m^2 surface area) and biomass (weight per m^2 surface area) were estimated by species and by the sum of all species (referred to as total zooplankton density or biomass).

RESULTS

Adult Sockeye Escapement Assessment

Neva

Weir and Weir-based Mark-Recapture Estimate of Total Escapement.

The adult salmon weir was operated continuously on the outlet of Neva Lake from June 4 to October 9 in 2003 (Table 8; Appendix B.1). The weir count totaled 11,099 sockeye salmon – 9,248 adults and 1,851 jacks. The first sockeye passed on June 22 and the last passed on October 8. Counts of other species totaled 1,691 coho salmon (including 113 jacks), 553 pink salmon, 2 chum salmon, 27 cutthroat trout, 279 Dolly Varden char, and 1 sculpin.

The only time that the weir operator suspected that salmon were able to pass through the weir uncounted was on September 1 when he found that six pickets had been pulled on the face of the trap sometime between 0930 and 1500 hr. The weir operator had passed 119 sockeye salmon that morning and there were no fish behind the weir at 1530 hr and only 27 sockeye to pass at 1830hr. There was a surge in migration around this time with 1,329 sockeye, 12% of the total weir count, counted through the weir during the 5-day period from August 30 to September 3.

The midpoint of the adult and jack escapement was August 7 and 5. The middle 80% of the escapement of adults and jacks was between July 21 and September 2 and July 18 and September 5.

Table 8. Daily counts, and estimated number, of sockeye salmon that passed through the Neva Creek weir, 2003.

	Daily Weir Counts:			Estimated Daily Escapement:			Estimated Cum. Daily Escapement:						
Date	Adults	Jacks	Total	Adults	Jacks	Total	Adults	%	Jacks	%	Total	%	Comments:
6/4	0	0	0	0	0	0	0	0%	0	0%	0	0%	weir fish light at 1050hr, no adult salmon observed
6/5	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%	
6/7	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%	
6/9	0	0	0	0	0	0	0	0%	0	0%	0	0%	cleared logjam between staff gauge and weir
6/10	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%	
6/12	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%	
6/14	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%	
6/16	0	0	0	0	0	0	0	0%	0	0%	0	0%	
6/17	0	0	0	0	0	0	0	0%	0	0%	0	0%	
6/18	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%	
6/20	0	0	0	0	0	0	0	0%	0	0%	0	0%	
6/21	0	0	0	0	0	0	0	0%	0	0%	0	0%	
6/22	1	0	1	1	0	1	1	0%	0	0%	1	0%	
6/23	4	1	5	4	1	5	5	0%	1	0%	6	0%	
6/24	0	0	0	0	0	0	5	0%	1	0%	6	0%	
6/25	5	1	6	5	1	6	10	0%	2	0%	12	0%	
6/26	2	0	2	2	0	2	12	0%	2	0%	14	0%	
6/27	0	0	0	0	0	0	12	0%	2	0%	14	0%	
6/28	0	0	0	0	0	0	12	0%	2	0%	14	0%	
6/29	4	2	6	4	2	6	16	0%	4	0%	20	0%	
6/30	1	1	2	1	1	2	17	0%	5	0%	22	0%	
7/1	0	0	0	0	0	0	17	0%	5	0%	22	0%	
7/2	15	11	26	15	11	26	32	0%	16	1%	48	0%	
7/3	29	14	43	29	14	43	61	1%	30	2%	91	1%	
7/4	63	36	99	63	36	99	124	1%	66	3%	190	2%	
7/5	21	11	32	21	11	32	145	2%	77	4%	222	2%	
7/6	2	4	6	2	4	6	147	2%	81	4%	228	2%	
7/7	0	3	3	0	3	3	147	2%	84	4%	231	2%	
7/8	0	0	0	0	0	0	147	2%	84	4%	231	2%	
7/9	0	0	0	0	0	0	147	2%	84	4%	231	2%	
7/10	0	0	0	0	0	0	147	2%	84	4%	231	2%	
7/11	0	0	0	0	0	0	147	2%	84	4%	231	2%	
7/12	0	0	0	0	0	0	147	2%	84	4%	231	2%	
7/13	0	0	0	0	0	0	147	2%	84	4%	231	2%	
7/14	8	11	19	8	11	19	155	2%	95	5%	250	2%	
7/15	1	2	3	1	2	3	156	2%	97	5%	253	2%	
7/16	0	0	0	0	0	0	156	2%	97	5%	253	2%	
7/17	0	0	0	0	0	0	156	2%	97	5%	253	2%	
7/18	359	137	496	359	137	496	515	5%	234	12%	749	7%	
7/19	225	136	361	225	136	361	740	8%	370	19%	1,110	10%	
7/20	21	24	45	21	24	45	761	8%	394	20%	1,155	10%	
7/21	914	221	1,135	914	221	1,135	1,675	18%	615	32%	2,290	20%	
7/22	61	31	92	61	31	92	1,736	18%	646	34%	2,382	21%	
7/23	3	4	7	3	4	7	1,739	18%	650	34%	2,389	21%	
7/24	0	0	0	0	0	0	1,739	18%	650	34%	2,389	21%	
7/25	1	0	1	1	0	1	1,740	18%	650	34%	2,390	21%	
7/26	2	4	6	2	4	6	1,742	18%	654	34%	2,396	21%	
7/27	1	3	4	1	3	4	1,743	18%	657	34%	2,400	21%	
7/28	49	18	67	49	18	67	1,792	19%	675	35%	2,467	22%	
7/29	1,758	156	1,914	1,758	156	1,914	3,550	37%	831	43%	4,381	38%	
7/30	217	14	231	217	14	231	3,767	40%	845	44%	4,612	40%	
7/31	59	17	76	59	17	76	3,826	40%	862	45%	4,688	41%	
8/1	122	20	142	122	20	142	3,948	42%	882	46%	4,830	42%	
8/2	170	22	192	170	22	192	4,118	43%	904	47%	5,022	44%	
8/3	8	1	9	8	1	9	4,126	44%	905	47%	5,031	44%	
8/4	4	7	11	4	7	11	4,130	44%	912	47%	5,042	44%	
8/5	333	34	367	333	34	367	4,463	47%	946	49%	5,409	47%	
8/6	112	13	125	112	13	125	4,575	48%	959	50%	5,534	49%	
8/7	71	8	79	71	8	79	4,646	49%	967	50%	5,613	49%	
8/8	279	32	311	279	32	311	4,925	52%	999	52%	5,924	52%	1 sculpin
9/9	91	12	103	91	12	103	5,016	53%	1,011	53%	6,027	53%	
8/10	4	3	7	4	3	7	5,020	53%	1,014	53%	6,034	53%	
8/11	4	0	4	4	0	4	5,024	53%	1,014	53%	6,038	53%	
8/12	195	29	224	195	29	224	5,219	55%	1,043	54%	6,262	55%	
8/13	131	12	143	131	12	143	5,350	57%	1,055	55%	6,405	56%	

(continued)

Table 8. (continued)

	Daily Weir Counts:			Estimated Daily Escapement:			Estimated Cum. Daily Escapement:						
Date	Adults	Jacks	Total	Adults	Jacks	Total	Adults	%	Jacks	%	Total	%	Comments:
8/14	580	73	653	580	73	653	5,930	63%	1,128	59%	7,058	62%	
8/15	632	84	716	632	84	716	6,562	69%	1,212	63%	7,774	68%	
8/16	201	32	233	201	32	233	6,763	71%	1,244	65%	8,007	70%	1 dead pink salmon on weir, 36 tissue samples
8/17	67	17	84	67	17	84	6,830	72%	1,261	66%	8,091	71%	
8/18	6	2	8	6	2	8	6,836	72%	1,263	66%	8,099	71%	
8/19	2	1	3	2	1	3	6,838	72%	1,264	66%	8,102	71%	
8/20	3	3	6	3	3	6	6,841	72%	1,267	66%	8,108	71%	
8/21	40	8	48	40	8	48	6,881	73%	1,275	66%	8,156	72%	
8/22	58	25	83	58	25	83	6,939	73%	1,300	68%	8,239	72%	
8/23	48	19	67	48	19	67	6,987	74%	1,319	69%	8,306	73%	
8/24	13	4	17	13	4	17	7,000	74%	1,323	69%	8,323	73%	
8/25	47	17	64	47	17	64	7,047	74%	1,340	70%	8,387	74%	
8/26	54	13	67	54	13	67	7,101	75%	1,353	70%	8,454	74%	
8/27	29	16	45	29	16	45	7,130	75%	1,369	71%	8,499	75%	
8/28	36	14	50	36	14	50	7,166	76%	1,383	72%	8,549	75%	
8/29	10	5	15	10	5	15	7,176	76%	1,388	72%	8,564	75%	
8/30	524	97	621	524	97	621	7,700	81%	1,485	77%	9,185	81%	
8/31	138	35	173	138	35	173	7,838	83%	1,520	79%	9,358	82%	
9/1	72	24	96	292	98	390	8,130	86%	1,618	84%	9,748	86%	294 fish likely passed uncounted by non-project person (see Table 11)
9/2	514	53	567	514	53	567	8,644	91%	1,671	87%	10,315	91%	
9/3	81	28	109	81	28	109	8,725	92%	1,699	88%	10,424	91%	
9/4	34	15	49	34	15	49	8,759	93%	1,714	89%	10,473	92%	
9/5	39	18	57	39	18	57	8,798	93%	1,732	90%	10,530	92%	
9/6	41	14	55	41	14	55	8,839	93%	1,746	91%	10,585	93%	
9/7	36	13	49	36	13	49	8,875	94%	1,759	91%	10,634	93%	
9/8	49	20	69	49	20	69	8,924	94%	1,779	92%	10,703	94%	
9/9	53	23	76	53	23	76	8,977	95%	1,802	94%	10,779	95%	
9/10	21	17	38	21	17	38	8,998	95%	1,819	94%	10,817	95%	
9/11	18	7	25	18	7	25	9,016	95%	1,826	95%	10,842	95%	
9/12	17	7	24	17	7	24	9,033	95%	1,833	95%	10,866	95%	
9/13	62	13	75	62	13	75	9,095	96%	1,846	96%	10,941	96%	
9/14	38	10	48	38	10	48	9,133	96%	1,856	96%	10,989	96%	
9/15	25	6	31	25	6	31	9,158	97%	1,862	97%	11,020	97%	
9/16	7	4	11	7	4	11	9,165	97%	1,866	97%	11,031	97%	1 left axillary and 2 unmarked sockeye dead on weir
9/17	9	7	16	9	7	16	9,174	97%	1,873	97%	11,047	97%	
9/18	2	2	4	2	2	4	9,176	97%	1,875	97%	11,051	97%	
9/19	3	4	7	3	4	7	9,179	97%	1,879	98%	11,058	97%	
9/20	7	6	13	7	6	13	9,186	97%	1,885	98%	11,071	97%	
9/21	31	8	39	31	8	39	9,217	97%	1,893	98%	11,110	98%	
9/22	14	3	17	14	3	17	9,231	97%	1,896	98%	11,127	98%	
9/23	0	2	2	0	2	2	9,231	97%	1,898	99%	11,129	98%	
9/24	14	3	17	14	3	17	9,245	98%	1,901	99%	11,146	98%	
9/25	139	13	152	139	13	152	9,384	99%	1,914	99%	11,298	99%	
9/26	15	1	16	15	1	16	9,399	99%	1,915	99%	11,314	99%	
9/27	32	2	34	32	2	34	9,431	100%	1,917	100%	11,348	100%	1 left ventral, 1 dorsal, and 1 unmarked sockeye dead on weir
9/28	13	3	16	13	3	16	9,444	100%	1,920	100%	11,364	100%	1 marked coho dead on weir
9/29	8	4	12	8	4	12	9,452	100%	1,924	100%	11,376	100%	
9/30	2	1	3	2	1	3	9,454	100%	1,925	100%	11,379	100%	
10/1	2	0	2	2	0	2	9,456	100%	1,925	100%	11,381	100%	
10/2	5	0	5	5	0	5	9,461	100%	1,925	100%	11,386	100%	
10/3	0	0	0	0	0	0	9,461	100%	1,925	100%	11,386	100%	
10/4	2	0	2	2	0	2	9,463	100%	1,925	100%	11,388	100%	
10/5	3	0	3	3	0	3	9,466	100%	1,925	100%	11,391	100%	
10/6	0	0	0	0	0	0	9,466	100%	1,925	100%	11,391	100%	
10/7	0	0	0	0	0	0	9,466	100%	1,925	100%	11,391	100%	
10/8	2	0	2	2	0	2	9,468	100%	1,925	100%	11,393	100%	
10/9	0	0	0	0	0	0	9,468	100%	1,925	100%	11,393	100%	weir removed at 1300hr
10/10							9,468	100%	1,925	100%	11,393	100%	
Totals	9,248	1,851	11,099	9,468	1,925	11,393							

Project personnel succeeded in finclipping a running average of 50% of the adult and jack sockeye passed upstream of the weir (Appendix B.1.). There was no indication of any handling mortality associated with the counting, marking, and sampling of fish at the weir. No fresh dead (pre-spawn) salmon were observed on the face of the weir or anywhere upstream.

Sockeye salmon were sampled for these weir finclips in the main inlet stream (MIS) that flows into the Northwest end of the lake (Figure 9) on 14 occasions from August 11 to October 5 and in the beach index area on eight occasions from October 3 to October 29 (Table 9). One thousand, four hundred, and eight (49.6%) of the 2,841 sockeye examined had been finclipped at the weir.

I initially stratified this recovery data into 11 strata – 7 in the MIS index area and 4 in the beach index area (Table 9). These strata correspond to the strata used for the corresponding MIS and beach index mark-recapture study (see "Stream and Beach Mark-Recapture for Indexing Escapement" section below). Separate analyses were done for adults, jacks, and adults and jacks combined. Tests for complete mixing and equal proportions (Arnason et al. 1995) were significant at $P<0.05$ indicating that the stratified Darroch estimator should be used over a pooled Peterson estimator. Chi Square tests for equal probability of recaptures across release and recovery strata (Bernard and Hansen 1992) were always significant across release strata but not when releases were pooled into MIS and beach strata.

The optimum Darroch model for estimating total escapement is probably the one with adults and jacks combined and three release and two recovery strata (MIS and beach) which gives an estimate of 11,393 (SE 213, CV=2%; Table 10). This estimate is 294 fish (2.6%) greater than the 11,099-weir count and 197 fish greater than the pooled Peterson estimate of 11,196 (SE=183). Different combinations of pooled or dropped recovery strata, with adults and jacks separate or combined, all yielded similar estimates (Table 11).

I assumed that these 294 sockeye salmon passed through the weir uncounted on September 1 when fish were moving and weir pickets had been pulled by a non-project person. I apportioned these 294 sockeye salmon into adults and jacks based on the proportion of adults and jacks actually counted (74 adults and 24 jacks) on September 1 (Table 8).

Table 9. Mark and recapture data, and Darroch and Pooled Peterson abundance estimates using three release and 11 recovery strata, for sockeye salmon marked at the Neva Creek weir, 2003.

Marking Data: At the Neva Creek weir:				Recapture Data: Main Inlet Stream							Beach						Darroch Abundance Estimate:				Pooled Peterson Estimate:	
Marking Dates	Finclip Strata	Weir Count	Number Marked	Aug.1 1-12	Aug. 16-17	Aug. 21-22	Aug. 26-27	Sept. 4-5	Sept. 15	Oct. 5	Oct. 3 4	Oct. 7 8	Oct. 11-12	Oct. 28 29	Total	% Recaptured	Number	S.E. (Number)	Probability of Capture	S.E. (Prob. Capture)	Number	S.E. (Number)
Estimates made using 3 release and 11 recovery strata:																						
Adults																	(Complete mixing Significance = 0.00, Equal proportions significance = 0.00)					
				Number recaptured:																		
June 22 to July 27	Left Axillary	1,743	871	54	31	86	47	95	33	1	0	9	3	6	365	42%	1,768	94	0.49	0.03		
July 28 to Aug. 10	Left Ventral	3,277	1,639	12	1	13	7	22	35	14	50	109	61	93	417	25%	1,671	623	0.98	0.37		
Aug. 11 to Oct. 8	Dorsal	4,228	2,114	0	0	1	1	11	8	6	69	101	63	125	385	18%	6,418	783	0.33	0.04		
	Total	9,248	4,624	66	32	100	55	128	76	21	119	219	127	224	1,167		9,857	301			9,249	165
																	(CV = 3%)				(CV = 2%)	
				Number examined for marks and Percent Marked:																		
				117	57	161	125	271	140	37	305	439	261	422	2,335							
				56%	56%	62%	44%	47%	54%	57%	39%	50%	49%	53%	50%							
Jacks																	(Complete mixing Significance = 0.00, Equal proportions significance = 0.02)					
				Number recaptured:																		
June 22 to July 27	Left Axillary	657	329	13	19	28	33	41	9	0	0	0	0	0	143	43%	749	65	0.44	0.04		
July 28 to Aug. 10	Left Ventral	357	179	2	1	0	7	21	12	0	0	3	0	7	53	30%	192	86	0.93	0.42		
Aug. 11 to Oct. 8	Dorsal	837	418	0	1	0	0	2	1	1	4	9	7	20	45	11%	1,148	154	0.36	0.05		
	Total	1,851	926	15	21	28	40	64	22	1	4	12	7	27	241		2,089	138			1,941	77
																	(CV = 7%)				(CV = 4%)	
				Number examined for marks and Percent Marked:																		
				28	33	76	90	114	41	1	20	25	22	56	506							
				54%	64%	37%	44%	56%	54%	100%	20%	48%	32%	48%	48%							
																	Total adults and jacks from above 3x11 Darroch estimates:					
																	11,946	331			11,190	183
																	(CV = 3%)				(CV = 2%)	
Adults and Jacks Combined																	(Complete mixing Significance = 0.00, Equal proportions significance = 0.00)					
				Number recaptured:																		
June 22 to July 27	Left Axillary	2,400	1,200	67	50	114	80	136	42	1	0	9	3	6	508	42%	2,446	113	0.49	0.02		
July 28 to Aug. 10	Left Ventral	3,634	1,818	14	2	13	14	43	47	14	50	112	61	100	470	26%	2,479	549	0.73	0.16		
Aug. 11 to Oct. 8	Dorsal	5,065	2,532	0	1	1	1	13	9	7	73	110	70	145	430	17%	6,860	699	0.37	0.04		
	Total	11,099	5,550	81	53	128	95	192	98	22	123	231	134	251	1,408		11,784	308			11,196	183
																	(CV = 3%)				(CV = 2%)	
				Number examined for marks and Percent Marked:																		
				145	90	237	215	385	181	38	325	464	283	478	2,841							
				56%	59%	54%	44%	50%	54%	58%	38%	50%	47%	53%	50%							

Table 10. Mark and recapture data, and Darroch and Pooled Peterson abundance estimates using three release and two recovery strata (MIS and Beach), for sockeye salmon marked at the Neva Creek weir, 2003.

Marking Data: At the Neva Creek weir:				Recapture Data: Main Inlet Stream						Beach						Darroch Abundance Estimate:				Pooled Peterson Estimate:	
Marking Dates	Finclip Strata	Weir Count	Number Marked	Aug.1 1-12	Aug. 16-17	Aug. 21-22	Aug. 26-27	Sept. 4-5	Sept. 15	Oct. 5	Oct. 3 4	Oct. 7 8	Oct. 11-12	Oct. 28 29	Total	% Recaptured	Number	S.E. (Number)	Probability of Capture	S.E. (Prob. Capture)	Number	S.E. (Number)
Estimates made using 3 release and 2 recovery strata pooled into Main Inlet Stream and Beach:																						
Adults																						
				Number recaptured:													(Complete mixing Significance = 0.00, Equal proportions significance = 0.04)					
June 22 to July 27	Left Axillary	1,743	871							347				18	365	42%	Estimate for Main Inlet Stream spawners:					
July 28 to Aug. 10	Left Ventral	3,277	1,639							104				313	417	25%	2,008	96	0.45	0.02		
Aug. 11 to Oct. 8	Dorsal	4,228	2,114							27				358	385	18%	Estimate for Beach spawners:					
	Total	9,248	4,624							478				689	1,167		7,388	263	0.19	0.01		
				Number examined for marks and Percent Marked:													Total:					
										908				1427	2,335		9,396	187.84			9,249	165
										53%				48%	50%		(CV = 2%)				(CV = 2%)	
Jacks																						
				Number recaptured:													(Complete mixing Significance = 0.00, Equal proportions significance = 0.07)					
June 22 to July 27	Left Axillary	657	329							143				0	143	43%	Estimate for Main Inlet Stream spawners:					
July 28 to Aug. 10	Left Ventral	357	179							43				10	53	30%	875	54	0.44	0.03		
Aug. 11 to Oct. 8	Dorsal	837	418							5				40	45	11%	Estimate for Beach spawners:					
	Total	1,851	926							191				50	241		1,205	164	0.10	0.01		
				Number examined for marks and Percent Marked:													Total:					
										383				123	506		2,080	128.9			1,941	77
										50%				41%	48%		(CV = 6%)				(CV = 4%)	
																	Total adults and jacks from above 3x2 Darroch estimates:					
																	11,475	228			11,190	183
																	(CV = 2%)				(CV = 2%)	
Adults and Jacks Combined																						
				Number recaptured:													(Complete mixing Significance = 0.00, Equal proportions significance = 0.03)					
June 22 to July 27	Left Axillary	2,400	1,200							490				18	508	42%	Estimate for Main Inlet Stream spawners:					
July 28 to Aug. 10	Left Ventral	3,634	1,818							147				323	470	26%	2,655	111	0.45	0.02		
Aug. 11 to Oct. 8	Dorsal	5,065	2,532							32				398	430	17%	Estimate for Beach spawners:					
	Total	11,099	5,550							669				739	1,408		8,538	296	0.18	0.01		
				Number examined for marks and Percent Marked:													Total:					
										1,291				1,550	2,841		11,393	213.32			11,196	183
										52%				48%	50%		(CV = 2%)				(CV = 2%)	

Table 11. Estimates of the adult and jack sockeye salmon escapement into Neva Lake and main inlet stream (MIS) and beach spawning areas, 2003. The best estimate of total escapement is in bold type.

Adults and Jacks Combined:

Method	Location	Total (Adults and Jacks)	S.E.	Relative Difference from Weir Count
Weir Count	All	11,099		
Pooled Peterson (mark at weir and recapture on spawning ground)	All	11,196	183	0.9%
Darroch Mark-Recapture: (mark at weir and recapture on spawning ground)				
No Pooling (3 release and 11 recovery strata)	All	11,784	308	6.2%
Pooled into MIS and Beach	**All**	**11,393**	**213**	**2.6%**
Pooled MIS1-4, MIS5-7, Beach1-4	All	11,525	355	3.8%
Dropped MIS1,3,5,7 and Beach1,3	All	10,861	360	-2.1%
Pooled MIS1-7 and Dropped Beach1-4	All	11,411	288	2.8%
Dropped MIS1-7 and Pooled Beach1-4	All	11,641	288	4.9%
Blick-modified Jolly-Seber: (mark and recapture in MIS and beach "index" areas)				
	MIS[a]	3,315	192	
	Beach Index[b]	3,688	need	
	Beach[c]	7,784		
	Total[d]	11,099		

Adults and Jacks Separate:

Method	Location	Adults	S.E.	Jacks	S.E.	Total	S.E.
Weir Count	All	9,248		1,851		11,099	
Pooled Peterson (mark at weir and recapture on spawning ground)	All	9,249	165	1,941	77	11,190	183
Relative Difference from Weir Count		0.0%		4.9%		0.8%	
Darroch Mark-Recapture: (mark at weir and recapture on spawning ground)							
No Pooling (3 release and 11 recovery strata)	All	9,857	301	2,089	138	11,946	331
Relative Difference from Weir Count		6.6%		12.8%		7.6%	
Pooled into MIS and Beach	MIS	2,008	96	875	54	2,882	110
	Beach	7,388	263	1,205	164	8,593	310
	Total	9,396	188	2,080	129	11,475	228
Relative Difference from Weir Count		1.6%		12.3%		3.4%	
Blick-modified Jolly-Seber: (mark and recapture in MIS and beach "index" areas)							
	MIS[a]	2,417	need[e]	1,062	need[e]	3,479	need[e]
	Beach Index[b]	3,325	need[e]	381	need[e]	3,706	need[e]
	Beach[c]	6,831		789		7,620	
	Total[d]	9,248		1,851		11,099	

[a]The Jolly-Seber estimate is probably a total estimate of spawners in the MIS.
[b]The Jolly-Seber estimate is an "index" of the numbers of spawners in the Beach index area. The later spawning fish were not sampled.
[c]Estimated by subtracting the Blick-modified Jolly-Seber estimate of MIS spawners from the weir count.
[d]Weir count.
[e]Unable to calculate using the bootstrap method probably due to few recaptures in the last two samples.

Stream and Beach Mark-Recapture for Indexing Escapement.

Seven mark-recapture trips were successfully accomplished in the MIS index area and four in the beach index areas in conjunction with the weir mark-recapture study (Table 9). Modified Jolly-Seber estimates of the abundance of sockeye salmon in the MIS and beach index areas were made for adults and jacks separately and combined (Table 12). Sampling in the MIS index area extended throughout the early August through early September spawning period and these estimates should represent the total abundance of adults and jacks spawning in the MIS. The estimates made for the beach index area only represent the abundance of spawners prior to late October since the last trip was done on October 28-29 and spawning extends through November (Van Alen 2004).

Mixing between the MIS and beach index areas was negligible; none of the sockeye marked in the MIS were recaptured in the lake and only one sockeye marked on the beach on October 4 was recaptured in the MIS on October 5. Most sockeye spawned in the MIS in August and September and on the beaches in October and November.

Table 12. Modified Jolly-Seber estimates of the abundance of adult and jack sockeye salmon in Neva Lake's main inlet stream (MIS) and beach index areas, 2003.

			Peterson Estimates for each Trip:							Modified Jolly-Seber Estimates:													
Index Area, Adults or Jacks	Trip No.	Dates	Number of New Fish Marked on Day 1 (M)	Number of New Fish Marked on Day 2	Number of Recaptures on Day 2 (R)	Total Number Caught on Day 2 (C)	Peterson Estimate for Trip (N*)	SE (N*)	CV (N*)	Marks from Trip 1	Marks from Trip 2	Marks from Trip 3	Marks from Trip 4	Marks from Trip 5	Marks from Trip 6	n = Total Number Caught this Trip	m = Total Number Recaps. this Trip	Ni = Peterson Est. for this Trip	M = m*N/n	$\phi = M_{i+1} / (M-m+n)$	B = $N_{i+1} - \phi N$	B* = B log(ϕ)/(ϕ-1)
MIS, Adults	1	Aug. 11-12	88	29	59	88	131	6	4%							117	0	131	0	0.544	54	167
	2	Aug. 16-17	100	16	63	79	125	4	3%	59						116	58	125	64	0.305	196	336
	3	Aug. 21-22	93	98	64	162	235	12	5%	3	27					191	30	235	37	0.619	108	136
	4	Aug. 26-27	197	45	157	202	253	4	2%			117				242	117	253	123	0.046	345	1,111
	5	Sept. 4-5	194	86	102	188	357	16	5%			1	8			280	9	357	11	0.166	171	368
	6	Sept. 15	113	39	37	76	230	21	9%				1	30		152	31	230	47	0.010	63	289
	7	Oct. 5	22	15	7	22	65	14	22%						1	37	1	65	2			
																					Total = sum(B*) =	2,407
																					SE, CV =	[a]
MIS, Jacks	1	Aug. 11-12	17	11	11	22	34	4	11%							28	0	34	0	0.737	38	73
	2	Aug. 16-17	34	15	17	32	63	7	11%	16						49	16	63	21	0.697	117	139
	3	Aug. 21-22	40	59	19	78	161	22	14%	2	21					99	23	161	37	0.547	77	103
	4	Aug. 26-27	101	43	67	110	166	7	4%	1	1	52				144	54	166	62	0.216	285	557
	5	Sept. 4-5	65	62	15	77	321	61	19%			2	11			127	13	321	33	0.088	71	189
	6	Sept. 15	31	15	6	21	100	26	26%					6		46	6	100	13	0.000	1	
	7	Oct. 5	1	0	1	1	1	0	0%							1	0	1	0			
																					Total = sum(B*) =	1,062
																					SE, CV =	[a]
MIS, Adults and Jacks	1	Aug. 11-12	105	40	70	110	165	7	4%							145	0	165	0	0.582	90	240
	2	Aug. 16-17	134	31	80	111	186	7	4%	75						165	75	186	84	0.402	309	471
	3	Aug. 21-22	133	157	83	240	383	21	5%	5	48					290	53	383	70	0.599	185	237
	4	Aug. 26-27	298	88	224	312	415	7	2%	1	1	169				386	171	415	184	0.079	552	1,520
	5	Sept. 4-5	259	146	117	265	585	30	5%			3	19			407	22	585	32	0.144	237	537
	6	Sept. 15	144	54	43	97	322	30	9%				1	36		198	37	322	60	0.007	61	299
	7	Oct. 5	23	15	8	23	63	13	20%						1	38	1	63	2			
																					Total = sum(B*) =	3,304
																					SE, CV =	[b]
Beach, Adults	1	Oct. 3-4	97	196	43	239	534	53	10%							293	0	534	0	0.632	961	1,619
	2	Oct. 7-8	320	192	62	254	1298	126	10%	73						512	73	1,298	185	0.361	259	414
	3	Oct. 11-12	251	127	66	193	729	61	8%	21	96					378	117	729	226	0.084	478	1,292
	4	Oct. 28-29	217	191	128	319	540	23	4%	7	5	19				408	31	540	41			
																					Total = sum(B*) =	3,325
																					SE, CV =	131, 4%
Beach, Jacks	1	Oct. 3-4	3	13	0	13	55	33	60%							16	0	55	0	0.335	54	119
	2	Oct. 7-8	19	8	2	10	72	29	40%	2						27	2	72	5	1.368	44	38
	3	Oct. 11-12	15	16	1	17	143	73	51%	3	6					31	9	143	42	0.075	80	224
	4	Oct. 28-29	32	25	13	38	91	14	16%			3				57	3	91	6			
																					Total = sum(B*) =	381
																					SE, CV =	[a]
Beach, Adults and Jacks	1	Oct. 3-4	100	209	43	252	580	59	10%							309	0	580	0	0.624	1,024	1,738
	2	Oct. 7-8	339	200	64	264	1385	133	10%	75						539	75	1,385	193	0.388	290	448
	3	Oct. 11-12	266	143	67	210	827	71	9%	24	102					409	126	827	255	0.086	659	1,502
	4	Oct. 28-29	249	216	141	357	629	27	4%	7	5	22				465	34	629	46			
																					Total = sum(B*) =	3,688
																					SE, CV =	154, 4%

[a]No standard error estimates could be obtained due to errors in bootstrap estimates.

[b]Standard error estimates could not be obtained when all seven trips were in the analysis but omitting trip seven data yielded a total estimate of 3,010 (SE=192, CV=6%).

Visual Survey Counts.

Fifty seven foot surveys were made to count sockeye salmon in Neva Creek from June 5 to August 18 (Table 13). Ten or more sockeye were only counted on five of the 52 trips made in June and July. The highest count was made on July 18 when 114 live and 37 dead sockeye salmon were counted. The dead sockeye had died trying to navigate past a shallow water section in the upper part of the creek. The higher counts were generally timed with increased passage of fish through the weir.

Table 13. Foot survey counts of live sockeye salmon in Neva Creek, 2003

Date	Weir to Drive-in	Drive-in to Fish Site	Fish Site	Fish Site to South Creek	Dead	Comments
Jun-05			0		0	
Jun-07	0	0	0	0	0	several large new blow down trees
Jun-09			0			
Jun-11		0	0	0	0	
Jun-12			0			
Jun-13			0			
Jun-14			0			3 sockeye seen from Lower S. Creek bridge at high tide
Jun-15	0	0	0	0	0	
Jun-16			0			
Jun-17		0	0	0	0	
Jun-18			0			
Jun-19	0	0	0	0	0	
Jun-20			1		1	evidence of eagle kill at fish site
Jun-21	0	0	0	0	2	evidence of two eagle kills just below fish site
Jun-22			5			all under the same log at lower end of fish site
Jun-23	2	1	5	0	0	
Jun-24	0	0	2		0	
Jun-25			1		0	
Jun-26	1	1	0		0	
Jun-27			2		0	
Jun-28			2		0	
Jun-29		0	1	0	12	dead were eagle kills, partially eaten, 25-50m above S. Creek confluence
Jun-30			0			
Jul-01	0	0	0		0	
Jul-02			16		0	
Jul-03	3	0	0	0	1	carcasses from June 29 are gone - wolf tracks
Jul-04			10	15	4	4 eagle kills 50m below weir
Jul-05	2	0	0	0	0	
Jul-06			0		0	
Jul-07	0	0	0		0	
Jul-08			0		0	
Jul-09			0		0	
Jul-10			0		0	
Jul-11			0	0	0	about 550 sockeye in S. Creek between Neva Creek and road corner
Jul-12			0		0	
Jul-13			0		0	about 300 fish below lower S. Creek bridge at high tide - most are sockeye
Jul-14	6	1	0	0	18	
Jul-15			0		0	
Jul-16			0		0	about 700 sockeye, and a few pink, salmon in S. Creek within 300m of Neva
Jul-17			0		0	
Jul-18	105	0	9		37	Dead were due to stranding in low water in upper section.
Jul-19			0			
Jul-20			0		0	
Jul-22			20		0	66 sockeye heads at Fish Site from subsistence harvest
Jul-23			1		0	
Jul-24	1		4			bears have eaten the dead sockeye, 200 pink and 200 sockeye holding in S. Creek
Jul-25			2		0	
Jul-26			2		0	
Jul-27			2	18	0	watched 18 swim into Neva Creek in 15min., 120 waiting to go
Jul-28			4		0	
Jul-31			9		0	20 pink salmon at Fish Site, 50 sockeye and 150 pink at mouth of Neva Creek
Aug-02			10		0	10 pink salmon at Fish Site
Aug-04			12		0	15 pink salmon at Fish Site
Aug-05			12		0	15 pink salmon at Fish Site
Aug-07			11		1	10 pink salmon at Fish Site, 50 sockeye and 150 pink at mouth of Neva Creek
Aug-09			25		1	5 pink salmon at Fish Site
Aug-18			35		0	20 pink salmon at Fish Site

Visual survey counts were made for sockeye salmon in the MIS index area on 15 occasions and in the lake on 16 occasions (Table 14). Total counts approached 10% of the 11,393 estimated escapement in the October lake surveys but complete MIS and lake surveys between late-August and mid-September are probably the best for indexing the total escapement of these two populations.

We found it difficult to count sockeye salmon on and off the beach index areas since they would spook offshore and mix with sockeye milling in the lake and both groups had to be counted simultaneously. This makes expanding the abundance estimate for the beach index areas to an abundance estimate for the entire lake difficult as is done at Sitkoh Lake (Conitz and Cartwright 2003a).

Table 14. Visual counts of sockeye salmon in Neva Lake's main inlet stream (foot surveys) and lake (boat surveys), 2003.

		Main Inlet Stream			Area of Lake														
Date	Observer	count down	count up	MIS Total	Off Mouth of MIS	North	Near Outlet	N.W.	N.E.	S.W.	S.E.	Rest of Lake	South "Index"	South Non-index	South Total	Lake Total	Grand Total	Percent of Total Esc. (11,099)
Jul-13	Lonn		0	0	0					- partial lake survey -								
Jul-26	Lonn		0	0	20					- partial lake survey -								
Aug-01	Lonn		0	0	50					- partial lake survey -								
Aug-04	Lonn		0	0	50					- partial lake survey -								
Aug-07	Lonn		62	62	60					- partial lake survey -								
Aug-10	Lonn		111	111	10					- partial lake survey -								
Aug-11	James		129	129	0					- partial lake survey -								
	Lonn		101	101	15					- partial lake survey -								
	Average		115	115	8					- partial lake survey -								
Aug-12	James		135	135	20	52		13	18	0	8	-			4	115	250	
	Lonn		139	139	30	50		13	28	0	11	-			12	144	283	
	Average		137	137	25	51		13	23	0	10	-			8	130	267	2%
Aug-16	James		181	181														
	Lonn		180	180	55					- partial lake survey -								
	Average		181	181	55					- partial lake survey -								
Aug-17	James		146	146	75	7		0	30	1	18	-			45	176	322	
	Lonn		138	138	90	8		0	40	0	18	-			130	286	424	
	Average		142	142	83	8		0	35	1	18	-			88	231	373	3%
Aug-21	James		166	166														
	Lonn		154	154	90					- partial lake survey -								
	Average		160	160	90					- partial lake survey -								
Aug-22	James		257	257	50	0	0	0	30	0	20	-			99	199	456	
	Lonn		252	252	95	0	0	0	2	0	20	-			100	217	469	
	Van Alen		236	236	45	0	0	0	2	0	16	-			61	126	362	
	Average		248	248	63	0	0	0	11	0	19	-			87	181	429	4%
Aug-26	James		350	350	100	61	37	0	65	2	25	-			169	459	0 809	
	Lonn		337	337	120	147	36	0	75	1	44	-			160	583	920	
	Schultz		274	274	127	249	45	0	72	0	52	-			150	695	969	
	Average		320	320	116	152	39	0	71	1	40	-			160	579	899	8%
Aug-27	James		367	367														
	Lonn		334	334														
	Schultz		322	322														
	Average		341	341														
Sep-04	James		476	476														
	Lonn		519	519														
	Average		498	498														
Sep-05	Lonn		476	476														
	Pfiehl		450	450														
	Average		463	463														
Sep-07	Lonn				150	40						-	65	285	350	540	540	5%
Sep-15	Lonn	262	284	273														
	Rickards	170	223	197														
	Van Alen	258	262	260														
	Average	230	256	243														
Sep-29	Lonn		86	86														
			86	86														
Oct-03	Gallant				-	-		-	-	-	-	465			458	923	923	
	Kroiz				-	-	-	-	-	-	-	430			450	880	880	
	Average				-	-	-	-	-	-	-	448			454	902	902	8%
Oct-04	Gallant				-	-	-	-	-	-	-	250			540	790	790	
	Kroiz				-	-	-	-	-	-	-	175			488	663	663	
	Average				-	-	-	-	-	-	-	213			514	727	727	7%
Oct-05	Gallant	14	12	13	63					- partial lake survey -								
	Kroiz	14	11	13	63					- partial lake survey -								
	Average	14	11	13	63					- partial lake survey -								
Oct-07	Gallant		61	61	-	-	-	-	-	-	-	140			748	887	948	
	Kroiz		55	55	-	-	-	-	-	-	-	186			538	704	759	
	Average		58	58	-	-	-	-	-	-	-	163			643	795	853	8%
Oct-08	Gallant				25	51	0	0	114	0	66	-			632	888	888	
	Kroiz				30	60	0	0	96	0	93	-			588	865	865	
	Average				28	56	0	0	105	0	79	-			610	877	877	8%
Oct-11	Gallant				81	26	0	26	102	75	96	-			750	1,156	1,156	
	Kroiz				45	30	0	45	85	75	75	-			578	933	933	
	Average				63	28	0	36	94	75	86	-			664	1,045	1,045	9%
Oct-12	Gallant				75	24	0	19	28	100	79	-			900	1,225	1,225	
	Kroiz				60	30	0	45	85	125	55	-			550	950	950	
	Average				68	27	0	32	57	113	67	-			725	1,088	1,088	10%
Oct-28	Gallant	0	0	0	0	12		0	26	83	27	-	271	420	691	839	839	
	Van Alen	0	0	0	0	14	20	0	21	95	36	-	268	281	549	675	675	
	Average	0	0	0	0	13	20	0	23	59	32	-	270	351	621	788	788	7%

Age, Sex, and Length Composition

Ninety-five percent of the Neva sockeye escapement were "one check", age-1.-, fish aged 1.2 (71%), 1.1 (jacks, 18%), and 1.3 (4.8%, Table 15). The sex composition was 54% males.

Table 15. Age composition of sockeye salmon in the Neva Lake escapement, 2003.

	Brood Year and Age Class						
	2000	1999	1999	1998	1998	1997	
	1.1	1.2	2.1	1.3	2.2	2.3	Total
June 22 - July 12							
All Fish							
Sample Size	8	12		1			21
Percent	38.1	57.1		4.8			100.0
Std. Error	10.4	10.6		4.5			
Escapement	88	132		11			231
July 13 - 19							
All Fish							
Sample Size	50	48		7			105
Percent	47.6	45.7		6.7			100.0
Std. Error	4.6	4.6		2.3			
Escapement	419	402		59			879
July 20 - 26							
All Fish							
Sample Size	24	68	1	4			97
Percent	24.7	70.1	1.0	4.1			100.0
Std. Error	4.2	4.5	1.0	2.0			
Escapement	318	902	13	53			1,286
July 27 - August 2							
All Fish							
Sample Size	20	201	2	13	5	1	242
Percent	8.3	83.1	0.8	5.4	2.1	0.4	100.0
Std. Error	1.7	2.3	0.6	1.4	0.9	0.4	
Escapement	217	2,181	22	141	54	11	2,626
August 3 - 9							
All Fish							
Sample Size	17	76	1	1	1	1	97
Percent	17.5	78.4	1.0	1.0	1.0	1.0	100.0
Std. Error	3.7	4.0	1.0	1.0	1.0	1.0	
Escapement	176	787	10	10	10	10	1,005
August 10 - 16							
All Fish							
Sample Size	29	146	2	4	4	2	187
Percent	15.5	78.1	1.1	2.1	2.1	1.1	100.0
Std. Error	2.5	2.9	0.7	1.0	1.0	0.7	
Escapement	307	1,546	21	42	42	21	1,980

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Table . (Page 2 of 2).

	Brood Year and Age Class						
	2000	1999	1999	1998	1998	1997	
	1.1	1.2	2.1	1.3	2.2	2.3	Total
August 17 - 23							
Sample Size	8	20	2	2			32
Percent	25.0	62.5	6.3	6.3			100.0
Std. Error	7.3	8.2	4.1	4.1			
Escapement	75	187	19	19			299
August 24 - 30							
Sample Size	10	41	2	1	1	2	57
Percent	17.5	71.9	3.5	1.8	1.8	3.5	100.0
Std. Error	4.9	5.8	2.4	1.7	1.7	2.4	
Escapement	154	632	31	15	15	31	879
August 31 - Sept. 6							
All Fish							
Sample Size	26	89	3	7	8	1	134
Percent	19.4	66.4	2.2	5.2	6.0	0.7	100.0
Std. Error	3.2	3.8	1.2	1.8	1.9	0.7	
Escapement	215	735	25	58	66	8	1,106
Sept. 7 - 13							
All Fish							
Sample Size	10	14	2	7	4	1	38
Percent	26.3	36.8	5.3	18.4	10.5	2.6	100.0
Std. Error	6.8	7.5	3.5	6.0	4.8	2.5	
Escapement	94	131	19	66	37	9	356
Sept. 14 - 20							
All Fish							
Sample Size	9	2	1	1	3		16
Percent	56.3	12.5	6.3	6.3	18.8		100.0
Std. Error	12.0	8.0	5.9	5.9	9.4		
Escapement	73	16	8	8	24		130
Sept. 21 - October 11							
All Fish							
Sample Size	3	21		4			28
Percent	10.7	75.0		14.3			100.0
Std. Error	5.7	8.0		6.4			
Escapement	35	242		46			322
Combined Periods (Percentages are weighted by period escapements)							
Sample Size	214	738	16	52	26	8	1,054
Percent	19.5	71.1	1.5	4.8	2.3	0.8	100.0
Std. Error	1.1	1.3	0.4	0.6	0.4	0.3	
Escapement	2,170	7,892	168	528	250	91	11,099

The average mid-eye-to-fork length was 360 mm for the age-1.1 jacks, 508 mm for the age-1.2 fish, and 558 mm for the age-1.3 fish (Table 16, Figure 10).

Table 16. Length composition (mm) of sockeye salmon in the Neva Lake escapement, 2003.

		Brood Year and Age Class						
		2000	1999	1999	1998	1998	1997	
		1.1	1.2	2.1	1.3	2.2	2.3	Total
June 22 - July 12								
All Fish	Avg. Length	346	520		570			456
	Std. Error	5.2	4.4					19.7
	Sample Size	8	12		1			21
July 13 - 19								
All Fish	Avg. Length	360	521		558			447
	Std. Error	2.0	2.6		6.6			8.3
	Sample Size	50	48		7			105
July 20 - 26								
All Fish	Avg. Length	356	515	425	555			476
	Std. Error	1.9	2.9		2.0			7.5
	Sample Size	24	68	1	4			97
July 27 - August 2								
All Fish	Avg. Length	351	512	398	556	519	540	501
	Std. Error	4.2	1.7	37.5	5.2	4.6		3.4
	Sample Size	20	201	2	13	5	1	242
August 3 - 9								
All Fish	Avg. Length	364	505	400	585	490	580	481
	Std. Error	4.6	2.9					6.2
	Sample Size	17	76	1	1	1	1	97
August 10 - 16								
All Fish	Avg. Length	365	505	413	541	501	565	483
	Std. Error	3.6	1.8	17.5	14.3	17.5	10.0	4.1
	Sample Size	29	146	2	4	4	2	187
August 17 - 23								
All Fish	Avg. Length	373	501	423	573			468
	Std. Error	3.4	4.5	2.5	2.5			11.4
	Sample Size	8	20	2	2			32
August 24 - 30								
All Fish	Avg. Length	358	503	398	565	505	583	477
	Std. Error	3.0	3.5	12.5			7.5	8.6
	Sample Size	10	41	2	1	1	2	57

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Table 16. (Page 2 of 2).

		Brood Year and Age Class						
		2000	1999	1999	1998	1998	1997	
		1.1	1.2	2.1	1.3	2.2	2.3	Total
August 31 - Sept. 6								
All Fish	Avg. Length	369	500	398	564	517	570	477
	Std. Error	4.0	1.9	10.9	3.0	5.7		5.2
	Sample Size	26	89	3	7	8	1	134
Sept. 7 - 13								
All Fish	Avg. Length	361	488	405	542	510	600	465
	Std. Error	4.3	6.0	10.0	11.3	7.4		12.1
	Sample Size	10	14	2	7	4	1	38
Sept. 14 - 20								
All Fish	Avg. Length	362	493	410	540	513		421
	Std. Error	2.6	12.5			10.1		18.6
	Sample Size	9	2	1	1	3		16
Sept. 21 - October 11								
All Fish	Avg. Length	382	515		569			509
	Std. Error	4.4	6.5		21.6			10.8
	Sample Size	3	21		4			28
Combined Periods (Lengths weighted by period escapements)								
All Fish	Avg. Length	360	508	406	558	509	563	481
	Std. Error	1.1	0.9	5.1	3.1	3.6	6.7	2.0
	Sample Size	214	738	16	52	26	8	1054

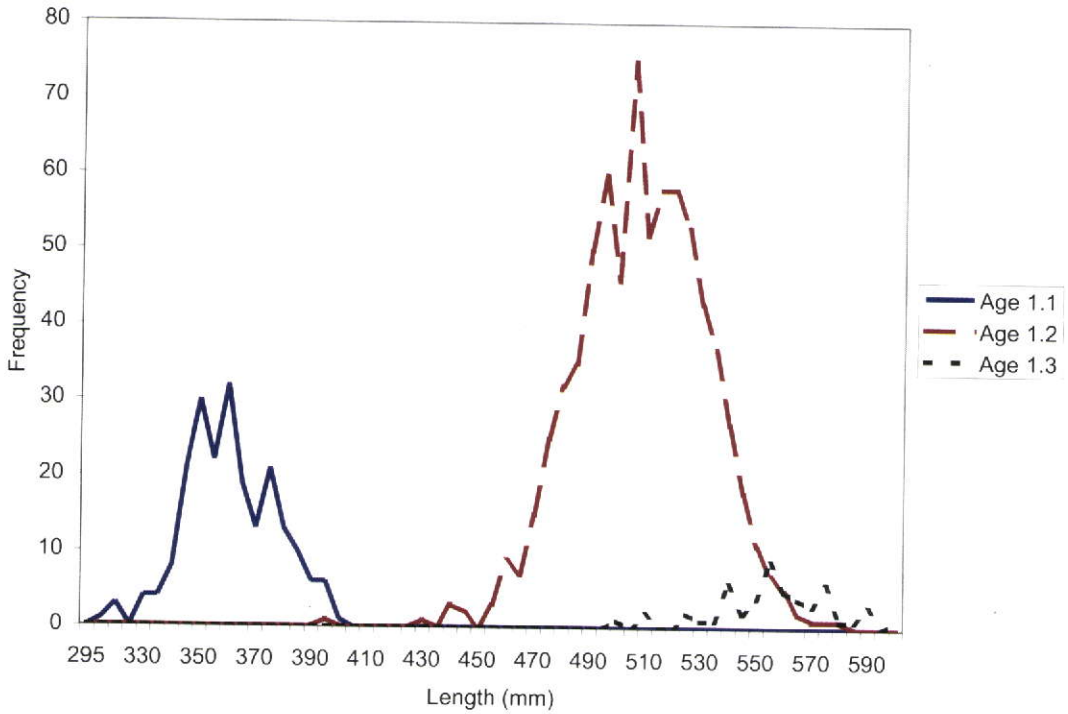


Figure 10. Length composition of the age-1.1, 1.2, and 1.3 sockeye escapement to Neva Lake, 2003. (N = 1,054)

Harvest Monitoring

The subsistence fishery for Neva sockeye salmon was open from June 1 to through July 31. The daily and annual household possession limit was 25 sockeye salmon. Daily and annual limits had been 10 fish in prior years. The fishery was open to any Alaskan resident who obtained a permit. The permits were issued by the ADF&G, Division of Commercial Fisheries. Federal regulations provide Hoonah area residents with a "Customary and Traditional Use Determination" for the subsistence harvest of salmon in this area. This distinction allows residents of Hoonah to also use rod and reel gear to take salmon in freshwater.

From June 23 to July 31 and August 21 to August 28, a project employee working regular daytime hours interviewed all sport and subsistence fishers observed in, and off the mouth of, South Creek. He also made occasional trips to the traditional subsistence fishing area in the lower part of Neva Creek. The sport harvest observed totaled 53 sockeye and 40 coho salmon and the subsistence harvest observed was 278 sockeye and 0 coho salmon (Table 17). The subsistence harvest of sockeye salmon was highest the last few days in July. Subsistence fishers targeted the Neva sockeye salmon off the mouth of South Creek using drift gillnets, at the mouth of South Creek using rod and reel gear, and in Neva Creek using gaffs. The sport harvest was taken at the mouth of South Creek using rod and reel.

Table 17. Observed sport and subsistence effort and harvest on Neva sockeye and coho salmon, June 23 to August 28, 2003.

	Sport					Subsistence[a]				
Date	Number of Contacts	Number of Individuals	Gear Hours	Sockeye Harvest	Coho Harvest	Number of Contacts	Number of Individuals	Gear Hours	Sockeye Harvest	Coho Harvest
Jun-23	2	4	4	0	0	0				
Jun-24	0					0				
Jun-25	0					0				
Jun-26	0					0				
Jun-27	0					0				
Jun-28	2	5	3	0	0	1	2	3	1	0
Jun-29	1	2	3	1	0	0				
Jul-01	1	2	3	1	0	0				
Jul-02	1	2	3	0	0	0				
Jul-03	1	2	3	1	0	0				
Jul-04	0					0				
Jul-05	1	2	3	0	0	1	1	0	0	0
Jul-06	0					2	2	1	1	0
Jul-08	3	6	8	6	0	1	2	2	0	0
Jul-09	1	4	8	4	0	0				
Jul-10	1	2	2	0	0	1	3	4	20	0
Jul-13	1	2	2	0	0	0				
Jul-14	2	6	9	0	0	0				
Jul-15	1	3	2	4	0	0				
Jul-16	1	4	3	5	0	1	1	4	0	0
Jul-17	1	4	2	0	0	0				
Jul-18	1	3	4	2	0	0				
Jul-19	4	12	11	7	0	1	2	1	7	0
Jul-20	2	3	4	3	0	0				
Jul-23	3	8	3	4	0	2	5	4	7	0
Jul-24	2	7	7	4	0	1	2	2	2	0
Jul-25	1	1	3	1	0	0				
Jul-26	1	6	4	0	0	1	4	4	30	0
Jul-27	0					1	5	10	50	0
Jul-28	1	6	0	4	0	0				
Jul-29	0					2	11	8	54	0
Jul-30	0					0				
Jul-31	3	11	8	6	0	1	4	3	106	0
Aug-11	0									
Aug-12	0									
Aug-13	0									
Aug-15	0									
Aug-16	0									
Aug-17	0									
Aug-18	0									
Aug-19	0									
Aug-20	0									
Aug-21	2	5	3	0	8					
Aug-22	0									
Aug-23	0									
Aug-24	3	6	8	0	11					
Aug-25	3	8	18	0	9					
Aug-26	3	6	16	0	2					
Aug-27	3	16	11	0	6					
Aug-28	4	10	18	0	4					
Total	56	158	175	53	40	16	44	46	278	0

[a]The State subsistence season was from June 1 through July 31, 2003.

Pavlof

Trap-to-Spawning Ground Mark-Recapture Estimate of Total Escapement

The trap was operated at the top of the fishpass at the outlet of Pavlof Lake from June 12 to August 5, August 7 to 13, and August 19 to 28. All the sockeye, coho, pink and chum salmon that ascended the fish pass on these dates were counted. Counts totaled 996 sockeye, 1,121 coho, 1,790 pink, and 144 chum salmon (Table 18). Eight hundred and seventy four Dolly Varden char and 10 cutthroat trout were also counted.

Table 18. Daily counts of salmon through the trap at the top of Pavlof Lake's outlet fishpass, 2003.

Date	Weather	Water Level (cm)	Water Temp. (°C)	Air Temp. (°C)	Daily Sockeye	Cumulative Percent Sockeye	Daily Coho	Daily Pink	Daily Chum	Daily Dolly Varden	Daily Cutthroat	Comments
Jun-12	clear				0	0%	0	0	0	0	0	trap fish light at 0900hrs.
Jun-13	partly cloudy				0	0%	0	0	0	0	0	
Jun-14					0	0%	0	0	0	0	0	
Jun-15	partly cloudy	15.8			3	0%	0	0	0	2	0	
Jun-16	overcast	16.0			0	0%	0	0	0	0	0	
Jun-17	rain	16.0			0	0%	0	0	0	0	0	
Jun-18	rain	20.0			1	0%	0	0	0	33	0	
Jun-19	partly cloudy	19.8			8	1%	0	0	0	4	0	
Jun-20	partly cloudy	19.8			1	1%	0	0	0	0	0	
Jun-21	overcast	19.5			5	2%	0	0	0	9	0	
Jun-22	partly cloudy	18.8	13		14	3%	0	0	0	2	0	
Jun-23	overcast	17.0	12		69	10%	0	0	0	4	0	
Jun-24	overcast	18.0			0	10%	0	0	0	0	0	
Jun-25	showers	18.0	17		26	13%	0	0	0	1	0	
Jun-26	partly cloudy	22.8	10	10	91	22%	0	0	0	40	0	excludes 3 retrapped sockeye
Jun-27	rain	20.0	11	17	0	22%	0	0	0	2	0	
Jun-28	showers	26.0	10	17	22	24%	0	0	0	98	0	
Jun-29	partly cloudy	22.5	10	24	1	24%	1	0	0	46	0	
Jun-30	partly cloudy	19.5	13	26	1	24%	0	0	0	10	0	
Jul-01					0	24%	0	0	0	20	0	no daily data form completed
Jul-02	overcast	18.0	14	25	50	29%	0	0	0	8	0	
Jul-03	showers	21.0	13	12	26	32%	0	0	0	13	0	24 sockeye released w/o mark
Jul-04	overcast	10.5	13	14	30	35%	0	0	0	31	0	
Jul-05	partly cloudy		12		12	36%	0	0	0	9	0	
Jul-06	overcast	18.0	12.5		9	37%	0	0	0	4	0	
Jul-07	partly cloudy	17.5	13.5		176	55%	0	0	0	36	0	excludes 8 retrapped sockeye
Jul-08	overcast	17.0			17	56%	0	0	0	32	0	includes 4 dead sockeye in trap
Jul-09	overcast	16.0	16		185	75%	1	0	0	46	0	excludes 26 retrapped sockeye
Jul-10	partly cloudy	15.8	17		16	77%	3	0	0	96	3	
Jul-11	overcast	15.8	18		20	79%	0	0	0	26		includes 2 dead sockeye in trap
Jul-12	overcast	15.0	21		75	86%	5	0	0	124		
Jul-13	clear	15.0	20		38	90%	3	1	0	44	0	excludes 5 retrapped sockeye
Jul-14	overcast	14.8	17		13	91%	2	0	0	38	0	
Jul-15	overcast	12.0	9		0	91%	0	0	0	30	0	
Jul-16					0	91%	0	0	0	0	0	no daily data form completed
Jul-17	partly cloudy	14.5	16		8	92%	1	0	0	3	0	
Jul-18					2	92%	0	0	0	16	0	no daily data form completed
Jul-19					0	92%	0	0	0	6	0	no daily data form completed
Jul-20					0	92%	0	0	0	0	0	no daily data form completed
Jul-21	partly cloudy				27	95%	25	2	1	4	2	
Jul-22	showers	15.0	15		3	95%	20	4	2	2	0	
Jul-23	overcast	17.0	15		14	97%	50	23	5	7	0	
Jul-24	overcast	15.0	15		3	97%	3	114	3	2	0	
Jul-25	overcast	13.0	15	13	4	97%	0	58	2	2	0	
Jul-26	rain	12.5	14.5		0	97%	4	117	2	1	0	
Jul-27	overcast	12.5	14.5		1	97%	2	18	2	3	0	
Jul-28	overcast	12.5	14.5		2	98%	5	27	5	5	1	
Jul-29	partly cloudy	15.0	14		2	98%	55	73	7	11	1	
Jul-30	partly cloudy	15.0	14		7	99%	77	120	11	6	3	
Jul-31	partly cloudy	16.0	14		2	99%	11	176	4	0	0	
Aug-01					0	99%	0	150	8	10	0	no daily data form completed
Aug-02	partly cloudy				1	99%	23	100	9	3	0	
Aug-03	overcast	16.0	14		2	99%	37	152	6	2	0	
Aug-04	overcast	16.0	15		3	99%	37	198	3	4	0	
Aug-05	partly cloudy	13.0	14		3	100%	58	40	0	0	0	trap closed at 1700hr
Aug-06						100%						trap not operated
Aug-07	clear	12.0	20		0	100%	15	18	1	1	0	trap operational at 1130hr
Aug-08	clear	12.0	17		0	100%	16	18	1	1	0	
Aug-09	clear	12.0	17	26	0	100%	15	94	0	0	0	
Aug-10					1	100%	22	81	0	0	0	
Aug-11	overcast	12.0	17		1	100%	29	38	0	0	0	
Aug-12	cloudy	12.0	17		1	100%	27	40	0	0	0	
Aug-13	overcast	12.0	17		0	100%	2	38	0	0	0	trap closed at 1500hr
Aug-14						100%						trap not operated
Aug-15						100%						trap not operated
Aug-16						100%						trap not operated
Aug-17						100%						trap not operated
Aug-18						100%						trap not operated
Aug-19		15.5	14.5		0	100%	0	0	0	0	0	trap operational at 1230hr
Aug-20	overcast	16.0	14.5		0	100%	80	16	0	0	0	
Aug-21	partly cloudy	17.0	14.5		0	100%	88	29	0	0	0	
Aug-22		17.0	14		0	100%	82	42	0	0	0	
Aug-23		15.0	13.5		0	100%	50	17	17	0	0	
Aug-24					0	100%	79	28	0	1	0	no daily data form completed
Aug-25		15.0	14.5		0	100%	45	18	0	0	0	
Aug-26	clear	12.5	14		0	100%	69	0	30	0	0	
Aug-27					0	100%	40	0	22	0	0	no daily data form completed
Aug-28					0	100%	38	0	3	0	0	no daily data form completed
Total					996		1,121	1,790	144	900	10	

-Daily sockeye counts include 6 that died at the trap and exclude 42 that were previously counted and retrapped. Of the 990 sockeye released all but 24 (966) were marked with an adipose fin clip.

The first sockeye salmon passed on June 15 and the last on August 12. The midpoint of the sockeye run was on July 7 and half of the sockeye escaped between July 2 and 9. The number of jack sockeye salmon was not recorded and few were observed. Six sockeye died in the trap. All but 24 (966, 97%) of the 990 sockeye passed upstream of the trap were marked with an adipose clip as part of the trap to spawning ground mark-recapture study. Forty-two marked fish were recaptured in the trap and re-released – these fish had dropped back over the falls and re-ascended the fish pass.

Five, two-day, mark-recapture trips were made in the main inlet stream "index area" between July 25 and August 20 (Table 19). Four hundred and eighty one (66%) of the 734 sockeye examined on these trips had adipose fin clip yielding a pooled Peterson escapement estimate of 1,474 (CV 2%) sockeye salmon into Pavlof Lake (Table 19). Sixty-nine percent (990 of 1,474) of the sockeye salmon used the fish pass to migrate into the lake.

Table 19. Mark-recapture estimate of the escapement of adult sockeye salmon in Pavlof Lake, 2003.

Marking Data - from Trap on Outlet Fishpass:			
Dates	Trap Count	Number Marked	Percent Marked
6/12-8/28	996	966	97%
Recapture Data - from MIS Index Area:			
Date	Number Examined	Number with Marks	Percent Marked
7/25	192	122	64%
7/26	16	10	63%
7/30	65	41	63%
7/31	113	86	76%
8/4	96	63	66%
8/5	84	53	63%
8/12	34	20	59%
8/13	37	26	70%
8/19	71	43	61%
8/20	26	17	65%
Total	734	481	66%
Pooled Peterson Estimate[a]:			
Number	S.E.	CV	
1,474	28	2%	

[a] Chapman's modification (Seber 1982):

$$\hat{N} = \frac{(M+1)(C+1)}{(R+1)} - 1 \qquad \text{var}(\hat{N}) = \frac{(M+1)(C+1)(M-R)(C-R)}{(R+1)^2(R+2)}$$

Stream Mark-Recapture for Indexing Escapement

The modified Jolly-Seber estimate of the number of sockeye salmon in the MIS index area was 1,452 (Table 20). The standard error of the estimate could not be calculated probably because of too few recaptures from Trip 3.

Table 20. Mark-recapture index of the abundance of adult sockeye salmon in Pavlof Lake's main inlet stream study area, 2003.

Peterson Estimates for each Trip:

Trip No.	Dates	Number of New Fish Marked on Day 1 (M)	Number of New Fish Marked on Day 2	Number of Recaptures on Day 2 (R)	Total Number Caught on Day 2 (C)	Peterson Estimate for Trip (N*)	SE (N*)	CV (N*)
1	July 25-26	158	47	69	116	265	15	6%
2	July 30-31	78	123	57	180	246	14	6%
3	Aug. 4-5	180	135	94	229	437	24	5%
4	Aug. 12-13	34	37	11	48	142	28	20%
5	Aug. 19-20	90	47	46	93	181	13	7%

Modified Jolly-Seber Estimates:

Trip No.	Dates	Marks from Trip 1	Marks from Trip 2	Marks from Trip 3	Marks from Trip 4	n = Total Number Caught this Trip	m = Total Number Recaps. this Trip	Ni = Peterson Est. for this Trip	M = m*N/n	ϕ = M_{i+1} / (M– μ+v)	B = Ni+1 - fN	B* = B log(f)/ (f-1)
1	July 25-26					205	0	265	0	0.137	209	565
2	July 30-31	23				201	23	246	28	0.896	217	229
3	Aug. 4-5	62	71			315	133	437	185	0.016	135	564
4	Aug. 12-13			3		71	3	142	6	0.714	80	94
5	Aug. 19-20				40	137	40	181	53	0.000	0	
										Total = sum(B*) =		1,452
										SE, CV =		[a]

[a]No standard error estimates could be obtained due to errors in bootstrap estimates.

Foot/Boat Survey Counts

No beach spawning sockeye salmon were observed in the lake. Sockeye salmon were observed milling off the main inlet stream in mid- to late-July. These fish were difficult to see and no counts were attempted. Formal survey counts were conducted in the main inlet stream on July 13, 21, 25, 31, August 5 and 26 (Table 21).

Table 21. Foot survey counts of sockeye salmon in the MIS index area, Pavlof Lake, 2003.

Date	Observer	Upstream Count	Downstream Count	Average
Jul-13	Elijah Sheakley	0		0
	Fred Gallant	0		0
	Average	0		0
Jul-21	Elijah Sheakley	0		0
	Fred Gallant	0		0
	Average	0		0
Jul-25	Ben Van Alen	0	0	0
	Fred Gallant	0	0	0
	Jerome Abbott	3	1	2
	Average	1	0	1
Jul-31	Elijah Sheakley	181	401	291
	Jerome Abbott	332	361	347
	Robbie Piehl	305	317	311
	Average	273	360	316
Aug-05	Ben Van Alen	315	320	318
	Fred Gallant	216	272	244
	Robbie Piehl	316	330	323
	Average	282	307	295
Aug-13	crew	- no counts made/recorded -		
Aug-20	crew	- no counts made/recorded -		
Aug-26	crew	0	0	0

About 300 sockeye salmon were counted in the MIS index area on both July 31 and August 5. These fish were still in the lake on July 25 and had all spawned and died by August 26.

Radio Tagging

All 16 of the sockeye salmon that were radio tagged at the trap were tracked to the lower part of the main inlet stream (Table 22). Six coho salmon were radio tagged and tracked up into the system. An fixed wing survey on September 26, 2003 located five of the coho tags in the upper part of the main inlet stream and one in the middle part of the main inlet stream (Table 22).

Table 22. Disposition of adult sockeye and coho salmon radio tagged at the outlet of Pavlof Lake, 2003.

Species	Release Date	Cum. % Sockeye Trap Count	Tracked to
Sockeye	Jun-23	10%	Lower MIS
Sockeye	Jun-25	13%	Lower MIS, just upstream from index area
Sockeye	Jun-28	24%	Lower MIS
Sockeye	Jul-02	29%	Lower MIS
Sockeye	Jul-06	37%	Lower MIS
Sockeye	Jul-06	37%	Lower MIS
Sockeye	Jul-07	55%	Lower MIS
Sockeye	Jul-08	56%	Lower MIS
Sockeye	Jul-09	75%	Lower MIS
Sockeye	Jul-09	75%	Lower MIS
Sockeye	Jul-09	75%	Lower MIS
Sockeye	Jul-17	92%	Lower MIS
Sockeye	Jul-17	92%	Lower MIS
Sockeye	Jul-30	99%	Lower MIS
Sockeye	Jul-31	99%	Lower MIS
Sockeye	Aug-02	99%	Lower MIS
Coho	Jul-22		High in MIS
Coho	Jul-30		High in MIS
Coho	Jul-30		Fish fell back down falls in bad shape
Coho	Aug-02		Outlet of Lake area
Coho	Aug-04		High in MIS
Coho	Aug-07		High in MIS
Coho	Aug-07		No signal heard
Coho	Aug-20		Middle of MIS near ponds
Coho	Aug-22		High in MIS

Age, Sex, and Length Composition

Two hundred and fourteen (92%) of the 233 Pavlof sockeye sampled at the trap for scales were age-1.3 (Table 23). Only one jack (age-1.1) sockeye salmon was sampled. The average length of the age-1.3 fish was 568 mm (Table 24).

Table 23. Age and sex composition of sockeye salmon sampled from the tbp at the top of the outlet fishpass at Pavlof Lake, 2003.

	Brood Year and Age Class				
	2003	1999	1998	1997	
	1.1	1.2	1.3	2.3	Total
June 22 - August 16					
Male					
Sample Size	1	5	112	2	120
Percent	0.4	2.2	48.9	0.9	52.4
Std. Error	0.4	1.0	3.3	0.6	3.3
Female					
Sample Size		7	98	4	109
Percent		3.1	42.8	1.7	47.6
Std. Error		1.1	3.3	0.9	3.3
All Fish					
Sample Size	1	12	214	6	233
Percent	0.4	5.2	91.8	2.6	100.0
Std. Error	0.4	1.4	1.8	1.0	

Table 24. Length composition (mm), by sex, of sockeye salmon sampled from the trap at the top of the outlet fishpass at Pavlof Lake, 2003.

		Brood Year and Age Class				
		2000	1999	1998	1997	
		1.1	1.2	1.3	2.3	Total
June 22 - August 16						
Male	Avg. Length	340	507	582	575	577
	Std. Error		5.8	2.4	5.0	3.3
	Sample Size	1	5	110	2	118
Female	Avg. Length		501	553	570	550
	Std. Error		15.5	2.8	10.8	3.0
	Sample Size		7	98	4	109
All Fish	Avg. Length	340	504	568	572	564
	Std. Error		9.1	2.1	7.0	2.4
	Sample Size	1	12	211	6	230

Hoktaheen

Stream Mark-Recapture for Indexing Escapement

Between September 4 and 26, six independent mark-recapture trips were made to the index area in upper Hoktaheen Lake's main inlet stream. Sockeye salmon were caught using seines at the mouth and dipnets in the stream. One thousand seven hundred and forty four sockeye salmon were marked, 1,872 were examined for marks, and 871 marked fish were recaptured. The modified Jolly-Seber estimate of the total sockeye abundance in the main inlet stream index area was 3,438 (CV 3%; Table 25). Most of the sockeye salmon that spawned in the main inlet stream were in or off the mouth of the stream in early-September.

Table 25. Modified Jolly-Seber estimate of the abundance of adult sockeye salmon in upper Hoktaheen Lake's main inlet stream index area, 2003.

Peterson Estimates for each Trip:

Trip No.	Dates	Number of New Fish Marked on Day 1 (M)	Number of New Fish Marked on Day 2	Number of Recaptures on Day 2 (R)	Total Number Caught on Day 2 (C)	Peterson Estimate for Trip (N*)	SE (N*)	CV (N*)
1	9/4-9/5	425	382	114	496	1,840	128	7%
2	9/8-9/9	256	323	59	382	1,640	169	10%
3	9/11-9/12	338	307	68	375	1,846	178	10%
4	9/15-9/16	244	105	48	153	769	80	10%
5	9/19	188	169	67	236	658	54	8%
6	9/26	69	58	19	77	272	43	16%

Modified Jolly-Seber Estimate:

Trip No.	Dates	Marks from Trip 1	Marks from Trip 2	Marks from Trip 3	Marks from Trip 4	Marks from Trip 5	n = Total Number Caught this Trip	m = Total Number Recaps. this Trip	Ni = Peterson Est. for this Trip	M = m*N/n	ϕ = Mt+1 / (M−μ_{t+1})	B = Ni+1 - fN	B* = B log(f)/(f-1)
1	9/4-9/5						807	0	1,840	0	0.800	167	1,829
2	9/8-9/9	228					579	228	1,640	646	0.666	754	917
3	9/11-9/12	112	120				645	232	1,846	664	0.327	165	273
4	9/15-9/16	44	32	84			349	160	769	353	0.670	142	173
5	9/19	51	24	66	56		357	197	658	363	0.221	127	245
6	9/26	5	8	3	4	34	127	54	272	116			
												Total = sum(B*) =	3,438
												SE, CV =	99, 3%

Two mark-recapture trips were completed on September 17 and 18 and September 20 and 21 in the index area in the upper third of upper Hoktaheen Lake's outlet stream. A "marking" trip was also completed on September 23 but heavy rains and high water the next day forced cancellation of the September 24 "recovery" trip. Using a conservative estimate of 100 sockeye salmon in the study area for September 24 yields a modified Jolly-Seber estimate of 325 spawners (Table 26). An estimate of 200 sockeye salmon for September 24 only increases the total estimate by 10 fish. As in the main inlet stream, there did not appear to be many new fish arriving in the index area after the first mark-recapture trip.

Table 26. Modified Jolly-Seber estimate of the abundance of adult sockeye salmon in upper Hoktaheen Lake's main outlet stream index area, 2003.

Peterson Estimates for each Trip:

Trip No.	Dates	Number of New Fish Marked on Day 1 (M)	Number of New Fish Marked on s on Day 2	Number of Recapture (R)	Total Number Caught on Day 2 (C)	Peterson Estimate for Trip (N*)	SE (N*)	CV (N*)
1	9/17-9/18	42	39	9	48	210	50	24%
2	9/20-9/21	27	59	10	69	177	37	21%
3	9/23	79				100 [a]		

Modified Jolly-Seber Estimate:

Trip No.	Dates	Marks from Trip 1	Marks from Trip 2	n = Total Number Caught this Trip	m = Total Number Recaps. this Trip	Ni = Peterson Est. for this Trip	M = m*N/n	ϕ = Mt+1 / (M-μ+v)	B = Ni+1 - fN	B* = B log(f)/(f-1)
1	9/17-9/18			81	0	210	0	0.305	113	303
2	9/20-9/21	12		86	12	177	25	0.474	16	23
3	9/23	14	23	79	37	100	47	0.000	0	
								Total = sum(B*) =		325
								SE, CV =		[b]

[a]Estimated.
[b]No standard error estimate could be calculated.

Comparison of abundance indices between years

The Peterson abundance estimate of sockeye salmon in the main inlet stream index area in early September was 1,840 in 2003 compared to 737 in 2002 and 660 in 2001 (Table 27).

Table 27. Abundance index of sockeye salmon in Hoktaheen Lake's main inlet stream from the first two-day mark-recapture trip made in early-September in 2001, 2002, and 2003.

Year	Date Marked	Number Marked	Date Examined	Number Examined for Marks	Number Recaptured	Peterson Estimate	SE	CV%
2001	9/3	178	9/4	132	35	660	83	13%
2002	9/5	312	9/6	242	102	737	45	6%
2003	9/4	425	9/5	496	114	1,840	128	7%

Foot/Boat Survey Counts

Boat and foot surveys were made to count live sockeye adults in the main inlet stream and outlet index areas on days when mark-recapture sampling was done (Table 28). No beach spawners were observed in either the upper or lower Hoktaheen Lake in surveys

conducted on August 20, September 6, and September 18 in 2002 (Van Alen 2004) and only 46 sockeye salmon were observed in a September 9, 2003, boat survey of upper Hoktaheen Lake. These fish were observed along the south shore of the upper lake but were not obviously homing to a beach spawning area(s). The lake is stained dark from tannin and it is difficult to see salmon if they are more than one or two meters deep.

Table 28. Boat and foot survey counts of live adult sockeye salmon in Hoktaheen Lake, 2003.

				Main Inlet Stream			Outlet Stream		
Date	Water Level	Observer	Lake	Count Down	Count Up	Total	Count Down	Count Up	Total
Sep-04	normal	Ben Van Alen		497		497	18		18
		Elijah Sheakley		363		363	23		23
		Fred Gallant		283		283			
		Average		381		381	21		21
Sep-05	normal	Elijah Sheakley		432		432			
		Fred Gallant		384		384			
		Robbie Piehl		387		387			
		Average		401		401			
Sep-08	high	Elijah Sheakley		363		363			
		Fred Gallant		374		374			
		Jerome Abbott		419		419			
		Robbie Piehl		391		391			
		Average		387		387			
Sep-09	high	Elijah Sheakley		591		591			
		Fred Gallant		478		478			
		Jerome Abbott		534		534			
		Robbie Piehl	46	498		498			
		Average	46	525		525			
Sep-11	high	Elijah Sheakley		421		421			
		Fred Gallant		464		464			
		Jerome Abbott		520		520			
		Robbie Piehl		451		451			
		Average		464		464			
Sep-12	high	Elijah Sheakley		504		504			
		Fred Gallant		533		533			
		Jerome Abbott		533		533			
		Average		523		523			
Sep-15	normal	Elijah Sheakley		458		458			
		Fred Gallant		398		398			
		Jerome Abbott		388		388			
		Average		415		415			

Table 28. (Continued)

Date	Water Level	Observer	Lake	Main Inlet Stream Count Down	Main Inlet Stream Count Up	Main Inlet Stream Total	Outlet Stream Count Down	Outlet Stream Count Up	Outlet Stream Total
Sep-16	normal	Elijah Sheakley		314		314			
		Fred Gallant		298		298	38		38
		Jerome Abbott		311		311			
		Average		308		308	38		38
Sep-18	normal	Elijah Sheakley		289	283	286	155		155
		Fred Gallant		270		270	101		101
		Jerome Abbott		239	239	239	182		182
		Sam Kroiz		266	177	222	95		95
		Average		266	233	252	133		133
Sep-19	low	Elijah Sheakley		200		200			
		Fred Gallant		179		179			
		Jerome Abbott		203		203			
		Sam Kroiz		195		195			
		Average		194		194			
Sep-20	high	Elijah Sheakley					205	218	212
		Fred Gallant					99	130	115
		Jerome Abbott					163	209	186
		Sam Kroiz					230	201	216
		Average					174	190	182
Sep-21	high	Elijah Sheakley					111	187	149
		Fred Gallant					80	120	100
		Jerome Abbott					125	169	147
		Sam Kroiz					160	171	166
		Average					119	162	140
Sep-23	low	Elijah Sheakley					183	190	187
		Fred Gallant					111	158	135
		Jerome Abbott					133	161	147
		Sam Kroiz					189	191	190
		Average					154	175	165
Sep-26	high	Elijah Sheakley		103		103	191	199	195
		Fred Gallant		110		110	167	174	171
		Jerome Abbott		105		105	145	156	151
		Sam Kroiz		117		117	182	189	186
		Average		108		108	171	180	175

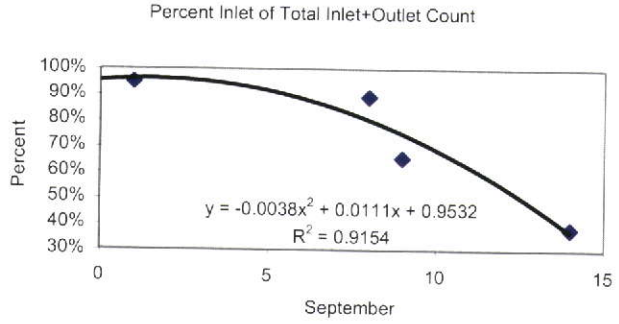
Consistent with the mark-recapture estimates (Tables 25 and 26), the survey counts were higher in the main inlet stream than in the outlet until late in September (Table 29). The percent of the sockeye counted in the main inlet stream declined from 95% to 38% from

September 4 to 26 (Table 29). This relationship was used to interpolate for missed surveys.

Table 29. Average foot survey counts of live sockeye salmon in Hoktaheen Lake's main inlet stream and outlet index areas with interpolated values for missed surveys, 2003.

	Average of Survey Counts					Goal Seek Fill-in's for Missed Surveys[b]		
Date	Main Inlet Stream	Outlet Stream	Total	Percent Inlet	Predicted % Inlet[a]	Main Inlet Stream	Outlet Stream	Total Inlet+Outlet
04-Sep	381	21	402	95%	95%	381	21	402
05-Sep	401				96%	401	*17*	418
08-Sep	387				95%	387	*19*	406
09-Sep	525				95%	525	*30*	556
11-Sep	464				92%	464	*39*	503
12-Sep	523				91%	523	*54*	578
15-Sep	415				84%	415	*78*	493
16-Sep	308	38	346	89%	81%	308	38	346
18-Sep	252	133	385	65%	75%	252	133	385
19-Sep	194				72%	194	*77*	271
20-Sep		182	182		68%	*383*	182	564
21-Sep		140	140		64%	*246*	140	386
23-Sep		165	165		55%	*198*	165	362
26-Sep	108	175	284	38%	39%	108	175	284

[a] Percent of main inlet stream predicted with the following relationship:



[b] Excel's goal seek function was used to fill-in counts for missed surveys (in italics).

Adult Age, Sex, and Length

Sockeye salmon were sampled for scales (age), sex, and length data both from the main inlet stream (262 ageable scales) and the outlet (149 ageable scales) index areas. In the main inlet stream, age 1.- fish comprised 97% of the sample and 91% were age-1.3 (Table 30). In the outlet stream, age 1.- fish comprised 95% of the sample and 77% were age 1.3 and 18% were age 1.2 (Table 31). The inlet stream sample included only three age 1.1 jacks and few were observed in our mark-recapture sampling.

Table 30. Age and sex composition of sockeye salmon sampled in the main inlet stream to upper Hoktaheen Lake from September 4 to 7, 2003.

	Brood Year and Age Class					
	2000	1999	1998	1998	1997	
	1.1	1.2	1.3	2.2	2.3	Total
Male						
Sample Size	3	8	125		3	139
Percent	1.1	3.1	47.7		1.1	53.1
Std. Error	0.7	1.1	3.1		0.7	3.1
Female						
Sample Size		6	112	3	2	123
Percent		2.3	42.7	1.1	0.8	46.9
Std. Error		0.9	3.0	0.7	0.5	3.1
All Fish						
Sample Size	3	14	237	3	5	262
Percent	1.1	5.3	90.5	1.1	1.9	100.0
Std. Error	0.7	1.4	1.8	0.7	0.8	

Table 31. Age and sex composition of sockeye salmon sampled in the outlet stream of upper Hoktaheen Lake from September 17 to 23, 2003.

	Brood Year and Age Class				
	1999	1998	1998	1997	
	1.2	1.3	2.2	2.3	Total
Male					
Sample Size	14	91	2	4	111
Percent	9.4	61.1	1.3	2.7	74.5
Std. Error	2.4	4.0	0.9	1.3	3.6
Female					
Sample Size	13	23	1	1	38
Percent	8.7	15.4	0.7	0.7	25.5
Std. Error	2.3	3.0	0.7	0.7	3.6
All Fish					
Sample Size	27	114	3	5	149
Percent	18.1	76.5	2.0	3.4	100.0
Std. Error	3.2	3.5	1.2	1.5	

The average length of sockeye sampled from the main inlet stream was 545mm and from the outlet stream was 555mm (Tables 32 to 33).

Table 32. Length composition (mm), by sex, of adult sockeye salmon sampled in Hoktaheen Lake's main inlet stream from September 4 to 7, 2003.

		Brood Year and Age Class					
		2000	1999	1998	1998	1997	
		1.1	1.2	1.3	2.2	2.3	Total
Male	Avg. Length	327	490	565		548	555
	Std. Error	4.4	9.8	2.2		6.0	3.8
	Sample Size	3	8	125		3	139
Female	Avg. Length		493	535	508	563	533
	Std. Error		6.8	2.5	19.2	12.5	2.5
	Sample Size		6	111	3	2	122
All Fish	Avg. Length	327	491	551	508	554	545
	Std. Error	4.4	6.1	1.9	19.2	6.2	2.4
	Sample Size	3	14	236	3	5	261

Table 33. Length composition (mm), by sex, of sockeye salmon sampled in the outlet stream of upper Hoktaheen Lake from September 17 to 23, 2003.

		Brood Year and Age Class				
		1999	1998	1998	1997	
		1.2	1.3	2.2	2.3	Total
Male	Avg. Length	521	570	505	574	563
	Std. Error	6.2	2.1	10.0	8.3	2.5
	Sample Size	14	90	2	4	110
Female	Avg. Length	504	547	525	565	532
	Std. Error	6.5	5.4			5.2
	Sample Size	13	23	1	1	38
All Fish	Avg. Length	513	565	512	572	555
	Std. Error	4.7	2.2	8.8	6.6	2.6
	Sample Size	27	113	3	5	148

Limnology

Light, Temperature, and Dissolved Oxygen Profiles

An underwater photometer was used to record the incident light levels in Neva, Pavlof, and Hoktaheen Lakes at 0.5 m intervals from just below the lake surface (depth 0.0) to the depth with about 1% of this subsurface reading (Table 34).

Table 34. Light meter and secchi disk readings at Stations A in Neva, Pavlof, and Hoktaheen Lakes, 2003.

Light Meter Readings (μmol s^{-1} m^{-2}):										
	Neva				Pavlof				Hoktaheen	
Depth (m)	Jun-04	Aug-20	Oct-06	Oct-28	Jun-11	Jul-25	Aug-26	Oct-30	Jul-11	Sep-06
0.0	-895.4	-1,224.4			-864.0	-371.7	-337.9		-1,645.0	-72.1
0.5	-712.7	-927.2			-297.2	-165.3	-123.9		-665.6	-15.8
1.0	-527.0	-679.6			-544.7	-105.5	-78.9		-386.4	-9.3
1.5	-481.9	-775.5			-428.5	-64.4	-39.4		-197.0	-5.0
2.0	-400.8	-585.1			-289.7	-48.6	-29.3		-102.4	-3.2
2.5	-341.5	-488.6			-227.2	-32.5	-15.4		-61.2	-1.9
3.0	-283.1	-385.4			-154.8	-23.6	-11.8		-33.2	-1.2
3.5	-222.5	-342.2			-110.4	-14.0	-6.8		-18.7	-0.6
4.0	-178.5	-285.1	- meter problems -	- meter problems -	-87.7	-11.5	-5.0	- meter problems -	-12.0	-0.4
4.5	-149.8	-226.1			-69.2	-7.5	-2.8			
5.0	-119.9	-139.1			-44.6	-5.3	-2.2			
5.5	-102.6	-116.1			-21.5	-3.1	-1.2			
6.0	-90.3	-65.5				-1.9	-0.9			
6.5	-71.2	-60.8					-0.5			
7.0	-54.7	-45.3					-0.4			
7.5	-43.2	-35.6								
8.0	-33.8	-28.5								
8.5	-25.2	-17.0								
9.0	-18.8	-13.5								
9.5	-14.8	-11.8								
10.0	-14.0	-9.9								
10.5	-10.9	-8.8								
11.0	-8.3	-8.0								
Secchi Disk (averaged depth of disappear/reappear readings in meters):										
	7.8	6.8	3.5	3.5	5.0	4.5	3.8	3.3	3.5	2.5

The mean euphotic zone depths (EZD) were 10.6 m in Neva Lake, 6.2 m in Pavlof Lake, and 3.9 m in Hoktaheen Lake (Table 35). These EZD's were similar to those observed in 2002.

Table 35. Euphotic zone depths in Neva, Pavlof, and Hoktaheen Lakes, 2003.

Lake	Sample Date	EZD (m)
Neva	Jun-04	10.9
	Aug-20	10.2
	Average	10.6
Pavlof	Jun-11	7.9
	Jul-25	5.7
	Aug-26	5.0
	Average	6.2
Hoktaheen	Jul-11	3.8
	Sep-06	3.9
	Average	3.9

Vertical temperature stratification was evident in Neva Lake from the first sampling on May 23 to the last sampling on October 5 (Table 36). The epilimnion extended down to about 6 m on the July 26 and August 25 sampling dates. The lowest reading in the hypolimnion was 5.0 °C. The percent O_2 saturation was over 100% in most readings near the surface and was above 90% at all depths down to 6 m in all four trips (Table 36). In all lakes the percent O_2 saturation decreased both through the summer and with depth.

There was little vertical stratification in temperature or dissolved oxygen in the 8 m deep Pavlof Lake (Table 37). The temperature averaged 5.8, 10.3, and 10.3 °C on the May, July, and August trips. The percent O_2 saturation was 38-43% in May and 91-95% in July. No dissolved oxygen readings were made on the August trip due to problems with the meter.

Vertical temperature stratification was evident in Hoktaheen Lake in the May, August, and September trips (Table 38). The epilimnion extended down to about 7 m in August and September. The hypolimnion remained below 6 °C the whole summer. Compared to Neva Lake, the percent O_2 saturation was lower near the surface but higher at depths.

Table 36. Temperature and dissolved oxygen profiles for Neva Lake, 2003.

	Temperature (°C)			Dissolved Oxygen (mg L^{-1})			Percent O_2 Saturation[a]		
Depth (m)	Jun-04	Aug-20	Oct-06	Jun-04	Aug-20	Oct-06	Jun-04	Aug-20	Oct-06
1	13.4	16.6	10.8	9.0	8.7	9.3	86%	89%	84%
2	13.5	16.5	10.7	8.9	8.9	9.1	85%	91%	82%
3	13.6	16.5	10.6	9.2	9.0	8.8	89%	93%	79%
4	12.9	16.5	10.4	9.6	9.0	8.1	91%	92%	72%
5	11.9	16.4	10.3	10.3	9.1	6.6	95%	93%	59%
6	10.6	14.4	10.2	10.8	10.1	5.9	97%	99%	52%
7	8.4	11.7	10.1	11.1	9.9	3.7	94%	91%	33%
8	7.2	9.4	9.9	10.8	9.1	3.3	89%	79%	29%
9	6.3	7.8	9.3	8.5	7.8	3.0	69%	65%	26%
10	5.4	7.0	8.2	7.6	7.6	2.7	60%	63%	23%
11		6.0			6.1			49%	
12		5.5			5.0			39%	
13		5.5			4.3			34%	
14		5.1			2.9			23%	
15	4.5	4.8	5.3	3.1	1.6	2.2	24%	12%	17%
16		4.7			1.5			12%	
17		4.7			1.5			12%	

[a] $\%O_2$ saturation = (dissolved oxygen) / (0.005399 * temperature^2 - 0.381784 * temperature + 14.571252)

Table 37. Temperature and dissolved oxygen profiles for Pavlof Lake, 2003.

	Temperature (°C)			Dissolved Oxygen (mg L^{-1})			Percent O_2 Saturation[a]		
Depth (m)	Jun-11	Jul-25	Aug-26	Jun-11	Jul-25	Aug-26	Jun-11	Jul-25	Aug-26
1	14.5	14.6	13.7	9.0	7.5	9.9	88%	74%	95%
2	14.2	13.9	12.9	9.0	7.7	9.9	88%	75%	94%
3	13.1	13.7	12.5	9.3	7.4	9.7	89%	72%	91%
4	12.3	13.5	12.4	9.3	7.4	9.7	87%	72%	91%
5	10.4	12.9	12.1	8.6	5.9	9.4	77%	56%	87%
6	10.1	11.3	12.0	7.7	1.7	9.4	68%	16%	87%
7	9.6		11.9	5.8		8.8	51%		81%

[a] $\%O_2$ saturation = (dissolved oxygen) / (0.005399 * temperature^2 - 0.381784 * temperature + 14.571252)

Table 38. Temperature and dissolved oxygen profiles for Hoktaheen Lake, 2003.

	Temperature (°C)		Dissolved Oxygen (mg L^{-1})		Percent O_2 Saturation[a]	
Depth (m)	Jul-11	Sep-06	Jul-11	Sep-06	Jul-11	Sep-06
1	19.1	14.2	10.3	10.4	111%	102%
2	17.3	13.4	10.5	10.4	110%	100%
3	13.7	12.8	10.6	10.2	102%	97%
4	11.9	12.4	10.9	10.1	101%	95%
5	9.7	11.8	11.9	10.0	105%	93%
6	8.5	9.6	11.7	9.8	100%	86%
7	7.0	8.7	12.0	10.0	99%	86%
8	6.4	7.5	12.3	10.1	100%	84%
9	5.2	6.5	12.4	10.3	97%	84%
10	4.9	5.8	12.9	10.5	101%	84%
11	5.0	5.3	12.9	10.6	101%	84%
12	4.9	5.0	12.9	10.6	101%	83%
13	4.7	4.7	13.0	10.5	101%	82%
14	4.6	4.5	13.0	10.4	101%	81%
15	4.6	4.3	13.1	10.4	101%	80%
16	4.4	4.3	13.2	10.6	102%	82%
17	4.3	4.3	13.2	9.9	101%	76%
18	4.3	4.2	13.3	9.6	102%	74%
19	4.2	4.2	13.3	9.3	102%	71%
20	4.1	4.2	13.3	9.1	102%	70%
25	4.2	4.3	13.3	8.3	102%	64%
30	4.2	4.3	13.0	7.7	100%	59%
35	4.2	4.3	12.8	7.0	98%	54%
40	4.2	4.4	12.4	6.5	95%	50%
45		4.4		6.1		47%

[a] $\%O_2$ saturation = (dissolved oxygen) / (0.005399 * temperature^2 - 0.381784 * temperature + 14.571252)

Daily and Seasonal Temperatures

Temperature data loggers recorded water temperatures every four hours in the inlet and outlet streams and at 1 m and mid-hypolimnion depths at Station A in Neva, Pavlof, and Hoktaheen Lakes. Stream and lake temperatures tended to peak 1 to 3°C higher, and warm temperatures persisted longer, in 2003 than in 2002 in all three lakes (Appendix C.1 to C.12). At Neva in 2002, the average daily temperature observed in the main inlet stream never reached 9°C; however, in 2003, the main inlet stream averaged more than 10°C on 19 days between July 8 and August 18 (Appendix C.1). Likewise, the outlet temperature averaged over 20°C on some days in late-July, mid-July, and mid-August but there was only a one-day peak of 18°C on August 5 in 2002 (Appendix C.2). Water temperatures at the 1 m and 13 m depths were also 2-3°C higher in July and August of 2003 than they were in 2002 (Appendix C.3 to C.4). The fall turnover occurred abruptly in Neva Lake in early-November (Appendix C.4).

Water temperatures peaked in mid-July and mid-August in Pavlof Lake's main inlet stream and lake surface (1 m) and in early-August at the 5 m depth (Appendix C.6 to C.8). Unfortunately, the logger that was cabled in the top of the fish pass at the outlet of

Pavlof Lake was removed by somebody in early June 2003 and the data logger at the 1 m depth in Pavlof Lake quit recording on October 30, 2003.

At Hoktaheen, temperatures in the main inlet stream varied widely between 9 and 12°C from mid-June to mid-September (Appendix C.9). The outlet temperatures varied less each day and had obvious peaks near 20°C in mid-July and mid-August (Appendix C.10) as did the temperature in the lake at 1 m (Appendix C.11). The temperature at 10 m declined steadily after early-October with initiation of fall turnover (Appendix C.12).

Secondary Production

The seasonal mean density (number m^{-2}) of zooplankton from vertical tows at Stations A and B in Neva, Pavlof, and Hoktaheen Lakes was 311,311, 16,022, and 153,698 (Tables 39, 40, and 41). The weighted biomass (mg m^{-2}) was 582, 13, and 463, respectively (Tables 39, 40, and 41). The samples were dominated by *Daphnia* in Neva Lake, *Bosmina* in Pavlof Lake, and *Cyclops* in Hoktaheen Lake. The density and biomass of zooplankton in Pavlof Lake was extremely low but the lake is only 7.5 m deep.

Table 39. Density, size, and biomass of zooplankton in Neva Lake, June to October, 2003.

Taxa	Zooplankton Density (no. m^{-2}) Date 04-Jun	20-Aug	06-Oct	28-Oct	Mean	%	Mean Wet Length (mm) Date 04-Jun	20-Aug	06-Oct	28-Oct	Weighted Length (mm)	Seasonal Weighted Biomass (mg m^{-2})	%
Station A:													
Cyclops	60,074	56,073	8,830	10,188	33,791	11%	0.74	0.74	0.72	0.98	0.76	67	12%
Ovig. Cyclops	2,547	1,019	0	0	892	0%	1.06	1.11			1.07	4	1%
Bosmina	5,943	15,283	18,339	14,264	13,457	4%	0.38	0.42	0.43	0.47	0.43	23	4%
Ovig. Bosmina	1,274	0	2,038	4,075	1,847	1%	0.43		0.49	0.47	0.47	4	1%
Daphnia l.	31,839	320,937	288,674	369,842	252,823	82%	0.64	0.63	0.63	0.65	0.64	438	79%
Ovig. Daphnia l.	13,585	5,094	679	1,019	5,094	2%	0.87	1.04	0.87	0.90	0.91	19	3%
Copepod nauplii	5,943	0	0	0	1,486	0%							
Total	121,205	398,406	318,560	399,388	309,390							555	
Tow Depth (m)	15.5	15.5	15.5	17.0	16								
Station B:													
Cyclops	84,904	42,792	4,075	3,057	33,707	11%	0.72	0.87	0.95	0.88	0.78	71	12%
Ovig. Cyclops	2,972	1,019	0	0	998	0%	1.03	1.10	1.06	1.14	1.05	4	1%
Bosmina	14,009	14,264	21,396	14,264	15,983	5%	0.41	0.43	0.44	0.47	0.44	29	5%
Ovig. Bosmina	1,274	0	3,057	4,075	2,102	1%	0.46		0.48	0.50	0.49	5	1%
Daphnia l.	30,141	328,069	346,409	301,579	251,550	80%	0.65	0.62	0.71	0.67	0.67	480	79%
Ovig. Daphnia l.	9,339	6,113	2,038	5,094	5,646	2%	0.88	0.93	0.81	0.91	0.89	20	3%
Sida c.	0	0	0	0	0	0%			2.37		2.37	0	
Copepod nauplii	3,821	9,170	0	0	3,248	1%							
Total	146,460	401,427	376,975	328,069	313,233							609	
Tow Depth (m)	16.7	15.7	15.5	15.0	16								
Average of Stations A and B					311,311							582	

Table 40. Density, size, and biomass of zooplankton in Pavlof Lake, June to October, 2003.

Taxa	Zooplankton Density (no. m^{-2}) Date Jun-11	Jul-25	Aug-26	Oct-30	Mean	%	Mean Wet Length (mm) Date Jun-11	Jul-25	Aug-26	Oct-30	Weighted Length (mm)	Seasonal Weighted Biomass ($mg\ m^{-2}$)	%
Station A:													
Cyclops	255	255	1,936	0	612	5%	0.51	0.55	0.50		0.51	1.00	11%
Bosmina	87	6,969	34,080	15	10,288	88%	0.35	0.29	0.28	0.32	0.28	7.00	77%
Ovig. Bosmina	0	76	2,496	10	646	6%		0.34	0.34	0.33	0.34	1.00	11%
Scapholeberis	0	0	51	0	13	0%			0.54		0.54	0.04	0%
Sida c.	0	20	0	0	5	0%		1.39	1.30		1.39	0.05	1%
Copepod nauplii	0	0	458	0	115	1%							0%
Total	342	7,320	39,021	25	11,677							9.09	
Tow Depth (m)	5.0	5.0	5.0	5.0	5.0								
Station B:													
Cyclops	2,868	204	2,547	0	1,405	7%	0.48	0.56	0.50		0.49	1.00	6%
Bosmina	3,306	3,464	64,595	306	17,918	88%	0.33	0.28	0.29	0.30	0.29	14.00	88%
Ovig. Bosmina	41	68	3,260	92	865	4%	0.39	0.30	0.34	0.34	0.34	1.00	6%
Scapholeberis	0	0	0	0	0	0%							0%
Sida c.	0	0	0	0	0	0%		1.46			1.46	0.00	0%
Copepod nauplii	0	713	0	0	178	1%							
Total	6,215	4,449	70,402	398	20,366							16.00	
Tow Depth (m)	2.3	2.0	3.0	3.0	2.6								
Average of Stations A and B					16,022							12.55	

Table 41. Density, size, and biomass of zooplankton in Hoktaheen Lake, July to September, 2003.

Taxa	Zooplankton Density (no. m^{-2}) Date Jul-11	Sep-06	Mean	%	Mean Wet Length (mm) Date Jul-11	Sep-06	Weighted Length (mm)	Seasonal Weighted Biomass ($mg\ m^{-2}$)	%
Station A:									
Cyclops	101,885	68,518	85,202	61%	0.85	0.89	0.87	225	58%
Ovig. Cyclops	3,821	6,113	4,967	4%	1.21	1.14	1.17	25	6%
Bosmina	67,499	11,717	39,608	28%	0.45	0.47	0.45	76	20%
Ovig. Bosmina	0	509	255	0%		0.56	0.56	1	0%
Daphnia l.	7,641	0	3,821	3%	0.69		0.69	8	2%
									0%
Daphnia m.	4,670	3,057	3,864	3%	1.67	1.37	1.55	46	12%
									0%
Holopedium	2,972	0	1,486	1%	0.58		0.58	4	1%
Total			139,201					386	
Tow Depth (m)	43.0	47.5	45.3						
Station B:									
Cyclops	129,479	91,017	110,248	66%	1.07	0.78	0.95	356	66%
Ovig. Cyclops	6,368	5,094	5,731	3%	1.26	1.19	1.23	32	6%
Bosmina	65,801	22,584	44,193	26%	0.51	0.46	0.50	103	19%
Ovig. Bosmina	0	679	340	0%		0.56	0.56	1	0%
Daphnia l.	5,943	170	3,057	2%	0.74	0.71	0.74	7	1%
									0%
Daphnia m.	5,519	1,189	3,354	2%	1.53	1.29	1.49	37	7%
									0%
Holopedium	2,547	0	1,274	1%	0.65		0.65	5	
Total	215,657	120,733	168,195					541	
Tow Depth (m)	49.5	44.5	47.0						
Average of Stations A and B			153,698					463	

DISCUSSION

The Neva sockeye run appears relatively healthy the past two years. The 11,393 sockeye escapement into Neva Lake in 2003 was over twice the 2002 escapement of 4,951 and the 2002 escapement was higher than expected for this small 36.1 ha lake. Project personnel only observed a subsistence take of 278 and a sport take of 53 sockeye salmon (Table 17) which yields and exploitation rate of less than 3%. The Neva sockeye run appears

healthy given the probable low exploitation rates in recent years, the natural condition of the watershed, the relatively small size of the lake, the abundance and spawning duration of inlet stream and beach spawning from August through November, the high proportion of age-1.- fish (95%), high zooplankton biomass and proportion of *Daphnia*. Alaska Department of Fish and Game managers recognized this good health of the Neva sockeye run and increased daily and annual subsistence/personal use sockeye 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.

The high proportion of jacks (24% age-1.1 fish) in 2002 relates to the high proportion (73%) of this 1999 brood in the 2003 run. With almost 17% jacks observed again in the 2003 escapement, I would also expect a relatively large run of brood year 2000 fish in 2004.

Over 95% of the run has been composed of age 1.- fish suggesting that the sockeye juveniles are attaining the minimum threshold size for smolting after their first year of rearing in the lake and that the fry production is not exceeding the lake's rearing capacity.

The migration of sockeye salmon through the Neva Creek weir fluctuated with stream flow. Prior to September 4, there were seven distinct pulses of fish each corresponding to a rise in water level (Figure 11). After September 4, water levels continued to fluctuate, but at high levels, and the daily passage of sockeye salmon was steadier.

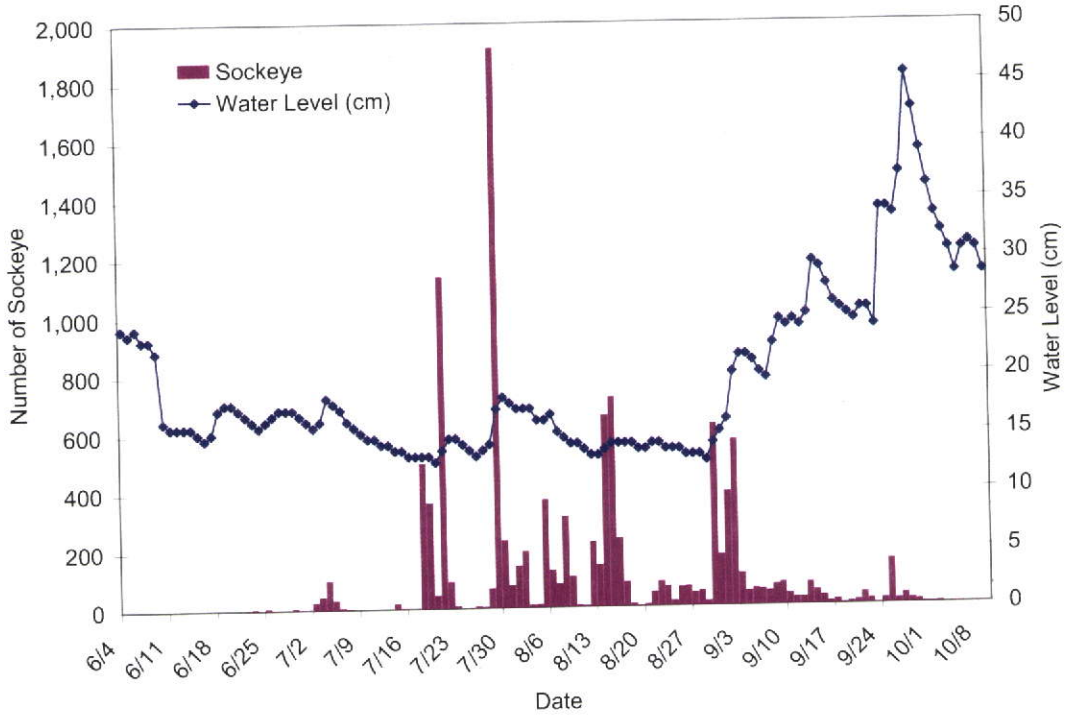


Figure 11. Daily sockeye migration and stream depth at the Neva weir, 2003.

Ninety-percent of the Neva sockeye escapement passed through the weir between July 18 and September 8 (Table 8). During 68% of this time water levels were below 15 cm and during 58% of this time water temperatures were at or above 17°C (Appendix B.1; Figure 12). On July 18, 37 sockeye salmon were found stranded and dead in the upper shallow section of Neva Creek (Table 13). This was the only die-off event observed in 2003.

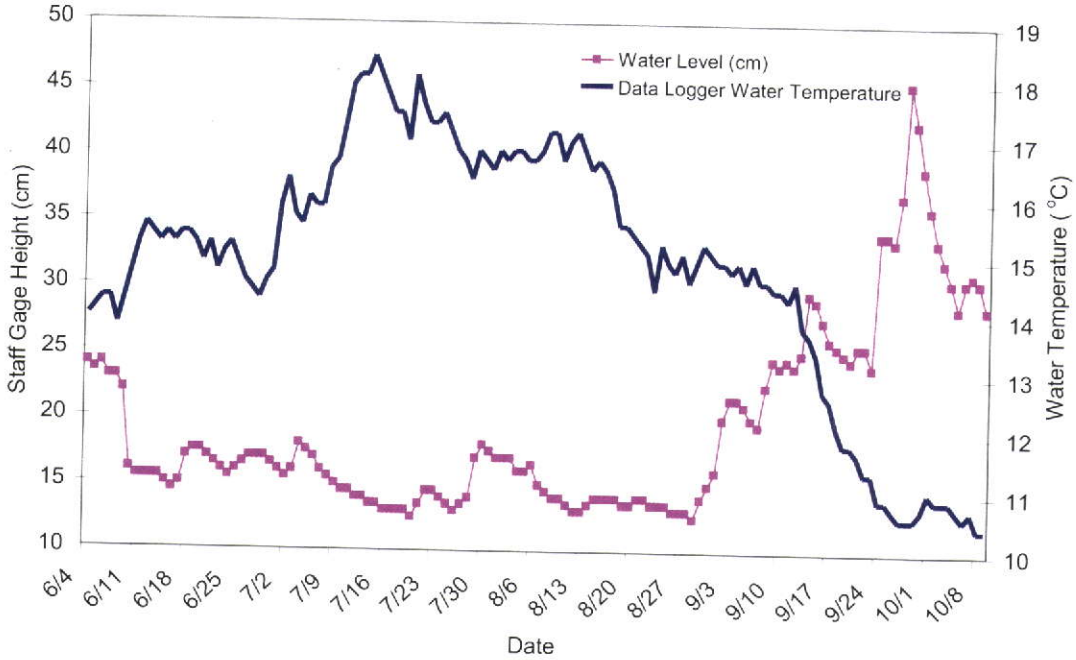


Figure 12. Daily stream depth and temperature (°C) at the Neva weir, 2003.

This was the second year that I relied on the weir-to-spawning ground mark-recapture study to estimate the total sockeye escapement into Neva Lake. The weir is overbuilt for this small stream (Figure 13) and was "fish tight" both years but pickets were pulled and fish were passed by a non-project person during a peak sockeye passage day in both years – July 2, 2002 and September 1, 2003. This weir tampering reflects a complication of operating a weir in a semi-remote location and the value of the back-up mark-recapture study for assuring a reliable estimate of the total escapement.

Figure 13. Photo of the Neva Creek weir and trap (under construction).

The 1,474 (CV = 2%) escapement of sockeye salmon into Pavlof Lake in 2003 was a little larger than the 2002 estimate of 1,350 (CV =6%). The radio tagging study confirmed that all the sockeye spawn in the lower section of the main inlet stream from late-July to mid-August. Knowing this will help focus efforts of future mark-recapture studies.

There has not been any appreciable directed subsistence or sport fishing on Pavlof sockeye salmon for over 30 years and the only harvest occurs in commercial purse seine fisheries in Icy Strait and Chatham Strait. The Pavlof system is a better producer of coho salmon than sockeye salmon. There are too few sockeye salmon to support directed subsistence fishing by more than a few families.

At Hoktaheen Lake, we were able to build on experiences in 2001 and 2002 to know where and when to mark-recapture sockeye spawners (Conitz and Cartwright 2002a; Van Alen 2004). Keeping the fisheries crew at Hoktaheen from September 4 to 26 worked well. They accomplished over eight, two-day, mark-recapture "trips" in the inlet and outlet streams (Tables 25 and 26) and reduced the number of flights needed to this small, remote lake where inclement weather conditions in September often limits access.

Escapement index results suggest that the Hoktaheen sockeye escapement in the main inlet stream was over twice as high in 2003 as it was in 2002 and 2001 (Table 27). I am reluctant to assess the status of Hoktaheen sockeye salmon based on these results since there is little historical basis for comparison. Project results from 2004 will help with this assessment. The capacity of the lake to rear sockeye fry looks good.

Our ability to index the sockeye escapement into these systems was much better in 2003 than in 2002. We were able to complete three or more mark-recapture trips to each index area in each lake and this included both the main inlet stream and beach study areas in Neva Lake and the main inlet stream and outlet study areas of Hoktaheen Lake. As important, we had enough recaptures from prior trips to compute reliable and robust stratified Darroch and Jolly-Seber abundance estimates.

CONCLUSIONS

Project objectives were appropriate and attainable. This year's results, and project results from 2002 and 2004 are needed to understand current escapement levels and the adequacy of these escapements for maintaining healthy runs and meeting subsistence needs.

RECOMMENDATIONS

Continue this project in 2004 following the 2003 objectives. However, discontinue the radio tagging study at Pavlof since that study was completed in 2003. Collect as much mark-recapture data as possible, particularly at Neva Lake, so we have the data needed to evaluate the performance of different stratified estimators. Finally, submit documents needed to have Neva Lake's main inlet stream listed in the State's Anadromous Waters Catalog.

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APPENDICES

Appendix A. Mark-recapture and harvest monitoring data forms.

Appendix A.1. Data form used to record both weir mark-recapture and six trips of spawning mark-recapture data, 2003.

System:
Date:
Observers:
Mark Used this Trip: round square triangle diamond tree heart

Water Level (circle): Low Normal High
Trip Number : one two three four five six
Day Number: one two

		Weir (adipose) Mark-Recapture:					Spawning Mark-Recapture: (see key to sampling on back)															
							New:	Recapture:														
Fishing Location/ Set	Time	Disregard (has opercule mark)	Un-Mark (has adipose)	Marked Adipose+ Left Axillary	Marked Adipose+ Left Ventral	Marked Adipose+ Dorsal	No Opercule Mark	Round	Square	Triangle	Diamond	Tree	Heart	Round Square	Round Triangle	Square Triangle	Square Diamond	Triangle Diamond	Triangle Tree	Other:	Other:	Other:

Comments:

Appendix A.2. Data form used to record five trips of spawning mark-recapture index data, 2003.

System and Study Area:
Date:
Observers:
Mark Used this Trip: round square triangle tree heart

Water Level (circle): Low Normal High
Trip Number : one two three four five
Day Number: one two

		Spawning Mark-Recapture (see key to sampling on back)															
		New	Recapture														
Fishing Location/ Set	Time	No Opercule Mark	Round	Square	Triangle	Tree	Heart	Round Square	Round Triangle	Round Tree	Round Square Triangle	Round Triangle Tree	Round Square Triangle Tree	Square Triangle	Square Tree	Square Triangle Tree	Triangle Tree

Comments:

Appendix A.3. Data form used for monitoring subsistence and sport harvests in the Neva area, 2003.

Sockeye Harvest Daily Interview Form (Subsistence and Sport)

System: _____ Page _____

Samplers: _____

Background							Type of Fishery					Total Harvest by Species				
Date	Interview #	Time (military)	Number in Party	Residency	Location Fished (Saltwater, Interfidal, South Creek, Neva Creek)	Subsistence (SUB) / Sport (SPT)	Gear (BS=beach seine, GN=gillnet, S=spear, G=gaff, D=dipnet, R=rod&reel)	Units of Gear	Hours Fished per Units of Gear	Total Hours Fished (gear x hrs)[1]	Missed Interview #	Sockeye	Coho	Chum	Pink	Comments

[1]**Total Hours Fished:** Multiply number of units of gear (i.e., Rods or Nets) by the number of hours each was fished.

Appendix B. Detailed Neva Creek weir data, 2003.

Appendix B.1. Weather and stream measurements and daily numbers of fish counted and finclipped at the Neva Creek weir, 2003.

	Weather and Stream Measurements[a]					Sockeye Counted			Sockeye Finclipped						Number of Other Species Counted								
Date	Weather	Water Level (cm)	Therm-ometer Water Temp (°C)	Air Temp (°C)	Data Logger Water Temp (°C)	Adults	Jacks	Total	Finclip Used (Adipose +)	Adults	Cum. % Adults Clipped	Jacks	Cum. % Jacks Clipped	Adult Coho[a]	Jack Coho[a]	Total Coho	Pink	Chum	Cutthroat	Dolly Varden	Sculpin	Comments
6/4	overcast	24.0	14.5	13.0	14.0	0	0	0	Left Axillary	0		0					0					weir fish tight at 1050hr, no adult salmon observed
6/5	overcast	23.5	15.0	14.0	14.1	0	0	0	Left Axillary	0		0					0					
6/6	showers	24.0	14.0	11.0	14.3	0	0	0	Left Axillary	0		0					0					
6/7	overcast	23.0	14.0	12.0	14.3	0	0	0	Left Axillary	0		0					0					
6/8	clear	23.0	15.5	12.5	13.8	0	0	0	Left Axillary	0		0					0					
6/9	clear	22.0	15.0	12.0	14.3	0	0	0	Left Axillary	0		0					0					
6/10	clear	16.0	15.0	10.0	14.8	0	0	0	Left Axillary	0		0					0					cleared logjam between staff gauge and weir
6/11	partlycloudy	15.5	16.0	10.0	15.2	0	0	0	Left Axillary	0		0					0					
6/12	overcast	15.5	15.5	11.5	15.8	0	0	0	Left Axillary	0		0					0					
6/13	showers	15.5	15.5	11.5	15.4	0	0	0	Left Axillary	0		0					0					
6/14	partlycloudy	15.5	15.5	11.0	15.2	0	0	0	Left Axillary	0		0					0					
6/15	overcast	15.0	15.5	10.5	15.4	0	0	0	Left Axillary	0		0					0					
6/16	partlycloudy	14.5	15.5	10.0	15.2	0	0	0	Left Axillary	0		0					0					
6/17	rain	15.0	15.0	11.0	15.4	0	0	0	Left Axillary	0		0					0					
6/18	showers	17.0	15.0	9.5	15.4	0	0	0	Left Axillary	0		0					0					
6/19	showers	17.5	15.0	10.0	15.2	0	0	0	Left Axillary	0		0					0					
6/20	showers	17.5	15.0	10.0	14.9	0	0	0	Left Axillary	0		0					0					
6/21	overcast	17.0	15.0	10.0	15.2	0	0	0	Left Axillary	0		0					0					
6/22	overcast	16.5	15.0	10.5	14.8	1	0	1	Left Axillary	0	0%	0					0					
6/23	overcast	16.0	15.0	11.0	15.1	4	1	5	Left Axillary	3	60%	0					0					
6/24	showers	15.5	15.0	11.0	15.2	0	0	0	Left Axillary	0	60%	0					0					
6/25	showers	16.0	15.0	11.0	14.9	5	1	6	Left Axillary	2	50%	1					0					
6/26	showers	16.5	14.5	9.5	14.6	2	0	2	Left Axillary	1	50%	1					0					
6/27	showers	17.0	14.5	10.0	14.4	0	0	0	Left Axillary	0	50%	0					0					
6/28	showers	17.0	14.5	10.0	14.3	0	0	0	Left Axillary	0	50%	0					0			1		
6/29	overcast	17.0	14.5	10.5	14.8	4	2	6	Left Axillary	2	50%	0					0					
6/30	partlycloudy	16.5	15.0	11.5	14.8	1	1	2	Left Axillary	0	47%	1					0					
7/1	clear	16.0	16.5	13.5	15.9	0	0	0	Left Axillary	0	47%	0					0					
7/2	overcast	15.5	16.0	11.0	16.3	15	11	26	Left Axillary	8	50%	6	56%				0					
7/3	showers	16.0	16.0	12.0	15.7	29	14	43	Left Axillary	15	51%	7	53%				0					
7/4	partlycloudy	18.0	15.5	11.0	15.8	63	36	99	Left Axillary	32	51%	18	52%				0			1		
7/5	overcast	17.5	16.0	11.5	16.0	21	11	32	Left Axillary	9	50%	5	51%				0					
7/6	overcast	17.0	16.0	12.0	15.9	2	4	6	Left Axillary	1	50%	2	51%				0					
7/7	clear	16.0	16.0	12.5	16.9	0	3	3	Left Axillary	0	50%	2	51%				0					
7/8	overcast	15.5	17.0	13.0	16.5	0	0	0	Left Axillary	0	50%	0	51%				0					
7/9	partlycloudy	15.0	17.0	13.5	16.7	0	0	0	Left Axillary	0	50%	0	51%				0					
7/10	clear	14.5	18.0	14.0	17.3	0	0	0	Left Axillary	0	50%	0	51%				0					
7/11	cloudy	14.5	18.0	14.0	17.9	0	0	0	Left Axillary	0	50%	0	51%				0					
7/12	clear	14.0	19.0	14.0	18.1	0	0	0	Left Axillary	0	50%	0	51%				0					
7/13	partlycloudy	14.0	19.0	15.0	18.1	0	0	0	Left Axillary	0	50%	0	51%				0					
7/14	overcast	13.5	19.0	13.5	18.4	8	11	19	Left Axillary	5	50%	7	53%				0					
7/15	overcast	13.5	18.5	13.0	18.1	1	2	3	Left Axillary	0	50%	0	52%				0					
7/16	overcast	13.0	18.0	13.0	17.8	0	0	0	Left Axillary	0	50%	0	52%				0					
7/17	overcast	13.0	18.0	13.0	17.5	0	0	0	Left Axillary	0	50%	0	52%				0					
7/18	partlycloudy	13.0	18.0	13.0	17.5	359	137	496	Left Axillary	185	51%	71	52%				0					
7/19	clear	13.0	18.0	11.5	17.0	225	136	361	Left Axillary	98	49%	70	52%				0			1		
7/20	rain	12.5	18.5	15.0	18.1	21	24	45	Left Axillary	19	50%	7	50%				0					
7/21	rain	13.5	18.0	13.5	17.8	914	221	1135	Left Axillary	466	51%	106	49%				0			3		
7/22	showers	14.5	17.5	12.0	17.3	61	31	92	Left Axillary	22	50%	26	51%				0					
7/23	partlycloudy	14.5	17.5	13.0	17.3	3	4	7	Left Axillary	2	50%	0	51%				0		1			

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Appendix B.1. (page 2 of 3)

	Weather and Stream Measurements:[a]					Sockeye Counted:			Sockeye Finclipped:						Number of Other Species Counted:								
Date	Weather	Water Level (cm)	Thermometer Water Temp (°C)	Air Temp (°C)	Data Logger Water Temp (°C)	Adults	Jacks	Total	Finclip Used (Adipose +)	Adults	Cum. % Adults Clipped	Jacks	Cum. % Jacks Clipped	Adult Coho[b]	Jack Coho[b]	Total Coho	Pink	Chum	Cutthroat	Dolly Varden	Sculpin	Comments
7/24	overcast	14.0	18.0	13.0	17.5	0	0	0	Left Axillary	0	50%	0	51%				0					
7/25	overcast	13.5	17.5	12.0	17.1	1	0	1	Left Axillary	0	50%	0	51%				0					
7/26	rain	13.0	17.0	13.0	16.8	2	4	6	Left Axillary	1	50%	0	50%				0					
7/27	rain	13.5	17.0	12.0	16.7	1	3	4	Left Axillary	0	50%	0	50%				0					
7/28	rain	14.0	17.0	12.5	16.3	49	18	67	Left Ventral	24	50%	8	50%				0			1		
7/29	rain	17.0	17.0	12.5	16.8	1758	156	1914	Left Ventral	877	50%	72	48%				4		1	65		
7/30	overcast	18.0	17.0	12.0	16.7	217	14	231	Left Ventral	111	50%	11	50%				3			4		
7/31	partlycloudy	17.5	16.5	12.0	16.5	59	17	76	Left Ventral	30	50%	10	50%				4					
8/1	showers	17.0	17.0	12.0	16.8	122	20	142	Left Ventral	61	50%	7	50%				0		1			
8/2	overcast	17.0	17.0	12.0	16.7	170	22	192	Left Ventral	85	50%	15	50%				1					
8/3	overcast	17.0	17.0	12.0	16.8	8	1	9	Left Ventral	8	50%	1	50%				0					
8/4	overcast	18.0	17.0	12.5	16.8	4	7	11	Left Ventral	0	50%	3	50%				0			1		
8/5	overcast	16.0	16.5	12.0	16.7	333	34	367	Left Ventral	164	50%	18	50%				1			2		
8/6	clear	16.5	17.0	12.0	16.7	112	13	125	Left Ventral	57	50%	5	50%				0					
8/7	clear	15.0	17.5	12.0	16.8	71	8	79	Left Ventral	36	50%	5	50%				1					
8/8	clear	14.5	17.5	12.0	17.1	279	32	311	Left Ventral	139	50%	18	50%				1					1 sculpin
8/9	clear	14.0	17.5	13.5	17.1	91	12	103	Left Ventral	46	50%	3	50%				0					
8/10	clear	14.0	17.0	8.5	16.7	4	3	7	Left Ventral	1	50%	2	50%				0		1			
8/11	overcast	13.5	18.0	11.0	17.0	4	0	4	Dorsal	2	50%	0	50%				0					
8/12	showers	13.0	17.5	12.0	17.1	195	29	224	Dorsal	97	50%	11	50%				2		1			
8/13	showers	13.0	17.0	12.5	16.8	131	12	143	Dorsal	66	50%	7	50%				0					
8/14	rain	13.5	17.0	12.5	16.5	580	73	653	Dorsal	278	50%	38	50%				0					
8/15	showers	14.0	17.0	14.0	16.7	632	84	716	Dorsal	327	50%	42	50%				1			1		
8/16	showers	14.0	17.0	13.0	16.5	201	32	233	Dorsal	102	50%	18	50%	1		1	3					
8/17	showers	14.0	17.0	12.5	16.2	67	17	84	Dorsal	36	50%	10	50%	1		1	7					
8/18	overcast	14.0	16.5	10.5	15.8	6	2	8	Dorsal	0	50%	0	50%	0		0	0					
8/19	showers	13.5	16.0	10.5	15.6	2	1	3	Dorsal	1	50%	0	50%	0		0	0					
8/20	showers	13.5	16.0	10.5	15.4	3	3	6	Dorsal	1	50%	0	50%	0		0	0					
8/21	overcast	14.0	16.0	10.0	15.2	40	8	48	Dorsal	20	50%	2	50%	0		0	1		1	1		
8/22	overcast	14.0	18.0	11.0	15.1	58	25	83	Dorsal	27	50%	15	50%	0		0	1			1	1	
8/23	partlycloudy	13.5	15.5	8.5	14.4	48	19	67	Dorsal	27	50%	10	50%	0		0	4			2		
8/24	showers	13.5	16.0	11.5	15.2	13	4	17	Dorsal	6	50%	2	50%	0		0	1					
8/25	partlycloudy	13.5	15.5	10.5	14.9	47	17	64	Dorsal	24	50%	8	50%	0		0	8			1		
8/26	partlycloudy	13.0	15.5	12.0	14.8	54	13	67	Dorsal	28	50%	9	50%	0		0	4					
8/27	overcast	13.0	15.5	11.0	15.1	29	16	45	Dorsal	13	50%	9	50%	0		0	5		1			
8/28	partlycloudy	13.0	15.0	10.5	14.8	36	14	50	Dorsal	18	50%	4	50%	0		0	0					
8/29	overcast	12.5	15.5	12.0	14.9	10	5	15	Dorsal	5	50%	3	50%	0		0	1					
8/30	rain	14.0	15.5	12.5	15.2	524	97	621	Dorsal	259	50%	50	50%	43		43	11		2			
8/31	showers	15.0	15.0	10.0	15.1	138	35	173	Dorsal	72	50%	20	50%	70	1	71	16		1	2		
9/1	rain	16.0	15.0	10.5	14.9	72	24	96	Dorsal	36	50%	7	50%	19	1	20	27					fish likely passed uncounted by non-project person
9/2	showers	20.0	15.0	11.0	14.9	514	53	567	Dorsal	259	50%	25	50%	138	2	140	45		2	7		
9/3	showers	21.5	15.0	12.0	14.8	81	28	109	Dorsal	39	50%	16	50%	83	1	84	20			2		
9/4	partlycloudy	21.5	15.0	10.5	14.9	34	15	49	Dorsal	16	50%	8	50%	33	2	35	19			3		
9/5	partlycloudy	21.0	14.5	8.0	14.6	39	18	57	Dorsal	19	50%	9	50%	24	2	26	24		1	3		
9/6	partlycloudy	20.0	15.0	11.0	14.9	41	14	55	Dorsal	22	50%	5	50%	23	2	25	14			5		
9/7	rain	19.5	14.5	11.5	14.8	36	13	49	Dorsal	18	50%	8	50%	14	6	20	15					
9/8	showers	22.5	14.5	11.0	14.5	49	20	69	Dorsal	23	50%	13	50%	48	8	56	38			6		
9/9	overcast	24.5	14.0	10.0	14.4	53	23	76	Dorsal	29	50%	11	50%	108	5	114	48		1	13		
9/10	showers	24.0	14.5	10.5	14.4	21	17	38	Dorsal	10	50%	7	50%	123	4	127	14			5		
9/11	partlycloudy	24.5	14.0	10.0	14.3	18	7	25	Dorsal	8	50%	5	50%	16	9	25	25		1	8		
9/12	overcast	24.0	14.0	11.0	14.6	17	7	24	Dorsal	9	50%	7	50%	31	3	34	10			2		

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Appendix B.1. (page 3 of 3)

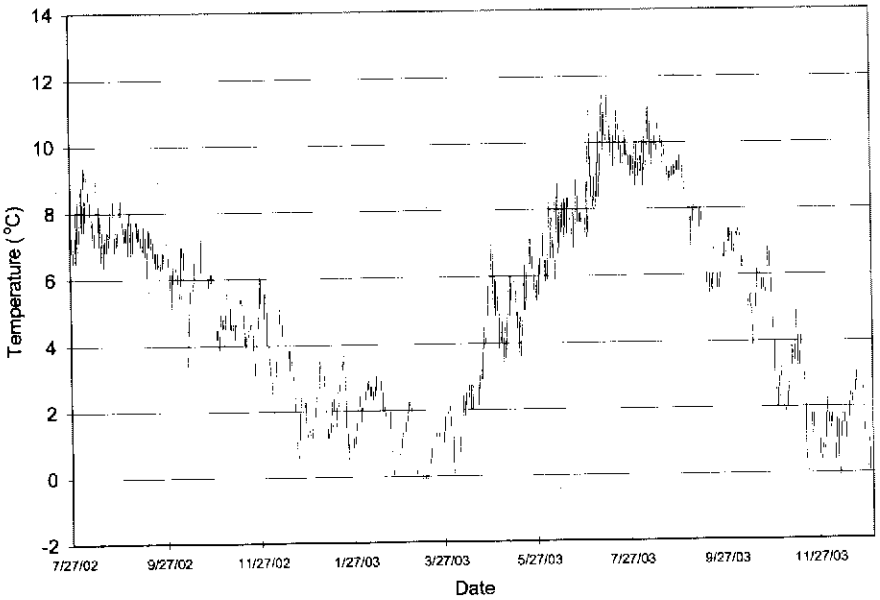
	Weather and Stream Measurements:[a]					Sockeye Counted			Sockeye Finclipped					Number of Other Species Counted									
Date	Weather	Water Level (cm)	Thermometer Water Temp (°C)	Air Temp (°C)	Data Logger Water Temp (°C)	Adults	Jacks	Total	Finclip Used (Adipose +)	Adults	Cum. % Adults Clipped	Jacks	Cum. % Jacks Clipped	Adult Coho[b]	Jack Coho[b]	Total Coho	Pink	Chum	Cutthroat	Dolly Varden	Sculpin	Comments
9/13	rain	25.0	14.0	10.0	13.8	62	13	75	Dorsal	30	50%	2	50%	214	11	225	41		1	15		
9/14	rain	29.5	13.0	8.0	13.7	38	10	48	Dorsal	20	50%	5	50%	77	4	81	33		1	6		
9/15	overcast	29.0	13.0	6.5	13.4	25	6	31	Dorsal	14	50%	3	50%	62	2	64	15			3		
9/16	clear	27.5	12.0	3.0	12.7	7	4	11	Dorsal	4	50%	2	50%	19	1	20	2			2		1 left axillary and 2 unmarked sockeye dead on weir
9/17	overcast	26.0	12.0	5.0	12.6	9	7	16	Dorsal	6	50%	6	50%	12	3	15	3			6		
9/18	showers	25.5	12.0	6.0	12.1	2	2	4	Dorsal	0	50%	0	50%	10	1	11	8			5		
9/19	showers	25.0	12.0	6.0	11.8	3	4	7	Dorsal	0	50%	0	50%	3	2	5	9			7		
9/20	showers	24.5	12.0	8.0	11.8	7	6	13	Dorsal	3	50%	4	50%	22	4	26	6		2	6		
9/21	showers	25.5	11.0	7.0	11.7	31	8	39	Dorsal	14	50%	4	50%	32	5	37	15	1		5		
9/22	overcast	25.5	11.0	5.0	11.3	14	3	17	Dorsal	7	50%	1	50%	7	1	8	9			5		
9/23	overcast	24.0	11.0	5.0	11.3	0	2	2	Dorsal	0	50%	1	50%	4	3	7	1			5		
9/24	rain	34.0	10.5	6.5	10.9	14	3	17	Dorsal	9	50%	2	50%	39	6	45	14			12		
9/25	showers	34.0	10.5	9.0	10.9	139	13	152	Dorsal	68	50%	7	50%	79	6	85	10	1	1	5		
9/26	showers	33.5	10.0	9.0	10.7	15	1	16	Dorsal	15	50%	1	50%	19	3	22	0			15		
9/27	rain	37.0	10.0	9.0	10.6	32	2	34	Dorsal	10	50%	2	50%	76	3	79	10			6		1 left ventral, 1 dorsal, and 1 unmarked sockeye dead on weir
9/28	overcast	45.5	10.0	9.5	10.6	13	3	16	Dorsal	4	50%	0	50%	26	1	27	0			2		1 marked coho dead on weir
9/29	partlycloudy	42.5	10.5	8.5	10.6	8	4	12	Dorsal	5	50%	0	50%	21	1	22	2			12		
9/30	partlycloudy	39.0	10.5	9.0	10.7	2	1	3	Dorsal	1	50%	1	50%	22	1	23	0			4		
10/1	partlycloudy	36.0	11.0	8.5	11.0	2	0	2	Dorsal	1	50%	0	50%	21	2	23	0			6		
10/2	partlycloudy	33.5	10.5	8.0	10.9	5	0	5	Dorsal	2	50%	0	50%	16	2	18	0			0		
10/3	partlycloudy	32.0	10.5	8.0	10.9	0	0	0	Dorsal	0	50%	0	50%	4	0	4	0			2		
10/4	partlycloudy	30.5	11.0	8.0	10.9	2	0	2	Dorsal	1	50%	0	50%	4	0	4	0			1		
10/5	overcast	28.5	10.0	10.0	10.7	3	0	3	Dorsal	2	50%	0	50%	2	2	4	0			0		
10/6	rain	30.5	10.5	10.0	10.6	0	0	0	Dorsal	0	50%	0	50%	2	0	2	0			2		
10/7	overcast	31.0	10.5	10.0	10.7	0	0	0	Dorsal	0	50%	0	50%	2	1	3	0		1	2		
10/8	partlycloudy	30.5	10.0	10.0	10.4	2	0	2	Dorsal	1	50%	0	50%	7	2	9	0		4	2		
10/9	partlycloudy	28.5	10.0	10.0	10.4	0	0	0	Dorsal	0	50%	0	50%	0	0	0	0		2	2		weir removed at 1300hr
10/10					10.1																	
Totals						9,248	1,851	11,099		4,624		926		1,578	113	1,691	553	2	27	279	1	

[a] The water temperature was recorded by the data logger at 0647 hour, all other observations were made about 0900 hour.

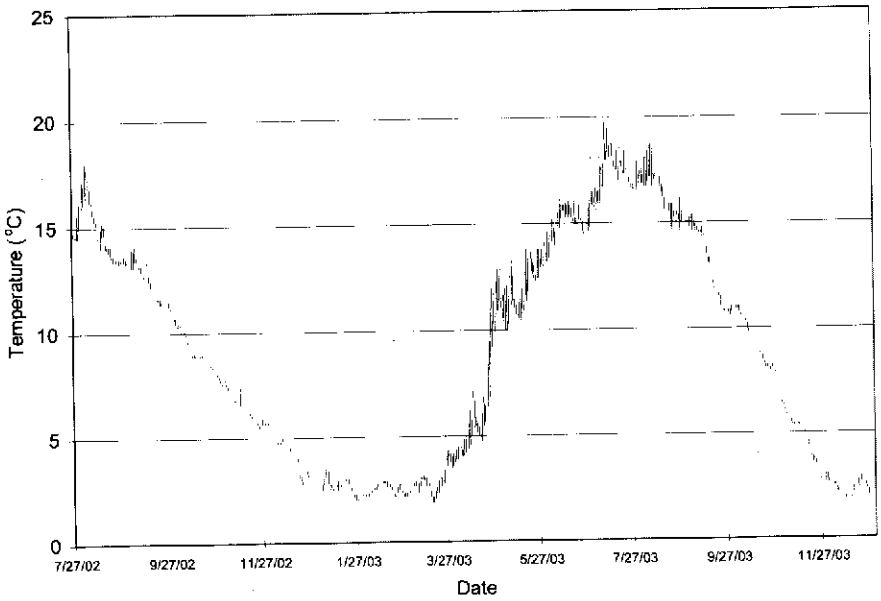
[b] All adult and jack coho salmon were marked with a left ventral clip.

-continued-

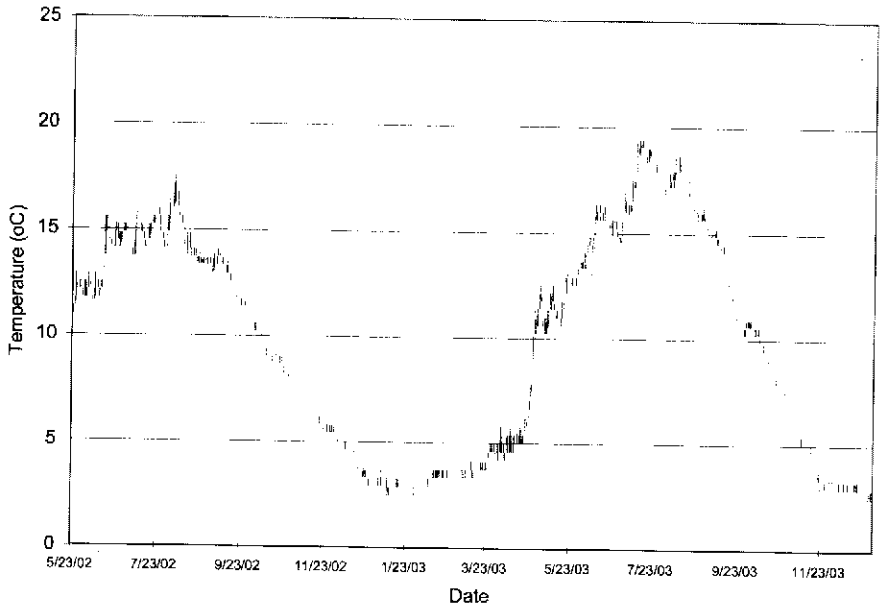
Appendix C. Water temperature data logger figures.



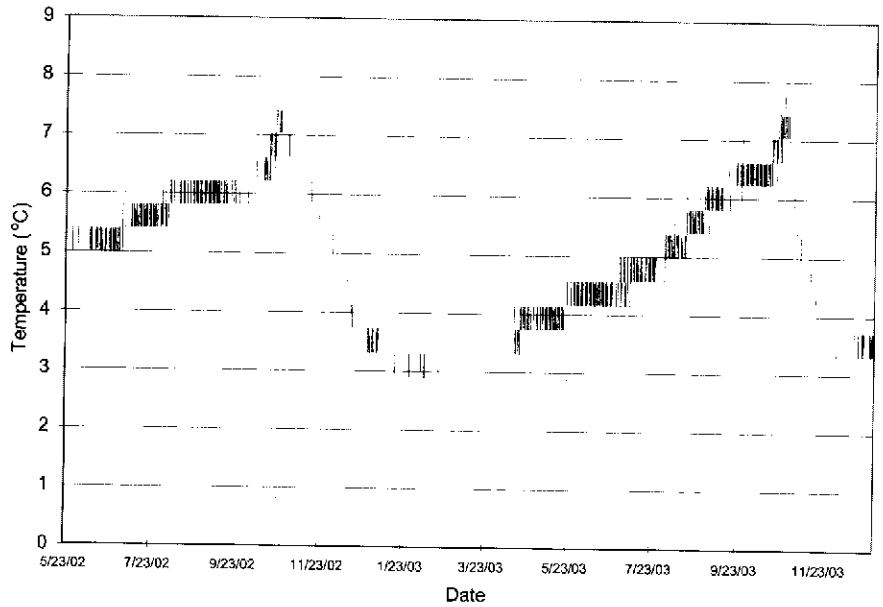
Appendix C.1. Daily maximum, minimum, and average stream temperatures at the lower end of the Neva Lake's main inlet stream, July 27, 2002 to December 31, 2003.



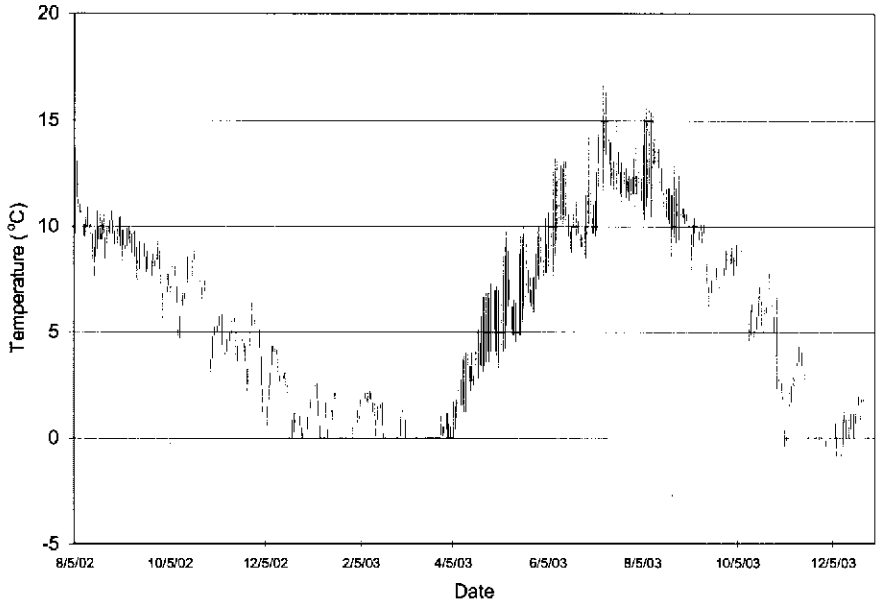
Appendix C.2. Daily maximum, minimum, and average stream temperatures at the upper end of Neva Creek, July 27, 2002 to December 31, 2003.



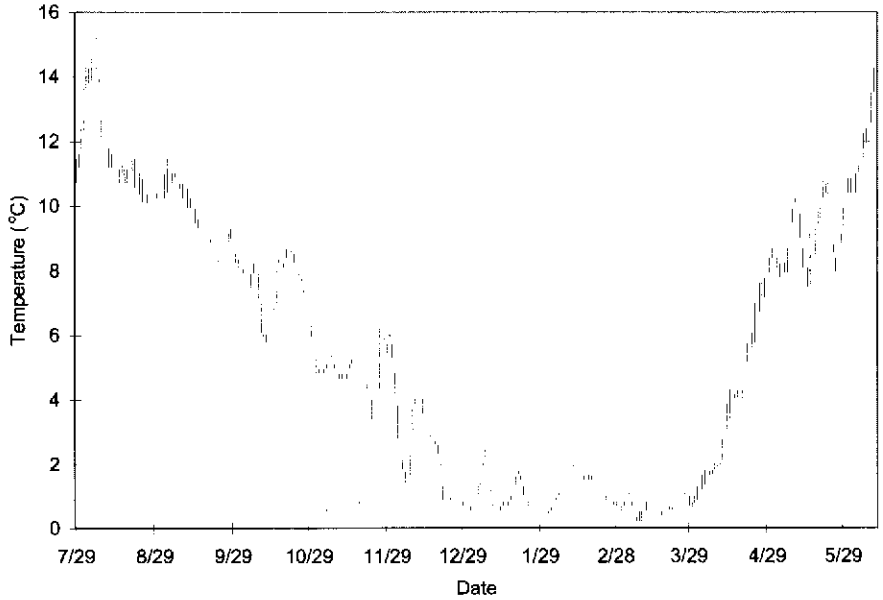
Appendix C.3. Daily maximum, minimum, and average temperature at a depth of 1 m at Station A in Neva Lake, May 23, 2002 to December 31, 2003.



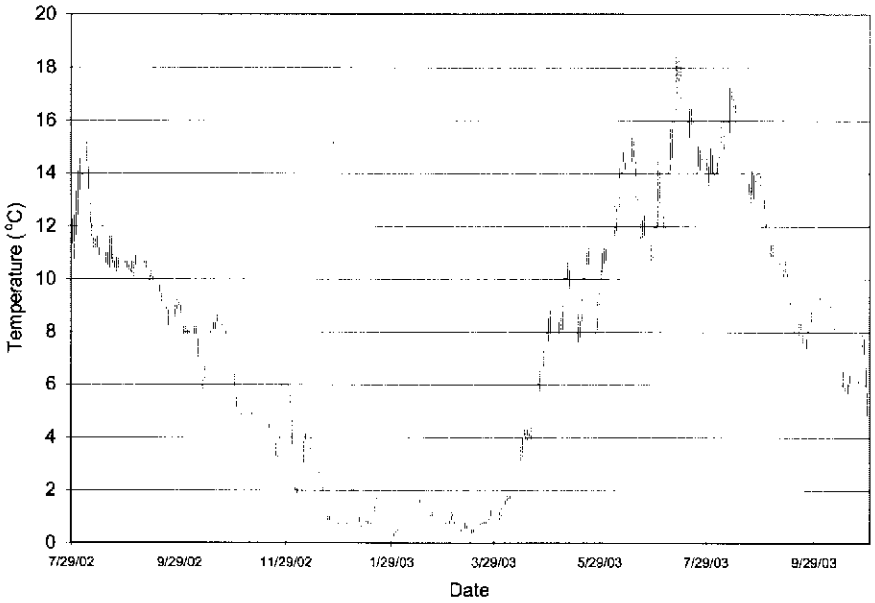
Appendix C.4. Daily maximum, minimum, and average temperature at a depth of 13 m at Station A in Neva Lake, May 23, 2002 to Sccember 31, 2004.



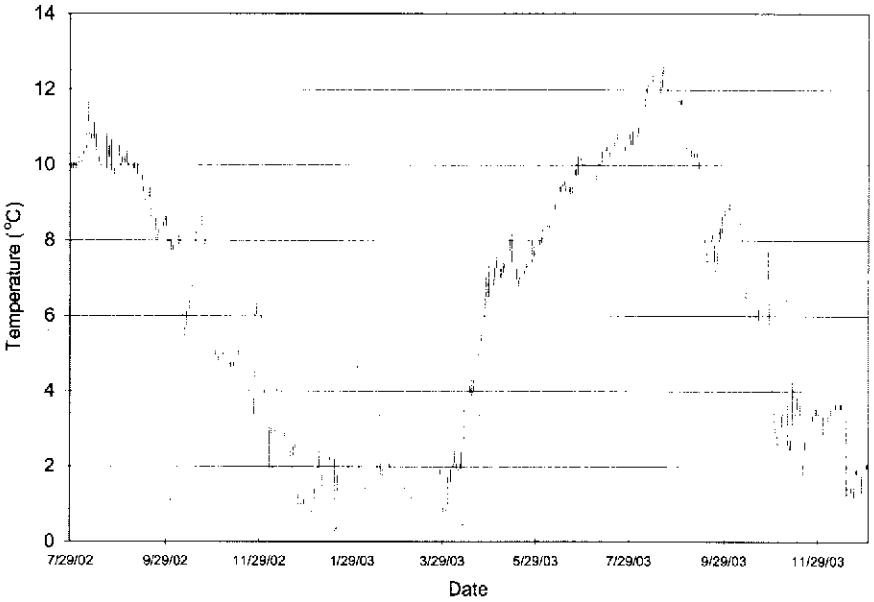
Appendix C.5. Daily maximum, minimum, and average stream temperatures at the lower end of Pavlof Lake's main inlet stream, August 5, 2002 to December 31, 2003.



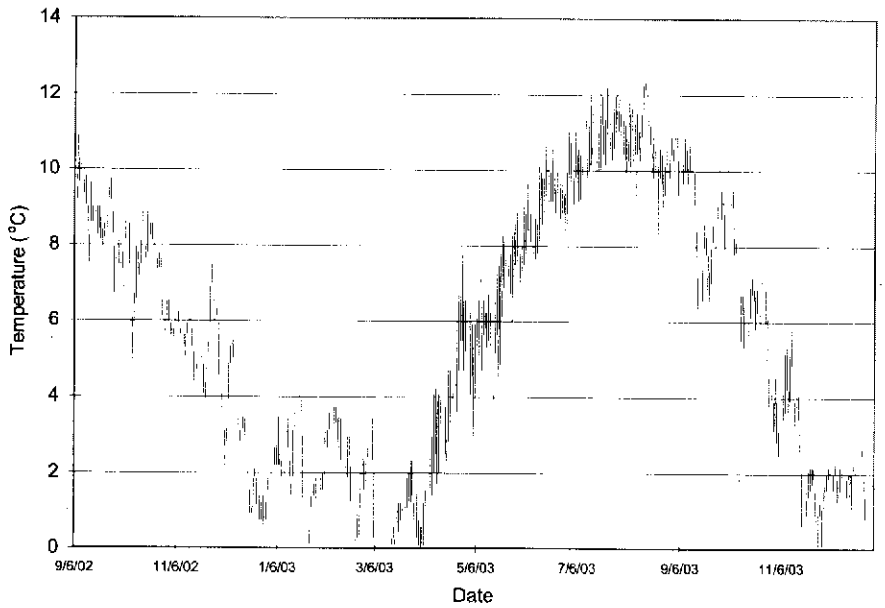
Appendix C.6. Daily maximum, minimum, and average stream temperatures at the top of the fishpass at the outlet of Pavlof Lake, July 29, 2002 to June 11, 2003 when the logger was "lost".



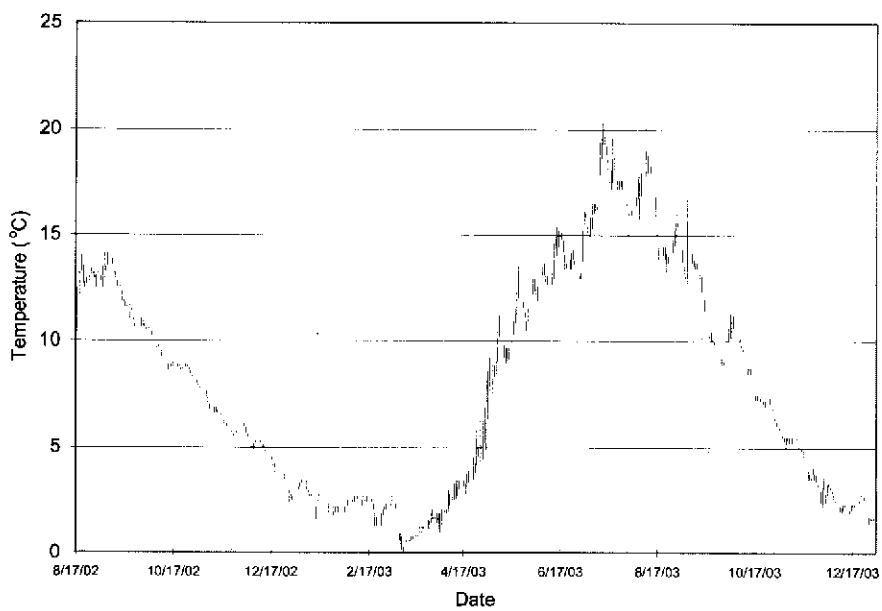
Appendix C.7. Daily maximum, minimum, and average temperature at a depth of 1 m at Station A in Pavlof Lake, from July 29, 2002 to October 30, 2003 when the logger quit recording temperatures.



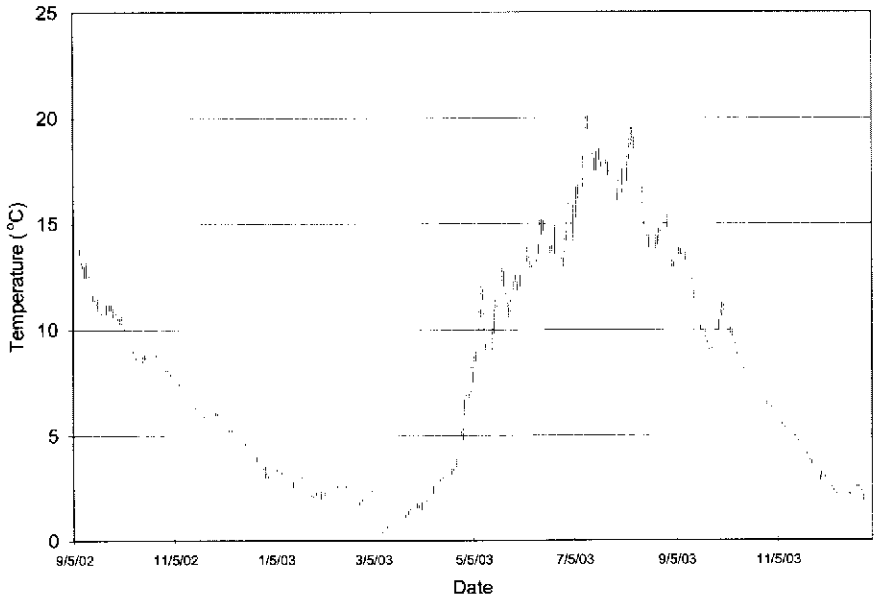
Appendix C.8. Daily maximum, minimum, and average temperature at a depth of 5 m at Station A in Pavlof Lake, July 29, 2002 to December 31, 2003.



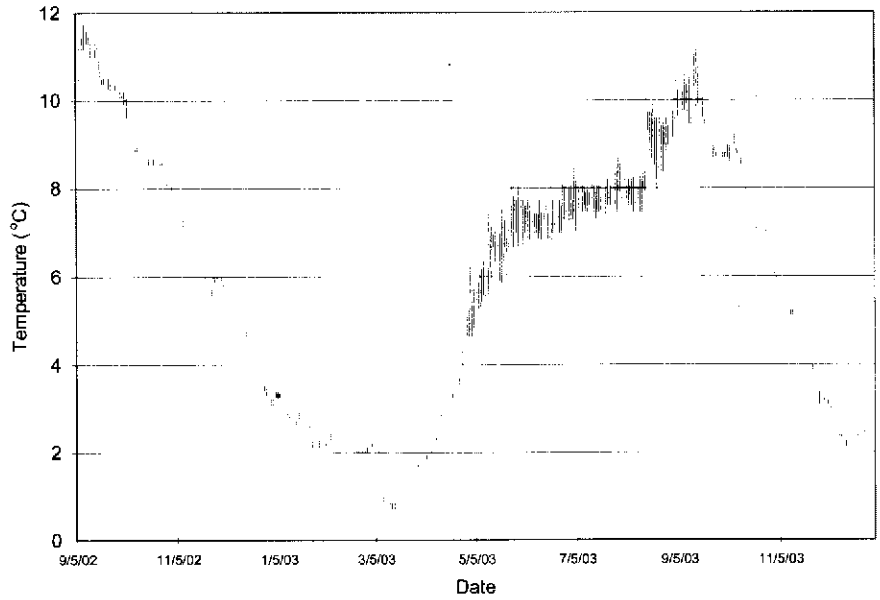
Appendix C.9. Daily maximum, minimum, and average stream temperatures at the lower end of the main inlet "index" stream that enters into the east side of Hoktaheen Lake, September 6, 2002 to December 31, 2003.



Appendix C.10. Daily maximum, minimum, and average stream temperatures at the top of the outlet stream from upper Hoktaheen Lake, August 17, 2002 to December 31, 2003.



Appendix C.11. Daily maximum, minimum, and average temperature at a depth of 1 m at Station A in Hoktaheen Lake, September 5, 2002 to December 31, 2003.



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U.S. Fish and Wildlife Service
Office of Subsistence Management
Fisheries Resource Monitoring Program

Neva, Pavlof, and Hoktaheen Sockeye Salmon Stock Assessment, 2002

Annual Report for Study FIS02-012-1

This report has been prepared to assess project progress. Review comments may not be addressed in this report, but will be incorporated into the final report for this project.

Benjamin W. Van Alen
USDA Forest Service
Juneau Ranger District
8465 Old Dairy Road
Juneau, Alaska 99801

April 2004
U.S. Fish and Wildlife Service

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ABSTRACT

Sockeye salmon (*Oncorhynchus nerka*) returns to Neva, Pavlof, and Hoktaheen Lakes have long been an important subsistence resource for Tlingit families living in Hoonah and other areas of northern Southeast Alaska. This annual report summarizes the sockeye stock assessment project findings from the first year, 2002, of a three-year cooperative Hoonah Indian Association, Alaska Department of Fish and Game, and U.S. Forest Service study. This project uses a weir and mark-recapture methods to estimate the sockeye escapement into Neva Lake, a fishpass trap and mark-recapture to estimate the sockeye escapement into Pavlof Lake, and mark-recapture to index the sockeye escapement in Hoktaheen Lake. Age, sex, and length data and limnology data were also collected to help assess the status of these stocks. The Neva sockeye escapement was 4,951 (CV = 8%) - 3,738 (CV = 6%) were adults and 1,213 (CV = 12%) were jacks. They migrated into the lake from mid-June through mid-September and the midpoint of the run was in early August. The early running fish spawned in the main inlet stream and the later running fish were beach spawners. Ninety-five percent of the Neva sockeye escapement was age-1.-. The Pavlof sockeye escapement was 1,350 (CV = 6%). The run extended from the third week in June to the third week in July with a midpoint around July 3. Less than half the sockeye salmon used the fishpass to migrate into the lake. The sockeye spawned in the lower part of the main inlet stream from late-July to mid-August. Age-1.3 fish dominated the escapement. Estimates of the abundance of sockeye salmon in the upper Hoktaheen Lake were 737, 763, and 156 on September 6, 7, and 18 in the main inlet stream index area and 139 and 233 on September 7 and 18 in the outlet index area. Only a few spawning sockeye were observed outside of these two index areas. Age-1.2, 1.3, and 2.2 fish each comprised about one-third of the sockeye sampled. The dominant zooplankton was *Daphnia* sp. in Neva Lake, *Cyclops* sp. in Pavlof, and *Bosmina* sp. in Hoktaheen. The weighted "seasonal" biomass of zooplankton was 402, 1, and 618 mg m^{-2}, respectively, in Neva, Pavlof, and Hoktaheen Lakes and euphotic zone depths were 12.1, 4.9, and 4.2 m.

Key Words: Sockeye salmon, *Oncorhynchus nerka*, Neva, Pavlof, Hoktaheen, escapement, mark-recapture, age composition, limnology.

Citation: Van Alen, B. W. 2004. Neva, Pavlof, and Hoktaheen sockeye salmon stock assessment, 2002. Federal Subsistence Fishery Monitoring Program, Annual Project Report No. FIS 02-012-1. U.S. Fish and Wildlife Service, Office of Subsistence Management, Fishery Information Services Division, Anchorage, Alaska.

INTRODUCTION

Sockeye salmon returns to Neva Lake (Alaska Department of Fish and Game stream number 114-80-045), Pavlof Lake (112-50-010), and Hoktaheen Lake (113-94-003) 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; Figure 1). Household subsistence surveys done in Hoonah in 1996 found that 86% of the families used salmon and 65% used sockeye salmon (Table 1).

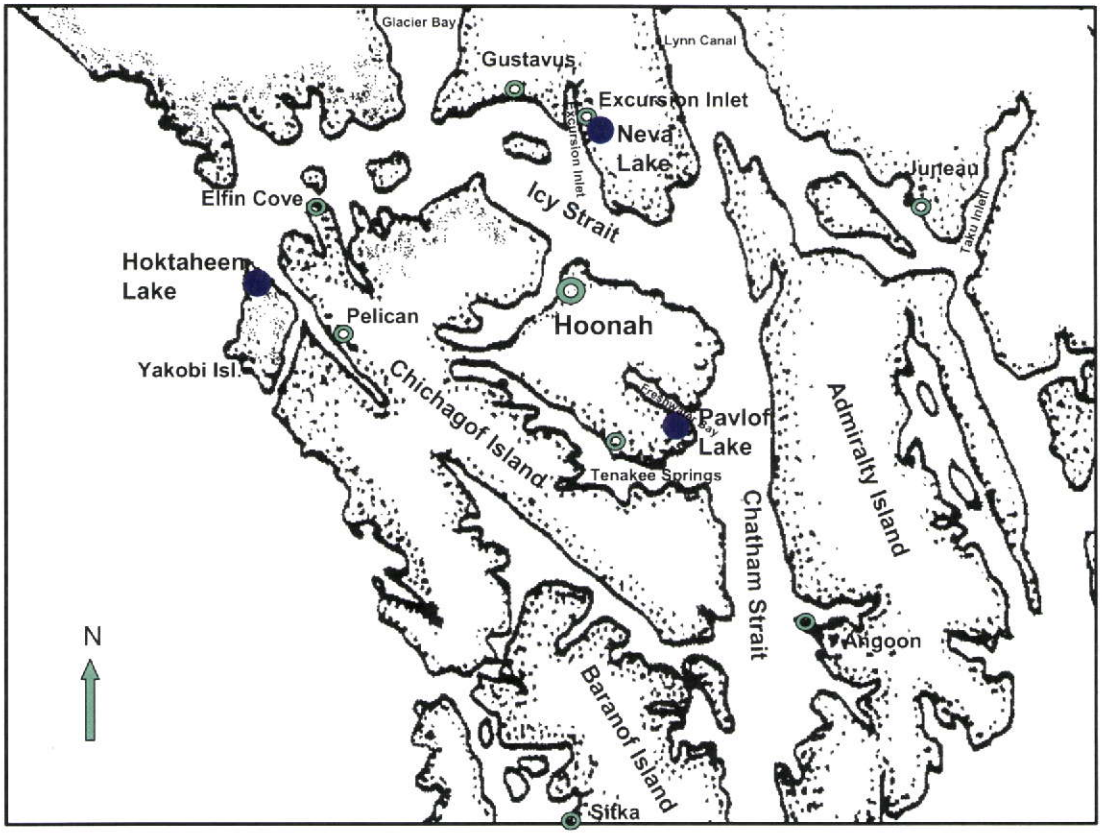

Figure 1. Map of northern Southeast Alaska showing the location of Neva, Pavlof, and Hoktaheen Lakes.

Table 1. Subsistence use and harvest of salmon by households in Hoonah. (ADF&G, Division of Subsistence, Community Profile Database, 2003).

	Sockeye Salmon		All Salmon	
Year	Percent Households Using	Percent Households Harvesting	Percent Households Using	Percent Households Harvesting
1985	32%	17%	86%	55%
1987	38%	29%	92%	69%
1996	65%	43%	86%	74%

Unfortunately, little is known about the health of these sockeye runs. Management has had to rely on infrequent and imprecise aerial survey counts and subsistence harvest reports to assess run sizes and trends. I am not aware of any prior studies that estimated or indexed the sockeye escapement into these lakes. We do not know if escapements are at levels that would maximize returns and harvests. We do not know if management is too conservative and if subsistence harvests limits could be liberalized, or, if these runs are depressed and need rebuilding from over harvesting that occurred with the onset of commercial fishing in the late-1800s and early-1900s (Bean 1891; Moser 1899; Rich and Ball 1933; Cooley 1963; Van Alen 2000). Most importantly, we do not know if escapements are trending downward and if management actions are needed to protect these important subsistence resources.

This project estimates sockeye escapements into Neva and Pavlof Lakes, indexes the sockeye escapement into Hoktaheen Lake, and collects associated biological and limnological data need to assess the current status of these important subsistence stocks. Mark-recapture methods are used to estimate the relative and/or absolute sockeye escapement in all lakes. This information is needed to estimate escapement goals and understand the current status of these runs (Geiger et al. 2003).

This report covers the first season (2002) of a joint Hoonah Indian Association (HIA)/U.S. Forest Service (USFS)/Alaska Department of Fish and Game (ADF&G) study into the status of Neva, Pavlof, and Hoktaheen sockeye salmon. The stock assessment of sockeye salmon in Hoktaheen Lake was part of an Organized Village of Kake and ADF&G project in 2001 (Conitz and Cartwright 2002a) but was included in this project since Hoktaheen is in the traditional fishing area of the Hoonah people. .

This Neva, Pavlof, and Hoktaheen Sockeye Salmon Project is one of eight new projects, initiated in 2001 and funded through the U.S. Fish & Wildlife Service Fisheries Resource Monitoring Program, to assess significant subsistence sockeye runs in southeast Alaska (Conitz and Cartwright 2002a, 2002b, 2002c; Conitz et al. 2002; Lewis and Cartwright 2002a, 2002b, 2002c). 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 all involve cooperation among community Tribal associations, ADF&G, and USFS.

There is also a Federal Office of Subsistence Management-funded, cooperative HIA and ADF&G, Division of Subsistence, project currently studying the historic and contemporary subsistence use by the people of Hoonah. Results from both these studies will help us assure the adequacy of these runs for meeting escapement and customary and traditional subsistence needs.

Neva

Neva Lake (58°24.219' N, 135°24.258' W; NAD27 datum) is located on the mainland on the east side of Excursion Inlet (Figure 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.

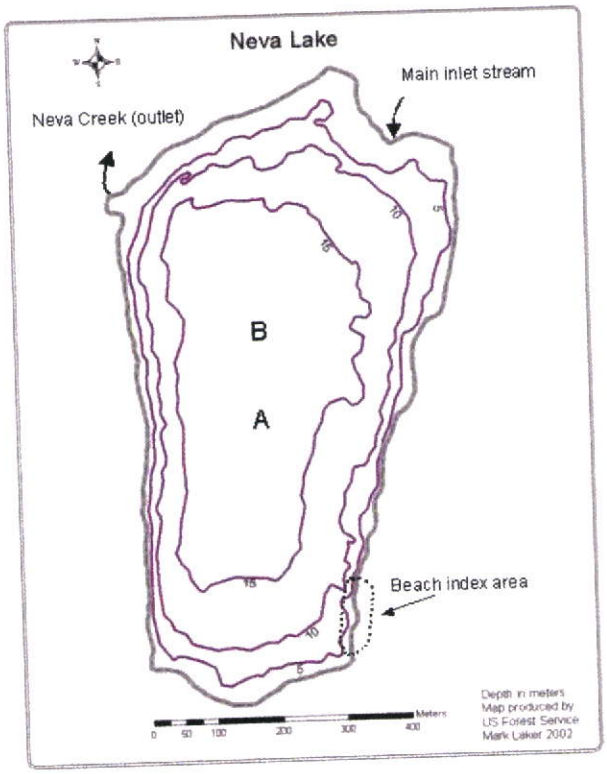

Figure 2. Bathymetric map of Neva Lake showing 5 m depth contours and approximate locations of the two fixed sampling stations, the main inlet stream, the outlet, and the beach spawning index area.

Neva Lake is in the traditional lands used for subsistence harvesting and gathering by the Huna Tlingit (Schroeder and Kookesh 1990). There used to be a village of Wooshkeetaan clan people in Excursion Inlet near the present cannery site (Goldschmidt and Haas 1998). Villagers would fish for "a good run of sockeye" salmon returning to Neva Lake and there were several smokehouses in the area. Stone barriers are still evident in Neva Creek that were built to impede the upstream migration of salmon.

A salmon cannery began operation in Excursion Inlet in 1918. The location and ownership of the cannery has changed several times over the years (Galginaitis 2003). During World War II construction began on facilities for a resupply point for the Aleutian campaign. A dam, reservoir, and water distribution system was built which taps water out of Neva Lake's main inlet stream. This water system is still used by the cannery today. Neva Lake is accessible by road from the cannery.

The State currently holds title to the land surrounding Neva Lake and outlet, and the cannery site is privately owned, but the majority of the watershed is on National Forest System Land. The State has subdivided and sold land along the eastern shore of Excursion Inlet and there are now about 80 cabins/homes and a sport fishing lodge in the area that are mostly used for summer recreation. Unguided fishing excursions commonly target salmon at the mouth of South Creek.

This area is in the Federal subsistence customary and traditional use area for residents in the Hoonah area (Federal Register 50 CFR Part 100 and 36 CFR Part 242) and 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, returned, and the reported harvest since 1984. The return of these permits is voluntary. No sockeye salmon were reported harvested at Neva prior to 1990 and the peak effort (22 permits) and harvest (411 sockeye salmon) was in 1996 (Figure 3). Subsistence and personal use fishing for Neva sockeye salmon occurs both in saltwater, at the mouth 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.

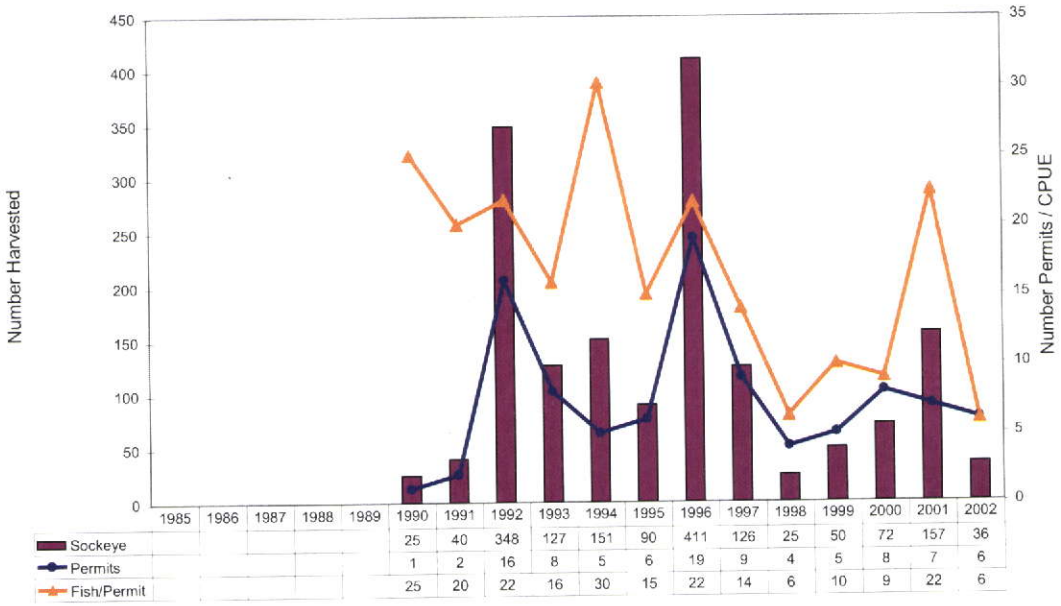

Figure 3. Subsistence/personal use effort and harvest of sockeye salmon at Neva from 1985 to 2002 as reported on permits returned to ADF&G (ADF&G, Division of Commercial Fisheries database, 2003).

Neva sockeye salmon would primarily be harvested in commercial fisheries in Excursion Inlet and Icy Strait. These fisheries also harvest sockeye salmon bound for Lynn Canal, Taku River, Chatham Strait, and other northern inside systems. Rich and Ball (1933) reported no harvests of sockeye salmon in Excursion Inlet prior to 1914 and annual harvests of zero to 50,722 sockeye salmon in Excursion Inlet from 1914 to 1927 (Table 2). Beach seines, purse seines, gillnets, and traps fishing on passing stocks in Icy Strait harvested hundreds of thousands of sockeye salmon annually through 1927 (Rich and Ball 1933; Table 2). Commercial harvest estimates for Icy Strait and Excursion Inlet from 1928 to statehood (1959) are not available. Traps were outlawed in 1959; however, the purse seine fishing effort remained high in Icy Strait into the early 1970s (Table 3). The annual sockeye harvest has ranged between zero and 2,584 fish in Excursion Inlet since 1960 (Table 3). Seine openings in Excursion Inlet have not been directed at Neva sockeye salmon and it is likely that many of the sockeye harvested there were bound for other systems.

The ADF&G, Division of Sport Fish, estimates sport effort, catch, and harvest from an annual statewide mail survey (Mills and Howe 1992). Twelve or more responses are needed for estimates to be useable. There have been too few responses to estimate effort or harvests of salmon in the Neva Lake system but the sport fish harvest of sockeye salmon in the entire Excursion Inlet area (excluding Excursion River) has averaged only 34 fish from 1984 to 1999 (Table 4). There has been an increasing trend in sport effort and harvest in both the Excursion Inlet area (Table 4) and the Glacier Bay Area that includes Excursion Inlet (Table 5).

Aerial and foot escapement surveys have been conducted by ADF&G, Commercial Fisheries Division, intermittently since 1960. These surveys are primarily geared to

indexing pink and chum salmon escapements. They should not be considered a reliable estimate or index of sockeye abundance without further study. Survey locations, dates, and observers are not standardized (Bevan 1961; Jones *et al.* 1998) and usually only a small fraction of the escapement is visible due to the forest canopy, dark water, and the natural dispersal of fish within a system. Nevertheless, counts as high as 1,250 sockeye salmon have been made in Neva Lake in recent years (Table 6).

Table 2. Historic commercial harvest of sockeye salmon in Icy Strait, and Hoktaheen Cove and Excursion Inlet (Neva), and Northern Chatham Strait, and Freshwater Bay (Pavlof), 1889 to 1927 (Rich and Ball, 1933).

Year	Icy Strait[a]	Hoktaheen Cove	Excursion Inlet	Northern Chatham Strait[b]	Freshwater Bay
1889	51,600				
1890	144,000			4,902	
1891	91,200				
1892				21,875	
1893					
1894					
1895				4,260	
1896				36,969	
1897				566	
1898					
1899					
1900	151,901			194,200	25,000
1901	96,547			131,055	
1902	218,084			128,080	
1903	236,167			241,175	
1904	432,262			199,200	
1905	584,275	8,279		93,664	
1906	375,459	11,348		177,200	
1907	511,265	7,000		121,394	
1908	661,140	10,677		256,619	
1909	626,511	10,391		304,351	
1910	609,802	9,896		150,892	
1911	635,726	7,196		158,956	
1912	818,162	7,197		248,964	1,000
1913	686,268	5,344		208,937	
1914	1,304,877	7,686	3	223,738	
1915	768,068	8,301		241,763	
1916	679,561			127,681	560
1917	712,770		6,036	270,713	179
1918	827,768	2,519	61	242,056	
1919	822,679	5,463	385	205,552	808
1920	608,953	3,218	50,722	173,875	
1921	271,138			91,406	
1922	425,725	653	390	103,996	
1923	518,006	5,266	78	86,297	30
1924	552,789	2,310	2,382	121,589	
1925	525,391	2,335	3,039	153,412	
1926	523,110	1,834	546	140,680	
1927	345,635	2,021	2,469	102,367	
Spearman's rho non-parametric trend test (Conover 1980):					
rho	0.46	-0.85	0.35	0.22	-0.83
P-value	0.01	0.00	0.30	0.21	0.04
N	31	20	11	33	6

[a] The beach seine, purse seine, gillnet, and traps in the Icy Strait District primarily targeted passing stocks. Hoktaheen and Excursion Inlet (Neva) are in this district.

[b] The Northern Chatham Strait area includes the beach seine, purse seine, gillnet, and trap harvests north of Pt. Gardner and Takatz Bay. Freshwater Bay (Pavlof) is in this district.

Table 3. Commercial purse seine effort and harvest of sockeye salmon in waters adjacent to Neva Lake (Icy Strait and Excursion Inlet), Pavlof Lake (Upper Chatham Strait and Freshwater Bay), and Hoktaheen Lake (Hoktaheen Cove), 1960 to 2002 (from ADF&G, Division of Commercial Fisheries, Alexander Database, 2003).

	Icy Strait (Dist. 114)		Excursion Inlet (Dist. 114-80)		Upper Chatham (Dist. 112)		Freshwater Bay (Dist. 112-50)		Hoktaheen Cove (Dist. 113-94)	
Year	Sockeye Harvest	Boat-Days	Sockeye Harvest	Boat-Days	Sockeye Harvest	Boat-Days	Sockeye Harvest	Boat-Days	Sockeye Harvest	Boat-Days
1960	136,796	1,552			12,399	236	1,046	58		
1961	213,619	2,965			45,493	726	69	15		
1962	136,712	1,208			11,148	160	114	0		
1963	201,535	5,440			24,268	1,312	18	4		
1964	204,304	4,162	9		34,225	1,282				
1965	280,730	4,682	1		48,756	1,383	15	0		
1966	216,858	2,747	12		28,737	1,363	3	0		
1967	160,019	3,113	306		15,891	525	17	0		
1968	230,741	3,004	2		41,874	3,213	448	0	1,073	
1969	231,624	3,627			29,563	1,610				
1970	163,224	4,384	4	190	49,598	4,844	14	27	149	6
1971	88,758	3,188	3	232	18,533	1,728			315	36
1972	96,853	3,374	13	220	33,761	2,651	528	48	8	3
1973	130,805	1,714	10	102	32,118	620			205	4
1974	20,594	656	2	184	23,639	858				
1975	2,391	226	0	110						
1976	21	303	21	303						
1977										
1978					1,261	434				
1979	3	53	2	52	1,577	261	8	4		
1980	1,792	216	1,685	198	1,300	662				
1981	10,638	596	266	238	17,188	602				
1982	234	119			26,524	3,408				
1983	2,333	135	85	28	25,979	1,001				
1984	6,882	190	1,876	138	22,208	1,548				
1985	3,638	253	919	26	37,140	2,448				
1986	1,479	69	168	35	8,391	2,181				
1987	3,793	307	396	156	44,989	1,486				
1988	1,244	135	952	73	3,927	642				
1989	6,111	164	151	2	48,985	1,653				
1990	4,161	110	2,348	52	17,477	873				
1991	4,307	208	1,153	31	40,289	2,735				
1992	6,454	180	2,584	65	54,403	1,869				
1993	9,806	249	216	1	81,676	2,989				
1994	10,536	412			76,582	4,044				
1995	264	8	264	8	20,387	2,799	1,576	54		
1996					37,482	3,102				
1997	5,123	259	518	5	25,946	2,528	1,582	46		
1998					30,820	2,546				
1999	17,301	893	105	24	55,942	3,725				
2000	1,111	99	376	77	30,594	2,538				
2001	43,739	443			64,427	1,777				
2002	4,592	262			24,751	1,761				

Table 4. Sport fish effort and harvest in Excursion Inlet and Neva Lake, 1984 to 1999 (from ADF&G, Division of Sport Fish, Statewide Harvest Database, 2003).

Year	Number of Anglers	Number of Trips	Days Fished	Coho Harvest	Sockeye Harvest	Number of Responses
1984	12	55	33	59	0	1
1985	163	130	121	50	0	3
1986	204	681	706	45	11	6
1987	225	449	444	44	110	6
1988	402	2,135	1,893	54	0	5
1989	290	273	321	152	28	10
1990	232	249	443	0	21	9
1991	724	1,252	3,164	176	0	19
1992	660	1,383	1,420	97	66	29
1993	588	1,042	1,062	163	0	24
1994	1,166	1,428	2,496	1,053	74	42
1995	1,113	1,419	3,042	290	34	40
1996	613	1,197	1,633	620	0	34
1997	1,170	1,921	2,867	840	50	52
1998	1,005	1,955	2,720	924	124	49
1999	1,257	1,675	3,357	2,762	32	51
Average	614	1,078	1,608	458	34	24
Spearman's non-parametric trend test:						
Rho	0.91	0.71	0.79	0.85	0.43	0.96
P-value	0.00	0.00	0.00	0.00	0.10	0.00
N	16	16	16	16	16	16

Table 5. Sport fish harvest and effort in the Sitka area (on and around Baranof and Chichagof Islands) and Glacier Bay areas, 1977 to 2001 (from ADF&G, Division of Sport Fish, Statewide Harvest Database, 2003).

		Sitka Area (includes Pavlof and Hoktaheen):					Glacier Bay Area (includes Excursion Inlet and Neva):				
Watertype	Year	Number of Anglers	Number of Trips	Days Fished	Coho Harvest	Sockeye Harvest	Number of Anglers	Number of Trips	Days Fished	Coho Harvest	Sockeye Harvest
Freshwater	1977			6,927	261	192			1,362	0	6
	1978			5,303	176	56			129	0	0
	1979			3,946	154	36			79	0	0
	1980			5,510	326	69			143	9	43
	1981			3,844	184	0			196	11	22
	1982			5,663	146	0			17	0	0
	1983			4,998	336	76			253	0	0
	1984	2,720	2,938	4,258	255	102	208	429	535	124	78
	1985	2,941	4,670	4,680	348	0	291	747	433	12	0
	1986	2,809	3,942	4,587	115	38	646	805	651	167	11
	1987	2,582	4,826	5,611	42	14	428	673	1,845	88	143
	1988	3,089	4,112	5,077	308	1,092	682	1,176	1,009	837	419
	1989	2,424	4,017	5,154	261	214	511	1,023	887	559	0
	1990	2,826	3,676	4,404	87	120	598	813	1,371	495	0
	1991	3,026	3,610	6,970	390	323	997	1,995	2,335	780	48
	1992	3,535	5,066	6,674	461	0	559	1,706	2,029	349	164
	1993	3,148	6,142	9,444	925	177	627	1,640	1,912	212	142
	1994	3,031	5,776	7,789	389	151	627	1,788	2,114	669	0
	1995	3,251	4,273	7,718	937	77	866	2,808	4,071	846	219
	1996	2,355	3,324	4,426	479	252	369	877	903	154	99
	1997	3,309	4,840	7,123	828	547	1,173	1,931	3,087	815	271
	1998	2,822	3,075	5,298	823	259	804	598	1,187	129	81
	1999	3,268	5,051	8,368	1,196	637	666	1,118	1,351	197	0
	2000	1,748	4,178	6,289	324	212	1,026	2,257	3,249	749	244
	2001	1,369	3,163	4,733	137	133	1,111	2,905	3,503	1,668	108
Spearman's non-parametric trend test:											
	Rho	0.00	0.07	0.37	0.50	0.56	0.67	0.61	0.77	0.78	0.48
	P-value	0.99	0.79	0.07	0.01	0.00	0.00	0.01	0.00	0.00	0.02
	N	18	18	25	25	25	18	18	25	25	25
Saltwater	1977			30,817	2,855	620			3,013	744	231
	1978			27,638	2,188	268			1,529	880	169
	1979			36,564	1,554	754			2,563	227	0
	1980			33,172	1,876	1,326			2,299	207	17
	1981			34,650	3,122	594			2,242	562	22
	1982			37,686	3,741	628			2,747	1,163	0
	1983			39,160	4,312	306			3,237	619	41
	1984	9,367	28,715	35,791	2,389	533	941	1,411	2,848	247	0
	1985	12,429	32,650	31,935	3,332	210	1,876	3,407	3,468	324	0
	1986	13,733	32,786	35,173	3,962	328	2,380	2,973	3,213	224	0
	1987	14,005	38,882	39,972	2,673	433	2,716	4,023	5,333	956	121
	1988	16,736	36,028	43,603	2,437	2,055	2,445	7,395	8,267	508	91
	1989	17,618	44,824	54,076	8,030	1,934	4,144	5,612	8,008	1,817	216
	1990	22,612	46,777	57,502	7,721	1,224	3,483	5,013	6,486	1,251	21
	1991	23,009	44,672	61,223	11,084	487	7,318	12,145	19,630	4,873	84
	1992	29,824	55,978	71,607	8,706	434	5,221	9,072	13,250	1,158	215
	1993	28,460	52,358	65,500	13,593	949	6,017	9,394	13,142	2,508	172
	1994	40,327	67,455	100,204	42,489	1,987	8,220	9,401	16,105	6,142	93
	1995	37,258	62,777	93,420	15,677	1,502	9,224	13,343	21,243	2,130	477
	1996	32,219	41,539	60,556	35,413	2,789	6,266	9,224	13,533	4,513	228
	1997	34,501	53,446	81,442	37,125	2,962	6,890	12,763	20,083	5,140	264
	1998	37,305	46,188	72,136	50,645	3,522	6,812	8,368	13,071	3,652	99
	1999	34,042	55,906	96,789	75,050	6,929	7,955	11,361	21,556	11,793	85
	2000	22,190	50,067	84,602	39,182	2,170	8,115	21,355	38,126	12,522	172
	2001	24,502	50,642	87,657	83,377	1,829	8,415	18,499	38,963	25,250	146
Spearman's non-parametric trend test:											
	Rho	0.74	0.68	0.91	0.92	0.68	0.87	0.86	0.94	0.84	0.46
	P-value	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.02
	N	18	18	25	25	25	18	18	25	25	25

Table 6. Peak aerial, foot, or boat counts of sockeye salmon at Neva, Pavlof, and Hoktaheen, 1960 to 2002 (from ADF&G, Division of Commercial Fisheries, Alexander Database, May 2003).

	Neva Creek		Pavlof River		Hokatheen Cove	
Year	Number Counted	Number of Surveys	Number Counted	Number of Surveys	Number Counted	Number of Surveys
1960						
1961			200	1		
1962			300	1		
1963			850	1		
1964						
1965			2,500	3	3,000	1
1966			4,000	1		
1967			2,500	5		
1968			3,300	4	2,000	2
1969					1,500	2
1970						
1971						
1972					0	1
1973					500	2
1974						
1975						
1976						
1977					1,500	1
1978					500	1
1979						
1980						
1981			800	1		
1982			200	2		
1983			170	4		
1984			150	2		
1985			0	1		
1986			0	2		
1987			200	5		
1988	100	1				
1989	140	2	100	3		
1990	470	3	300	6		
1991	300	2				
1992	0	1	300	4		
1993	0	1	800	5		
1994	0	2	100	2		
1995	250	1	400	3		
1996	610	2	400	2		
1997	50	4	620	2	2	3
1998	123	10	350	5		
1999	810	4	40	3	150	2
2000	215	4	200	4	404	3
2001	1,250	4	300	2	745	3
2002	100	2	100	2		

Pavlof

Pavlof Lake (57°50.605' N, 135°02.672' W) is located on the northeast side of Chichagof Island (Figure 1). Pavlof Lake empties directly into Pavlof Harbor on the southeast side of Freshwater Bay. There is a short 4 m falls on the outlet. Pavlof Harbor is about 48 km

by boat from Hoonah and Angoon and 24 km from Tenakee Springs. Pavlof Lake has a surface area of 36.6 ha, a maximum depth of 8 m, a mean depth of 2.3 m, a volume of 860,000 m^3, and an elevation of 5 m (Figure 4; Barto and Cook 1999). This small, shallow lake has an extensive growth of lily pads (*Nuphar* spp.) and other aquatic vegetation. The small lake does little to buffer rainfall or snowmelt events and there is a wide range in daily stream flows, particularly in the fall (Figure 5).

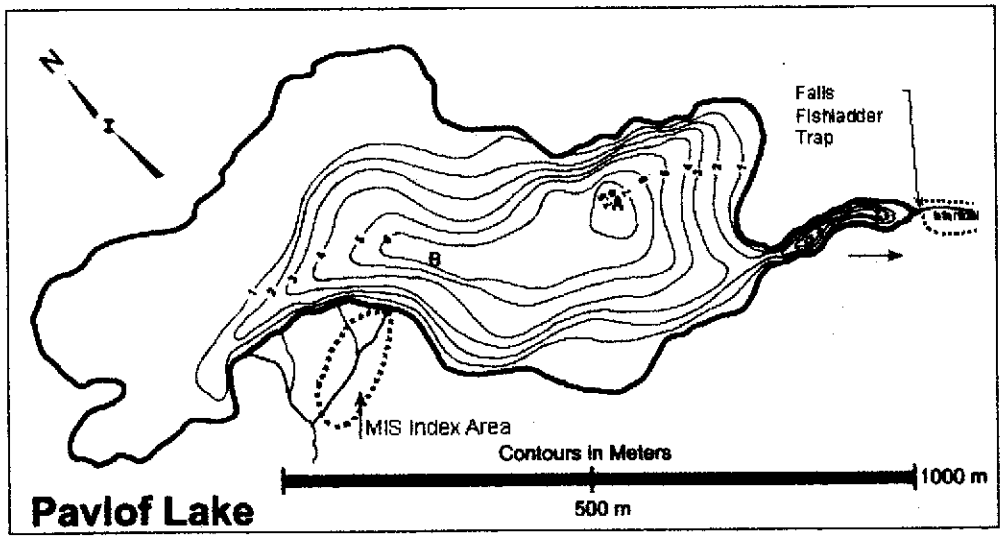

Figure 4. Bathymetric map of Pavlof Lake showing 1 m depth contours and locations of the two fixed sampling stations, the index area in the main inlet stream, and the fish pass and trap at the outlet of the lake (from ADF&G).

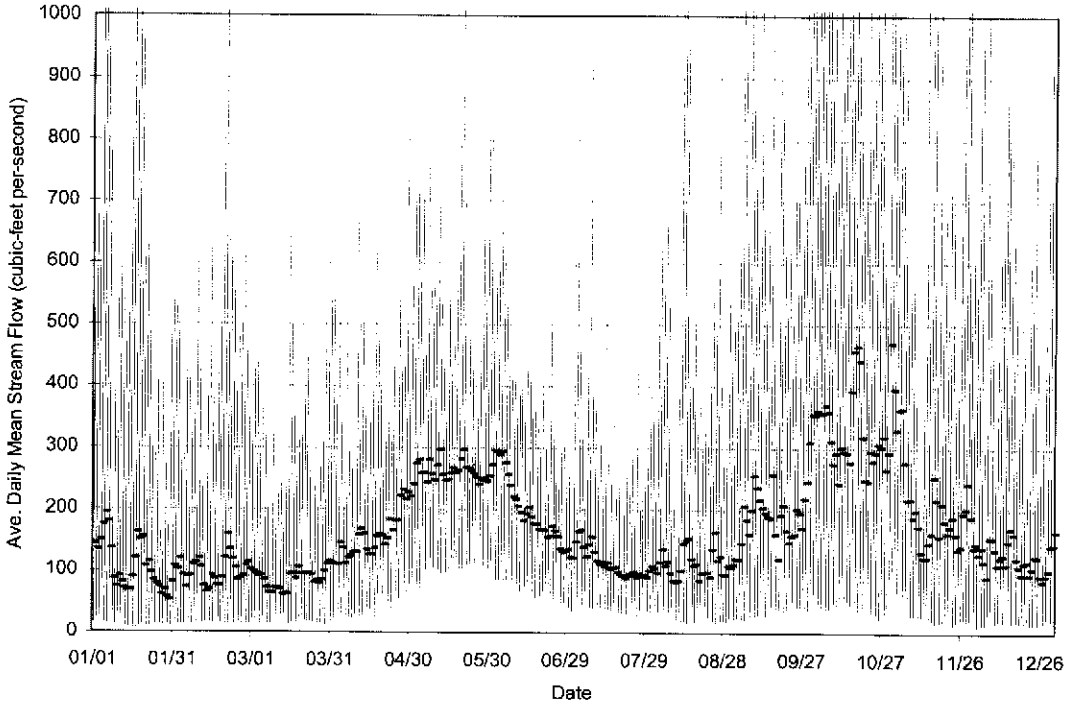

Figure 5. Average daily mean stream flow (cubic-feet per-second) and minimum and maximum (truncated at 1,000 from peaks up to 3,370) daily measurements for Pavlof River, June 1, 1957 to September 30, 1981. (From USGS)

The Pavlof Harbor area is in the traditional territory of Wooshkeetaan clan members associated with Angoon, Auk (Juneau), and Tenakee (Goldschmidt and Haas 1998). Goldschmidt and Haas reported that Wooshkeetan people from Angoon had lived for a time in a small village near Pavlof Harbor called Asaank''i and that a smoke house was located below the waterfall at the outlet of Pavlof Lake. De Laguna (1960) interviewed an elderly man in Angoon who also collaborated Goldschmidt and Haas's report. He said when he was a small boy there were two "Wuckitan" lineage houses in a small village about a mile east of "the sockeye stream in Freshwater Bay". De Laguna (1960) clarifies that this territory originally belonged to an independent division of the Wuckitan, the Freshwater Bay branch, and that they subsequently "inherited rights at Angoon when the Kootznahoo branch of this sib became extinct." A picture of a Tlingit man gaffing salmon in 1901 in a Freshwater Bay creek (believed to be Pavlof Creek with the waterfall in the background) is shown on Page 107 in the book "The Tlingit Indians" by Emmons (1991).

Shroeder and Kookesh (1990) report that a cannery was operated in Pavlof Harbor in 1889 and 1919-1923. The waterfall was incorporated into cannery operations. The Federal Works Progress Administration constructed a concrete fish ladder with 14 step pools on the left side (looking downstream) of the falls in 1935. Prior to the construction of this fish ladder it is believed that the cascading falls at the outlet of the lake was a partial

barrier to upstream migrating salmon (Barto and Cook 1999). The USFS installed an aluminum "Alaskan steep pass" inside the concrete fish ladder in 1986. The USFS also installed an "Alaskan steep pass" fishpass on a waterfall in the main inlet tributary in 1987. The intent of this upper fishpass is to provide coho salmon with better access to upriver spawning and rearing habitat.

The State of Alaska currently holds title to the land around the lake and outlet but the majority of the watershed is on National Forest System Lands. Large portions of the watershed were clearcut logged in years 1977 to 1981, 1987 and 1988, and 1991 to 1993. Roads now traverse the watershed and provide vehicle access with Hoonah. The area immediately around the lake and outlet has not been logged and it is not possible to drive to the lake or outlet.

Barto and Cook (1999) conducted a limnology and fisheries investigation of Pavlof Lake in 1997. Their study evaluated rearing conditions for sockeye salmon and applied empirical sockeye production models developed by Koenings and Burkett (1987) to identify potential management or enhancement strategies for optimizing sockeye production. They concluded that the lake's sockeye carrying capacity was relatively small, that sockeye production was near capacity, and that coho production might be compromised if the lake was fertilized in an attempt to boost sockeye production.

Coho salmon spawners from Pavlof were a brood source for an ADF&G, Fisheries Rehabilitation Enhancement and Development Division's, effort to boost recreational sport fishing opportunities in the Juneau area. Between 1987 and 1996, 109 coho salmon adults were killed during egg take operations in late-September in the upper reaches of the main inlet stream. These eggs were incubated in Juneau and the fry released into Juneau area streams.

The Pavlof area is not in either a Federal or State customary and traditional use area. Subsistence use data ranked the Pavlof Lake area as high use by residents of Tenakee Springs and middle use by residents of Hoonah and Angoon (ADF&G, Subsistence Division, Tongass Land Management Plan Revision, 1996). Pavlof has not been listed on the annual subsistence/personal use permits issued by ADF&G and sockeye harvests have only been reported in two years (Figure 6).

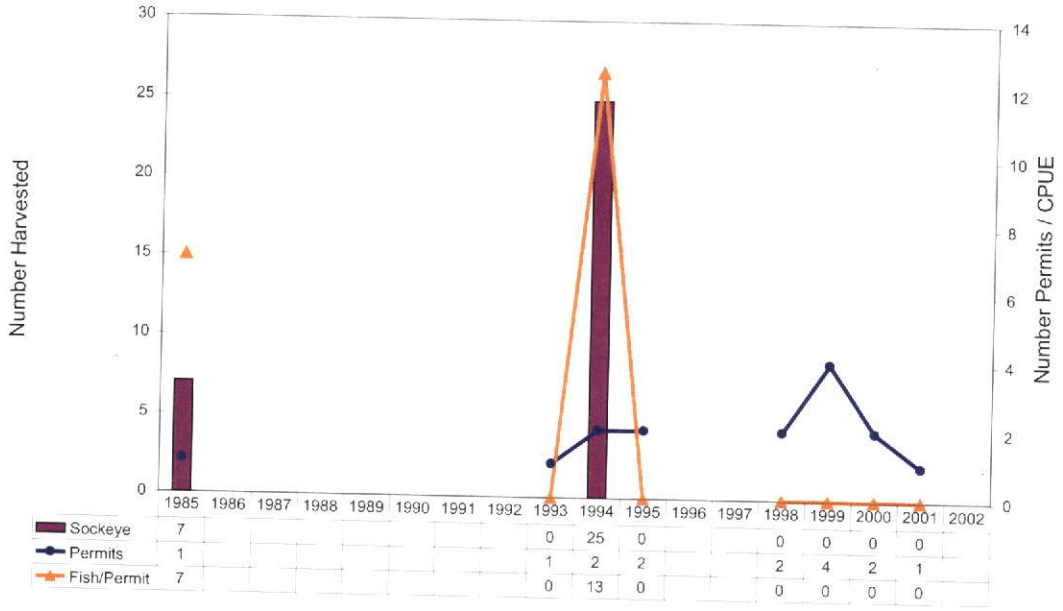

Figure 6. Subsistence/personal use effort and harvest of sockeye salmon at Pavlof from 1985 to 2002 as reported on permits returned to ADF&G (ADF&G, Division of Commercial Fisheries, Alexander Database, 2003).

Sockeye salmon returning to Pavlof Lake would be harvested in Icy Strait and Chatham Strait area fisheries. Rich and Ball (1933) reported six years of sockeye harvested in Freshwater Bay starting with 25,000 harvested in 1900 and ending with 30 in 1923 (Table 2). Sockeye harvests in Freshwater Bay since statehood (1959) are between zero and 1,582 fish (Table 3). These seine openings target pink salmon.

Pavlof Harbor is a popular anchorage for pleasure boaters and sport fishing for trout and salmon is also popular in the area. However, the sport harvest of sockeye salmon in the Pavlof area is small. Only nine sockeye salmon were reported harvested in the Pavlof Lake, Pavlof Bay, Freshwater Bay area from 1977 to 1999 (ADF&G, Division of Sport Fish, Statewide Harvest Survey database, 2002). The saltwater sport effort and harvests are trending upward in the area (Table 5).

Aerial and foot escapement surveys since 1980 have usually counted around 200 sockeye salmon in the Pavlof River (Table 6). The run timing of sockeye and pink salmon overlaps and the tannin stained water makes counting fish difficult.

Hoktaheen

Hoktaheen Lake (58°03.236' N, 136°30.381' W) is located on the northwest side of Yakobi Island, about 25 km from the community of Pelican (Figure 1). The lake is at

about 51 m in elevation and drains a watershed area of about 20 km^2. It has a surface area of 67 ha, an average depth of about 20 m, and a maximum depth of about 50 m (Conitz and Cartwright 2002a; Figure 7). There are two lakes in the Hoktaheen Lake system. A short, 0.5 km, stream connects the larger, upper lake to the lower lake. The outlet of the smaller lake flows about 2 km to Hoktaheen Cove on the Gulf of Alaska.

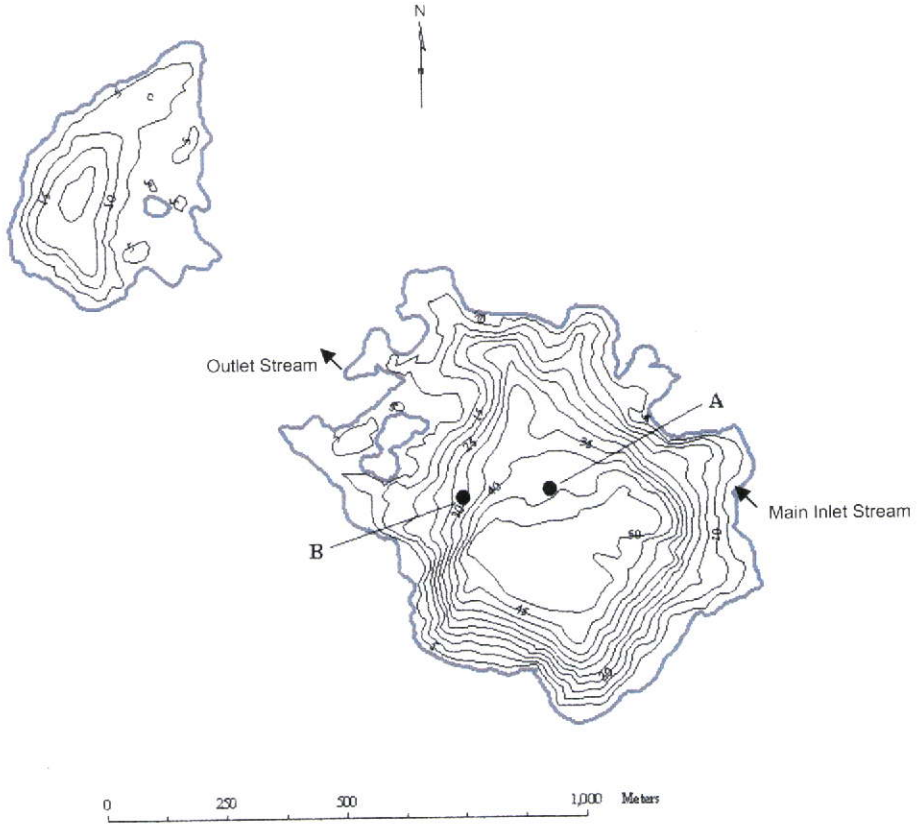

Figure 7. Bathymetric map of Hoktaheen Lakes with 5 m depth contours, location of limnology sampling stations A and B, and locations of the Main Inlet Stream and outlet.

The Hoktaheen Lake system on Yakobi Island is within the traditional subsistence harvesting and gathering area claimed by the Hoonah people. Goldschmidt and Hass (1946) believed that the Hoktaheen Cove area belonged to the T'akdeintaan clan. They reported that "Hoktaheen Creek is a good sockeye stream" and that smokehouses were located there. The summer camps and smoke houses are now gone but subsistence fishers from Hoonah, Pelican, and Elfin Cove continue to make day or overnight trips to Hoktaheen Cove. Travel is often by skiff and weather and sea conditions must be good for safe boating.

Hoktaheen Lake is in the West Chichagof Yakobi Wilderness Area. The entire watershed is on National Forest land.

The reported subsistence harvest of sockeye salmon at Hoktaheen peaked at 1,720 fish in 1997 (Figure 8). Harvests vary with effort and the fish-per-permit, a rough indicator of annual abundances, is variable but steady. The public has expressed concern about aggressive fishing and possible overharvest in the Hoktaheen subsistence and personal use fisheries (Conitz and Cartwright 2002a).

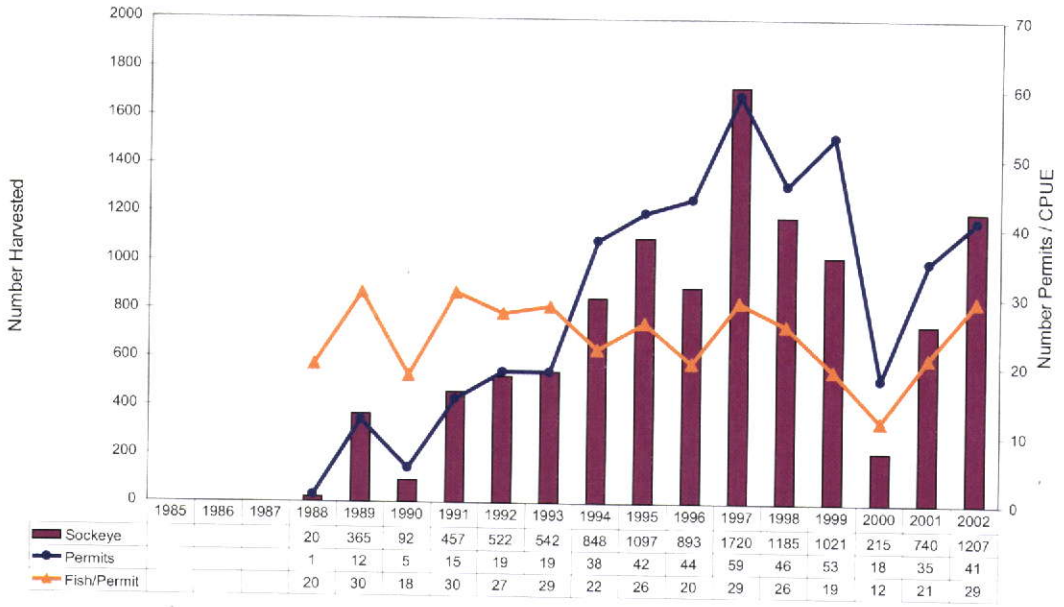

Figure 8. Subsistence/personal use effort and harvest of sockeye salmon at Hoktaheen from 1985 to 2002 as reported on permits returned to ADF&G (ADF&G, Division of Commercial Fisheries database, 2004).

The historical commercial harvests of sockeye salmon in Hoktaheen Cove decreased significantly (Spearman's rho rank correlation trend test, at $\rho = 0.05$; Conover 1980) from around 10,000 fish a year in years 1905 to 1910 to around 2,000 fish a year by 1927 (Rich and Ball 1933; Table 2). We don't know what the sockeye harvest was from then to statehood but less than 1,800 have been harvested since statehood and the last time Hoktaheen Cove was open to seining was in 1973 (Table 3). There have not been seine fisheries operating in the immediate vicinity of Hoktaheen Cove in recent years, but those at the mouth of Lisianski Inlet, in Icy Straits, and southward along the outside Chichagof Island coast may incidentally harvest some sockeye salmon returning to Hoktaheen Lake.

The sport harvest of sockeye salmon from Hoktaheen is unknown; the ADF&G, Division of Sport Fish Division's statewide harvest survey has received less than three responses a year from those fishing in the Hoktaheen area. However, the area around Hoktaheen

Cove has become increasingly popular for sport fishing since the late 1980s (Conitz and Cartwright 2002a).

Escapement surveys have only been done in a few years at Hoktaheen. These aerial surveys have been directed at indexing escapements of pink salmon and no surveys were flown in the 1980s and early 1990s. Recent counts have been in the hundreds and historical counts were in the thousands (Table 6).

OBJECTIVES

The original Investigation Plan listed the following objectives:

1) Estimate the annual escapement of sockeye salmon into Neva Lake such that the estimate is within 10% of the actual abundance 95% of the time.

2) Index the escapement of sockeye salmon into Pavlof Lake such that:
    a. The index reflects the actual annual abundance; and
    b. The index is not biased high.

3) Estimate the age, length, and sex composition of the sockeye escapements into Neva and Pavlof Lakes such that the estimates are within 10% of the true composition, 95% of the time.

4) Estimate the sockeye carrying capacity in Neva and Pavlof Lakes using established ADF&G limnological sampling and analytical procedures.

These objectives were expanded to include estimating the total escapement of sockeye salmon into Pavlof Lake and indexing the escapement of sockeye salmon in Hoktaheen Lake. The precision goals were also reworded to follow the revised objectives listed in Conitz and Cartwight (2002a). The revised objectives now read:

1) Use an outlet weir/trap and mark-recapture methods to estimate the annual escapement of sockeye salmon into Neva and Pavlof Lakes such that the estimated coefficient of variation is less than 10%.

2) Use mark-recapture methods to index the escapement of sockeye salmon into Neva, Pavlof, and Hoktaheen Lakes such that:
    a. The index reflects the actual annual abundance;
    b. The index is not biased high; and
    c. The estimated coefficient of variation is less than 15%.

3) Estimate the age, length, and sex composition of the sockeye escapements into Neva, Pavlof, and Hoktaheen Lakes such that the estimated coefficient of variation is less than 5%.

4) Collect baseline data on in-lake productivity of each lake using established ADF&G limnological sampling procedures which may include zooplankton sampling and vertical sub-surface temperature, dissolved oxygen, and light intensity measurements.

5) Describe the distribution of spawning sockeye salmon in the Neva Lake system using radio tags.

METHODS

Adult Sockeye Escapement Assessment

Neva

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 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 2002a; Conitz and Cartwright 2003b).

Independent mark-recapture studies and visual survey counts were also done to index the abundance of sockeye spawning in the main inlet stream (MIS) and lake. These visual or mark-recapture indices might prove to be a good predictor of the total escapement but three or more years of paired observations are needed to develop expansion factors (Heinl et al. 2000).

Weir.

Upstream migrating adult salmon, trout, and char were captured and counted as they were passed upstream of a trap mounted on the face of a weir installed across Neva Creek. The weir was placed about 80 meters downstream from the lake (58°24.894' N, 135°26.295' W). The weir was in place from June 4 to September 15 but project

personnel had to pull pickets and allow fish to pass uncounted on three occasions late in the season due to work commitments at other locations. Separate counts were kept for adult and jack sockeye and coho salmon. Jacks were identified by their visual appearance.

The weir was constructed using an aluminum bipod and channel superstructure and 19.05 mm x 305 cm (¾ in x 10 ft) EMT conduit pickets (Appendix A). Seven bipods were used to support the 16.5 m wide weir. Upstream migrating salmon, trout, and char were counted and sampled from a 152.5 x 244 x 244 cm (5 x 8 x 8 ft), bear proof, trap attached to the front of the weir. The maximum gap between pickets in the weir and trap was 2.54 cm. 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 in the side of the trap and into quiet water created with a short sand bag and picket diversion. A plastic fish tub, 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 was used to initially record the number of adult and jack, marked and unmarked, salmon, trout, and char passed upstream. Five mL of a 20:80, Clove oil:ethyl alcohol (Everclear), mix in 40+ L fresh river water was occasionally used to lightly anesthetize the sockeye or coho salmon that were marked or scale sampled (Anderson et al. 1997).

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. Recording thermometers (Onset Computer Corporation, "Optic StowAway Temp" loggers[1]) were also deployed on July 27, 2002 at the weir gauging station and in the lower part of the main inlet stream. These thermographs were placed about three inches below the streambed in short aluminum pipes. They recorded the temperature every six hours at 0000, 0400, 0800, 1200, 1600, and 2000 hour. Two additional thermographs were deployed at depths of 1 m and 13 m at Station A on May 23.

Weir-to-Spawning Ground 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. A running average of half (50%) of the sockeye salmon counted through the weir each day were marked with an adipose fin clip and either a left axillary clip for the first third of the run, a left ventral clip for the middle third of the run, or a dorsal clip for the last third of the run. The dates for each third of the run were approximated as start-of-run to July 2, July 2 to July 21, and July 22 to end-of-run since there are no historical records of the timing of sockeye salmon into this system. These finclips involved severing the entire adipose fin, the entire axillary fin, the lower two-thirds of the ventral fin, and cutting across the posterior

[1] Product names used in this report are included for scientific completeness but do not constitute product endorsement.

base of the last four dorsal fin rays. Scissors were used to do the finclips. All clips could be done with the fish's head underwater.

Nine "recapture" trips were then made between August 9 and November 13 to examine sockeye salmon for marks in the main inlet stream (MIS) and beach spawning areas. Hand punches were used to give an opercule mark to all fish examined so fish were only sampled once (i.e., sampled without replacement). Again, separate counts were kept of the number of adult and jack sockeye salmon marked and examined for marks.

Stratified Darroch and "pooled" Peterson estimates and associated statistics (Standard Error, normal 95% Confidence Intervals) were calculated with the Stratified Population Analysis System (SPAS) software (Arnason et al. 1995). The Darroch estimator was used if either the SPAS test for "complete mixing" or "equal proportions" was significant at $P \leq 0.05$. Release and recovery strata for adults and jacks were pooled as needed to make abundance estimates and compare results.

Stream and Beach Mark-Recapture Escapement Indexing.

Two, two-day, mark and recapture trips were made to estimate jack and adult sockeye salmon in both the main inlet stream (MIS) and the beach "index" areas. The stream "study area" was between the lake and 58°24.561' N, 135°23.967' W. All sockeye observed in the MIS were within the study area. The beach study area included two small (one set) beach spawning areas on the Southeast side of the lake between about 58°23.981' N, 135°24.246' W and 58°23.949' N, 135°24.348' W. Fish were captured in the MIS using dip nets and in the beach study areas with a 21 m long by 3.66 m deep beach seine with 3.81 cm square mesh of No. 9 knotted Nylon web. We assume that the sockeye spawning in the MIS and beach study areas are separate populations given their geographic and temporal separation.

All sockeye captured on both the marking (day 1) and recapture (day 2) days were given that trip's mark – a left opercule punch unique for that trip (round or triangle). All sockeye captured on the day 2 were also given that trip's right opercule punch to facilitate sampling without replacement. Records were kept, for jacks and adults, of the number of new fish marked on both days, the number of day 1 recaptures on day 2, and, on the second trip, the number of trip 1 recaptures on trip 2. All sampling was done without replacement by disregarding a fish with that trips left opercule punch on day 1 and disregarding a fish with that trips right opercule punch on day 2.

A two-sample Peterson estimate was calculated for each trip using the SPAS program. Use of a modified Jolly-Seber method for multiple mark-recaptures in an open population (Cook 1998; Crabtree 2001; Conitz and Cartwright 2003a) was not possible since three or more recovery events are needed (Seber 1982) and weather and manpower constraints limited us to only two mark-recapture trips to both the MIS and beach study areas.

Visual Survey Counts.

Foot and boat surveys were conducted in conjunction with the MIS and beach mark-recapture indexing trips. In the MIS study area each observer counted live sockeye salmon when walking upstream and then when walking downstream. In the lake, each observer counted live sockeye salmon in, and out of, the beach study area from a skiff that was slowly motored around the perimeter of the lake. Each observer's counts were recorded separately and collectively they provide an estimate of what proportion of all the sockeye observed are in the study area(s). Separate counts were not made for adult and jack sockeye salmon.

Foot surveys were also done periodically through the summer to count the number of live sockeye and coho salmon in Neva Creek from the weir to the confluence with South Creek. Coho salmon were also counted in the MIS and lake on a few occasions.

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). Approximately every fifth jack or adult sockeye salmon was systematically sampled through the course of the run. 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 length was measured to the nearest millimeter by laying each fish on a fixed ruler in a "measuring trough". 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).

After the scales were aged, the scale samples were stratified by age and sex as described by Conitz and Cartwright (2003a). Let n be the total number of samples aged, n_k be the number of samples in stratum k, and N be the estimated escapement. The proportion of each stratum k was calculated by

$$\hat{p}_k = \frac{n_k}{n} \tag{1}$$

The estimated standard error was derived from the binomial formula with correction for finite population size (Thompson 1992, p. 35-36):

$$SE(\hat{p}_k) = \sqrt{\left(1 - \frac{n}{N}\right)\frac{\hat{p}_k(1-\hat{p}_k)}{n-1}} \tag{2}$$

The estimated mean length and associated standard error for stratum k were calculated as the sample mean of a simple random sample (Thompson 1992, p. 42-43):

$$\bar{y}_k = \frac{1}{n_k}\sum_{i=1}^{n_k} y_{ki}\text{, and } SE(\bar{y}_k) = \sqrt{\frac{1}{n_k}}\sqrt{\left(\frac{1}{n_k - 1}\right)\sum_{i=1}^{n_k}(y_{ki} - \bar{y}_i)^2} \qquad (3)$$

Radio Tagging.

Seventeen adult sockeye salmon were radio tagged at the weir through the course of the summer. A study design called for radio tagging approximately one out of every 100 sockeye passed through the weir. The radio tags (transmitters) were manufactured by Advanced Telemetry Systems. The Model F1845 transmitters were bottle shaped, weighed 24 g, and were 51 mm long and 20 mm in diameter with a 30.5 cm long wire antenna. Their pulse rate was 65 min^{-1}. Inserting these "esophageal" transmitters involved threading the antenna through a 3 x 20 cm plastic tube and using this tube to gently push the transmitter through the fish's mouth and into the stomach. The antenna was left sticking out of the mouth. Tagged fish were measured for mid-eye-to-fork length then tagged and released quickly to minimize handling stress. Tagged fish were watched till they swam out of sight above the weir to check for tag loss or handling mortality.

Harvest Monitoring.

The weir technician made an effort to monitor the subsistence/personal use fishing activities during the period from June 1 to July 31 that the fishery was open. His route to and from the weir site, two or more times a day, enabled routine monitoring of fishing activities in and off the mouth of South Creek. Fishing activities in Neva Creek were monitored during routine foot surveys of the creek (see the "Visual Survey Counts" section above) and by occasional visits to the traditional fishing site in the lower part of the creek. An effort was made to get harvest and effort information by speaking directly with the participants but this was not always possible. Records were kept of all the sockeye subsistence fishing activity observed.

Pavlof

The original project plan was to index the annual escapement of Pavlof sockeye salmon by marking and recapturing them on the spawning ground. Plans were expanded to also estimate the total escapement by marking fish as they enter the lake through a trap installed at the top the existing fishpass and recapturing them on the spawning grounds. We assumed that sockeye migrate into Pavlof Lake both up the fish ladder and up the falls so the trap count was not anticipated to be the total escapement estimate.

This was the first fishery technician work for the Hoonah Indian Association crew working at Pavlof Lake. Project activities focused on camp and field safety and

procedures, how to capture, handle, and sample fish, and basic record keeping. The crew lived in a floating wall tent anchored near the outlet of Pavlof Lake (Appendix B); this minimized habitat impacts and human-bear interactions.

Trap-to-Spawning Ground Mark-Recapture Estimate.

Upstream migrating salmon were captured and counted as they were passed upstream of a trap installed at the top of the outlet fishpass. Separate counts were not made for adults and jacks. All of the sockeye (and coho) salmon were marked with an adipose fin clip. The trap was in place from 1600 hour on June 21 to 1500 hour on August 8 but project personnel had to pull pickets and allow fish to pass uncounted on two occasions – June 28-30 and July 30–August 3 – due to manpower constraints and work commitments at other locations.

The aluminum channel and picket trap design was the same as used at the Neva weir (Appendix A). Salmon that ascended the fish pass were led through a "V" channel and picket entrance into the trap. The trap and V-entrance were on bedrock and sand bags were placed end-to-end around the outside of both.

Recording thermometers were deployed on July 29 at the top of the fish pass, at the lower end of the MIS, and at 1m and 6m depths at limnological sampling Station A (Figure 4). They recorded the temperature every six hours at 0000, 0400, 0800, 1200, 1600, and 2000 hour.

The crew did boat surveys around the lake and foot surveys up the main inlet stream in July and only found sockeye spawning in the lower part of the main inlet stream. The lower approximately 300 meters of the main inlet stream was designated the MIS study area. The upper end of the study area was at 57°50.468' N, 135°03.211' where there was a logjam extending across the river. Both left and right forks of the main inlet stream are included in the MIS study area but water only flows out the left fork at high water levels. A few sockeye salmon were observed upstream of the MIS study area but the highest concentration of fish was clearly between the upper end of the study area and where the river forks before emptying into Pavlof Lake.

One "recapture" trip was accomplished on August 4 and 5 to examine sockeye salmon for marks in the MIS study area. A 21 m long by 3.66 m deep beach seine with 3.81 cm square mesh and No. 9 knotted Nylon web was used to catch the sockeye salmon in a sequence of sets from upstream to downstream. A mark-recapture trip was also attempted on July 29 using dip nets but the river was too deep and wide for this capture method to be effective. Hand punches were used to give an opercule mark to all fish examined as part of the "Stream Mark-Recapture Escapement Indexing" study (see below). These opercule marks enabled us to "sample without replacement". The SPAS software (Arnason et al. 1995) was used to make a pooled Peterson estimate of the total escapement.

Stream Mark-Recapture Escapement Indexing.

Three, two-day, mark and recapture trips were planned to the MIS index area from late July to late August. Sockeye salmon were abundant on July 29 but, as mentioned above, we only had dip nets and the water was too deep for us to catch them. On an August 27 trip, there were only a few sockeye salmon left in the stream following a period of heavy rain and high water. The crew did complete a successful, two-day, mark-recapture trip using the beach seine on August 4 and 5 to index the abundance of sockeye salmon in the MIS index area.

All sockeye captured on both the marking (day 1) and recapture (day 2) days were given a round opercule punch. All sockeye captured on the day 2 were also given a round right opercule punch. Records were kept of the number of new fish marked on both days and the number of day 1 recaptures on day 2. All sampling was done without replacement by disregarding a fish with that trips' left opercule punch on day 1 and disregarding a fish with that trips' right opercule punch on day 2. A simple Peterson estimate was calculated for the August 4 and 5 trip following the method described above for Neva Lake's index estimates.

Visual Survey Counts.

Foot and boat surveys were conducted in conjunction with the MIS mark-recapture indexing trips on July 29, August 5, and August 27. Counting procedures were the same as those used at Neva Lake.

Age, Sex, and Length Sampling.

Adult sockeye salmon were sampled at the trap for age (scales), sex, and length data. Sampling, processing, and analysis procedures were the same as described above for the Neva Lake samples.

Hoktaheen

The escapement of sockeye salmon into Hoktaheen Lake was indexed in 2001 by an Organized Village of Kake and ADF&G crew (Conitz and Cartwright 2002a). Their studies found sockeye spawning in an inlet stream on the East side of the upper (larger) lake (58°03.379' N, 136°30.973' W) and in the upper section of the stream that connects the two lakes. Live sockeye salmon were available for sampling in the MIS on their September 9 and 20 trips but only carcasses were in the MIS on October 2. Based on this information we planned four mark and recapture trips to index the sockeye escapement into Hoktaheen Lake between late August and late September.

Stream Mark-Recapture Escapement Indexing.

We completed three trips to index the escapement of Hoktaheen sockeye salmon on August 19-21, September 5-7, and September 17-18. There were no sockeye salmon available for sampling in either the MIS or outlet stream on the August 19-21 trip and a fourth trip planned for late-September was not possible due to stormy weather conditions. The crew marked and recaptured sockeye salmon in both the MIS and outlet streams on the September 5-7 and 17-18 trips. Dip nets were used to capture sockeye salmon in the MIS and a 21 m long by 3.66 m deep beach seine with 3.81 cm square mesh of No. 9 knotted Nylon web was used to capture sockeye off the mouth of the MIS and in the outlet. The index study area in the MIS included sockeye schooling immediately off the mouth of the stream and extended upstream to a bedrock section of the stream at 58°03.897' N, 136°30.951' W. Few sockeye were observed spawning above this MIS index area. The index study area in the outlet stream extended from the outlet of the upper lake at 58°03.370' N, 136°30.939' W downstream about 0.2 km. Again few sockeye salmon were observed spawning downstream from the index area.

All sockeye captured on both the marking and recapture days were given a unique mark for that trip (left square opercule punch or adipose finclip). All sockeye captured during the recapture day(s) were also given a right opercule punch. Records were kept of the number of new fish marked on both days and the number of day 1 recaptures on day 2. All sampling was done without replacement by disregarding a fish with that trips' mark on the marking day and disregarding a fish with that trips' right opercule punch on the recapture day(s).

Simple Peterson estimates were calculated for each day that fish were examined for marks. The abundance of sockeye salmon was estimated on September 5, 6, 7, and 18 in the MIS index area and on September 7 and 18 in the outlet index area.

Visual Survey Counts. Foot and boat surveys were conducted in conjunction with the mark-recapture indexing trips on August 20, September 6, and September 18. Counting procedures were the same as those used at Neva Lake.

Age, Sex, and Length Sampling.

Adult sockeye salmon were sampled for age (scales), sex, and length data from both the MIS and outlet study areas. The sampling, processing, and analysis procedures were the same as described above for the Neva Lake samples.

Limnology Sampling

Four limnology sampling trips were scheduled to each lake at approximately six-week intervals from mid-May through October. Sampling trips were actually competed on the following dates:

Neva Lake	Pavlof Lake	Hoktaheen Lake
5/23	5/24	5/24
7/26	7/29	8/20
8/25	8/27	9/6
10/5		9/17

Two buoy and anchor sampling stations, "Station A" and "Station B", were setup over the deepest part of each lake (Table 7). Zooplankton samples were taken at both stations and physical data at Station A.

Table 7. Latitude and longitude coordinates for the limnological sampling stations in Neva, Pavlof, and Hoktaheen Lakes, 2002.

Lake	Station A	Station B
Neva	58°24.219' N, 135°24.258' W	58°24.270' N, 135°24.290' W
Pavlof	57°50.605' N, 135°02.672' W	57°50.629' N, 135°02.921' W
Hoktaheen	58°03.236' N, 136°30.381' W	58°03.292' N, 136°30.630' W

Light, Temperature, and Dissolved Oxygen Profiles

The subsurface light intensity was measured at 0.5-meter intervals from just below (5 cm) the surface down to one percent of the surface light reading. Protomatic International Light and Licor LI-250 submarine photometers were used; readings were in footcandles and $\mu mol\ s^{-1}\ m^{-2}$, respectively. The vertical light extinction coefficient (K_d) and euphotic zone depth (EZD) was calculated following procedures described by Conitz and Cartwright (2002a). The vertical light extinction coefficient (K_d) was calculated as the slope of the light intensity (natural log of percent subsurface light) versus depth. The euphotic zone depth (EZD) was calculated as $EZD = 4.6205/K_d$ and is defined as the part of the lake where photosynthesis is possible. Water transparency was also measured with a 20 cm diameter Secchi disk (Koenings *et al.* 1987).

All vertical temperature and dissolved oxygen (DO) measurements were made with a Yellow Springs Instruments Model 58 DO meter and probe except the May 23 measurements at Neva Lake were made with a Minnisonde 4a. The Model 58 DO meter was calibrated each trip by taking the average value of two 30 ml Winker titrations from a water sample collected at 1 m (Koenings *et al.* 1987). Readings were taken at one-meter intervals down to 20 meters then at five-meter intervals to within 2 m of the bottom or 50 meters, whichever is less. Dissolved oxygen (DO) readings were in mg L^{-1} and

temperature readings were in °C. The mg L^{-1} DO readings were converted to percent O_2 saturation using the following formula:

$$\%O_2 saturation = (DO/(0.004399 * temp^2 - 0.381784 + 14.571252)) * 100 \qquad (4)$$

The parameters in this equation were computed from data presented in Table 6.1 of Wetzel and Likens (2000). This regression of the solubility of O_2 on temperature had a correlation coefficient of 0.9998. No adjustment was made for altitude (barometric pressure) since Neva, Pavlof, and Hoktaheen Lakes are all at relatively low elevations of 44, 5, and 51 meters, respectively.

Zooplankton Composition and Density

A vertical zooplanton tow was made at both stations each trip. A 0.5 m diameter, 153 um mesh, 1:3 conical net was used. Vertical tows were pulled from 2 m from the bottom of the lake at 0.5 m sec^{-1}. Specimens were preserved in neutralized 10% formalin (Koenings *et al.* 1987). Zooplankton samples were analyzed at the ADF&G Commercial Fisheries Division Limnology Laboratory in Soldotna, Alaska. The identification to genus or species, enumeration, and density and biomass estimates were done as described by Conitz *et al.* 2002 and Koenings *et al.* 1987). The zooplankton density (individuals per m^2 surface area) and biomass (weight per m^2 surface area) were estimated by species and by the sum of all species (referred to as total zooplankton density or biomass).

The May 23 sample from Neva Lake was a single tow taken at Station A, the samples were preserved in 10% ethyl alcohol, and the sample was analyzed by Inverte, Inc. in Susquehanna, PA. The density (individuals per m^2 surface area) and mean wet length (mm) of the Cyclops, Bosmina, and Daphnia was measured.

RESULTS

Adult Sockeye Escapement Assessment

Neva

Weir and Weir-based Mark-Recapture Estimate of Total Escapement.

The adult salmon weir was in operation on the outlet of Neva Lake from June 4 to September 15 (Table 8; Appendix C.1). The weir was operated intermittently after August 29 and a concerned citizen passed an unknown number of fish through the trap on

June 3 when there was a surge of sockeye salmon moving upstream. Project personnel succeeded in finclipping a running average of 51% of the 3,397 adult sockeye and 1,074 jack sockeye that were physically counted through the weir. There was no indication of any handling mortality associated with the counting, marking, and sampling of fish at the weir. No fresh dead salmon were observed on the face of the weir or anywhere upstream.

Table 8. Daily counts, and estimated number, of sockeye salmon that passed through the Neva Creek weir, 2002.

	Daily Weir Counts:			Estimated Number Uncounted:			Estimated Daily Escapement:			Estimated Cum. Daily Escapement:						
Date	Adults	Jacks	Total	Adults	Jacks	Total	Adults	Jacks	Total	Adults	%	Jacks	%	Total	%	Comments:
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	1	0	1	1	0%	0	0%	1	0%	
6/11	0	0	0	0	0	0	0	0	0	1	0%	0	0%	1	0%	
6/12	0	0	0	0	0	0	0	0	0	1	0%	0	0%	1	0%	
6/13	0	0	0	0	0	0	0	0	0	1	0%	0	0%	1	0%	
6/14	0	0	0	0	0	0	0	0	0	1	0%	0	0%	1	0%	
6/15	0	0	0	0	0	0	0	0	0	1	0%	0	0%	1	0%	
6/16	0	0	0	0	0	0	0	0	0	1	0%	0	0%	1	0%	
6/17	1	0	1	0	0	0	1	0	1	2	0%	0	0%	2	0%	
6/18	2	0	2	0	0	0	2	0	2	4	0%	0	0%	4	0%	
6/19	0	0	0	0	0	0	0	0	0	4	0%	0	0%	4	0%	
6/20	1	0	1	0	0	0	1	0	1	5	0%	0	0%	5	0%	
6/21	0	0	0	0	0	0	0	0	0	5	0%	0	0%	5	0%	
6/22	1	0	1	0	0	0	1	0	1	6	0%	0	0%	6	0%	
6/23	1	0	1	0	0	0	1	0	1	7	0%	0	0%	7	0%	
6/24	0	0	0	0	0	0	0	0	0	7	0%	0	0%	7	0%	
6/25	0	0	0	0	0	0	0	0	0	7	0%	0	0%	7	0%	
6/26	1	0	1	0	0	0	1	0	1	8	0%	0	0%	8	0%	
6/27	62	0	62	0	0	0	62	0	62	70	2%	0	0%	70	1%	
6/28	35	0	35	0	0	0	35	0	35	105	3%	0	0%	105	2%	
6/29	0	0	0	0	0	0	0	0	0	105	3%	0	0%	105	2%	
6/30	31	0	31	0	0	0	31	0	31	136	4%	0	0%	136	3%	
7/1	188	0	188	0	0	0	188	0	188	324	9%	0	0%	324	7%	
7/2	333	7	340	0	2	2	333	9	342	657	18%	9	1%	666	13%	
7/3	52	2	54	184	1	185	236	3	239	893	24%	12	1%	905	18%	Fish passed uncounted by non-project person.
7/4	28	0	28	0	0	0	28	0	28	921	25%	12	1%	933	19%	
7/5	83	1	84	0	0	0	83	1	84	1,004	27%	13	1%	1,017	21%	
7/6	12	0	12	0	0	0	12	0	12	1,016	27%	13	1%	1,029	21%	
7/7	11	3	14	0	1	1	11	4	15	1,027	27%	17	1%	1,044	21%	
7/8	8	0	8	0	0	0	8	0	8	1,035	28%	17	1%	1,052	21%	
7/9	18	3	21	0	1	1	18	4	22	1,053	28%	21	2%	1,074	22%	
7/10	8	0	8	0	0	0	8	0	8	1,061	28%	21	2%	1,082	22%	
7/11	11	0	11	0	0	0	11	0	11	1,072	29%	21	2%	1,093	22%	
7/12	9	2	11	0	1	1	9	3	12	1,081	29%	24	2%	1,105	22%	
7/13	0	4	4	0	1	1	0	5	5	1,081	29%	29	2%	1,110	22%	
7/14	28	9	37	0	3	3	28	12	40	1,109	30%	41	3%	1,150	23%	
7/15	22	18	40	0	6	6	22	24	46	1,131	30%	64	5%	1,195	24%	
7/16	11	10	21	0	3	3	11	13	24	1,142	31%	77	6%	1,219	25%	
7/17	4	6	10	0	2	2	4	8	12	1,146	31%	85	7%	1,231	25%	
7/18	28	15	43	0	5	5	28	20	48	1,174	31%	105	9%	1,279	26%	
7/19	35	17	52	0	5	5	35	22	57	1,209	32%	127	10%	1,336	27%	
7/20	1	4	5	0	1	1	1	5	6	1,210	32%	132	11%	1,342	27%	
7/21	0	2	2	0	1	1	0	3	3	1,210	32%	135	11%	1,345	27%	
7/22	13	18	31	0	0	0	13	18	31	1,223	33%	153	13%	1,376	28%	
7/23	1	3	4	0	0	0	1	3	4	1,224	33%	156	13%	1,380	28%	
7/24	190	49	239	0	0	0	190	49	239	1,414	38%	205	17%	1,619	33%	
7/25	79	24	103	0	0	0	79	24	103	1,493	40%	229	19%	1,722	35%	
7/26	247	26	273	0	0	0	247	26	273	1,740	47%	255	21%	1,995	40%	
7/27	81	13	94	0	0	0	81	13	94	1,821	49%	268	22%	2,089	42%	
7/28	94	16	110	0	0	0	94	16	110	1,915	51%	284	23%	2,199	44%	
7/29	25	14	39	0	0	0	25	14	39	1,940	52%	298	25%	2,238	45%	
7/30	15	8	23	0	0	0	15	8	23	1,955	52%	306	25%	2,261	46%	
7/31	25	24	49	0	0	0	25	24	49	1,980	53%	330	27%	2,310	47%	
8/1	49	47	96	0	0	0	49	47	96	2,029	54%	377	31%	2,406	49%	
8/2	12	13	25	0	0	0	12	13	25	2,041	55%	390	32%	2,431	49%	
8/3	3	5	8	0	0	0	3	5	8	2,044	55%	395	33%	2,439	49%	
8/4	3	14	17	0	0	0	3	14	17	2,047	55%	409	34%	2,456	50%	
8/5	32	32	64	0	0	0	32	32	64	2,079	56%	441	36%	2,520	51%	
8/6	3	4	7	0	0	0	3	4	7	2,082	56%	445	37%	2,527	51%	
8/7	10	13	23	0	0	0	10	13	23	2,092	56%	458	38%	2,550	52%	
8/8	297	64	361	0	0	0	297	64	361	2,389	64%	522	43%	2,911	59%	
8/9	176	30	206	0	0	0	176	30	206	2,565	69%	552	46%	3,117	63%	
8/10	92	54	146	0	0	0	92	54	146	2,657	71%	606	50%	3,263	66%	
8/11	74	42	116	0	0	0	74	42	116	2,731	73%	648	53%	3,379	68%	
8/12	177	29	206	0	0	0	177	29	206	2,908	78%	677	56%	3,585	72%	
8/13	25	12	37	0	0	0	25	12	37	2,933	78%	689	57%	3,622	73%	

(continued)

Table 8. (continued)

Date	Daily Weir Counts:			Estimated Number Uncounted:			Estimated Daily Escapement:			Estimated Cum. Daily Escapement:						
	Adults	Jacks	Total	Adults	Jacks	Total	Adults	Jacks	Total	Adults	%	Jacks	%	Total	%	Comments:
8/14	26	9	35	0	0	0	26	9	35	2,959	79%	698	58%	3,657	74%	
8/15	38	42	80	0	0	0	38	42	80	2,997	80%	740	61%	3,737	75%	
8/16	26	15	41	0	0	0	26	15	41	3,023	81%	755	62%	3,778	76%	
8/17	33	19	52	0	0	0	33	19	52	3,056	82%	774	64%	3,830	77%	
8/18	54	20	74	0	0	0	54	20	74	3,110	83%	794	65%	3,904	79%	
8/19	24	21	45	0	0	0	24	21	45	3,134	84%	815	67%	3,949	80%	
8/20	22	18	40	0	0	0	22	18	40	3,156	84%	833	69%	3,989	81%	
8/21	31	25	56	0	0	0	31	25	56	3,187	85%	858	71%	4,045	82%	
8/22	54	25	79	0	0	0	54	25	79	3,241	87%	883	73%	4,124	83%	
8/23	39	8	47	0	0	0	39	8	47	3,280	88%	891	73%	4,171	84%	
8/24	15	14	29	0	0	0	15	14	29	3,295	88%	905	75%	4,200	85%	
8/25	20	20	40	0	0	0	20	20	40	3,315	89%	925	76%	4,240	86%	
8/26	16	11	27	0	0	0	16	11	27	3,331	89%	936	77%	4,267	86%	
8/27	19	16	35	0	0	0	19	16	35	3,350	90%	952	78%	4,302	87%	
8/28	28	12	40	0	0	0	28	12	40	3,378	90%	964	79%	4,342	88%	
8/29	17	10	27	9	6	16	26	16	43	3,404	91%	980	81%	4,385	89%	Pickets pulled at 0930hr.
8/30			0	18	13	31	18	13	31	3,423	92%	993	82%	4,416	89%	Pickets re-installed at 1700hr.
8/31	43	23	66	0	0	0	43	23	66	3,468	93%	1,016	84%	4,482	91%	
9/1	16	10	26	0	0	0	16	10	26	3,482	93%	1,026	85%	4,508	91%	
9/2	45	35	80	0	0	0	45	35	80	3,527	94%	1,061	87%	4,588	93%	Pickets pulled at 1730hr.
9/3	13	14	27	9	6	16	22	20	43	3,549	95%	1,081	89%	4,630	94%	Pickets re-installed at 1145hr.
9/4	22	9	31	0	0	0	22	9	31	3,571	96%	1,090	90%	4,661	94%	Pickets pulled at 1745hr.
9/5			0	18	13	31	18	13	31	3,589	96%	1,103	91%	4,692	95%	
9/6			0	18	13	31	18	13	31	3,608	97%	1,115	92%	4,723	95%	
9/7			0	18	13	31	18	13	31	3,626	97%	1,128	93%	4,754	96%	
9/8			0	18	13	31	18	13	31	3,645	98%	1,141	94%	4,785	97%	
9/9	6	9	15	9	6	16	15	15	31	3,660	98%	1,156	95%	4,816	97%	Pickets re-installed at 1730hr.
9/10	28	7	35	0	0	0	28	7	35	3,688	99%	1,163	96%	4,851	98%	
9/11	0	5	5	0	0	0	0	5	5	3,688	99%	1,168	96%	4,856	98%	
9/12	5	0	5	0	0	0	5	0	5	3,693	99%	1,168	96%	4,861	98%	
9/13	4	9	13	0	0	0	4	9	13	3,697	99%	1,177	97%	4,874	98%	
9/14	3	0	3	0	0	0	3	0	3	3,700	99%	1,177	97%	4,877	99%	
9/15	1	11	12	37	25	62	38	36	74	3,738	100%	1,213	100%	4,951	100%	Pickets pulled for season at 1400hr.
Total	3,397	1,074	4,471	341	139	480	3,738	1,213	4,951							

Sockeye salmon were sampled for marks in the main inlet stream (MIS) that flows into the Northwest end of the lake on five occasions and in the beach index area on four occasions. One hundred and thirty three marked adult and 39 marked jack sockeye salmon were recovered. Combinations of pooled and non-pooled, adult and jack, Darroch and Pooled Peterson methods all yielded similar estimates (Table 9). I estimate that 4,951 sockeye salmon escaped into Neva Lake in 2002 – 3,738 adults and 1,213 jacks (Tables 8 and 9). The weir count was 10% less than the estimated total escapement (Table 10).

Table 9. Mark-recapture estimate of the escapement of sockeye salmon in Neva Lake, 2002.

Marking Data: At the Neva Creek weir:				Recapture Data: Main Inlet Stream					Beach						Darroch Abundance Estimate:				Pooled Peterson Estimate:	
Marking Dates	Finclip Strata	Weir Count	Number Marked	Aug. 9	Aug. 10	Aug. 24	Aug. 25	Sept. 11	Oct. 5	Oct. 6	Nov. 12	Nov. 13	Total	% Recaptured	Number[a]	S.E. (Number)	Probability of Capture	S.E. (Prob. Capture)	Number	S.E. (Number)
Adults 3x9 (all data, no pooling)															(Complete mixing Significance = 0.01, Equal proportions significance = 0.88)					
				Number recaptured:																
June 10 to July 2	Left Axillary	426	196	4	4	8	2	0	0	0	0	0	18	9%	730	282	0.27	0.10		
July 2 to July 21	Dorsal	600	317	11	2	12	11	0	0	0	0	0	36	11%	523	210	0.61	0.24		
July 22 to Sept. 15	Left Ventral	2371	1,213	0	0	2	4	3	23	24	8	15	79	7%	2,541	214	0.48	0.04		
	Total	3,397	1,726	15	6	22	17	3	23	24	8	15	133		3,795	255			3,775	230
															(CV = 7%)				(CV = 6%)	
				Number examined for marks and Percent Marked:																
				34	19	52	34	8	49	45	20	31	292							
				44%	32%	42%	50%	38%	47%	53%	40%	48%	46%							
Jacks 3x9 (all data, no pooling)															See "Jacks 2x5" below, no jacks were observed at the weir prior to July 2.					
				Number recaptured:																
June 10 to July 2	Left Axillary	0	0	0	0	0	0	0	0	0	0	0	0							
July 2 to July 21	Dorsal	103	51	0	0	4	2	0	0	0	0	0	6	12%						
July 22 to Sept. 15	Left Ventral	971	500	0	0	4	5	0	12	11	0	1	33	7%						
	Total	1,074	551	0	0	8	7	0	12	11	0	1	39							
				Number examined for marks and Percent Marked:																
				2	1	18	13	0	23	26	1	3	87							
				0%	0%	44%	54%		52%	42%	0%	33%	45%							
Adults 2x9															(Complete mixing Significance = 0.00, Equal proportions significance = 0.88)					
				Number recaptured:																
June 10 to July 21	LA & D Pooled	1,026	513	15	6	20	13	0	0	0	0	0	54	11%	**1,210**	129	0.42	0.05		
July 22 to Sept. 15	Left Ventral	2,371	1,213	0	0	2	4	3	23	24	8	15	79	7%	**2,528**	212	0.48	0.04		
	Total	3,397	1,726	15	6	22	17	3	23	24	8	15	133		**3,738**	232			3,775	230
															(CV = 6%)				(CV = 6%)	
				Number examined for marks and Percent Marked:																
				34	19	52	34	8	49	45	20	31	292							
				44%	32%	42%	50%	38%	47%	53%	40%	48%	46%							
Jacks 2x5															(Complete mixing Significance = 0.17, Equal proportions significance = 0.73)					
				Number recaptured:																
June 10 to July 21	LA & D	103	51			4		2	0	0		0	6	12%	**135**	60	0.38	0.17		
July 22 to Sept. 15	Left Ventral	971	500			4		5	12	11		1	33	7%	**1,078**	158	0.46	0.07		
	Total	1,074	551			8		7	12	11		1	39		**1,213**	143			1,213	135
															(CV = 12%)				(CV = 11%)	
				Number examined for marks and Percent Marked:																
				2	1	18	13	0	23	26	1	3	87							
				0%	0%	44%	0%		52%	42%	0%	33%	45%							
Adults and Jacks 2x9															(Complete mixing Significance = 0.00, Equal proportions significance = 0.83)					
				Number recaptured:																
June 10 to July 21	LA & D	1,129	564	15	6	24	15	0	0	0	0	0	60	11%	1,353	143	0.42	0.04		
July 22 to Sept. 15	Left Ventral	3,342	1,213	0	0	2	4	3	23	24	8	15	79	7%	3,596	260	0.48	0.03		
	Total	4,471	1,777	15	6	26	19	3	23	24	8	15	139		4,948	271			5,003	269
															(CV = 5%)				(CV = 5%)	
				Number examined for marks and Percent Marked.																
				34	19	52	34	8	49	45	20	31	292							
				44%	32%	50%	56%	38%	47%	53%	40%	48%	46%							

[a] The final estimates are in bold type - **3,738** adults (CV = 6%) plus **1,213** jacks (CV = 12%) equals a total sockeye escapement of **4,951** (CV = 8%).

Table 10. Observed (weir counts) and expected (mark-recapture) estimates of sockeye salmon escapement into Neva Lake, 2002.

	Counted through weir:					ML Darroch M-R estimate:			Difference Weir from Mark-Recapture:			
Period	Adults	Jacks	Total	Adults Marked	Jacks Marked	Adults	Jacks	Total	Adults	Jacks	Total	% Relative Difference
6/4-7/21	1,026	103	1,129	513	51	1,210	135	1,345	-184	-32	-216	-16%
7/22-9/15	2,371	971	3,342	1,213	500	2,528	1,078	3,606	-157	-107	-264	-7%
Total	3,397	1,074	4,471	1,726	551	3,738	1,213	4,951	-341	-139	-480	-10%
	76%	24%	100%			75%	25%	100%				

I estimated the daily passage of jack and adult sockeye salmon through the weir using weir counts and mark-recapture results (Table 8). The mark-recapture estimate of adult sockeye that passed through the weir prior to July 22 was 184 fish higher than the weir count. I assumed that these fish passed uncounted on July 3 when a concerned citizen pulled pickets and passed fish during the first surge of fish at the weir (Figure 9). The remaining 32 jacks that were estimated to have passed prior to July 22 were added to the daily jack counts in proportion to the number of jacks counted during this period. The additional 157 adults and 107 jacks that were estimated to have passed after July 21 were apportioned among the days near the end of the run that the crew had to pull pickets due to work commitments at other locations. The half days that the weir was operational were weighted 0.5 and the last day was weighted 2.0 since a few sockeye salmon were still passing when the weir was pulled on September 15.

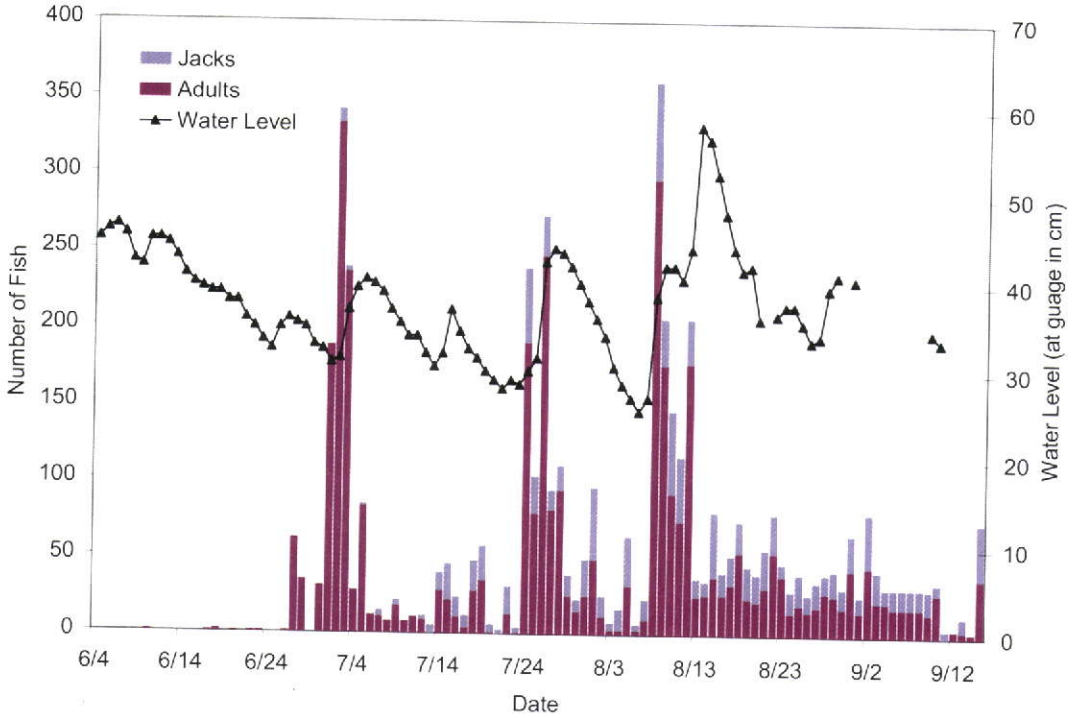

Figure 9. Daily escapement of jack and adult sockeye salmon and water level at the Neva Creek weir, 2002.

There were three surges of sockeye passage through the weir, each timed with rainfall events and increases in water level (Figure 9). The sockeye run was quite protracted. The first sockeye passed on June 10 and a few sockeye salmon were still entering the lake when the weir was pulled on September 15.

Project personnel also recorded the number of other salmon, trout, and char that they passed upstream through the Neva Creek weir. These unexpanded counts totaled 496 adult coho salmon, 85 jack coho salmon, 98 pink salmon, 2 chum salmon, 12 cutthroat trout, and 287 dolly varden char (Appendix C.1).

Stream and Lake Mark-Recapture for Indexing Escapement.

Two mark-recapture trips were successfully accomplished in both the MIS (August 9-10 and 24-25) and lake index areas (October 5-6 and November 12-13; Table 11). The Peterson estimates (and coefficient of variations) of the number of adult and jack sockeye salmon in the index areas on each trip were 100 (20%) and 151 (9%) in the MIS and 206 (13%) and 96 (20%) in the lake.

Table 11. Mark and recapture data, and abundance estimates, for sockeye salmon in the main inlet stream (MIS) and lake index areas, Neva Lake, 2002.

		Adults										Jacks								Adults and Jacks		
Location and Trip Number	Date	Mark Used[a]	Number Marked	Number Examined for Marks[b]	Trip #1 Recaps	Trip #2 Recaps	Total Recaps	Peterson Estimate	SE	CV	Number Marked	Number Examined for Marks[b]	Trip #1 Recaps	Trip #2 Recaps	Total Recaps	Peterson Estimate	SE	CV	Total	SE	CV
MIS #1	Aug-09	LRO	33	-	-	-	-	-	-	-	2	-	-	-	-	-	-				
	Aug-10	LRO	19	29	10	-	10	92	18	19%	1	1	0	-	0	-	-		100	20	20%
							(95% CI = 57 - 126)												(95% CI = 62 - 138)		
MIS #2	Aug-24	LTO	52	54	2	-	2	-	-		18	18	0	-	0	-	-				
	Aug-25	LTO	27	53	0	26	26	105	10	9%	12	19	0	7	7	47	9	20%	151	14	9%
							(95% CI = 85 - 124)								(95% CI = 28 - 84)				(95% CI = 124 - 178)		
Beach #1	Oct-05	LRO	49	-	-	-	-	-	-		23	-	-	-	-	-	-				
	Oct-06	LRO	27	45	18	-	18	120	16	14%	19	25	6	-	6	88	23	26%	206	27	13%
							(95% CI = 88 - 152)								(95% CI = 43 - 132)				(95% CI = 154 - 258)		
Beach #2	Nov-12	LTO	20	20	0	0	0	-	-		1	1	0	-	0	-	-				
	Nov-13	LTO	31	40	0	9	9	85	16	19%	3	3	0	0	0	-	-		96	19	20%
							(95% CI = 53 - 117)												(95% CI = 58 - 132)		

[a] LRO = left round opercule punch; LTO = left triangle opercule punch.
[b] Sampled without replacement.

There was no mixing of marked fish observed between the MIS and beach index areas. There was a geographic and temporal separation in the sockeye spawning in these two areas. Sockeye spawned in the MIS from late July through late September and on the beaches from mid-September through November.

Visual Survey Counts.

Foot surveys of Neva Creek, from the weir to below the lowest subsistence fishing site (just above the swift water section as Neva Creek flows into South Creek), were done periodically from June 1 to November 13 (Table 12). Double-digit counts of sockeye salmon were made on only 8 of the 36 surveys. The counts were highest in early June

and late July (the subsistence/personal use fishing is open from June 1 to July 31). The 248 adult sockeye counted in 34 surveys prior to August 2 represented 12% of the pre-August 2 escapement. The daily foot survey counts were a poor predictor of weir counts. The best fit had an $r^2 = 0.35$ when daily weir counts were regressed on the daily survey counts with a lag of 0-days (Figure 10) although I tried different combinations of moving averages and laggings.

Table 12. Foot survey counts of live sockeye and coho salmon in Neva Creek, 2002

Date	Observer	Sockeye	Coho
01-Jun	Van Alen	0	0
09-Jun	Lonn	0	0
10-Jun	Lonn	0	0
17-Jun	Lonn	0	0
19-Jun	Lonn	0	0
24-Jun	Lonn	0	0
27-Jun	Lonn	1	0
28-Jun	Lonn	3	0
29-Jun	Lonn	4	0
01-Jul	Lonn	10	0
02-Jul	Lonn	38	0
03-Jul	Lonn	15	0
04-Jul	Lonn	30	0
05-Jul	Lonn	7	0
06-Jul	Lonn	5	0
07-Jul	Lonn	1	0
08-Jul	Lonn	6	0
09-Jul	Lonn	2	0
11-Jul	Lonn	1	0
12-Jul	Lonn	7	0
13-Jul	Lonn	5	0
14-Jul	Lonn	8	0
15-Jul	Lonn	4	0
17-Jul	Lonn	2	0
20-Jul	Lonn	0	0
21-Jul	Lonn	19	0
22-Jul	Lonn	5	0
23-Jul	Lonn	0	0
24-Jul	Lonn	14	0
27-Jul	Lonn	35	0
28-Jul	Lonn	5	0
30-Jul	Lonn	8	0
31-Jul	Lonn	10	0
01-Aug	Lonn	3	0
06-Oct	Van Alen	0	2
13-Nov	Van Alen	0	0
Total		248	2

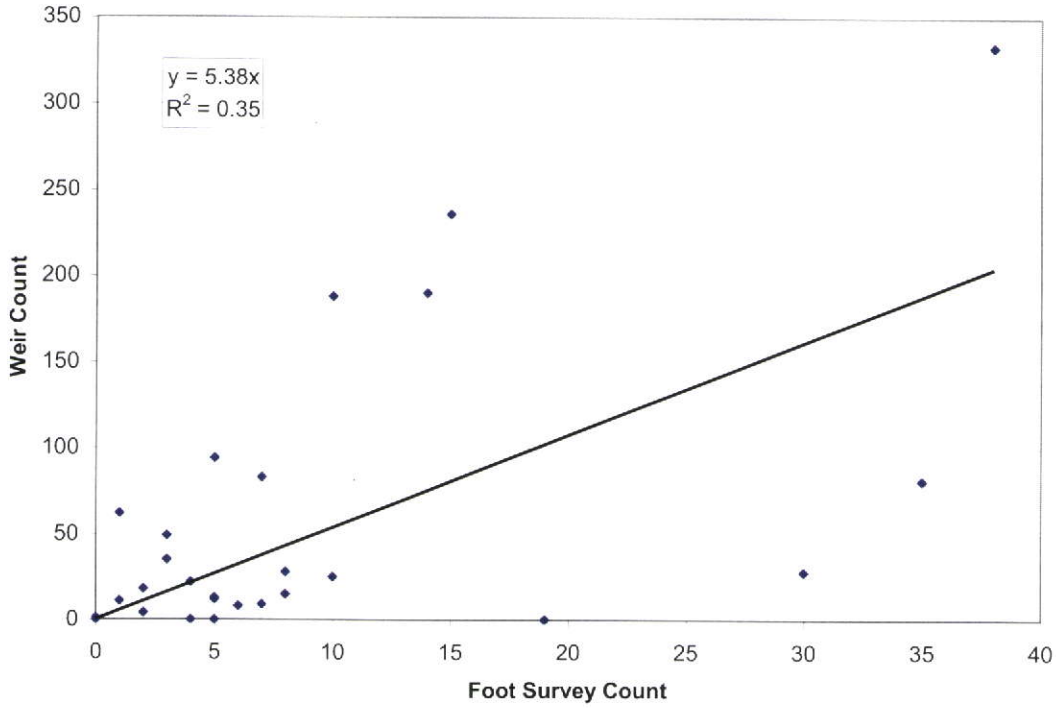

Figure 10. Foot survey counts of live sockeye salmon in Neva Creek on Neva Creek weir counts lagged 0 days, 2002.

Foot survey counts were made for sockeye salmon on eight occasions in the MIS index area (Table 13). Sockeye counts were highest in the August 15 and 24 surveys, 120 and 80 fish, respectively.

Table 13. Foot survey counts of sockeye salmon in Neva Lake's main inlet stream, 2002.

Date	Observer	Count Walking Upstream	Count Walking Downstream	Average
Jul-26	Lonn	2	2	2
	Van Alen	2	2	2
	Average	2	2	2
Aug-10	Abbott	17	22	20
	Gallant	15	16	16
	Lonn	15	17	16
	Sanders	9	4	7
	Average	14	15	14
Aug-15	Lagoudakis/Sanders	120		120
Aug-24	Abbott	82	67	75
	Gallant	86		86
	Van Alen	80	77	79
	Average	83	72	80
Sep-09	Abbott	25	45	35
	Gallant	35	43	39
	Average	30	44	37
Sep-10	Abbott/Gallant	32	29	31
Oct-05	Gallant	0	0	0
	Sanders	0	0	0
	Van Alen	0	0	0
	Average	0	0	0
Nov-12	Abbott	0	0	0
	Gallant	0	0	0
	Van Alen	0	0	0
	Average	0	0	0

Boat survey counts were made for sockeye salmon on six occasions in Neva Lake (Table 14). Sockeye counts peaked off the MIS in early August, peaked off and on index beaches in early October. There were still sockeye milling off the index beaches waiting to spawn when we made our last trip of the season on November 12-13.

Table 14. Boat survey counts of sockeye salmon in Neva Lake, 2002.

			Area of Lake							
					NE		SE			
Date	Observer	Boat Operator	SW	NW	Away from MIS	Near MIS	Off Index Beaches	On Index Beaches	Total	% on Index Beaches
Aug-10	Abbott		7	11		37	1		56	
	Gallant		5	0		71	0		76	
	Lonn		6	15		280	5		306	
	Sanders	yes	6	0		4	0		10	
	Average		6	7		98	2		112	
Aug-24	Abbott								82	
	Gallant								37	
	Van Alen	yes							50	
	Average								56	
Sep-10	Abbott		52	23	23	120	85		303	
	Gallant		53	19	14	110	93		289	
	Average		53	21	19	115	89		296	
Oct-05	Gallant		31	92	35	6	272	53	489	11%
	Van Alen		63	140	41	7	300	66	617	11%
	Average		47	116	38	7	286	60	553	11%
Oct-06	Gallant		10	26	67	10	51	93	257	36%
	Sanders	yes						91		
	Van Alen		8	43	33	9	99	93	285	33%
	Average		9	35	50	10	75	92	271	34%
Nov-12	Abbott		0	0	0	0	60	60	120	50%
	Gallant	yes	0	0	0	0	39	55	94	59%
	Van Alen		0	0	0	0	65	61	126	48%
	Average		0	0	0	0	55	59	113	52%

The visual survey counts were small relative to the total sockeye escapement. The highest relative count of adult sockeye salmon was from a boat survey on October 5 when 553 were counted in a boat survey around the lake – 15% of the estimated 3,738 adult sockeye escapement and 11% of the 4,951 total escapement.

Coho salmon were difficult to count in the system but counts of 50, 43, and 23 were made during lake surveys on October 5, 6, and November 12 (Table 15).

Table 15. Survey counts of coho salmon in the Neva Lake area, 2002.

Location	Date	Observer	Count
Neva Creek	Oct-06	Van Alen	2
Main Inlet Stream	Oct-05	Van Alen	1
	Nov-12	Van Alen	2
Lake	Oct-05	Van Alen	50
	Oct-06	Van Alen	43
	Nov-12	Van Alen	23

Age, Sex, and Length Composition

Ninety-five percent of the Neva sockeye escapement were "one check", age-1.-, fish aged 1.2 (45%), 1.3 (28%), and 1.1 (jacks, 22%, Table 16, Appendix C.2). The high proportion of jacks resulted in a sex composition of 60 percent males.

Table 16. Age and sex composition of sockeye salmon in the Neva Lake escapement, 2002.

	Brood Year and Age Class								
	2000	1999	1998	1998	1997	1997	1996	1996	
	0.1	1.1	1.2	2.1	1.3	2.2	1.4	2.3	Total
Male									
Sample Size	1	116	131	1	85	8	1	1	344
Percent	0.1	22.4	22.0	0.5	13.1	1.9	0.1	0.1	60.1
Std. Error	0.1	2.0	1.9	0.5	1.5	0.7	0.1	0.1	2.2
Escapement	5	1,105	1,090	24	649	93	4	5	2,975
Female									
Sample Size			147		106	7		2	262
Percent			23.2		14.6	1.9		0.2	39.9
Std. Error			1.9		1.4	0.8		0.1	2.2
Escapement			1,147		723	95		11	1,976
All Fish									
Sample Size	1	116	278	1	191	15	1	3	606
Percent	0.1	22.4	45.2	0.5	27.7	3.8	0.1	0.3	100.0
Std. Error	0.1	2.0	2.3	0.5	1.9	1.0	0.1	0.2	
Escapement	5	1,105	2,237	24	1,372	188	4	16	4,951

The average mid-eye-to-fork length was 363 mm for the age-1.1 jacks, 510 mm for the age-1.2 fish, and 565 mm for the age-1.3 fish (Table 17, Appendix C.3).

Table 17. Length composition (mm), by sex, of sockeye salmon in the Neva Lake escapement, 2002.

		Brood Year and Age Class								
		2000	1999	1998	1998	1997	1997	1996	1996	
		0.1	1.1	1.2	2.1	1.3	2.2	1.4	2.3	Total
Male	Avg. Length	380	363	511	402	563	507	585	580	473
	Std. Error		2.0	1.8		2.6	10.1			4.6
	Sample Size	1	115	131	1	85	8	1	1	343
Female	Avg. Length			508		568	523		568	529
	Std. Error			1.6		2.0	4.5		12.5	2.1
	Sample Size			147		106	7		2	262
All Fish	Avg. Length	380	363	510	402	565	518	585	572	493
	Std. Error		2.0	1.2		1.6	5.6		8.3	3.0
	Sample Size	1	115	278	1	191	15	1	3	605

Radio Tagging

Seventeen adult sockeye salmon were radio tagged at the Neva weir (Table 18). One tag was never detected. Of the 16 fish successfully tracked, 8 tags were recovered on August 24 from the banks of the MIS and the rest were tracked to the South or East side of the lake (one tag was recovered from a live fish caught while mark-recapture beach seining on November 12). The last radio tag tracking was done on October 5; there were no more radio tags detected in the MIS area.

Table 18. Release and recovery history for sockeye salmon radio tagged at the Neva Creek weir, 2002.

Release Data:				Recovery Data:			
Date	Sex	Length	Cum. % Run	Recovered[a]	Date	From	Where
Jun-27	F	580	2%	yes	Aug-24	loose on stream bank	MIS index area
Jun-30	M	515	4%	yes	Aug-24	loose on stream bank	MIS index area
Jul-02	F	575	18%	yes	Aug-24	loose on stream bank	MIS index area
Jul-02	M	545	18%	yes	Aug-24	loose on stream bank	MIS index area
Jul-05	M	590	27%	yes	Aug-24	loose on stream bank	MIS index area
Jul-07	F	580	27%	yes	Aug-24	loose on stream bank	MIS index area
Jul-12	F	565	29%	no, but somewhere in the South end of the lake on October 5.			
Jul-15	F	530	30%	no, but somewhere on the East shore of the lake on October 5.			
Jul-18	M	580	31%	no, but somewhere in the South end of the lake on October 5.			
Jul-22	F	565	33%	yes	Aug-24	loose on stream bank	MIS index area
Jul-24	F	575	38%	no, no signal detected			
Jul-24	M	565	38%	no, but somewhere in the South end of the lake on October 5.			
Jul-25	M	575	40%	yes	Aug-24	loose on stream bank	MIS index area
Jul-26	M	565	47%	no, but somewhere in the South end of the lake on October 5.			
Aug-08	M	550	64%	yes	Nov-12	live fish in seine set	beach index area
Aug-15	M	545	80%	no, but somewhere in the South end of the lake on October 5.			
Aug-26	M	506	89%	no, but somewhere in the South end of the lake on October 5.			

[a] The last tag recovery survey was conducted on October 5; there were no more tags in the MIS area.

The radio tagging results show that most MIS spawners entered the lake before the beach spawners did. All the adult sockeye salmon that were radio tagged in the first quarter of the run (on or before July 7) spawned in the MIS and all the sockeye radio tagged after 40% of the run (after July 25) were tracked to beach spawning areas. The adult sockeye that passed through the weir between 25 and 40% of the run were a mixture of MIS and beach spawners. The radio tag results suggest that lake spawners comprised over half of the run.

Harvest Monitoring

The subsistence/personal use fishery for Neva sockeye salmon was open from June 1 to through July 31. The daily and household possession limit was 10 sockeye salmon. The fishery was open to any Alaskan resident who obtained a permit from ADF&G, Division of Commercial Fisheries. Federal and State regulations provide Hoonah area residents with a "Customary and Traditional Use Determination" for the subsistence harvest of salmon in this area. This distinction allows Federally-qualified users from Hoonah to also use rod and reel gear to take salmon in freshwater under Federal regulations.

The weir technician made a special effort to document subsistence/personal use fishing activities during June and July during the two or more times that he traveled the road(s) between Excursion Inlet and the weir. The subsistence/personal use effort and harvest was relatively small. The documented harvest was only 44 sockeye salmon (Table 19), which is close to the 36 sockeye salmon reported on subsistence/personal use permits returned to ADF&G (Figure 3). No subsistence users were observed using rod and reel gear.

Table 19. Observations of subsistence/personal use fishing effort and sockeye harvest in the Neva area, June 1 to July 31, 2002.

Date	Documented Harvest	Location	Gear	Observations
Jul-01	4	Lower Neva Creek subsistence fishing site	unknown	Four heads found.
Jul-03	19	Lower Neva Creek subsistence fishing site	unknown	Ninteen filleted carcasses found at weir.
Jul-06	unknown	In saltwater off mouth of South Creek	gillnet	Boat observed fishing at 0830 hour.
Jul-10	2	In saltwater off mouth of South Creek	gillnet	Boat fished from 0930 to 1300 hour. Skipper interviewed.
Jul-10	4	Lower Neva Creek subsistence fishing site	gaff	Harvest reported by subsistence fisherman.
Jul-11	1	Lower Neva Creek subsistence fishing site	gaff	Fisherman interviewed at fishing site.
Jul-19	6	Lower Neva Creek subsistence fishing site	gaff	Fisherman interviewed at fishing site.
Jul-20	5	Lower Neva Creek subsistence fishing site	unknown	Five new dorsal fins found at fishing site.
Jul-20	0	Neva Creek	dipnet	Fisherman reported seeing and harvesting no sockeye today.
Jul-22	1	Lower Neva Creek subsistence fishing site	unknown	Evidence of one new sockeye taken at fishing site.
Jul-23	1	Lower Neva Creek subsistence fishing site	unknown	Evidence of one new sockeye taken at fishing site.
Jul-24	1	Lower Neva Creek subsistence fishing site	unknown	One jack sockeye head found at fishing site.
Total	44			

Pavlof

Trap-to-Spawning Ground Mark-Recapture Estimate of Total Escapement

The trap was operated at the top of the fishpass at the outlet of Pavlof Lake from June 21 to 27, July 1 to 29, August 4 to 8, and on August 27 to 28. All the sockeye, coho, pink and chum salmon that ascended the fish pass on these dates were counted. Counts totaled 557 sockeye, 853 coho, 435 pink, and 7 chum salmon (Table 20).

Table 20. Daily counts of salmon through the trap at the top of Pavlof Lake's outlet fishpass, 2002.

Date	Daily Sockeye	Cumulative Sockeye	Cumulative Percent Sockeye	Daily Coho	Daily Pink	Daily Chum	Comments
Jun-21	0	0	0%	0	0	0	trap fish tight, 1600hr.
Jun-22	1	1	0%	0	0	0	
Jun-23	23	24	4%	0	0	0	
Jun-24	0	24	4%	0	0	0	
Jun-25	29	53	10%	0	0	0	
Jun-26	10	63	11%	0	0	0	
Jun-27	19	82	15%	0	0	0	trap closed 1600
Jun-28		82	15%				trap closed
Jun-29		82	15%				trap closed
Jun-30		82	15%				trap closed
Jul-01	76	158	28%	0	0	0	trap open 0930
Jul-02	35	193	35%	0	0	0	
Jul-03	74	267	48%	0	0	0	
Jul-04	42	309	55%	0	0	0	
Jul-05	36	345	62%	0	0	0	
Jul-06	1	346	62%	0	0	0	
Jul-07	15	361	65%	0	0	0	
Jul-08	30	391	70%	6	0	0	
Jul-09	7	398	71%	1	0	1	
Jul-10	13	411	74%	1	0	0	
Jul-11	20	431	77%	8	0	0	
Jul-12	17	448	80%	6	0	0	
Jul-13	0	448	80%	0	0	0	
Jul-14	12	460	83%	0	0	0	
Jul-15	19	479	86%	20	0	0	
Jul-16	4	483	87%	0	0	0	
Jul-17	12	495	89%	5	0	0	
Jul-18	6	501	90%	5	0	0	
Jul-19	2	503	90%	0	0	0	
Jul-20	31	534	96%	41	0	1	
Jul-21	2	536	96%	24	0	0	
Jul-22	4	540	97%	163	0	1	
Jul-23	0	540	97%	11	0	0	
Jul-24	5	545	98%	27	3	0	
Jul-25	5	550	99%	19	6	0	
Jul-26	4	554	99%	1	5	0	
Jul-27	3	557	100%	17	5	0	
Jul-28	0	557	100%	11	3	0	
Jul-29	0	557	100%	35	3	0	trap closed 1800hr
Jul-30		557	100%				trap closed
Jul-31		557	100%				trap closed
Aug-01		557	100%				trap closed
Aug-02		557	100%				trap closed
Aug-03		557	100%				trap closed
Aug-04	0	557	100%	84	129	1	trap open 1430 hr
Aug-05	0	557	100%	115	120	1	
Aug-06	0	557	100%	162	117	1	
Aug-07	0	557	100%	16	41	1	
Aug-08	0	557	100%	65	2	0	trap closed 1500 hr
Aug-09		557	100%				trap closed
Aug-10		557	100%				trap closed
Aug-11		557	100%				trap closed
Aug-12		557	100%				trap closed
Aug-13		557	100%				trap closed
Aug-14		557	100%				trap closed
Aug-15		557	100%				trap closed
Aug-16		557	100%				trap closed
Aug-17		557	100%				trap closed
Aug-18		557	100%				trap closed
Aug-19		557	100%				trap closed
Aug-20		557	100%				trap closed
Aug-21		557	100%				trap closed
Aug-22		557	100%				trap closed
Aug-23		557	100%				trap closed
Aug-24		557	100%				trap closed
Aug-25		557	100%				trap closed
Aug-26		557	100%				trap closed
Aug-27		557	100%				trap opened 1300 hr
Aug-28	0	557	100%	10	1	0	trap closed 1100 hr
Total	557			853	435	7	

The first sockeye salmon passed on June 22 and the last on July 27. The midpoint of the sockeye run was probably on July 3 but could have been on July 2 if more than 170 sockeye escaped between June 27 and 30 when the crew was not available to operate the trap. The number of jack sockeye salmon was not recorded and few were observed. All 557 sockeye salmon were marked with an adipose clip. No handling induced mortality was observed. Two marked fish were recaptured in the trap – these fish had dropped back over the falls and re-ascended the fish pass.

On August 4 and 5 we examined 304 sockeye salmon for adipose clips in the MIS study area. One hundred and twenty five marked fish were observed (41% marked) yielding a pooled Peterson estimate of 1,350 (CV 6%) adult sockeye salmon in the escapement (Table 21). The fishpass was apparently used by less than half of the sockeye run. The MIS index area was an excellent place to seine sockeye salmon during normal flow conditions. On July 29 we tried to use dipnets but only caught a few fish before they moved out of reach into deep pools. No attempt was made to seine fish on the August 27 trip due to high water and few fish.

Table 21. Mark-recapture estimate of the escapement of adult sockeye salmon in Pavlof Lake, 2002.

Marking Data - from Trap on Outlet Fishpass:			
Dates	Trap Count	Number Marked	Percent Marked
6/22-7/27	557	557	100%
Recapture Data - from MIS Index Area:			
Date	Number Examined	Number with Marks	Percent Marked
8/4	173	69	40%
8/5	131	56	43%
Total	304	125	41%
Pooled Peterson Estimate:			
Number	S.E.	CV	
1,350	81	6%	

Stream Mark-Recapture for Indexing Escapement

An estimated 326 (CV 2%) adult sockeye salmon were in the MIS study area on August 5 (Table 22).

Table 22. Mark-recapture index of the abundance of adult sockeye salmon in Pavlof Lake's MIS study area on August 5, 2002.

Number Marked on 8/4	Number Examined for Marks on 8/5	Number of Recaptures	Peterson Estimate	S.E.	CV
173	279	148	326	7	2%

Foot/Boat Survey Counts

No beach spawning sockeye salmon were observed in the lake. A few sockeye salmon were observed milling off the main inlet stream in mid- to late-July. These fish were difficult to see and no counts were attempted. Formal survey counts were conducted in the main inlet stream on July 29, August 5, and August 27 (Table 23).

Table 23. Foot survey counts of sockeye salmon in the MIS index area, Pavlof Lake, 2002.

Date	Observer	Count
Jul-29	Ben Van Alen	249
	Fred Gallant	166
	William Sanders	55
	Average	157
Aug-05	Ben Van Alen	245
	Fred Gallant	187
	William Sanders	92
	Jerome Abbott	202
	Average	182
Aug-27	Fred Gallant	2
	William Sanders	2
	Jerome Abbott	2
	Average	2

There was about the same number of sockeye salmon in the MIS index area on July 29 and August 5. The average counts for the three observers who made counts on both July 29 and August 5 were 157 and 175. Survey conditions in the main inlet stream were excellent in normal flows and good lighting but poor when the water was high or if counts were attempted too early or late in the day. Conditions were excellent for the July 29 and August 5 surveys but the water was extremely high on August 27. Nevertheless, it was evident that sockeye spawning was over for the year.

Age, Sex, and Length Composition

Forty six (94%) of the 49 Pavlof sockeye sampled at the trap for scales were age-1.3 (Table 24). There was one age-1.2 and two age-2.2 fish in the sample. The average length of the age-1.3 fish was 525 mm (Table 25).

Table 24. Age and sex composition of sockeye salmon sampled from the trap at the top of the outlet fishpass at Pavlof Lake, 2002.

	Brood Year and Age Class			
	1998	1997	1997	
	1.2	1.3	2.2	Total
June 30 - July 27				
Male				
Sample Size	1	35		36
Percent	2.0	71.4		73.5
Std. Error	2.0	6.5		6.4
Female				
Sample Size		11	2	13
Percent		22.4	4.1	26.5
Std. Error		6.0	2.9	6.4
All Fish				
Sample Size	1	46	2	49
Percent	2.0	93.9	4.1	100.0
Std. Error	2.0	3.5	2.9	

Table 25. Length composition (mm), by sex, of sockeye salmon sampled from the trap at the top of the outlet fishpass at Pavlof Lake, 2002.

		Brood Year and Age Class			
		1998	1997	1997	
		1.2	1.3	2.2	Total
June 30 - July 27					
Male	Avg. Length	420	532		529
	Std. Error		5.8		6.4
	Sample Size	1	34		35
Female	Avg. Length		503	515	505
	Std. Error		7.5	45.0	8.2
	Sample Size		11	2	13
All Fish	Avg. Length	420	525	515	523
	Std. Error		5.1	45.0	5.4
	Sample Size	1	45	2	48

Hoktaheen

Stream Mark-Recapture for Indexing Escapement

Three multi-day trips were made into Hoktaheen Lake (the upper lake) in 2002 to index the escapement of sockeye salmon – August 19-21, September 5-7, and September 17-18. On the first trip, sockeye salmon were observed surfacing in the lake but none had moved into stream or beach areas where they could be captured with a beach seine or dip nets. On the second and third trips, sockeye salmon were found in, and off the mouth of, the "main inlet stream" (MIS) that flows into the East side of the lake (the inlet stream index area was from the stream mouth to GIS coordinates 58°03.897' N, 136°30.951' W) and in the upper third of the stream that connects the upper and lower lakes (the outlet stream index area was from 58°03.370' N, 136°30.939' W downstream about 0.2 m).

Main Inlet Stream.

On September 5, project personnel marked 185 sockeye salmon working upstream (99 caught with a beach seine off the mouth of the MIS and 86 caught with dip nets in the MIS) and 127 sockeye salmon working downstream (38 in the MIS and 89 off the mouth of the MIS, Table 26). Most of the sockeye salmon that were in the MIS were in the lower section below a logjam but the index area extended upstream to where the MIS turns sharply left (looking downstream) in the first bedrock section (58°03.897' N, 136°30.951' W). On September 6, project personnel marked 110 sockeye salmon working upstream (55 off the MIS and 55 in the MIS) and 30 sockeye salmon working downstream (18 in the MIS and 12 off the MIS). On September 7, 70 sockeye salmon were marked in the MIS. Heavy rainfall on the evenings of September 5 and 6 appeared to draw nearly all of the sockeye salmon that were schooled off the mouth of the MIS into the MIS by September 7. Recaptures totaled 66, 102, and 101 fish respectively on September 5, 6, and 7.

On September 17, project personnel caught and marked 60 sockeye salmon (48 in the MIS and 12 off the mouth, Table 26.) Ten sockeye salmon were marked in the MIS on September 18. Fifteen fish were recaptured from the September 5-7 trip and seven from September 17.

The Pooled Peterson abundance estimates for the MIS index area totaled 538, 737, 763, and 156 on September 5, 6, 7, and 18 (Table 26). Sockeye spawning in the MIS appeared to peak abruptly in early-mid September and be timed with rainfall events. This is consistent with observations in 2001.

Table 26. Mark and recapture data, and abundance estimates, for sockeye salmon in the main inlet stream (MIS) and outlet stream index areas, Hoktaheen Lake, 2002.

Location and Trip Number	Date	Mark Used[a]	Number Marked	Number Examined for Marks[b]	Trip #1 Recaps	Trip #2 Recaps	Both Trip #1 and #2 Recaps	Total Recaps	Peterson Estimate	SE	Lower 95% CI	Upper 95% CI	CV%
MIS #1	05-Sep	LSO	185	na	na	na	na	na	na	na	na	na	
	05-Sep	LSO	127	193	66	na	na	66	538 [c]	42	455	620	8%
	06-Sep [d]	LSO	140	242	102	na	na	102	737 [e]	45	649	826	6%
	07-Sep	LSO	70	171	101	na	na	101	763 [f]	42	680	846	6%
MIS #2 [g]	17-Sep	AD	60	60	11	na	na	na	na	na	na	na	
	18-Sep	AD	10	17	3	6	1	10	156 [h]	41	236	131	26%
Outlet#1	06-Sep	LSO	26	na	na	na	na	na	na	na	na	na	
	07-Sep	LSO	25	30	5	na	na	5	139 [i]	42	57	220	30%
Outlet#2 [g]	17-Sep	AD	140	140	11	na	na	na	na	na	na	na	
	18-Sep	AD	25	62	0	32	5	37	233 [j]	20	193	272	9%

[a] LSO = left square opercule punch; AD = adipose fin clip.

[b] Sampled without replacement.

[c] N(est) = 538 (M=185, C=193, R=66).

[d] It rained hard over night and nearly all sockeye that were schooled off the stream mouth on Sept. 5 had migrated into the stream on Sept. 6.

[e] N(est.) = 737 (M=312, C=242, R=102).

[f] N(est.)=763 (M=452, C=171, R=101).

[g] All Trip #1 recaptures were also given the Trip #2 mark.

[h] N(est.)=156 (M=60, C=17, R=7).

[i] N(est.)=139 (M=26, C=30, R=5).

[j] N(est.)=239 (M=140, C=62, R=37).

I compared sockeye escapement indices between 2001 and 2002 three ways (Table 27). In 2001, 178 sockeye salmon were marked on September 3 and fish were examined for marks on September 4 and 19-20 (J. Conitz, ADF&G, personal communication, Table 27). The sockeye escapement in 2002 was larger than in 2001. When I compare indices of sockeye marked and recaptured in the early September trip (September 3-4, 2001 and September 5-7, 2002) the 2002 estimate was 737 or 763 compared to 660 in 2001, a relative difference of 12-16% (Table 27). When I compare estimates from fish marked in early September and examined for marks later in the month (September 19-20, 2001 and September 17-18, 2002) the 2002 index of 2,719 is much greater than the 2001 index of 920, a relative difference of 196%. Finally, when the mark-recapture data is pooled from both trips, as reported in Conitz and Cartwright 2002a, the 2002 and 2001 indices were 1,271 and 745, a relative difference of 71%.

Table 27. Sockeye abundance indices for the main inlet stream (MIS), Hoktaheen Lake, 2001 and 2002.

Year	Date(s) Marked	Number Marked	Date(s) Examined	Number Examined for Marks	Number Recaptured	Peterson Estimate	SE	Lower 95% CI	Upper 95% CI	CV%	Relative Difference 2001-2002
Comparing indices of sockeye marked and recaptured on Trip #1:											
2001	9/3	178	9/4	132	35	660	83	498	83	13%	
2002	9/5	312	9/6	242	102	737	45	649	826	6%	12%
2002	9/5-6	452	9/7	171	101	763	42	680	846	6%	16%
Comparing indices of fish marked on Trip #1 and recaptured on Trip #2:											
2001	9/3	178	9/19-20	71	13	920	205	518	1,321	22%	
2002	9/5-7	522	9/17-18	77	14	2,719	602	1,538	3,899	22%	196%
Comparing indices of fish with mark and recapture data pooled for Trips #1 and #2:											
2001	9/3	178	9/4	132	35						
	9/19	1	9/20	70	13						
		179		202	48	745	78	591	898	11%	
2002	9/5-7	522	9/5-7	606	269						
	9/17[a]	0	9/17-18	77	15						
		522		683	284	1,254	38	1,179	1,329	3%	68%
2002	9/5-7	522	9/6-7	413	203						
	9/17	60	9/17-18	77	21						
		582		490	224	1,271	49	1,176	1,367	4%	71%

[a] Restricted to just the sockeye marked in Trip #1. This index is the most comparable to the index for 2001.

[b] Includes the sockeye marked in both Trip #1 and Trip #2.

Outlet of Upper Lake.

The pooled Peterson abundance estimates for the outlet index area totaled 139 sockeye salmon on September 6-7 and 233 on September 17-18 (Table 26). Of 51 sockeye marked on September 6-7, 16 were recaptured out of 202 fish examined for marks on September 17-18. This suggests that the stream life is relatively long and that there was not a lot of new fish moving into the stream.

Foot/Boat Survey Counts

Most adult sockeye salmon were observed in the MIS below the bedrock turn and in the upper third of the stream that connects the two lakes (Table 28). A few sockeye salmon were also counted in the small tributary that flows south into the outlet of the upper lake. The lake water is tannin stained and dark and it is difficult to see sockeye deeper than a meter or so. We did not observe any beach spawning. Sockeye were observed surfacing in the lake during the August 17-20 trip but none were seen in foot surveys of the MIS (up to the falls on each fork), the outlet tributary (20 minute hike upstream), or in a boat survey that circumnavigated the upper lake, the outlet stream, and the upper part of the

lower lake. The highest sockeye counts were made on September 6 in both the MIS and the upper third of the outlet index areas. However, the outlet stream was high, dark, and hard to see fish in during the September 18 survey. We counted four live sockeye spawners in the inlet stream that flows into the outlet. We also saw five dead sockeye in this stream and three of them had been marked during the September 6-7 trip. Thus, some of the sockeye marked in the outlet stream move into this small tributary to spawn.

Table 28. Boat and foot survey counts of live adult sockeye salmon in Hoktaheen Lake, 2002.

		Inlet	Main Inlet Stream Index			Outlet Upper Lake Index					
Date	Observer	Stream Near Outlet	Count Up	Count Down	Average	Count Up	Count Down	Average	Upper Lake Beaches	Total	% in Index Areas
Aug-20	Ben Van Alen	0	0		0		0	0	0	0	
	Fred Gallant	0	0		0		0	0	0	0	
	Jerome Abbott	0	0		0		0	0	0	0	
	William Sanders	0	0		0		0	0	0	0	
	Average	0	0		0		0	0	0	0	
Sep-06	Ben Van Alen	0	247	258	253	68	66	67	0	320	100%
	Fred Gallant	0	200	269	235	43	37	40	0	275	100%
	Jerome Abbott	0	208	237	223	70	48	59	0	282	100%
	William Sanders	0	156	120	138	15		15	0	153	
	Average	0	203	221	212	49	50	50	0	262	100%
Sep-18	Ben Van Alen	4		31	31	47		47	0	82	95%
	Fred Gallant	4		6	6	26		26	0	36	89%
	Jerome Abbott	4		11	11	44		44	0	59	93%
	William Sanders	4		5	5				0	9	
	Average	4		13	13	39		39	0	56	93%

Adult Age, Sex, and Length

Sockeye salmon were sampled for scales (age), sex, and length data both from the main inlet stream (218 ageable scales) and the outlet (213 ageable scales) index areas. Age-1.2, 1.3, and 2.2 fish each comprised about one-third of all those sampled (Table 29). However, age-2.- fish comprised 50 percent of the inlet spawners (Table 30) and only 25 percent of the outlet spawners (Table 31). Only one jack (age-1.1) was sampled and few were observed in all our sampling.

Table 29. Age and sex composition of sockeye salmon sampled in the inlet and outlet streams of upper Hoktaheen Lake, September 5, 6, 17, and 18, 2002.

	Brood Year and Age Class					
	1999	1998	1997	1997	1996	
	1.1	1.2	1.3	2.2	2.3	Total
Male						
Sample Size	1	91	90	67	25	274
Percent	0.2	20.1	19.9	14.8	5.5	60.6
Std. Error	0.2	1.9	1.9	1.7	1.1	2.3
Female						
Sample Size		51	53	64	10	178
Percent		11.3	11.7	14.2	2.2	39.4
Std. Error		1.5	1.5	1.6	0.7	2.3
All Fish						
Sample Size	1	142	143	131	35	452
Percent	0.2	31.4	31.6	29.0	7.7	100.0
Std. Error	0.2	2.2	2.2	2.1	1.2	

Table 30. Age and sex composition of sockeye salmon sampled in the main inlet stream to upper Hoktaheen Lake, September 5 and 17, 2002.

	Brood Year and Age Class				
	1998	1997	1997	1996	
	1.2	1.3	2.2	2.3	Total
Male					
Sample Size	31	20	44	7	102
Percent	14.2	9.2	20.2	3.2	46.8
Std. Error	2.4	1.9	2.7	1.2	3.4
Female					
Sample Size	24	33	51	8	116
Percent	11.0	15.1	23.4	3.7	53.2
Std. Error	2.1	2.4	2.9	1.3	3.4
All Fish					
Sample Size	55	53	95	15	218
Percent	25.2	24.3	43.6	6.9	100.0
Std. Error	2.9	2.9	3.3	1.7	

Table 31. Age and sex composition of sockeye salmon sampled in the outlet stream of upper Hoktaheen Lake, September 6, 17, and 18, 2002.

	Brood Year and Age Class					
	1999	1998	1997	1997	1996	
	1.1	1.2	1.3	2.2	2.3	Total
Male						
Sample Size	1	52	64	22	18	157
Percent	0.5	24.4	30.0	10.3	8.5	73.7
Std. Error	0.5	2.9	3.1	2.1	1.9	3.0
Female						
Sample Size		27	15	13	1	56
Percent		12.7	7.0	6.1	0.5	26.3
Std. Error		2.3	1.7	1.6	0.5	3.0
All Fish						
Sample Size	1	79	79	35	19	213
Percent	0.5	37.1	37.1	16.4	8.9	100.0
Std. Error	0.5	3.3	3.3	2.5	1.9	

On average, the males were larger than the females, the age-2.2 were longer than the age-1.2, and the age-1.3 were longer than the age-2.3 (Tables 32 to 34).

Table 32. Length composition (mm), by sex, of sockeye salmon sampled in the inlet and outlet streams of upper Hoktaheen Lake, September 5, 6, 17, and 18, 2002.

		Brood Year and Age Class					
		1999	1998	1997	1997	1996	
		1.1	1.2	1.3	2.2	2.3	Total
Male	Avg. Length	295	483	558	495	543	515
	Std. Error		3.2	3.7	3.1	3.7	2.8
	Sample Size	1	91	89	66	24	271
Female	Avg. Length		472	539	485	530	500
	Std. Error		3.4	3.7	2.8	4.2	2.8
	Sample Size		51	53	64	9	177
All Fish	Avg. Length	295	479	551	490	540	509
	Std. Error		2.4	2.8	2.1	3.1	2.1
	Sample Size	1	142	142	130	33	448

Table 33. Length composition (mm), by sex, of sockeye salmon sampled in the inlet streams of upper Hoktaheen Lake, September 5 and 17, 2002.

		Brood Year and Age Class				
		1998	1997	1997	1996	
		1.2	1.3	2.2	2.3	Total
Male	Avg. Length	467	560	492	551	502
	Std. Error	6.8	7.0	4.1	9.8	4.7
	Sample Size	31	20	44	7	102
Female	Avg. Length	473	542	483	528	501
	Std. Error	5.3	5.0	3.2	4.4	3.5
	Sample Size	24	33	51	7	115
All Fish	Avg. Length	470	549	487	540	501
	Std. Error	4.5	4.2	2.6	6.1	2.9
	Sample Size	55	53	95	14	217

Table 34. Length composition (mm), by sex, of sockeye salmon sampled in the outlet stream of upper Hoktaheen Lake, September 6, 17, and 18, 2002.

		Brood Year and Age Class					
		1999	1998	1998	1997	1996	
		1.1	1.2	1.3	2.2	2.3	Total
Male	Avg. Length	295	493	558	504	540	525
	Std. Error		2.8	4.4	3.9	3.4	3.5
	Sample Size	1	52	63	21	17	154
Female	Avg. Length		472	536	491	525	494
	Std. Error		4.6	6.4	6.3		4.8
	Sample Size		27	15	13	1	56
All Fish	Avg. Length	295	486	554	499	539	517
	Std. Error		2.7	3.9	3.5	3.3	3.0
	Sample Size	1	79	78	34	18	210

Limnology

Light, Temperature, and Dissolved Oxygen Profiles

An underwater photometer was used to record the incident light levels in Neva, Pavlof, and Hoktaheen Lakes at 0.5 m intervals from just below the lake surface (depth 0.0) to the depth with about 1% of this subsurface reading (Table 35).

Table 35. Light meter and secchi disk readings at Stations A in Neva, Pavlof, and Hoktaheen Lakes, 2002.

Light Meter Readings:									
Lake:	Neva				Pavlof		Hoktaheen		
Date:	May-23	Jul-26	Aug-25	Oct-05	May-24	Jul-29	May-24	Aug-20	Sep-17
Meter:	LiCor LI-250	Protomatic	LiCor LI-250	LiCor LI-250	Protomatic	Protomatic	Protomatic	LiCor LI-250	LiCor LI-250
Units:	$\mu mol\ s^{-1}\ m^{-2}$	footcandles	$\mu mol\ s^{-1}\ m^{-2}$	$\mu mol\ s^{-1}\ m^{-2}$	footcandles	footcandles	footcandles	$\mu mol\ s^{-1}\ m^{-2}$	$\mu mol\ s^{-1}\ m^{-2}$
Depth (m)									
0.0	-244	6,067	-202.8	-61.92	1200	1,600.0	2000	-922.5	-148.27
0.5	-204	4,000	-102.83	-33.28	650	650.0	1300	-238.5	
1.0	-200	3,000	-77.5	-19.31	350	320.0	800	-98.06	-21.24
1.5		2,400	-58.71	-14.43	220	140.0	450	-57.2	-8.38
2.0	-130	2,100	-47.44	-9.93	150	85.0	270	-25.91	-4.94
2.5		2,000	-44.3	-7.55	93	53.0	180	-13.85	-2.32
3.0	-93	1,800	-30.56	-6.05	65	33.0	110	-9.42	-1.21
3.5		1,600	-23.13	-4.55	40	20.0	90	-3.93	-0.61
4.0	-73	1,400	-19.08	-3.41	28	13.0	55	-2.83	-0.35
4.5		1,150	-15.45	-2.52	20	7.4	42	-1.56	-0.21
5.0	-50	1,000	-11.59	-2.01	15	4.7	25	-0.99	-0.16
5.5		880	-9.2	-1.26	10	3.0	17	-0.57	
6.0	-35	750	-7.39	-1.06		1.8	11		
6.5		620	-5.8	-0.88		1.0			
7.0	-24	530	-4.79	-0.76		0.5			
7.5		440	-4.18	-0.66		0.5			
8.0	-17	360	-3.55	-0.56					
8.5		310	-2.95	-0.51					
9.0	-12	260	-2.51	-0.46					
9.5		220	-2.07	-0.42					
10.0		190	-1.79	-0.35					
10.5			-1.51						
11.0			-1.29						
Secchi Disk (averaged depth of disappear/reappear readings in meters):									
	4.25	-	9.5	4.5	-	-	-	3	3

The mean euphotic zone depths (EZD) were 12.1 m in Neva Lake, 4.9 m in Pavlof Lake, and 4.2 m in Hoktaheen Lake (Table 36). The EZD's were the shallowest in the fall.

Table 36. Euphotic zone depths in Neva, Pavlof, and Hoktaheen Lakes, 2002.

Lake	Sample Date	EZD (m)
Neva	May-23	13.7
	Jul-26	14.6
	Aug-25	10.7
	Oct-05	9.4
	seasonal mean	12.1
Pavlof	May-24	5.4
	Jul-29	4.4
	seasonal mean	4.9
Hoktaheen	May-24	5.4
	Aug-20	3.7
	Sep-17	3.4
	seasonal mean	4.2

Vertical temperature stratification was evident in Neva Lake from the first sampling on May 23 to the last sampling on October 5 (Table 37). The epilimnion extended down to

about 6 m on the July 26 and August 25 sampling dates. The lowest reading in the hypolimnion was 5.0 °C. The percent O_2 saturation was over 100% in most readings near the surface and was above 90% at all depths down to 6 m in all four trips (Table 37). In all lakes the percent O_2 saturation decreased both through the summer and with depth.

There was little vertical stratification in temperature or dissolved oxygen in the 8 m deep Pavlof Lake (Table 38). The temperature averaged 5.8, 10.3, and 10.3 °C on the May, July, and August trips. The percent O_2 saturation was 38-43% in May and 91-95% in July. No dissolved oxygen readings were made on the August trip due to problems with the meter.

Vertical temperature stratification was evident in Hoktaheen Lake in the May, August, and September trips (Table 39). The epilimnion extended down to about 7 m in August and September. The hypolimnion remained below 6 °C the whole summer. Compared to Neva Lake, the percent O_2 saturation was lower near the surface but higher at depths.

Table 37. Temperature and dissolved oxygen profiles for Neva Lake, 2002.

	Temperature (°C)				Dissolved Oxygen (mg L^{-1})				Percent O_2 Saturation[a]			
Depth (m)	May-23	Jul-26	Aug-25	Oct-05	May-23	Jul-26	Aug-25	Oct-05	May-23	Jul-26	Aug-25	Oct-05
1	10.8	14.8	13.3	10.0	12.9	9.7	10.6	11.3	116%	96%	101%	100%
2	10.6	14.7	13.2	10.0	13.0	10.3	10.6	11.2	116%	102%	101%	99%
3	9.9	14.5	12.9	10.0	13.1	10.5	10.7	11.2	116%	103%	101%	99%
4	9.8	13.7	12.6	10.0	13.1	11.0	10.4	11.1	115%	106%	98%	98%
5	9.2	13.5	12.3	10.0	13.0	11.3	10.3	11.1	112%	109%	96%	98%
6	8.7	12.4	11.9	9.8	12.8	12.3	10.3	10.3	110%	115%	95%	91%
7	7.3	10.9	10.8	9.6	12.5	12.1	10.3	9.8	103%	110%	93%	86%
8	6.6	9.6	9.3	9.1	11.8	12.0	10.1	8.2	96%	105%	88%	71%
9	5.9	8.0	8.1	8.0	11.3	10.8	9.3	6.9	91%	91%	79%	58%
10	5.4	7.4	7.2	7.2	10.7	10.4	8.3	6.3	85%	87%	68%	52%
11	5.2	6.8	6.8	6.7	10.4	10.0	7.5	5.7	82%	82%	61%	47%
12	5.1	6.2	6.2	6.4	9.8	8.6	6.7	5.0	77%	69%	54%	41%
13	5.0	5.7	6.1	6.1	9.4	7.7	5.3	3.1	73%	61%	43%	25%
14		5.5	5.7	5.8		6.0	4.8	1.4		48%	38%	11%
15		5.3	5.6	5.5		4.2	3.2	1.2		33%	25%	10%
16		5.3	5.5	5.5		2.5	1.7	1.2		20%	13%	10%
17		5.2		5.5		1.1		1.2		9%		10%
18		5.1		5.5		0.1		1.1		1%		9%

[a] $\%O_2$ saturation = 0.005399 * temperature^2 - 0.381784 * temperature + 14.571252

Table 38. Temperature and dissolved oxygen profiles for Pavlof Lake, 2002.

	Temperature (°C)			Dissolved Oxygen (mg L^{-1})			Percent O_2 Saturation[a]		
Depth (m)	May-24	Jul-29	Aug-27	May-24	Jul-29	Aug-27	May-24	Jul-29	Aug-27
1	6.2	10.9	10.7	9.3	11.0	meter problems	43%	95%	meter problems
2	5.8	10.6	10.3	9.7	11.0		40%	93%	
3	5.9	10.3	10.3	10.1	11.4		40%	91%	
4	5.7	10.2	10.2	10.5	11.3		39%	91%	
5	5.6	10.2	10.2	10.9	11.1		38%	92%	
6	5.6	10.1	10.2	11.1	11.0		38%	92%	
7	5.5	10.0	10.1	11.4	11.4		38%	92%	

[a] $\%O_2$ saturation = 0.005399 * temperature^2 - 0.381784 * temperature + 14.571252

Table 39. Temperature and dissolved oxygen profiles for Hoktaheen Lake, 2002.

	Temperature (°C)			Dissolved Oxygen (mg L^{-1})			Percent O_2 Saturation[a]		
Depth (m)	May-24	Aug-20	Sep-17	May-24	Aug-20	Sep-17	May-24	Aug-20	Sep-17
1	10.3	13.8	11.5	9.3	8.7	8.7	83%	84%	80%
2	9.9	13.7	11.5	9.8	8.9	8.7	87%	86%	80%
3	9.3	12.3	11.5	10.4	8.8	8.7	91%	82%	80%
4	8.2	11.2	11.3	10.8	8.9	8.7	91%	81%	79%
5	7.7	10.8	11.2	11.2	9.0	8.6	94%	81%	78%
6	7.0	10.3	11.1	11.4	9.0	8.6	94%	80%	78%
7	5.8	9.7	10.7	11.7	9.2	8.6	93%	81%	77%
8	5.7	9.3	9.5	11.7	9.1	8.6	93%	79%	75%
9	5.5	7.4	7.8	11.7	9.6	8.7	93%	80%	73%
10	5.3	6.4	7.4	11.7	9.8	9.0	92%	79%	75%
11	5.2	5.7	6.3	11.6	10.1	9.2	91%	80%	74%
12	5.1	5.2	5.5	11.4	10.1	9.3	89%	79%	74%
13	5.0	5.0	5.1	11.3	10.1	9.5	88%	79%	74%
14	4.8	4.8	4.9	11.1	10.2	9.5	86%	79%	74%
15	4.7	4.7	4.8	11.1	10.0	9.6	86%	78%	75%
16	4.6	4.6	4.6	10.9	10.0	9.7	84%	77%	75%
17	4.5	4.4	4.5	10.8	10.1	9.9	83%	78%	76%
18	4.4	4.4	4.4	10.7	10.2	9.9	82%	78%	76%
19	4.4	4.4	4.4	10.6	10.1	9.8	82%	78%	75%
20	4.3	4.3	4.3	10.6	10.1	9.8	81%	78%	75%
25	4.1	4.3	4.3	10.3	9.5	9.1	79%	73%	70%
30	4.1	4.2	4.3	9.9	8.9	8.6	76%	68%	66%
35	4.0	4.2	4.2	9.3	8.4	8.1	71%	64%	62%
40	4.0	4.2	4.3	8.6	8.1	7.9	65%	62%	61%
45	4.0	4.2	4.3	7.3	7.2	7.3	56%	55%	56%

[a] $\%O_2$ saturation = 0.005399 * temperature^2 - 0.381784 * temperature + 14.571252

Daily and Seasonal Temperatures

Wide seasonal variations in water temperatures were observed in the inlet and outlet streams and at 1 m and mid-hypolimnion depths at Station A in each lake (Figures 11 to 22). The maximum temperature observed in 2002 in Neva Lakes main inlet stream was 9°C on August 4 (Figure 11). Temperatures at the 1 m depth and in the outlet of Neva Lake peaked at 18°C on August 4 and August 5, respectively (Figure 13 and 12). Temperatures also peaked in early August in Pavlof Lake – the peak average daily readings were 13°C in the inlet stream (Figure 15), 15°C in the outlet stream (Figure 16), and 15°C in the lake at 1 m (Figure 17). At Hoktaheen, temperatures were already trending down in the inlet (Figure 19), outlet (Figure 20), and lake (Figures 21 and 22) when the thermographs were deployed in late August and early September. The main inlet stream to Neva Lake had the coldest average September through December temperature (5°C) but lake and outlet temperatures averaged the coldest (6°C) at Pavlof (Table 40).

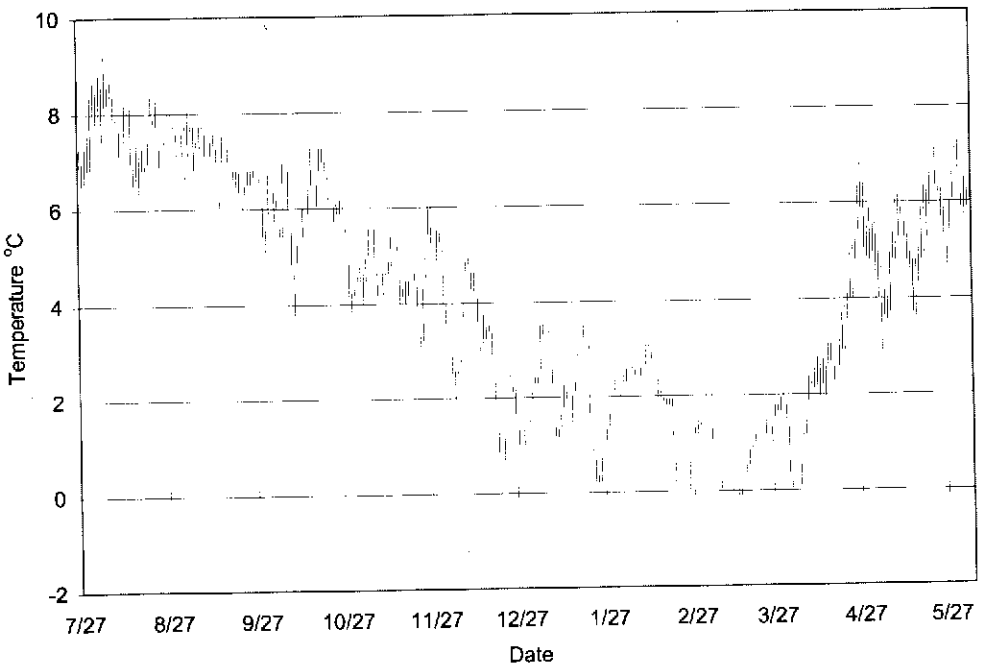

Figure 11. Daily maximum, minimum, and average stream temperatures at the lower end of the Neva Lake's main inlet stream, July 27, 2002 to June 4, 2003.

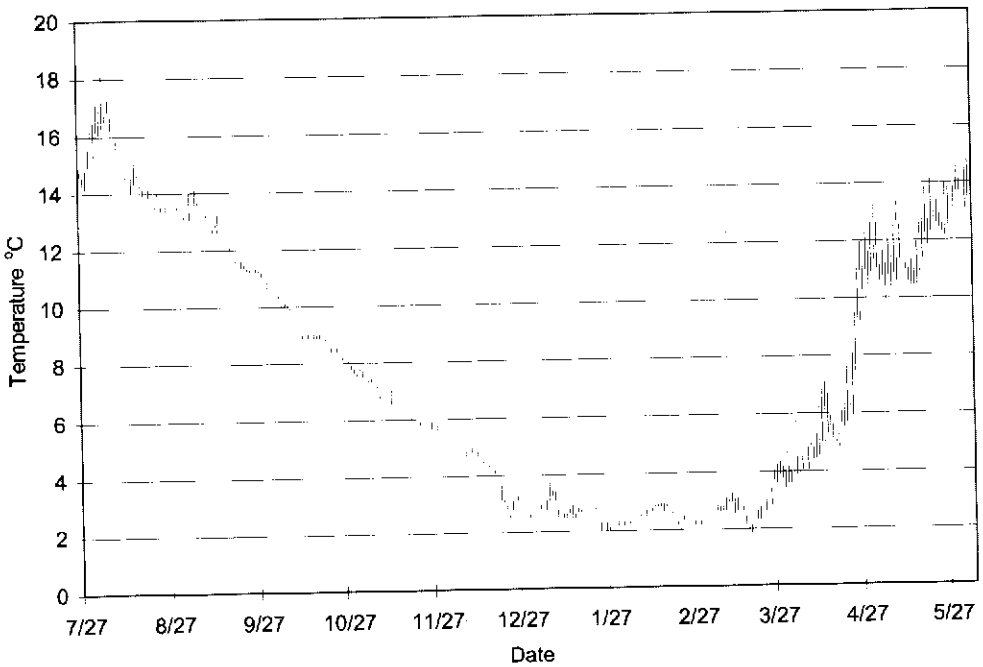

Figure 12. Daily maximum, minimum, and average stream temperatures at the upper end of Neva Creek, July 27, 2002 to June 4, 2003.

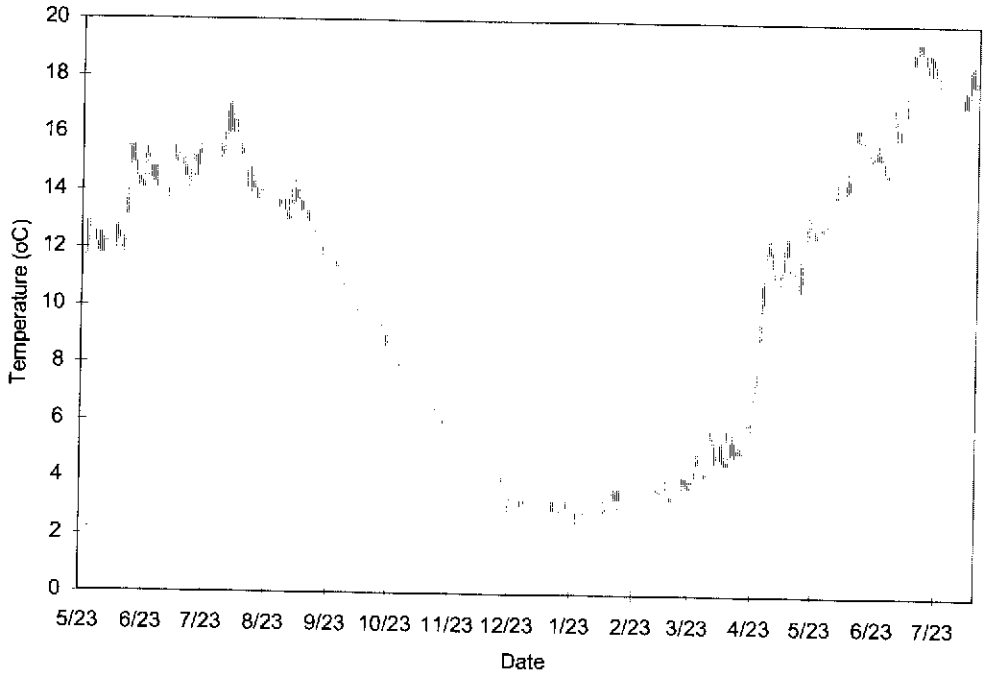

Figure 13. Daily maximum, minimum, and average temperature at a depth of 1 m at Station A in Neva Lake, May 23, 2002 to August 11, 2003.

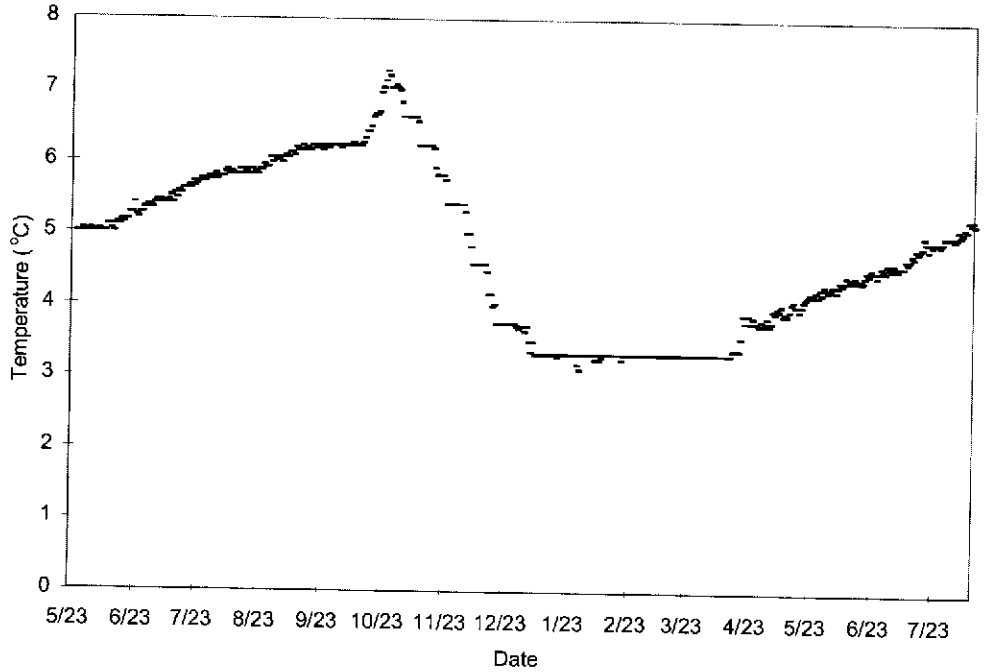

Figure 14. Daily maximum, minimum, and average temperature at a depth of 13 m at Station A in Neva Lake, May 23, 2002 to August 11, 2003.

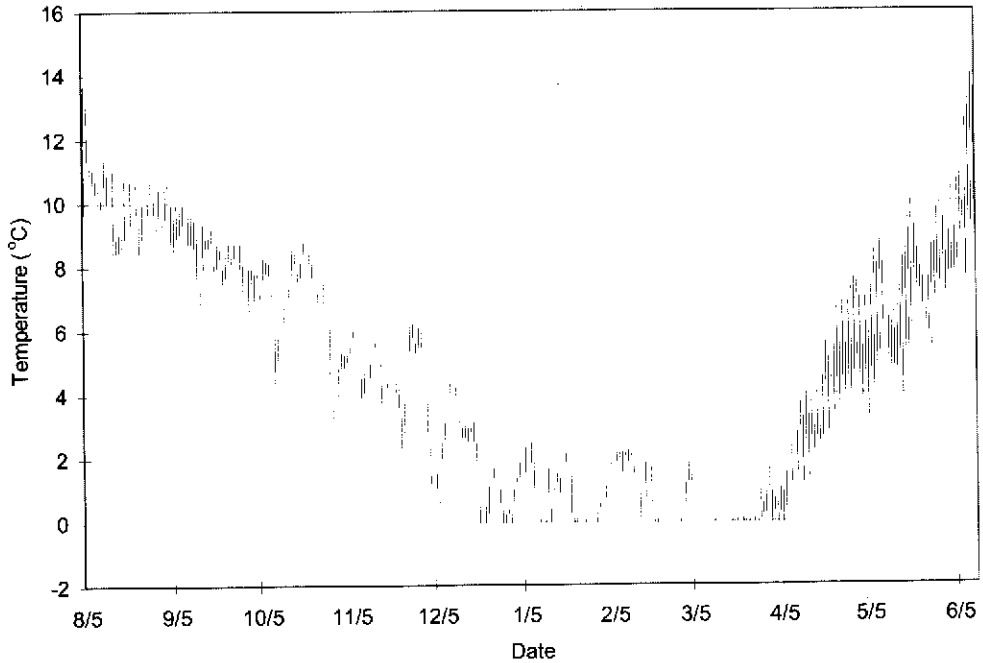

Figure 15. Daily maximum, minimum, and average stream temperatures at the lower end of Pavlof Lake's main inlet stream, August 5, 2002 to June 11, 2003.

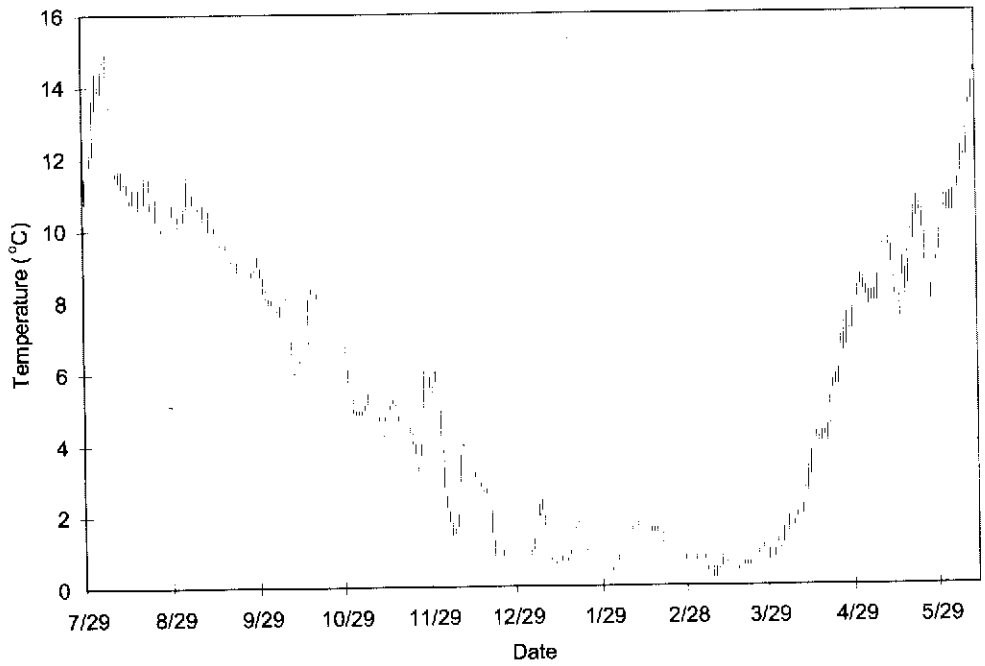

Figure 16. Daily maximum, minimum, and average stream temperatures at the top of the fishpass at the outlet of Pavlof Lake, July 29, 2002 to June 11, 2003.

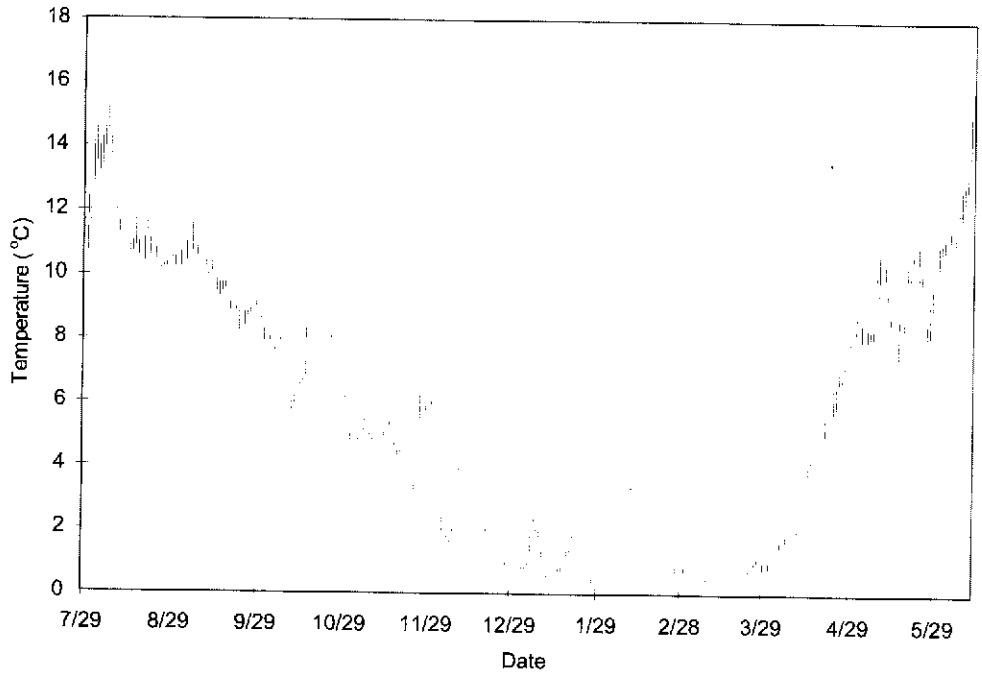

Figure 17. Daily maximum, minimum, and average temperature at a depth of 1 m at Station A in Pavlof Lake, July 29, 2002 to June 11, 2003.

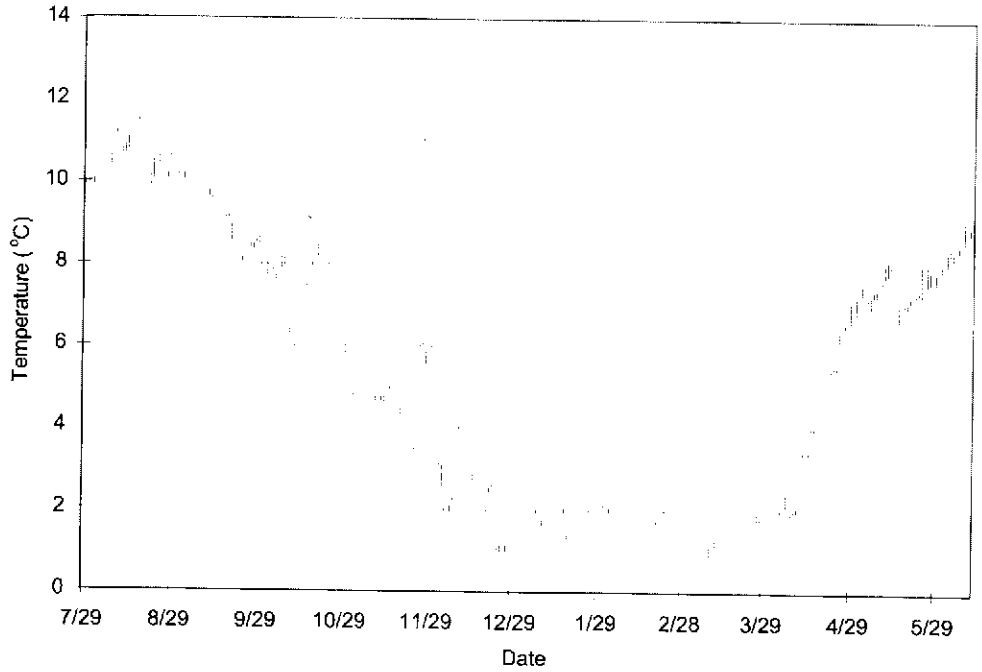

Figure 18. Daily maximum, minimum, and average temperature at a depth of 5 m at Station A in Pavlof Lake, July 29, 2002 to June 11, 2003.

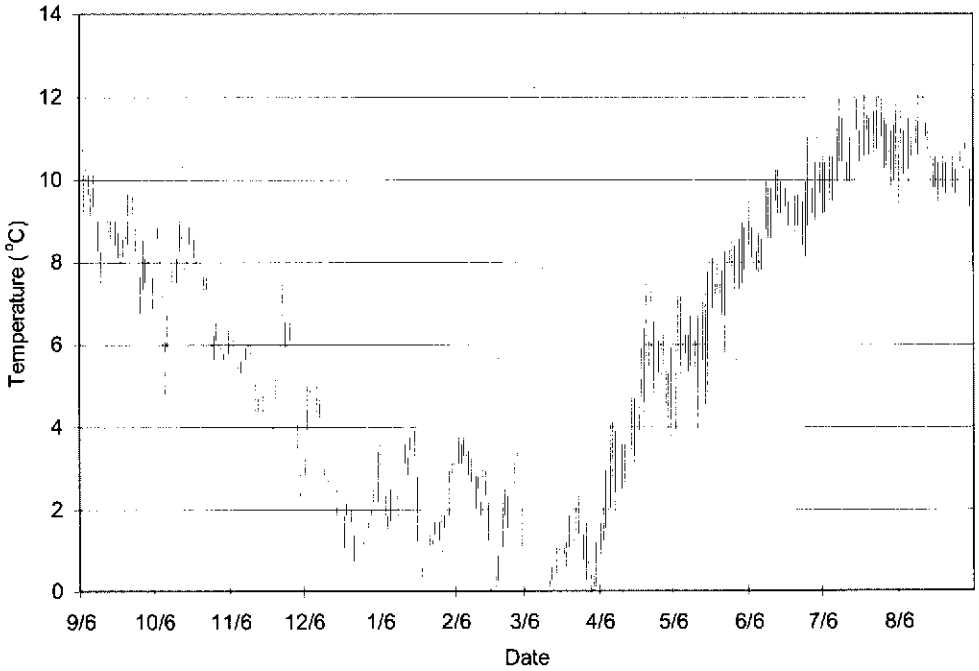

Figure 19. Daily maximum, minimum, and average stream temperatures at the lower end of the main inlet "index" stream that enters into the east side of Hoktaheen Lake, September 6, 2002 to September 5, 2003.

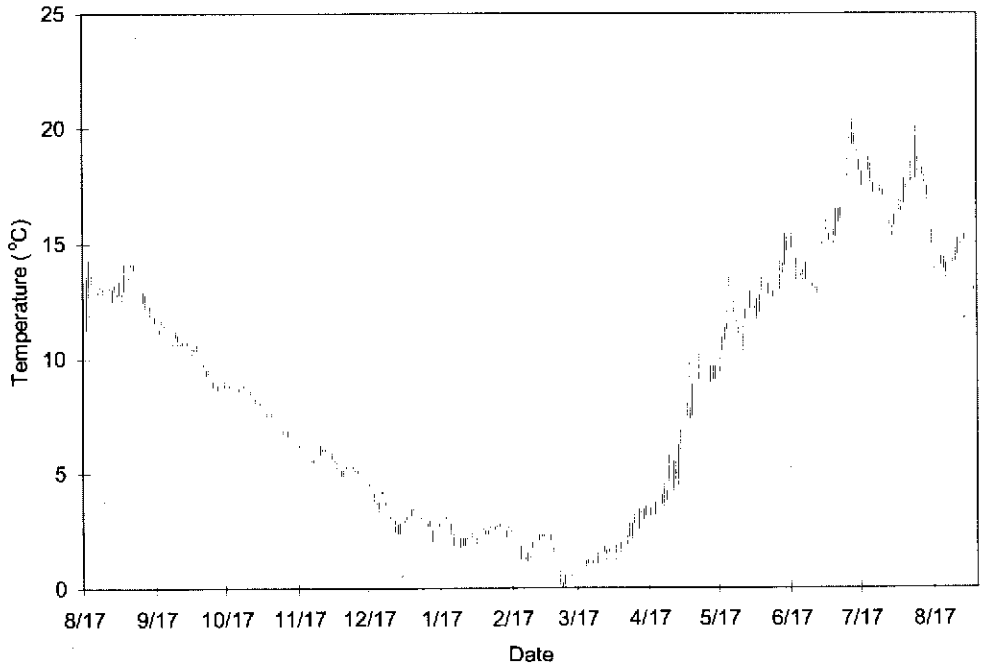

Figure 20. Daily maximum, minimum, and average stream temperatures at the top of the outlet stream from upper Hoktaheen Lake, August 17, 2002 to September 4, 2003.

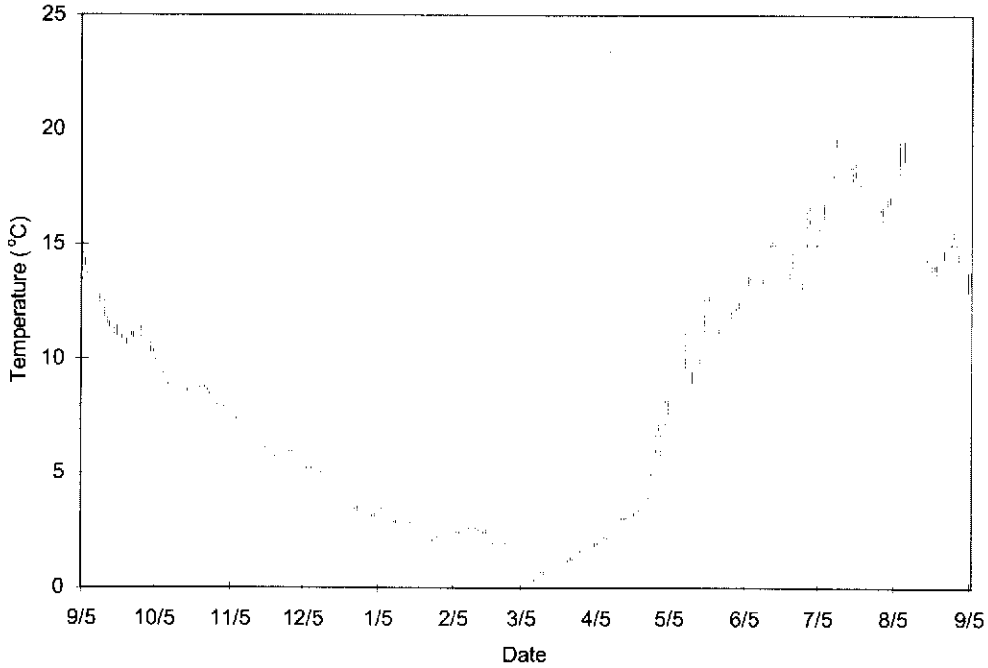

Figure 21. Daily maximum, minimum, and average temperature at a depth of 1 m at Station A in Hoktaheen Lake, September 5, 2002 to September 5, 2003.

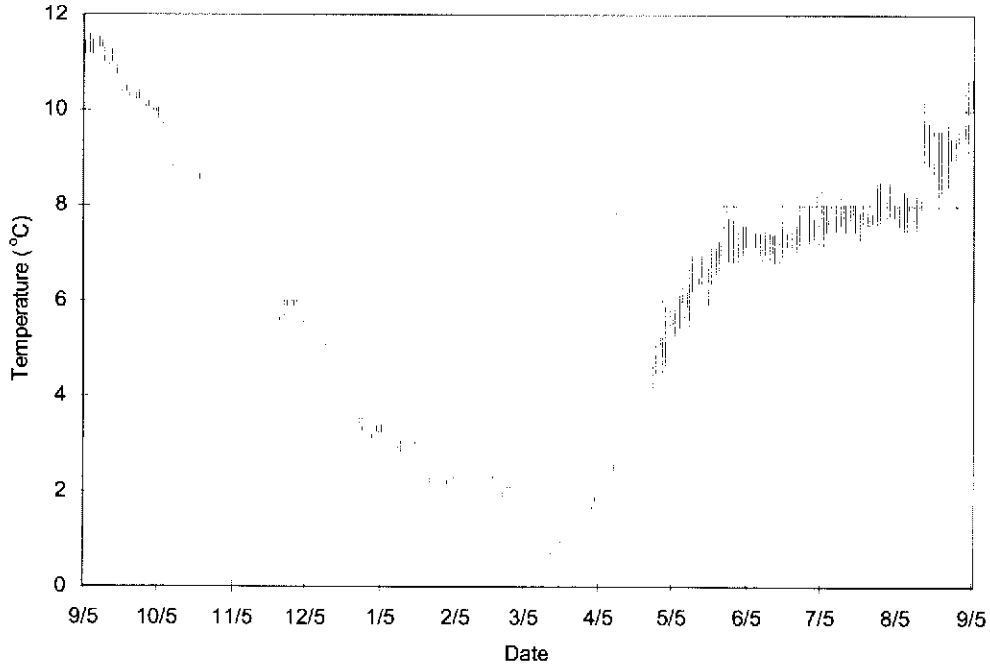

Figure 22. Daily maximum, minimum, and average temperature at a depth of 10 m at Station A in Hoktaheen Lake, September 5, 2002 to September 5, 2003.

Table 40. Average monthly water temperatures (°C) in the inlet stream, outlet stream, and lake, Neva, Pavlof, and Hoktaheen, August through December, 2002.

Period	Location	System		
		Neva	Pavlof	Hoktaheen
August	Inlet	8	10	-
	Outlet	15	12	-
	Lake @ 1 m	15	12	-
	Lake @ 5 m	-	10	-
	Lake @ 10 m	-	-	-
	Lake @ 13 m	6	-	-
September	Inlet	7	9	9
	Outlet	12	10	12
	Lake @ 1 m	13	10	12
	Lake @ 5 m	-	9	-
	Lake @ 10 m	-	-	11
	Lake @ 13 m	6	-	-
October	Inlet	6	7	8
	Outlet	9	7	9
	Lake @ 1 m	9	7	9
	Lake @ 5 m	-	7	-
	Lake @ 10 m	-	-	9
	Lake @ 13 m	7	-	-
November	Inlet	5	5	6
	Outlet	6	5	7
	Lake @ 1 m	6	5	7
	Lake @ 5 m	-	5	-
	Lake @ 10 m	-	-	7
	Lake @ 13 m	6	-	-
December	Inlet	3	2	3
	Outlet	4	2	4
	Lake @ 1 m	4	2	5
	Lake @ 5 m	-	3	-
	Lake @ 10 m	-	-	5
	Lake @ 13 m	4	-	-
Sept. to Dec.	Inlet	5	6	6
	Outlet	8	6	8
	Lake @ 1 m	8	6	8
	Lake @ 5 m	-	6	-
	Lake @ 10 m	-	-	8
	Lake @ 13 m	6	-	-

Secondary Production

The seasonal mean density (number m^{-2}) of zooplankton from vertical tows at Stations A and B in Neva, Pavlof, and Hoktaheen Lakes was 218,000, 1,000, and 283,000 (Tables 41, 42, and 43). The weighted biomass (mg m^{-2}) was 476, 1, and 618, respectively (Tables 41, 42, and 43). The seasonal mean density and weighted biomass of zooplankton at Neva Lake drops to 159,000 number m^{-2} and 402 mg m^{-2} when results from the May 23 sample from Station A is included (Table 44). Daphnia dominated the samples from Neva Lake and Cyclops and Bosmina dominated the samples from Pavlof

and Hoktaheen Lakes. The density and biomass of zooplankton in Pavlof Lake was extremely low.

Table 41. Density, size, and biomass of zooplankton in Neva Lake, July to August, 2002.

Taxa	Zooplankton Density (no. m^{-2}) Date 26-Jul	25-Aug	05-Oct	Mean	%	Mean Wet Length (mm) Date 26-Jul	25-Aug	05-Oct	Weighted Length (mm)	Seasonal Weighted Biomass ($mg\ m^{-2}$)	%
Station A:											
Cyclops	12,067	22,754	18,339	17,720	10%	0.76	1.09	0.80	0.92	53	12%
Ovig. Cyclops	200	0	1,358	519	0%	1.12		1.02	1.03	2	0%
Bosmina	9,509	32,603	6,792	16,301	9%	0.34	0.40	0.43	0.39	23	5%
Ovig. Bosmina	2,038	679	2,377	1,698	1%	0.50	0.51	0.50	0.50	4	1%
Daphnia l.	74,036	182,034	145,695	133,922	72%	0.85	0.67	0.65	0.70	281	66%
Ovig. Daphnia l.	11,207	5,094	23,434	13,245	7%	1.12	1.03	0.92	0.99	60	14%
Copepod nauplii	7,132	0	0	2,377	1%						
Total	116,189	243,164	197,995	185,783						422	
Tow Depth (m)	15.0	15.0	15.0								
Station B:											
Cyclops	64,952	21,905	29,801	38,886	16%	0.90	0.89	0.64	0.83	94	18%
Ovig. Cyclops	5,519	0	1,274	2,264	1%	1.15		1.00	1.12	10	2%
Bosmina	20,377	41,263	18,085	26,575	11%	0.39	0.39	0.46	0.41	40	8%
Ovig. Bosmina	5,519	509	7,132	4,387	2%	0.49	0.49	0.48	0.48	10	2%
Daphnia l.	109,102	193,327	190,525	164,318	66%	0.76	0.69	0.63	0.68	330	62%
Ovig. Daphnia l.	8,490	1,019	26,235	11,915	5%	1.15	0.97	0.83	0.91	45	8%
Copepod nauplii	7,217	0	0	2,406	1%						
Total	221,176	258,023	273,052	250,750						529	
Tow Depth (m)	15.0	14.0	15.0								
Average of Stations A and B				218,267						476	

Table 42. Density, size, and biomass of zooplankton in Pavlof Lake, May to August, 2002.

Taxa	Zooplankton Density (no. m^{-2}) Date May-24	Jul-29	Aug-27	Mean	%	Mean Wet Length (mm) Date May-24	Jul-29	Aug-27	Weighted Length (mm)	Seasonal Weighted Biomass (mg m^{-2})	%
Station A:											
Diaptomus	0	0	10	3	0%			0.80	0.80	0.01	1%
Cyclops	453	1,218	25	565	73%	0.59	0.45	0.55	0.49	0.44	67%
Ovig. Cyclops					0%						
Bosmina	51	275	10	112	14%	0.43	0.30	0.32	0.32	0.10	16%
Ovig. Bosmina	0	5	0	2	0%						
Daphnia l.	36	36	0	24	3%	0.83	0.60		0.72	0.05	8%
Ovig. Daphnia l.	5	0	0	2	0%						
Daphnia g.	5	0	0	2	0%	1.82			1.82	0.03	4%
Chydorinae	0	36	71	36	5%		0.28	0.28	0.28	0.02	4%
Copepod nauplii	0	82	0	27	4%						
Total	550	1,652	116	773						0.66	
Tow Depth (m)	6.0	5.5	5.5								
Station B:											
Diaptomus											
Cyclops	107	586	0	231	15%	0.66	0.46		0.49	0.18	14%
Ovig. Cyclops											
Bosmina	5	3,698	20	1,241	80%	0.34	0.31	0.31	0.31	1.07	80%
Ovig. Bosmina	0	102	0	34	2%		0.38		0.38	0.05	3%
Daphnia l.	0	15	0	5	0%		0.48		0.48	0.00	0%
Ovig. Daphnia l.											
Daphnia g.											
Holopedium	5	5	5	5	0%	0.50		0.70	0.60	0.02	1%
Chydorinae	15	56	36	36	2%	0.29	0.26	0.25	0.26	0.02	2%
Copepod nauplii											
Total	132	4,462	61	1,552						1.34	
Tow Depth (m)	6.0	4.0	4.5								
Average of Stations A and B				1,162						1.00	

Table 43. Density, size, and biomass of zooplankton in Hoktaheen Lake, May to September, 2002.

Taxa	Zooplankton Density (no. m^{-2}) Date May-24	Aug-20	Sep-06	Sep-17	Mean	%	Mean Wet Length (mm) Date May-24	Aug-20	Sep-06	Sep-17	Weighted Length (mm)	Seasonal Weighted Biomass (mg m^{-2})	%
Station A:													
Cyclops	86,942	91,696	167,091	74,121	104,963	46%	0.85	0.72	0.73	0.75	0.76	208	46%
Ovig. Cyclops	0	3,057	2,547	764	1,592	1%		1.14	1.17	1.18	1.16	8	2%
Bosmina	6,962	278,485	64,442	79,980	107,467	48%	0.50	0.45	0.45	0.47	0.45	208	46%
Ovig. Bosmina	0	4,415	509	1,528	1,613	1%	0.56	0.59	0.57	0.56	0.58	5	1%
Daphnia l.	5,264	340	509	1,528	1,910	1%	0.79	0.99	0.89	0.69	0.79	5	1%
Ovig. Daphnia l.	1,528	0	0	509	509	0%	1.02		1.01	0.90	0.99	2	1%
Daphnia g.	849	1,698	1,528	509	1,146	1%	1.70	1.58	1.65	1.52	1.62	15	3%
	0	0	0	255	64	0%		2.29			2.32	2	0%
Holopedium	0	0	255	509	191	0%			1.00	0.96	0.97	1	0%
Copepod nauplii	25,811	0	0	0	6,453	3%							
Total	127,356	379,691	236,881	159,703	225,908							454	
Tow Depth (m)	44.0	43.0	47.5	46.0									
Station B:													
Cyclops	52,437	230,769	225,420	134,997	160,906	47%	0.70	0.78	0.77	0.75	0.76	325	42%
Ovig. Cyclops	0	1,019	2,123	3,396	1,635	0%		1.17	1.18	1.19	1.18	8	1%
Bosmina	4,415	109,017	340,041	219,902	168,344	50%	0.48	0.39	0.55	0.53	0.52	427	55%
Ovig. Bosmina	204	764	4,245	3,396	2,152	1%	0.58	0.53	0.55	0.57	0.56	6	1%
Daphnia l.	6,792	1,783	8,449	1,698	4,681	1%	0.75	0.68	0.83	0.76	0.78	13	2%
Ovig. Daphnia l.	747	255	0	425	357	0%	1.05	0.91		0.99	1.01	2	0%
Daphnia g.	136	0	0	0	34	0%	1.82				1.82	1	0%
	68	0	0	0	17	0%	2.34				2.34	0	0%
Copepod nauplii	5,977	0	0	0	1,494	0%							
Total	70,776	343,607	580,278	363,814	339,619							782	
Tow Depth (m)	13.0	15.0	14.0	15.0									
Average of Stations A and B					282,763							618	

Table 44. Density, size, and biomass of zooplankton in Neva Lake, May to August, 2002.

Taxa[a]	Zooplankton Density (no. m^{-2}) Date May-23	Jul-26	Aug-25	Oct-05	Mean	%	Mean Wet Length (mm) Date May-23	Jul-26	Aug-25	Oct-05	Weighted Length (mm)	Seasonal Weighted Biomass[b] (mg m^{-2})	%
Station A:													
Cyclops	37,878	12,267	22,754	19,697	23,149	15%	0.63	0.77	1.09	0.82	0.80	55	14%
Bosmina	3,918	11,547	33,282	9,169	14,479	9%	0.42	0.37	0.40	0.45	0.40	29	7%
Daphnia l.	35,918	85,243	187,128	169,129	119,355	75%	0.52	0.89	0.68	0.69	0.71	319	79%
Copepod nauplii		7,132	0	0	2,377	1%							
Total	77,714	116,189	243,164	197,995	159,360							402	
Tow Depth (m)	13.0	15.0	15.0	15.0									

[a] The number of ovigerous and non-ovigerous individuals of each taxa are added together for the July, Aug., and Oct. samples.

[b] The biomass estimates for the May 23 sample were Cyclops = 54.72, Bosmina = 6.52, and Daphnia = 34.52 mg m^{-2}.

DISCUSSION

This was a good first year for the project. Project objectives were accomplished with few exceptions. This was the first season of fisheries technician work for the crew from the Hoonah Indian Association. Extra time was put into learning about field and sampling procedures. Crewmembers participated in Forest Service's aviation, radio, firearm, and bear safety training. Record keeping, work scheduling, and scale sampling are areas that need improvement for 2003. Mark-recapture data forms need to be revised so there are recovery fields for each mark type.

No changes are needed to the design, location, installation, or operation of the weir and trap on Neva Creek. Weir personnel know that rainfall triggers the sockeye salmon to migrate especially after mid-summer periods of low flows. The floating wall tent at Pavlof also worked well. It was easy to set up and provided comfortable and convenient housing for up to four individuals. Future platforms should be designed with the tent frame supports flush with the floor so that it would be easier to winterize the platform with a tarp (as shown in Appendix B.1).

Our ability to index the sockeye escapement into these systems would have been improved if we had been able to complete three or more mark-recapture trips to each index area. At least three trips are needed for an open population Jolly-Seber estimate of the total number of sockeye spawning in an index area (Seber 1982; Conitz and Cartwright 2003a). Sockeye salmon were found to spawn in two main spawning areas at both Neva and Hoktaheen. This effectively doubles the mark-recapture effort needed in each lake to index as high a proportion of the observed escapement as possible. The two abundance estimates we got in each of the two index areas in each lake in 2002 are useful for indexing escapements; however, completing additional trips to each index area will be an emphasis for 2003.

We did not know what the timing or distribution of sockeye migration or spawning was at Neva or Pavlof so extra effort was put into searching for fish and figuring out how best to capture them. At Neva, we found sockeye spawning and available for mark-recapture indexing in the main inlet stream index area from mid-August to mid-September and in the beach index area from late August through November. At Pavlof, sockeye salmon were catchable with a beach seine in and off the mouth of the main inlet stream from late-July through mid-August. The earlier run timing and spawning timing of the main inlet stream spawners at Neva and Pavlof relates to the colder water temperatures at these locations (Table 40).

We were able to build on last year's experiences at Hoktaheen for the timing of our trips (Conitz and Cartwright 2002a). Unfortunately, we were a little early on our first trip, August 19-21, and weather delays forced cancellation of a late September trip. Based on our observations of fish timing in 2002, the crew should continue index mark-recapture sampling in Pavlof Lake's main inlet stream through mid-August then move to mark-

recapture sampling at Hoktaheen for most of September. Mark-recapture should begin in Hoktaheen Lake's main inlet stream index area and end in the outlet index area with an overlap in areas sampled in mid-September. Four flights to Hoktaheen Lake were turned back due to weather this summer. We circled the lake on two of the flights under clear, sunny weather but localized downdrafts ("cat paw" winds) were too strong and unpredictable to safely land and take off. Keeping a crew at Hoktaheen for most of September should reduce flight costs and weather delays and, most importantly, improve our ability to collect multiple mark-recapture estimates in the inlet and outlet index areas. We observed how heavy rainfall and high water events flushed the sockeye salmon out of the main inlet streams in each of these lakes. This emphasizes the importance of completing as much mark-recapture sampling as possible when fish and weather cooperate.

This project obtained the first estimates on record of the sockeye salmon escapement into Neva and Pavlof Lakes. The Neva sockeye escapement of 4,951 (3,738 adults and 1,213 jacks) was higher than anticipated as was the abundance and duration of beach spawning. Only 36 sockeye salmon were reported in the subsistence/personal use harvest (Figure 3) and project personnel only documented a harvest of 44 fish (Table 19). Actual subsistence/personal use harvest was probably higher but the total exploitation rate, including sport and commercial fisheries, was probably less than 15%. The Neva sockeye run appears healthy given the probable low exploitation rates in recent years, the natural condition of the watershed, the relatively small size of the lake, the abundance of inlet stream and beach spawning from August through November, the high proportion of age-1.- fish (95%), third highest zooplankton biomass of the 15 Southeast Alaska sockeye rearing lakes sampled in 2002 (Table 45); and the highest percentage of Cladoceran zooplankton (75% *Daphnia*; a preferred prey species for sockeye fry; Koenings and Burkett 1987). Alaska Department of Fish and Game managers recognized the good health of the Neva sockeye run and increased daily and annual subsistence/personal use sockeye harvest limits from 10 fish in 2002 to 25 fish in 2003.

Table 45. Comparison of zooplankton biomass and percent *Daphnia* among 15 sockeye rearing lakes in Southeast Alaska, 2002 (from Conitz and Cartwright 2003b).

Lake	Seasonal Mean Biomass (mg m^{-2})	*Daphnia* as % of Total Biomass
Hoktaheen	618	3
Sitkoh	569	33
Neva	476	75
Tumakof	454	0
Kanalku	419	33
Luck	312	6
Kook	311	16
Klag	222	2
Salmon Bay	195	8
Kutlaku	130	27
Thoms	119	6
Hetta	47	10
Falls	29	2
Gut Bay	21	6
Pavlof	1	5

Results from Pavlof suggest that the sockeye production is small and at capacity in this small, shallow lake. The extremely low zooplankton density (a seasonal biomass of 1 mg m^{-2}) was the lowest observed for any lake (Table 45; John Edmundson, ADF&G, Statewide Limnology Lab, personal communication, 2003). Barto and Cook (1999) also concluded that the sockeye rearing capacity is limited. Increasing harvests and reducing escapements might increase returns a little. Pavlof has not been listed on ADF&G's subsistence/personal use harvest permits.

Escapement index results suggest that the Hoktaheen sockeye escapement was a little higher in 2002 than in 2001. The index of sockeye salmon in the main inlet stream was 660 on September 3-4, 2001 and 737 on September 5-6, 2002. The pooled Peterson estimate between the September 3-4 and 19-20 trips in 2001 was 745 compared to 1,254 between the September 5-7 and 17-18 trips in 2002. I am reluctant to assess the status of Hoktaheen sockeye salmon based on these results since there is little historical basis for comparison. Project results from the next two years will help with this assessment. The capacity of the lake to rear sockeye fry looks good. Hoktaheen Lake had the highest seasonal mean biomass of zooplankton (618 mg m^{-2}) of the 15 lakes sampled in 2002; however, *Daphnia* comprised only three percent of the zooplankton biomass (Table 45).

If future funding supports only one sockeye survey trip to each lake a year, these project findings suggest that you would want to visit Pavlof in early August, Hoktaheen in early September, and Neva in early October. Fortunately, this project continues for two more years, 2003 and 2004, and recommendations for how to best index or estimate escapements can wait till then.

CONCLUSIONS

Project objectives are appropriate and attainable. This year's results, and project results from the next two years, are needed to understand current escapement levels and the adequacy of these escapements for maintaining healthy runs and meeting subsistence needs.

RECOMMENDATIONS

1) Continue project using the revised Objectives with the exception noted in 2) below.
2) Change Objective #5 to "Estimate the distribution of spawning sockeye salmon in the Pavlof Lake system using radio tags."
3) Continue making improvements to mark-recapture study design and data forms.
4) Plan to work at Hoktaheen for most of September. Equip the camp at Hoktaheen with a small wall tent and heater and equip the boat with a small outboard.

ACKNOWLEDGEMENTS

This study is a cooperative effort among the Hoonah Indian Association (HIA), the Alaska Department of Fish and Game (ADF&G), and the U.S. Forest Service (USFS). Thanks to David Belton for coordinating HIA's project activities and to HIA's Johanna Dybdall for her help administering this new project. It was a pleasure working with HIA's field crew - Frederick Gallant (crew leader), William Sanders, Jerome Abbott, and Sam Willard - their enthusiasm for learning was contagious, we all learned a lot.

A number of ADF&G folks were instrumental to the success of this project. Meg Cartwright and Jan Conitz helped administratively, technically, and logistically. Their guidance with analysis and reporting was particularly helpful. Renate Riffe helped with limnology supplies, procedures, and sampling. Richard Bloomquist, Mark Olsen, and Iris Frank aged and tabulated our much less than perfect collection of scale, sex, and length samples. Malcolm McEwen and Bert Lewis of ADF&G did the juvenile sampling fieldwork and data analysis at Hoktaheen Lake. John Edmondson and the ADF&G Soldotna Limnology Lab crew processed most of the zooplankton samples. Lastly, Wayne Lonn's work at the Neva Creek weir was outstanding, his years of experience with salmon projects was apparent and appreciated.

Thanks to USFS biologists Mark Laker and Lance Lerum for bathemetric mapping of Neva Lake and assisting with the limnological studies. Juneau Ranger District employees Julie Laker, Dan Schultz, and Kevin Brownlee helped put in the Pavlof Lake camp and Pete Schneider and Julie Laker worked a long weekend at the Neva Creek weir. The Hoonah Ranger District staff was extremely helpful with preseason safety training, logistics, and in response to a safety incident at Pavlof Lake. We found Libby Dougan and the Sitka Dispatch office's professionalism especially reassuring with this bush flying-intensive project.

Ward Cove Packing's Gary Moore, Dave McLean, and Bruce Gordon helped with accommodations and other logistics at Excursion Inlet.

Thanks to the Southeast Regional Advisory Council and the Federal Subsistence Board for associating the importance of these sockeye systems with the funding needed to keep them healthy. Finally, we wish to thank the Hoonah-area residents who rely on the wise stewardship of these salmon resources.

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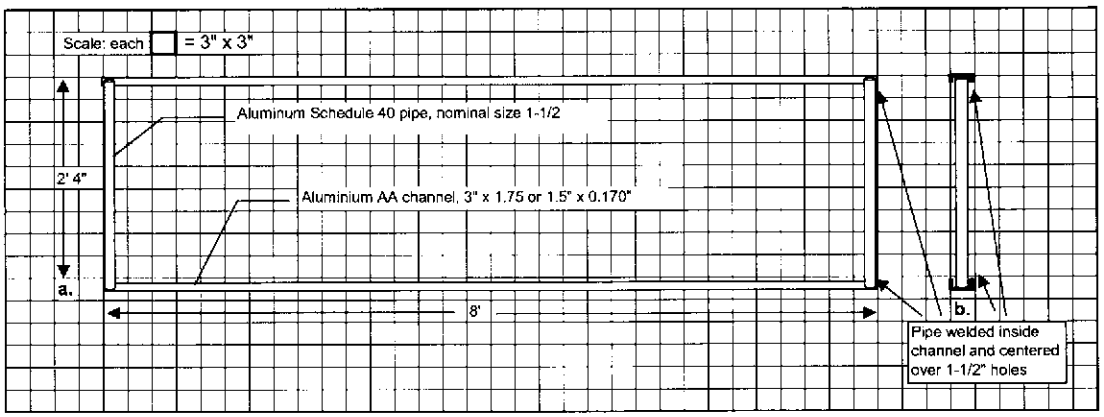
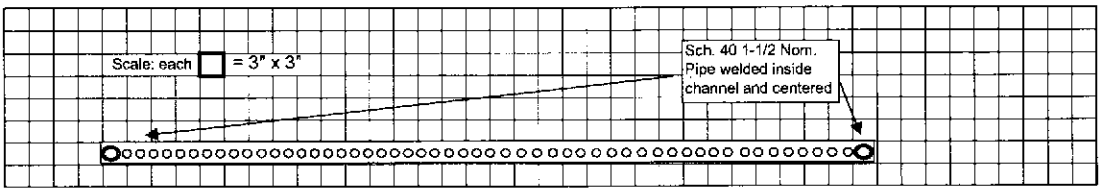
APPENDICES

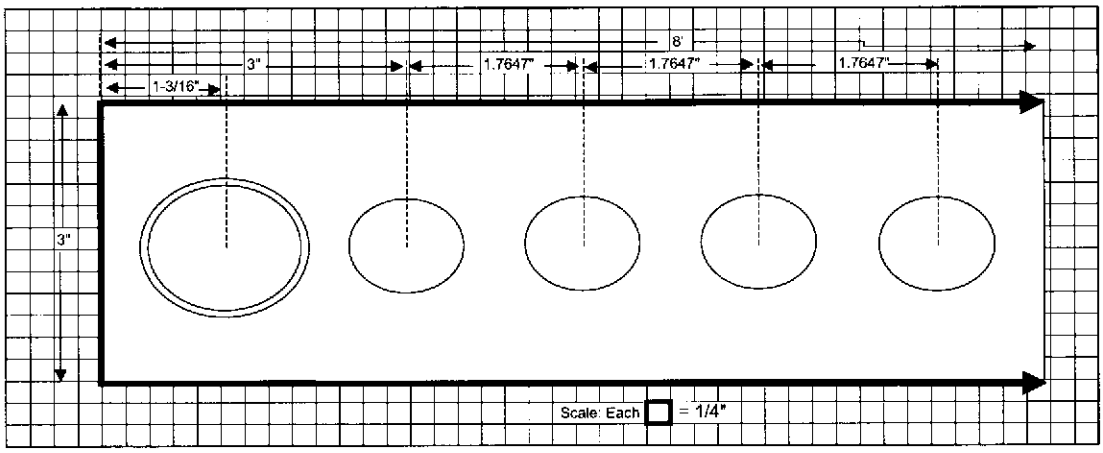
Appendix A. Weir and trap design.



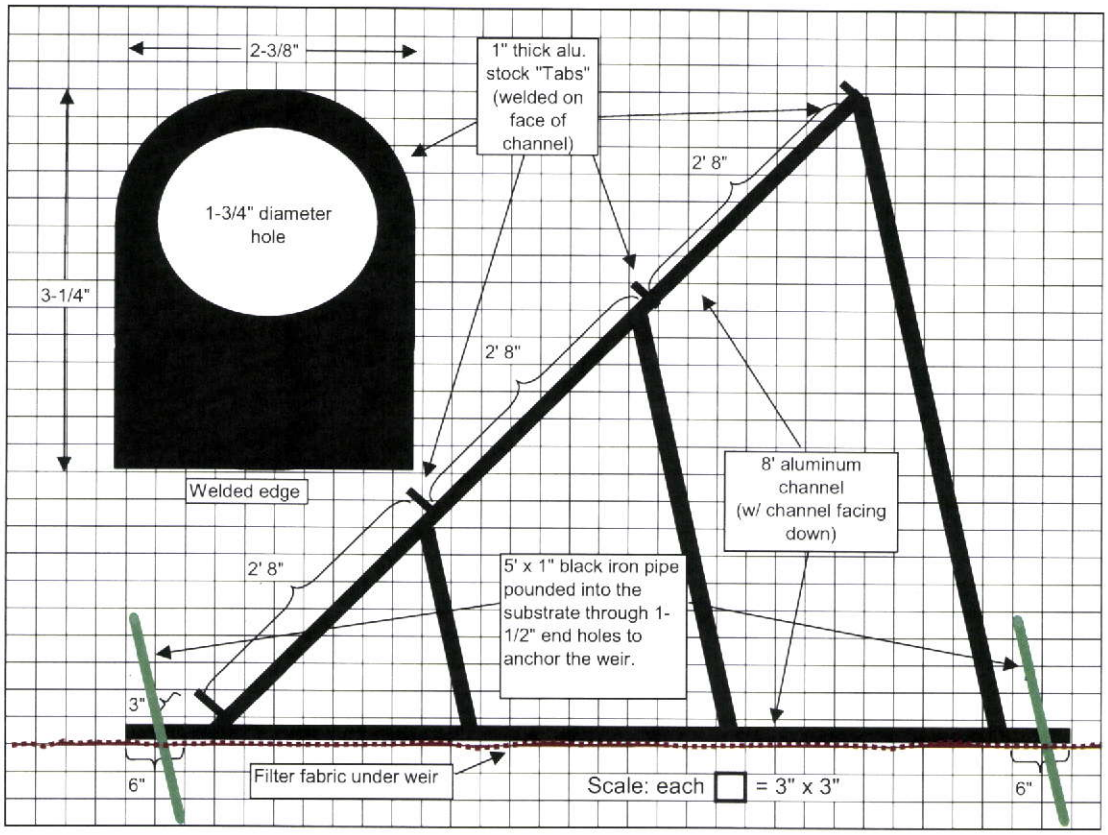
Appendix A.1. Side view (a.) of 8' weir panel with two 1-1/2" end holes and fifty-two 1-1/8" picket holes and end view (b.) of all the 8' x 2'4" weir panels. The 8' trap panels are identical except they are 2' high instead of 2'4" high.



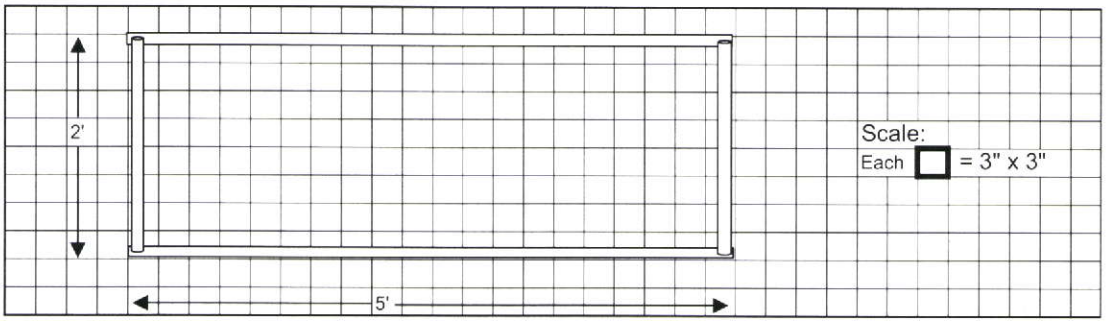
Appendix A.2. Top (or bottom) view of 8' weir or trap channel or panel with the two 1-1/2" end holes and fifty-two 1-1/8" picket holes. A 5' trap channel or panel has the two 1-1/2" end holes and thirty-one 1-1/8" picket holes.



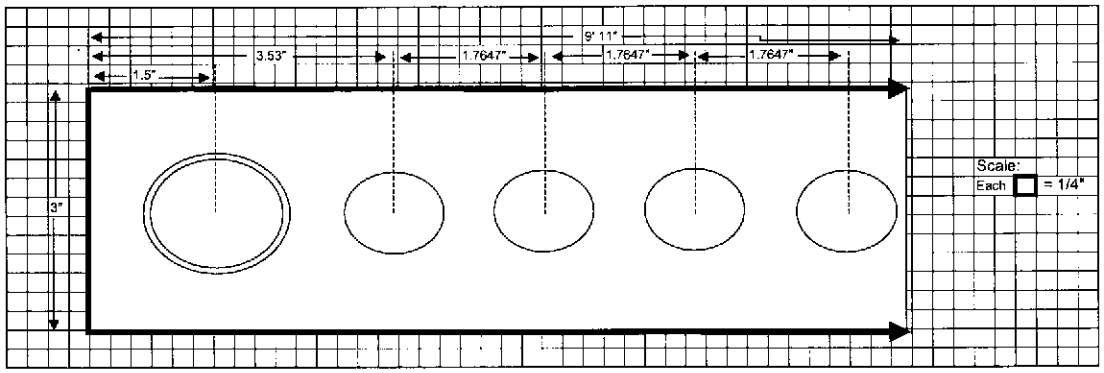
Appendix A.3. View of the end of an 8' channel showing one of the 1-1/2" end holes and four of the fifty-two 1-1/8" picket holes.



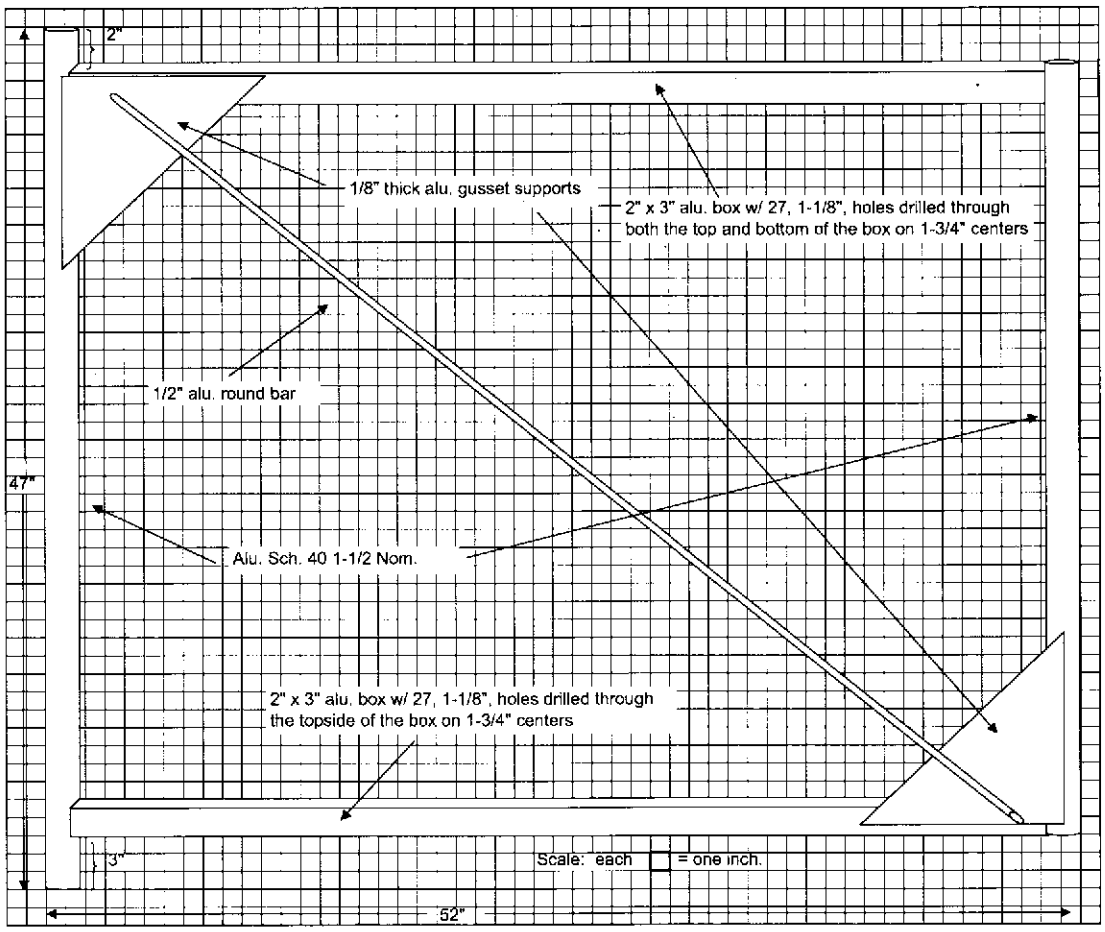
Appendix A.4. Weir bipod constructed from 3" x 1-3/4" aluminum AA channel.



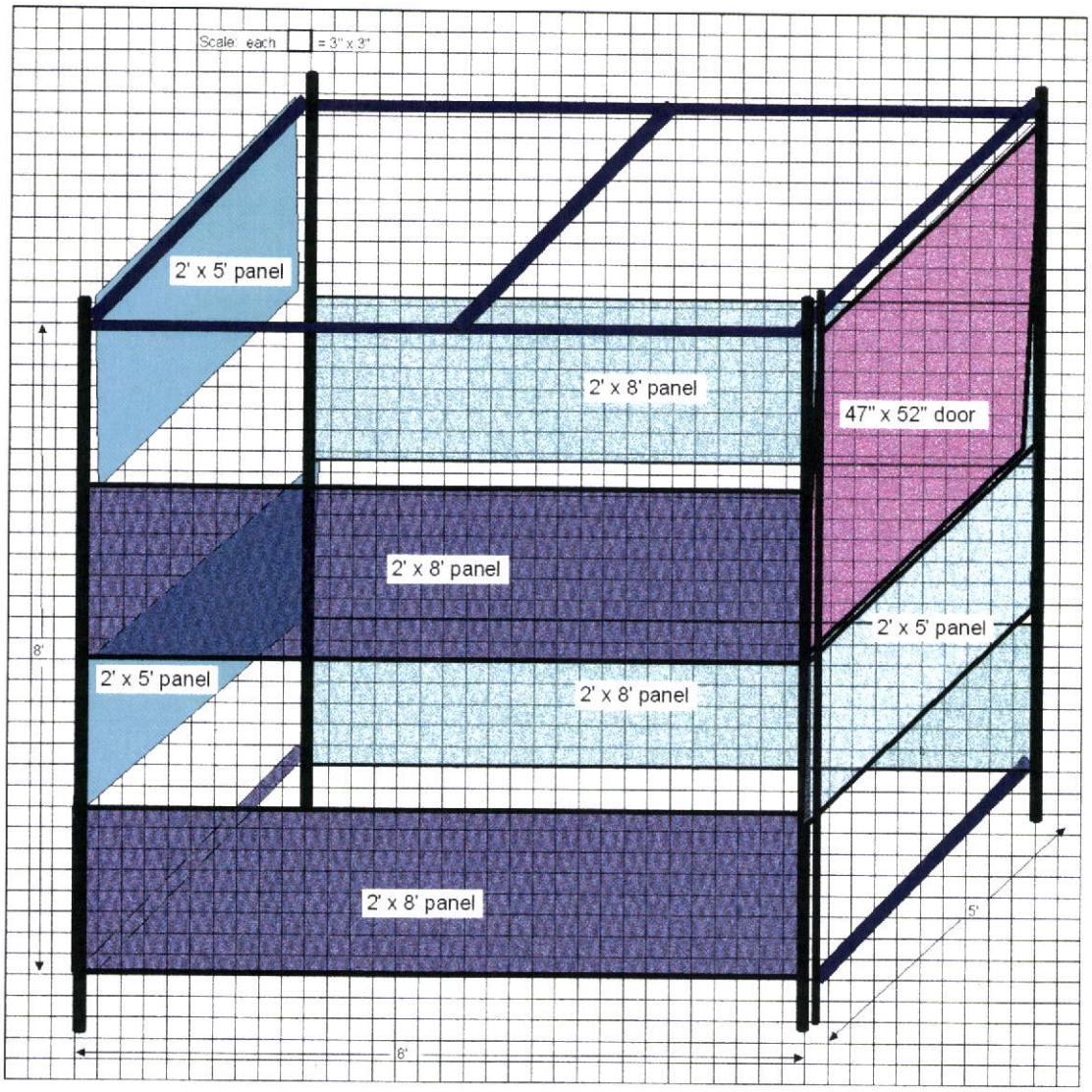
Appendix A.5. Side view of 5' trap panel.



Appendix A.6. View of the end of an 5' trap channel or panel showing one of the 1-1/2" end holes and four of the thirty-one 1-1/8" picket holes.

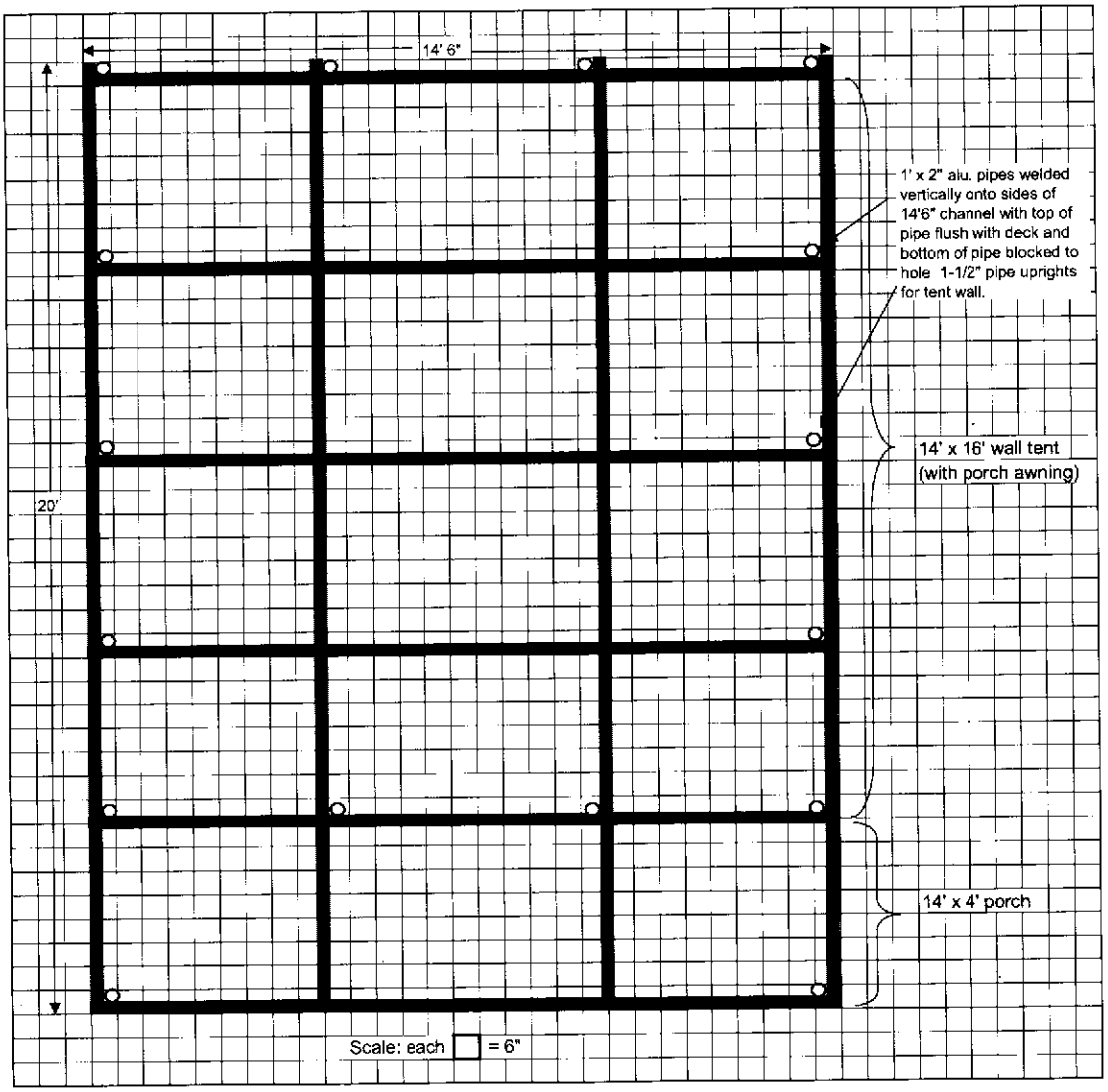


Appendix A.7. Trap door viewed from front.

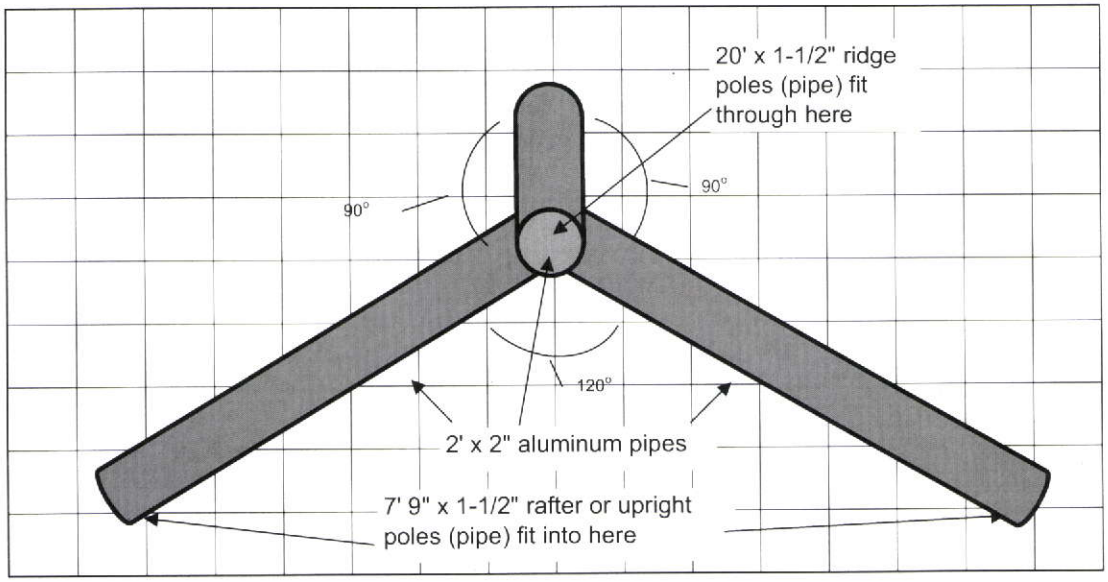


Appendix A.8. 3-D view of 5' x 8' x 8' trap.

Appendix B. Floating wall tent design.



Appendix B.1. Platform for floating wall tent.



Appendix B.2. Pole connectors for wall tent.

a) b)

Appendix B.3. Pictures of the floating wall tent: a) front view of the tent under construction; and b) rear view of the tent at anchor in the outlet slough of Pavlof Lake.

Appendix C. Daily weir count data and weekly sockeye age, sex, and length data from the Neva Creek weir, 2002.

Appendix C.1. Detailed Neva Creek weir counts, 2002.

	Weather and Stream Measurements:[a]					Sockeye Counted:			Sockeye Finclipped:				
Date	Weather	Water Level (cm)	Air Temp (°C)	Therm-ometer Water Temp (°C)	Data Logger Water Temp (oC)	Adults	Jacks	Total	Finclip Used (Adipose +)	Adults	Cum. % Adults Clipped	Jacks	Cum. % Jacks Clipped
6/4	rain	45.0	10.0	13.0		0	0	0		0		0	
6/5	showers	46.0		12.0		0	0	0		0		0	
6/6	overcast	46.5		12.0		0	0	0		0		0	
6/7	clear	45.5		12.0		0	0	0		0		0	
6/8	overcast	42.5	11.0	12.0		0	0	0		0		0	
6/9	rain	42.0	12.0	12.5		0	0	0		0		0	
6/10	showers	45.0	12.0	13.0		1	0	1	left axillary	0	0%	0	
6/11	overcast	45.0	12.0	12.0		0	0	0		0	0%	0	
6/12	partly cloudy	44.5	11.0	12.0		0	0	0		0	0%	0	
6/13	clear	43.0	12.0	13.0		0	0	0		0	0%	0	
6/14	clear	41.0	14.0	14.0		0	0	0		0	0%	0	
6/15	clear	40.0	15.0	16.0		0	0	0		0	0%	0	
6/16	clear	39.5	14.0	16.0		0	0	0		0	0%	0	
6/17	partly cloudy	39.0	13.0	15.0		1	0	1	left axillary	1	50%	0	
6/18	overcast	39.0	11.0	15.0		2	0	2	left axillary	1	50%	0	
6/19	showers	38.0	10.0	14.0		0	0	0		0	50%	0	
6/20	showers	38.0	10.0	14.0		1	0	1	left axillary	0	40%	0	
6/21	overcast	36.0	10.5	14.0		0	0	0		0	40%	0	
6/22	partly cloudy	35.0	12.0	14.0		1	0	1	left axillary	1	50%	0	
6/23	rain	33.5	14.0	15.0		1	0	1	left axillary	0	43%	0	
6/24	rain	32.5	12.5	15.0		0	0	0		0	43%	0	
6/25	rain	35.0	12.0	14.0		0	0	0		0	43%	0	
6/26	showers	36.0	12.0	14.5		1	0	1	left axillary	1	50%	0	
6/27	overcast	35.5	12.0	14.0		62	0	62	left axillary	40	63%	0	
6/28	partly cloudy	35.0	12.0	14.0		35	0	35	left axillary	0	42%	0	
6/29	overcast	33.0	12.0	15.0		0	0	0		0	42%	0	
6/30	showers	32.5	13.0	15.0		31	0	31	left axillary	22	49%	0	
7/1	showers	31.0	13.0	15.0		188	0	188	left axillary	97	50%	0	
7/2	rain	31.5	10.0	14.0		333	7	340	l. axil. & dorsal	169	51%	4	57%
7/3	showers	37.0	9.0	14.0		52	2	54	dorsal	19	50%	1	56%
7/4	showers	39.5	10.0	14.0		28	0	28	dorsal	18	50%	0	56%
7/5	overcast	40.5	11.0	13.5		83	1	84	dorsal	42	50%	1	60%
7/6	overcast	40.0	11.0	13.5		12	0	12	dorsal	3	50%	0	60%
7/7	clear	39.0	11.0	14.0		11	3	14	dorsal	7	50%	3	69%
7/8	overcast	37.0	14.0	15.0		8	0	8	dorsal	2	50%	0	69%
7/9	showers	35.5	12.0	15.0		18	3	21	dorsal	8	50%	2	69%
7/10	rain	34.0	11.0	15.0		8	0	8	dorsal	4	50%	0	69%
7/11	showers	34.0	11.0	14.5		11	0	11	dorsal	6	50%	0	69%
7/12	overcast	32.0	11.5	14.5		9	2	11	dorsal	4	50%	1	67%
7/13	rain	30.5	11.0	14.5		0	4	4	dorsal	0	50%	2	64%
7/14	showers	32.0	11.0	14.0		28	9	37	dorsal	15	50%	4	58%
7/15	overcast	37.0	12.0	14.0		22	18	40	dorsal	12	50%	8	53%
7/16	showers	34.5	12.0	14.5		11	10	21	dorsal	7	50%	4	51%
7/17	showers	32.5	11.0	14.5		4	6	10	dorsal	2	50%	3	51%
7/18	overcast	31.5	12.0	14.5		28	15	43	dorsal	19	51%	8	51%
7/19	overcast	30.0	12.0	15.0		35	17	52	dorsal	12	50%	7	49%
7/20	overcast	29.0	12.0	15.0		1	4	5	dorsal	1	50%	2	50%
7/21	rain	28.0	13.0	15.0		0	2	2	dorsal	0	50%	1	50%
7/22	showers	29.0	13.0	15.0		13	18	31	left ventral	12	51%	17	56%
7/23	overcast	28.5	14.0	15.5		1	3	4	left ventral	0	50%	0	55%
7/24	rain	30.0	14.0	15.5		190	49	239	left ventral	89	50%	20	51%
7/25	rain	31.5	12.0	15.0		79	24	103	left ventral	40	50%	12	51%
7/26	showers	42.5	11.0	14.5		247	26	273	left ventral	124	50%	14	51%
7/27	showers	44.0	12.0	14.5	14.6	81	13	94	left ventral	41	50%	8	52%
7/28	showers	43.5	10.5	14.0	14.3	94	16	110	left ventral	46	50%	4	50%
7/29	overcast	42.0	11.0	14.0	14.1	25	14	39	left ventral	11	50%	6	50%
7/30	partly cloudy	40.0	12.0	14.5	14.4	15	8	23	left ventral	14	50%	7	51%
7/31	overcast	38.0	12.5	15.0	14.9	25	24	49	left ventral	8	50%	9	50%

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Appendix C.1. (page 2 of 4).

	Number of Other Species Counted:							
Date	Adult Coho[b]	Jack Coho	Total Coho	Pink	Chum	Cutthroat	Dolly Varden	Comments
6/4	0		0	0	0	0	0	Weir fish tight at 1100 hour.
6/5	0		0	0	0	0	0	
6/6	0		0	0	0	0	0	
6/7	0		0	0	0	0	0	
6/8	0		0	0	0	0	0	
6/9	0		0	0	0	0.	0	
6/10	0		0	0	0	0	0	
6/11	0		0	0	0	0	0	
6/12	0		0	0	0	0	0	
6/13	0		0	0	0	0	0	
6/14	0		0	0	0	0	0	
6/15	0		0	0	0	0	0	
6/16	0		0	0	0	0	0	
6/17	0		0	0	0	0	0	
6/18	0		0	0	0	0	0	
6/19	0		0	0	0	0	0	
6/20	0		0	0	0	0	0	
6/21	0		0	0	0	0	0	
6/22	0		0	0	0	0	0	
6/23	0		0	0	0	0	0	
6/24	0		0	0	0	0	0	
6/25	0		0	0	0	0	0	
6/26	0		0	0	0	0	0	
6/27	0		0	0	0	0	0	
6/28	0		0	0	0	0	0	
6/29	0		0	0	0	0	0	
6/30	0		0	0	0	0	0	
7/1	0		0	0	0	0	0	
7/2	0		0	0	0	0	0	
7/3	0		0	0	0	0	0	Fish reportedly passed uncounted by non-project person.
7/4	0		0	0	0	0	0	
7/5	0		0	0	0	0	0	
7/6	0		0	0	0	0	0	
7/7	0		0	0	0	0	0	
7/8	0		0	0	0	0	0	
7/9	0		0	0	0	0	0	
7/10	0		0	0	0	0	0	
7/11	0		0	0	0	0	0	
7/12	0		0	0	0	0	0	
7/13	0		0	0	0	1	0	
7/14	0		0	0	0	0	1	
7/15	0		0	0	0	0	1	
7/16	0		0	0	0	0	0	
7/17	0		0	0	0	0	0	
7/18	0		0	0	0	0	11	
7/19	0		0	0	0	0	6	
7/20	0		0	0	0	0	5	
7/21	0		0	0	0	0		
7/22	0		0	0	0	0	16	
7/23	0		0	0	0	0	4	
7/24	0		0	0	0	0	6	
7/25	0		0	0	0	0	8	
7/26	0		0	0	0	0	5	
7/27	0		0	1	0	0	9	
7/28	0		0	0	0	0	18	
7/29	0		0	0	0	0	11	
7/30	0		0	0	0	0	12	
7/31	0		0	1	0	3	10	

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Appendix C.1. (page 3 of 4).

	Weather and Stream Measurements:[a]					Sockeye Counted:			Sockeye Finclipped:				
Date	Weather	Water Level (cm)	Air Temp (°C)	Therm-ometer Water Temp (°C)	Data Logger Water Temp (oC)	Adults	Jacks	Total	Finclip Used (Adipose +)	Adults	Cum. % Adults Clipped	Jacks	Cum. % Jacks Clipped
8/1	clear	36.0	13.0	15.0	15.2	49	47	96	left ventral	28	50%	22	49%
8/2	clear	34.0	13.0	16.0	15.9	12	13	25	left ventral	2	50%	9	50%
8/3	partly cloudy	30.5	12.0	16.0	16.0	3	5	8	left ventral	2	50%	3	50%
8/4	clear	28.5	13.5	17.0	16.2	3	14	17	left ventral	2	50%	7	50%
8/5	clear	27.0	12.5	16.5	16.5	32	32	64	left ventral	15	50%	15	50%
8/6	overcast	25.5	13.0	17.0	16.8	3	4	7	left ventral	2	50%	2	50%
8/7	rain	27.0	12.0	16.0	16.5	10	13	23	left ventral	6	50%	6	50%
8/8	showers	38.5	13.0	16.0	16.0	297	64	361	left ventral	147	50%	32	50%
8/9	showers	42.0	12.5	15.5	15.7	176	30	206	left ventral	85	50%	10	49%
8/10	overcast	42.0	13.0	15.0	15.2	92	54	146	left ventral	50	50%	30	49%
8/11	overcast	40.5	12.0	15.0	15.1	74	42	116	left ventral	37	50%	24	50%
8/12	rain	44.0	14.0	14.5	14.8	177	29	206	left ventral	89	50%	15	50%
8/13	showers	58.0	12.5	14.0	14.3	25	12	37	left ventral	12	50%	5	50%
8/14	overcast	56.5	12.5	14.0	14.0	26	9	35	left ventral	16	50%	5	50%
8/15	clear	52.5	11.0	14.0	14.3	38	42	80	left ventral	21	50%	17	49%
8/16	overcast	48.0	13.0	14.5	14.6	26	15	41	left ventral	22	51%	8	50%
8/17	overcast	44.0	10.5	13.5	14.0	33	19	52	left ventral	12	50%	4	49%
8/18	showers	41.5	11.0	13.5	13.8	54	20	74	left ventral	6	50%	20	50%
8/19	overcast	42.0	12.0	14.0	13.8	24	21	45	left ventral	16	50%	16	51%
8/20	overcast	36.0	12.0	13.5	14.0	22	18	40	left ventral	22	50%	1	50%
8/21	overcast		13.5		13.5	31	25	56	left ventral	7	50%	1	48%
8/22	overcast	36.5	13.0	13.0	13.4	54	25	79	left ventral	31	50%	14	49%
8/23	showers	37.5	11.5	13.0	13.5	39	8	47	left ventral	20	50%	3	49%
8/24	overcast	37.5	11.0	13.0	13.4	15	14	29	left ventral	10	50%	2	48%
8/25	showers	35.5	12.0	13.0	13.2	20	20	40	left ventral	4	50%	20	49%
8/26	overcast	33.5	12.0	13.0	13.2	16	11	27	left ventral	16	50%	11	50%
8/27	rain	34.0	12.5	13.0	13.4	19	16	35	left ventral	17	50%	10	50%
8/28	rain	39.5	12.0	13.5	13.4	28	12	40	left ventral	14	50%	6	50%
8/29	rain	41.0	12.5	13.0	13.4	17	10	27	left ventral	4	50%	5	50%
8/30					13.2						50%		50%
8/31		40.5		13.0	13.2	43	23	66	left ventral	28	50%	8	50%
9/1					13.1	16	10	26	left ventral	11	51%	10	50%
9/2					12.7	45	35	80	left ventral	25	51%	23	51%
9/3					13.1	13	14	27	left ventral	9	51%	10	51%
9/4					13.1	22	9	31	left ventral	15	51%	6	51%
9/5					13.4						51%		51%
9/6					13.4						51%		51%
9/7					13.2						51%		51%
9/8					13.1						51%		51%
9/9		34.5		12.0	12.9	6	9	15	left ventral	0	51%	6	51%
9/10		33.5		12.5	12.7	28	7	35	left ventral	12	51%	5	51%
9/11					12.6	0	5	5	left ventral	0	51%	3	51%
9/12					12.7	5	0	5	left ventral	5	51%	0	51%
9/13					12.6	4	9	13	left ventral	4	51%	9	52%
9/14					12.4	3	0	3	left ventral	3	51%	0	52%
9/15					12.1	1	11	12	left ventral	1	51%	0	51%
Total						3,397	1,074	4,471		1,726		551	

[a] The water temperature was recorded by the data logger at 0800 hour, all other observations were made about 0900 hour.

[b] Some jack coho salmon are likely included in these counts prior to 31 August.

[c] Thirty three adult sockeye salmon were given the left axillary clip and 136 the dorsal clip. All jacks were dorsal clipped.

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Appendix C.1. (page 4 of 4).

	Number of Other Species Counted:							
Date	Adult Coho[b]	Jack Coho	Total Coho	Pink	Chum	Cutthroat	Dolly Varden	Comments
8/1	0		0	0	0	0	1	
8/2	0		0	0	0	0	1	
8/3	0		0	0	0	0	0	
8/4	0		0	0	0	0	0	
8/5	0		0	0	0	0	2	
8/6	0		0	0	0	1	0	
8/7	0		0	0	0	0	0	
8/8	0		0	0	0	0	7	
8/9	2		2	1	0	0	1	
8/10	1		1	5	0	0	10	
8/11	1		1	2	0	0	7	
8/12	7		7	9	0	3	79	
8/13	2		2	4	0	0	4	
8/14	8		8	4	1	0	10	
8/15	13		13	1	0	0	5	
8/16	4		4	3	1	0	4	
8/17	10		10	0	0	0	16	
8/18	19		19	0	0	0	2	
8/19	5		5	1		1	0	
8/20	6		6	0	0	0	3	
8/21	5		5	2	0	0	3	
8/22	57		57	4	0	1	3	
8/23	39		39	10	0	0	1	
8/24	41		41	11	0	0	0	
8/25	18		18	0	0	0	0	
8/26	12		12	1	0	0	1	
8/27	12	4	16	5	0	0	0	
8/28	47		47	22	0	0	3	
8/29	49		49	6	0	1	0	Pickets pulled at 0930 hour.
8/30								Pickets re-installed at 1700 hour.
8/31	16	23	39					
9/1	10	16	26					
9/2	33	8	41					Pickets pulled at 1730 hour.
9/3	12	10	22					Pickets re-installed at 1145 hour.
9/4	20	6	26					Pickets pulled at 1745 hour.
9/5								
9/6								
9/7								
9/8								
9/9								Pickets re-installed at 1730 hour.
9/10	9	4	13	0	0	1	0	
9/11	9	3	12	5	0	0	0	
9/12	5	2	7	0	0	0	0	
9/13	12	9	21	0	0	0	0	
9/14	9	0	9	0	0	0	0	
9/15	3	0	3	0	0	0	1	Pickets pulled for season at 1400hour.
Total	496	85	581	98	2	12	287	

Appendix C.2. Age composition of sockeye salmon in the Neva Lake escapement, by sex and period, 2002.

	Brood Year and Age Class								
	2000	1999	1998	1998	1997	1997	1996	1996	
	0.1	1.1	1.2	2.1	1.3	2.2	1.4	2.3	Total
June 9 - 29									
Male									
Sample Size			5		4	2	1		12
Percent			17.9		14.3	7.1	3.6		42.9
Std. Error			6.3		5.8	4.2	3.1		8.2
Escapement			18		15	8	4		45
Female									
Sample Size			7		9				16
Percent			25.0		32.1				57.1
Std. Error			7.1		7.7				8.2
Escapement			26		34				60
All Fish									
Sample Size			12		13	2	1		28
Percent			42.9		46.4	7.1	3.6		100.0
Std. Error			8.2		8.2	4.2	3.1		
Escapement			44		49	8	4		105
June 30 - July 6									
Male									
Sample Size		2	37		19				58
Percent		1.5	27.4		14.1				43.0
Std. Error		1.0	3.6		2.8				4.0
Escapement		14	253		130				397
Female									
Sample Size			39		37	1			77
Percent			28.9		27.4	0.7			57.0
Std. Error			3.6		3.6	0.7			4.0
Escapement			267		253	7			527
All Fish									
Sample Size		2	76		56	1			135
Percent		1.5	56.3		41.5	0.7			100.0
Std. Error		1.0	4.0		3.9	0.7			
Escapement		14	520		383	7			924
July 7 - 13									
Male									
Sample Size		6	5		4	1			16
Percent		17.1	14.3		11.4	2.9			45.7
Std. Error		4.9	4.5		4.1	2.2			6.4
Escapement		14	12		9	2			37
Female									
Sample Size			9		10				19
Percent			25.7		28.6				54.3
Std. Error			5.6		5.8				6.4
Escapement			21		23				44
All Fish									
Sample Size		6	14		14	1			35
Percent		17.1	40.0		40.0	2.9			100.0
Std. Error		4.9	6.3		6.3	2.2			
Escapement		14	33		32	2			81

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Appendix C.2. (page 2 of 4)

	Brood Year and Age Class								
	2000	1999	1998	1998	1997	1997	1996	1996	
	0.1	1.1	1.2	2.1	1.3	2.2	1.4	2.3	Total
July 14 - 20									
Male									
Sample Size		13	6		3				22
Percent		44.8	20.7		10.3				75.9
Std. Error		8.8	7.2		5.4				7.6
Escapement		105	48		24				177
Female									
Sample Size			7						7
Percent			24.1						24.1
Std. Error			7.6						7.6
Escapement			56						56
All Fish									
Sample Size		13	13		3				29
Percent		44.8	44.8		10.3				100.0
Std. Error		8.8	8.8		5.4				
Escapement		105	104		24				233
July 21 - 27									
Male									
Sample Size		32	27		16	1		1	77
Percent		23.0	19.4		11.5	0.7		0.7	55.4
Std. Error		3.2	3.0		2.5	0.6		0.6	3.8
Escapement		172	145		86	6		5	414
Female									
Sample Size			35		24	1		2	62
Percent			25.2		17.3	0.7		1.4	44.6
Std. Error			3.3		2.9	0.6		0.9	3.8
Escapement			188		129	5		11	333
All Fish									
Sample Size		32	62		40	2		3	139
Percent		23.0	44.6		28.8	1.4		2.2	100.0
Std. Error		3.2	3.8		3.5	0.9		1.1	
Escapement		172	333		215	11		16	747
July 28 - August 3									
Male									
Sample Size	1	17	15		19				52
Percent	1.3	22.4	19.7		25.0				68.4
Std. Error	1.2	4.3	4.1		4.4				4.7
Escapement	5	78	69		87				239
Female									
Sample Size			14		10				24
Percent			18.4		13.2				31.6
Std. Error			4.0		3.5				4.7
Escapement			64		47				111
All Fish									
Sample Size	1	17	29		29				76
Percent	1.3	22.4	38.2		38.2				100.0
Std. Error	1.2	4.3	5.0		5.0				
Escapement	5	78	133		134				350

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Appendix C.2. (page 3 of 4)

	Brood Year and Age Class								
	2000	1999	1998	1998	1997	1997	1996	1996	
	0.1	1.1	1.2	2.1	1.3	2.2	1.4	2.3	Total
August 4 - 10									
Male									
Sample Size		11	16		10	1			38
Percent		16.7	24.2		15.2	1.5			57.6
Std. Error		4.4	5.1		4.3	1.5			5.9
Escapement		137	200		125	12			474
Female									
Sample Size			17		9	2			28
Percent			25.8		13.6	3.0			42.4
Std. Error			5.2		4.1	2.0			5.9
Escapement			213		112	25			350
All Fish									
Sample Size		11	33		19	3			66
Percent		16.7	50.0		28.8	4.5			100.0
Std. Error		4.4	5.9		5.4	2.5			
Escapement		137	413		237	37			824
August 11 - 17									
Male									
Sample Size		19	10		5				34
Percent		38.8	20.4		10.2				69.4
Std. Error		6.7	5.6		4.2				6.4
Escapement		219	116		58				393
Female									
Sample Size			11		3	1			15
Percent			22.4		6.1	2.0			30.6
Std. Error			5.8		3.3	2.0			6.4
Escapement			127		35	12			174
All Fish									
Sample Size		19	21		8	1			49
Percent		38.8	42.9		16.3	2.0			100.0
Std. Error		6.7	6.8		5.1	2.0			
Escapement		219	243		93	12			567
August 18 - 24									
Male									
Sample Size		4	3		2	3			12
Percent		23.5	17.6		11.8	17.6			70.6
Std. Error		10.4	9.3		7.9	9.3			11.1
Escapement		87	65		44	65			261
Female									
Sample Size			2		2	1			5
Percent			11.8		11.8	5.9			29.4
Std. Error			7.9		7.9	5.7			11.1
Escapement			44		43	22			109
All Fish									
Sample Size		4	5		4	4			17
Percent		23.5	29.4		23.5	23.5			100.0
Std. Error		10.4	11.1		10.4	10.4			
Escapement		87	109		87	87			370

-continued-

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	Brood Year and Age Class								
	2000	1999	1998	1998	1997	1997	1996	1996	
	0.1	1.1	1.2	2.1	1.3	2.2	1.4	2.3	Total
August 25 - Sept. 21									
Male									
Sample Size		12	7	1	3				23
Percent		37.5	21.9	3.1	9.4				71.9
Std. Error		8.5	7.3	3.1	5.1				7.9
Escapement		279	164	24	71				538
Female									
Sample Size			6		2	1			9
Percent			18.8		6.3	3.1			28.1
Std. Error			6.9		4.3	3.1			7.9
Escapement			141		47	24			212
All Fish									
Sample Size		12	13	1	5	1			32
Percent		37.5	40.6	3.1	15.6	3.1			100.0
Std. Error		8.5	8.6	3.1	6.4	3.1			
Escapement		279	305	24	118	24			750
Combined Periods (Percentages are weighted by period escapements)									
Male									
Sample Size	1	116	131	1	85	8	1	1	344
Percent	0.1	22.4	22.0	0.5	13.1	1.9	0.1	0.1	60.1
Std. Error	0.1	2.0	1.9	0.5	1.5	0.7	0.1	0.1	2.2
Escapement	5	1,105	1,090	24	649	93	4	5	2,975
Female									
Sample Size			147		106	7		2	262
Percent			23.2		14.6	1.9		0.2	39.9
Std. Error			1.9		1.4	0.8		0.1	2.2
Escapement			1,147		723	95		11	1,976
All Fish									
Sample Size	1	116	278	1	191	15	1	3	606
Percent	0.1	22.4	45.2	0.5	27.7	3.8	0.1	0.3	100.0
Std. Error	0.1	2.0	2.3	0.5	1.9	1.0	0.1	0.2	
Escapement	5	1,105	2,237	24	1,372	188	4	16	4,951

-continued-

Appendix C.3. Length composition of sockeye salmon in the Neva Lake escapement, by sex and period, 2002.

		Brood Year and Age Class								
		2000	1999	1998	1998	1997	1997	1996	1996	
		0.1	1.1	1.2	2.1	1.3	2.2	1.4	2.3	Total
June 9 - 29										
Male	Avg. Length			500		558	538	585		533
	Std. Error			8.4		12.3	7.5			10.3
	Sample Size			5		4	2	1		12
Female	Avg. Length			514		564				543
	Std. Error			6.4		7.8				8.2
	Sample Size			7		9				16
All Fish	Avg. Length			508		562	538	585		538
	Std. Error			5.3		6.4	7.5			6.4
	Sample Size			12		13	2	1		28
June 30 - July 6										
Male	Avg. Length		353	506		562				519
	Std. Error		17.5	3.6		6.2				6.2
	Sample Size		2	37		19				58
Female	Avg. Length			510		562	515			535
	Std. Error			3.5		3.6				3.9
	Sample Size			39		37	1			77
All Fish	Avg. Length		353	508		562	515			528
	Std. Error		17.5	2.5		3.2				3.5
	Sample Size		2	76		56	1			135
July 7 - 13										
Male	Avg. Length		358	507		556	540			465
	Std. Error		5.3	13.0		12.0				22.6
	Sample Size		6	5		4	1			16
Female	Avg. Length			514		566				541
	Std. Error			8.4		4.7				7.6
	Sample Size			9		10				19
All Fish	Avg. Length		358	511		563	540			506
	Std. Error		5.3	6.9		4.7				12.7
	Sample Size		6	14		14	1			35
July 14 - 20										
Male	Avg. Length		357	505		583				428
	Std. Error		4.5	6.6		3.3				19.6
	Sample Size		13	6		3				22
Female	Avg. Length			519						519
	Std. Error			6.6						6.6
	Sample Size			7						7
All Fish	Avg. Length		357	512		583				450
	Std. Error		4.5	4.9		3.3				16.6
	Sample Size		13	13		3				29

-continued-

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		Brood Year and Age Class								
		2000	1999	1998	1998	1997	1997	1996	1996	
		0.1	1.1	1.2	2.1	1.3	2.2	1.4	2.3	Total
July 21 - 27										
Male	Avg. Length		359	514		567	490		580	461
	Std. Error		3.6	3.8		5.8				10.4
	Sample Size		32	27		16	1		1	77
Female	Avg. Length			511		567	530		568	535
	Std. Error			3.4		4.2			12.5	4.4
	Sample Size			35		24	1		2	62
All Fish	Avg. Length		359	512		567	510		572	494
	Std. Error		3.6	2.5		3.4	20.0		8.3	6.8
	Sample Size		32	62		40	2		3	139
July 28 - August 3										
Male	Avg. Length	380	358	510		568				481
	Std. Error		5.7	6.2		5.9				13.1
	Sample Size	1	16	15		19				51
Female	Avg. Length			511		570				535
	Std. Error			4.0		8.5				7.3
	Sample Size			14		10				24
All Fish	Avg. Length	380	358	510		568				498
	Std. Error		5.7	3.7		4.8				9.6
	Sample Size	1	16	29		29				75
August 4 - 10										
Male	Avg. Length		375	519		563	510			489
	Std. Error		7.9	2.4		7.3				12.7
	Sample Size		11	16		10	1			38
Female	Avg. Length			505		567	525			526
	Std. Error			4.0		4.8	15.0			6.2
	Sample Size			17		9	2			28
All Fish	Avg. Length		375	512		565	520			505
	Std. Error		7.9	2.7		4.4	10.0			8.0
	Sample Size		11	33		19	3			66
August 11 - 17										
Male	Avg. Length		370	509		563				439
	Std. Error		5.5	3.1		11.5				14.5
	Sample Size		19	10		5				34
Female	Avg. Length			503		577	525			519
	Std. Error			6.5		1.5				9.2
	Sample Size			11		3	1			15
All Fish	Avg. Length		370	506		569	525			464
	Std. Error		5.5	5.4		7.3				11.7
	Sample Size		19	21		8	1			49
August 18 - 24										
Male	Avg. Length		351	524		570	519			473
	Std. Error		11.8	12.9		20.0	24.5			27.5
	Sample Size		4	3		2	3			12
Female	Avg. Length			513		573	538			542
	Std. Error			2.5		32.5				16.9
	Sample Size			2		2	1			5
All Fish	Avg. Length		351	519		571	524			493
	Std. Error		11.8	7.6		15.6	18.0			21.2
	Sample Size		4	5		4	4			17

-continued-

Appendix C.3. (page 3 of 3)

		Brood Year and Age Class								
		2000	1999	1998	1998	1997	1997	1996	1996	
		0.1	1.1	1.2	2.1	1.3	2.2	1.4	2.3	Total
August 25 - Sept. 21										
Male	Avg. Length		371	508	402	548				437
	Std. Error		5.2	6.5		6.5				16.1
	Sample Size		12	7	1	3				23
Female	Avg. Length			499		570	515			517
	Std. Error			7.8		5.0				11.4
	Sample Size			6		2	1			9
All Fish	Avg. Length		371	504	402	557	515			460
	Std. Error		5.2	5.0		6.7				13.5
	Sample Size		12	13	1	5	1			32
Combined Periods (Lengths weighted by period escapements)										
Male	Avg. Length	380	363	511	402	563	507	585	580	473
	Std. Error		2.0	1.8		2.6	10.1			4.6
	Sample Size	1	115	131	1	85	8	1	1	343
Female	Avg. Length			508		568	523		568	529
	Std. Error			1.6		2.0	4.5		12.5	2.1
	Sample Size			147		106	7		2	262
All Fish	Avg. Length	380	363	510	402	565	518	585	572	493
	Std. Error		2.0	1.2		1.6	5.6		8.3	3.0
	Sample Size	1	115	278	1	191	15	1	3	605

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U.S. Fish and Wildlife Service
Office of Subsistence Management
Fisheries Resource Monitoring Program

Neva, Pavlof, and Hoktaheen Sockeye Salmon Stock Assessment, 2002 to 2005

Final Report for Study 02-012

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

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(Cover photo: Frederick Gallant, III, Hoonah Indian Association, holds up a large male sockeye salmon while sampling at Hoktaheen Lake on September 6, 2002.)

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ABSTRACT

The escapement of sockeye salmon into Neva Lake was 5,003 fish in 2002, 11,393 in 2003, 9,513 in 2004, and 5,263 in 2005 based on weir counts and mark-recapture data. On average, the midpoint of the run was August 8 and 80% of the run passes between July 12 and September 9. The 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 and up to 24% of the fish were jacks. The subsistence and sport effort and harvest was relatively small.

The sockeye escapement into Pavlof Lake was 1,350 in 2002, 1,474 in 2003, and 715 in 2004 based on Peterson mark-recapture estimates with coefficient of variations less than 7%. Nearly all the fish entered the lake between June 21 and August 14 and spawned in the lower part of the main inlet stream from late-July to mid-August. Age-1.3 fish dominated the escapement and few jacks were observed. Thirty to 69% of the fish used the fishpass to migrate into the lake.

At Hoktaheen Lake, 3,438 (CV=3%) and 565 (CV=4%) sockeye salmon spawned in the upper lake's main inlet stream study area in 2003 and 2004 based on modified Jolly-Seber mark-recapture estimates. Most of these fish were in and off the mouth of the creek the first week of September. The only other concentration of spawners observed was in the upper half of the stream connecting the upper and lower lakes where 325 and 251 sockeye spawned from mid to late September in 2003 and 2004. Lake spawners might be present but none were observed in the tannin stained water. Age-1. and age-2. fish were sampled from the escapements.

Key words: Sockeye salmon, *Oncorhynchus nerka*, subsistence, Neva, Pavlof, Hoktaheen, escapement, weir, mark-recapture, age composition, zooplankton, limnology.

Citation: Van Alen, B. W. 2008. Neva, Pavlof, and Hoktaheen sockeye salmon stock assessment; 2002 to 2005. U.S. Fish and Wildlife Service, Office of Subsistence Management, Fishery Resource Monitoring Program, Final Report Study No. 02-012. Anchorage, Alaska.

INTRODUCTION

Sockeye salmon returns to Neva Lake (Alaska Department of Fish and Game, Division of Commercial Fisheries stream number 114-80-045), Pavlof Lake (112-50-010), and Hoktaheen Lake (113-94-003) 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; Figure 1). Household subsistence surveys done in Hoonah in 1996 found that 86% of the families used salmon and 65% used sockeye salmon (Table 1).

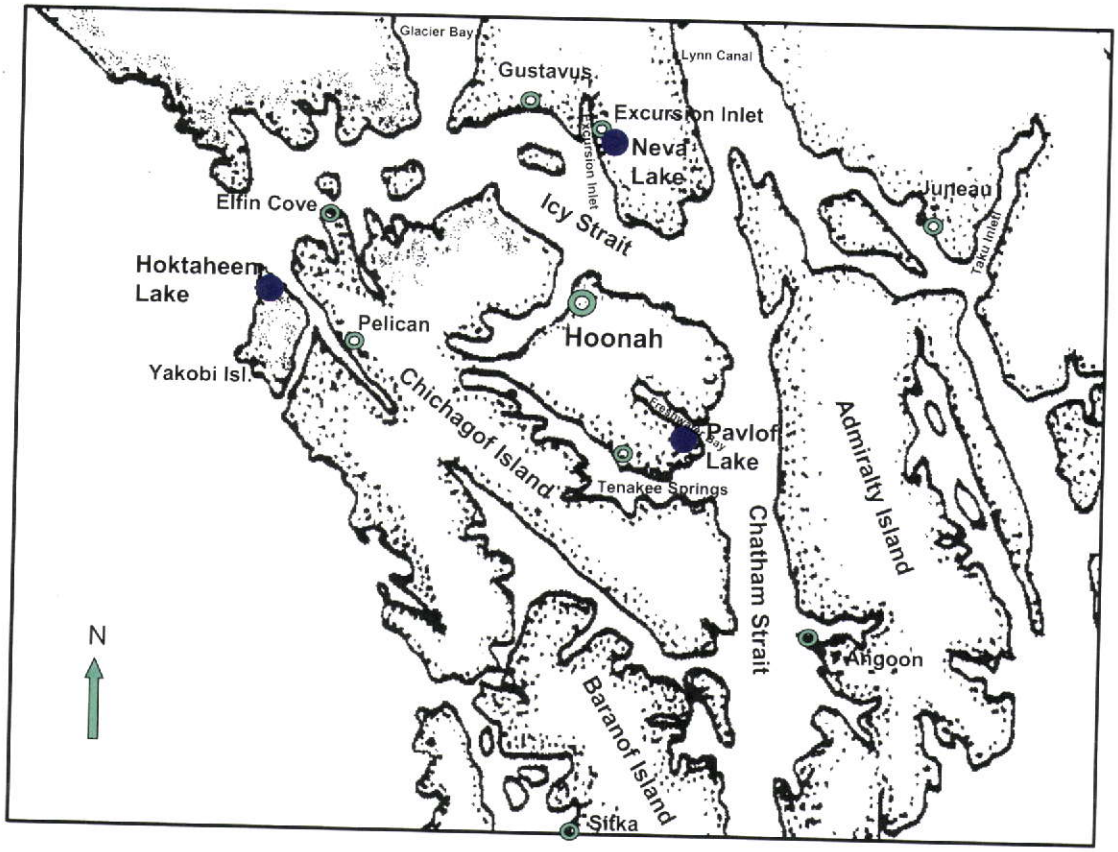


Figure 1. Map of northern Southeast Alaska showing the location of Neva, Pavlof, and Hoktaheen Lakes.

Table 1. Subsistence use and harvest of salmon by households in Hoonah, 1985, 1987, and 1996. (from ADF&G, Division of Subsistence, Community Profile Database, 2003)

	Sockeye Salmon		All Salmon	
Year	Percent Households Using	Percent Households Harvesting	Percent Households Using	Percent Households Harvesting
1985	32%	17%	86%	55%
1987	38%	29%	92%	69%
1996	65%	43%	86%	74%

Unfortunately, little is known about the health of these sockeye runs. Management has had to rely on infrequent and imprecise aerial survey counts and subsistence harvest reports to assess run sizes and trends. I am not aware of any prior studies that estimated or indexed the sockeye escapement into these lakes. We do not know if escapements are at levels that would maximize returns and harvests. We do not know if management is too conservative and if subsistence harvests limits could be liberalized, or, if these runs are depressed and need rebuilding. Rebuilding perhaps from over harvesting that occurred with the onset of commercial fishing in the late-1800s and early-1900s (Bean 1891; Moser 1899; Rich and Ball 1933; Cooley 1963; Van Alen 2000). Most importantly, we do not know if escapements are trending downward and if management actions are needed to protect these important subsistence resources.

This project estimates sockeye escapements into Neva and Pavlof Lakes, indexes the sockeye escapement into Hoktaheen Lake, and collects associated biological and limnological data needed to assess the current status of these important subsistence stocks. Mark-recapture methods are used to estimate the relative and/or absolute sockeye escapement in all lakes. This information is needed to estimate escapement goals and understand the current status of these runs (Geiger et al. 2003).

This final project report covers the third year (2004) of a joint Hoonah Indian Association (HIA)/U.S. Forest Service/Alaska Department of Fish and Game (ADF&G) study into the status of Neva, Pavlof, and Hoktaheen sockeye salmon. Results from the 2002 season were reported in Van Alen (2004) and for the 2003 season in Van Alen (2005). The stock assessment of sockeye salmon in Hoktaheen Lake was part of an Organized Village of Kake and ADF&G project in 2001 (Conitz and Cartwright 2002) but was included in this project since Hoktaheen is in the traditional fishing area of the Hoonah people.

This Neva, Pavlof, and Hoktaheen sockeye stock assessment project is one of several sockeye stock assessment projects done in southeast Alaska since 2001 with support by 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 all involve cooperation among community Tribal associations, ADF&G, and Forest Service.

There were also two Federal Office of Subsistence Management-funded, "Traditional Ecological Knowledge" projects recently completed regarding subsistence use of salmon in the Hoonah area (Ratner and Dizard 2005; Langdon 2006). Results from these studies will help us assure the adequacy of these runs for meeting escapement and subsistence needs.

BACKGROUND

Neva

Neva Lake (58°24.219' N, 135°24.258' W; NAD27 datum) is located on the mainland on the east side of Excursion Inlet (Figure 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.

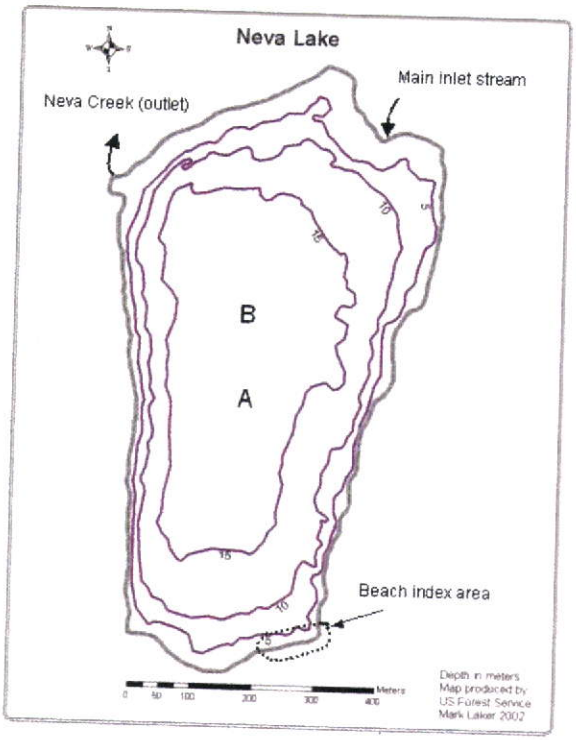


Figure 2. Bathymetric map of Neva Lake showing 5 m depth contours and approximate locations of the two fixed sampling stations, the main inlet stream, the outlet, and the beach spawning study area.

Neva Lake is in the traditional lands used for subsistence harvesting and gathering by the Huna Tlingit (Schroeder and Kookesh 1990). There used to be a village of Wooshkeetaan clan people in Excursion Inlet near the present cannery site (Goldschmidt and Haas 1998). Villagers would fish for "a good run of sockeye" salmon returning to Neva Lake and there were several smokehouses in the area. Stone barriers are still evident in Neva Creek that were built to fish upstream migrating salmon (Langdon 2006).

A salmon cannery began operation in Excursion Inlet in 1918. The location and ownership of the cannery has changed several times over the years (Galginaitis 2003). During World War II, between August 1942 and November 1943, over 3,000 civilian and U.S. Army workers constructed a barge terminal at Excursion Inlet as a potential resupply port for the Aleutian campaign (Cohen 1988). The $17 million port was never needed and from July 1945 to January 1946 the Army used about 700 German prisoners of war to dismantle and salvage as much as possible. A dam, reservoir, and water distribution system remained that is still used by the cannery today. This water system diverts water out of Neva Lake's main inlet stream. Neva Lake is accessible by road from the cannery.

The State currently holds title to the land surrounding Neva Lake and outlet, and the cannery site is privately owned, but the majority of the watershed is on National Forest System Land. The State is currently in the process of transferring some land selections in the Excursion Inlet/South Creek area to the Haines Borough. In the 1970s and 1980s, the State subdivided and sold land along the eastern shore of Excursion Inlet and there are now about 80 cabins/homes and a sport fishing lodge in the area that are mostly used for summer recreation. Unguided clients from sport fish lodges often target salmon at the mouth of South Creek.

This area is in the Federal subsistence customary and traditional use area for residents in the Hoonah area (Federal Register 50 CFR Part 100 and 36 CFR Part 242) and 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, returned, and the reported harvest since 1984. The return of these permits is voluntary. No sockeye salmon were reported harvested at Neva prior to 1990. The effort and harvest has peaked every four years, 1992, 1996, 2000, and 2004, with as many as 23 permits being fished and 411 sockeye harvested (Figure 3). Subsistence and personal use fishing for Neva sockeye salmon occurs both in saltwater, at the mouth 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.

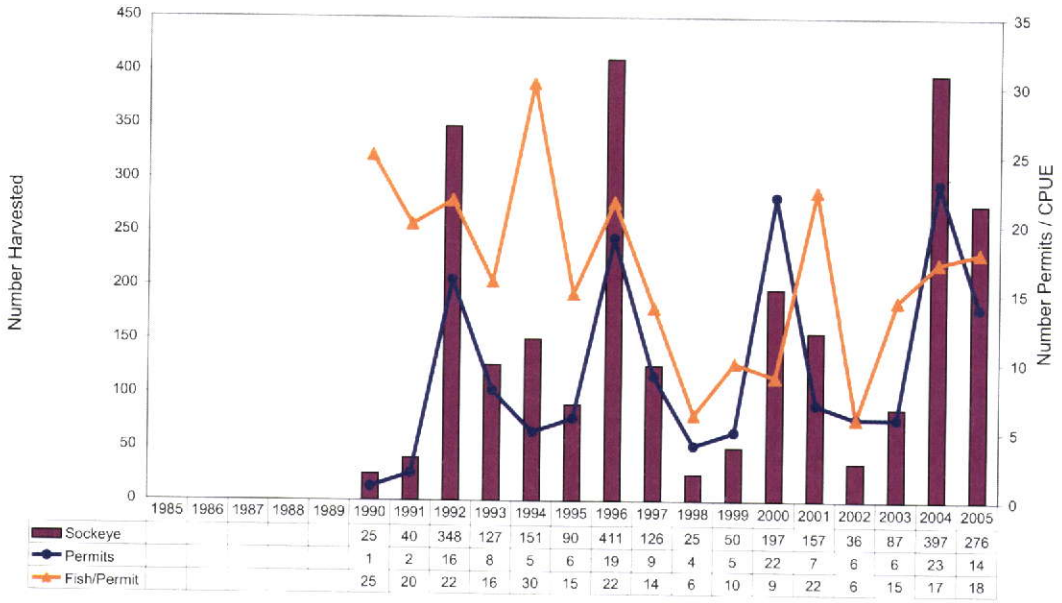


Figure 3. Subsistence/personal use effort and harvest of sockeye salmon at Neva from 1985 to 2005 as reported on permits returned to ADF&G. (from ADF&G, Division of Commercial Fisheries database, October, 2007)

Neva sockeye salmon would primarily be harvested in commercial fisheries in Excursion Inlet (Statistical Area 114-80; Figure 4) and Icy Strait. These fisheries also harvest sockeye salmon bound for Lynn Canal, Taku River, Chatham Strait, other northern inside systems, and since 2000, to Snettisham Hatchery. Rich and Ball (1933) reported no harvests of sockeye salmon in Excursion Inlet prior to 1914 and annual harvests of zero to 50,722 sockeye salmon in Excursion Inlet from 1914 to 1927 (Table 2). Beach seines, purse seines, gillnets, and traps fishing on passing stocks in Icy Strait harvested hundreds of thousands of sockeye salmon annually through 1927 (Rich and Ball 1933; Table 2). Commercial harvest estimates for Icy Strait and Excursion Inlet from 1928 to statehood (1959) are not available. Traps were outlawed in 1959; however, the purse seine fishing effort remained high in Icy Strait into the early 1970s (Table 3). The annual sockeye harvest has ranged between zero and 2,584 fish in Excursion Inlet since 1960 (Table 3). 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 5). There was a marked increase in sockeye harvest in the 1980s and 1990s when openings were advanced from September to August (Figure 6).

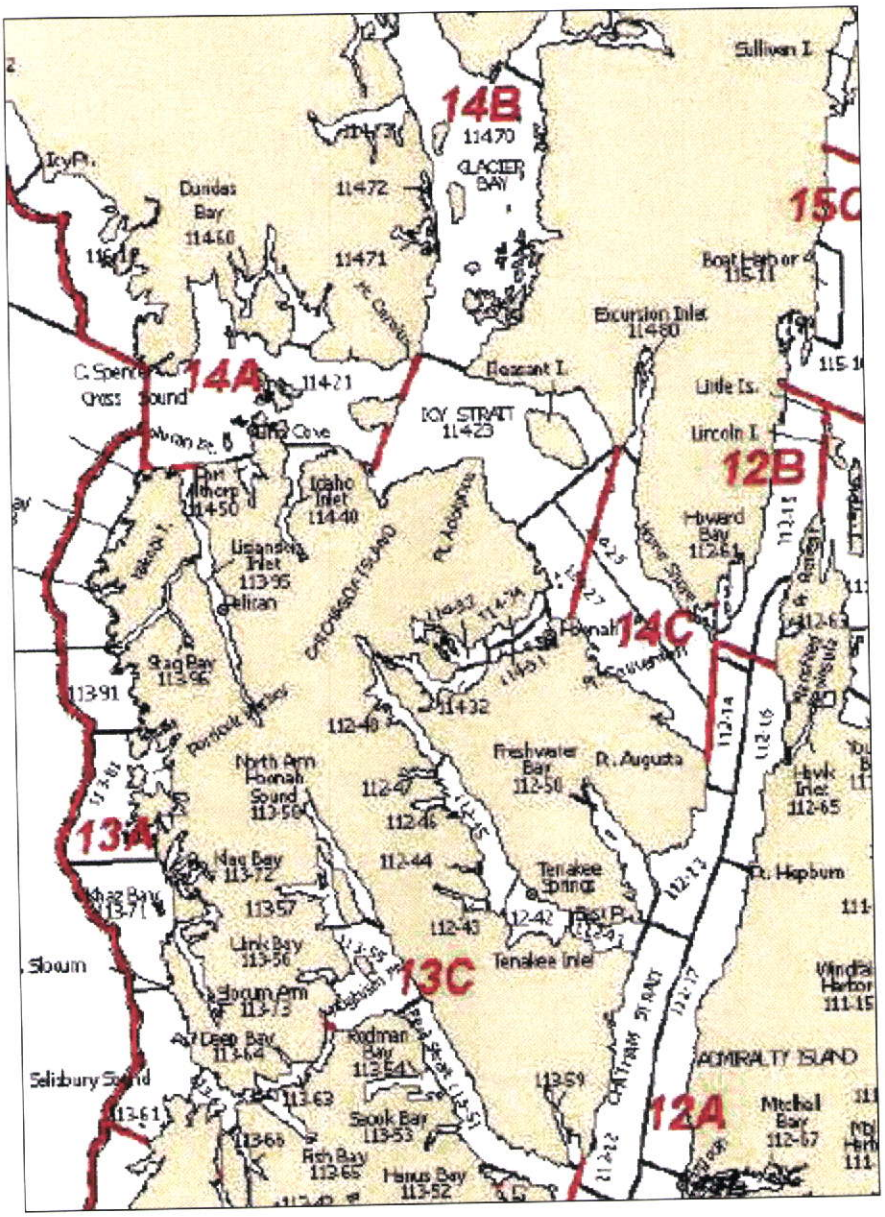


Figure 4. ADF&G salmon statistical areas and sections in the Icy Strait and northern Chatham Strait area. (from ADF&G, Chart No. 3)

The ADF&G, Division of Sport Fish, estimates sport effort, catch, and harvest from an annual statewide mail survey (Mills and Howe 1992). Twelve or more responses are needed for estimates to be useable. There have been too few responses to estimate effort or harvests of salmon in the Neva Lake system but the sport fish harvest of sockeye salmon in the entire Excursion Inlet area (excluding the Excursion River) has averaged only 34 fish from 1984 to 1999 (Table 4). There has been an increasing trend in sport effort and harvest in both the Excursion Inlet area (Table 4) and the Glacier Bay Area that includes Excursion Inlet (Table 5).

Aerial and foot escapement surveys have been conducted by ADF&G, Commercial Fisheries Division, intermittently since 1960. These surveys are primarily geared to indexing pink and chum salmon escapements. They should not be considered a reliable estimate or index of sockeye abundance without further study. Survey locations, dates, and observers are not standardized (Bevan 1961; Jones et al. 1998) and usually only a small fraction of the escapement is visible due to the forest canopy, dark water, and the natural dispersal of fish within a system. Nevertheless, counts as high as 1,250 sockeye salmon have been made in Neva Lake in recent years (Table 6).

Table 2. Historic commercial harvest of sockeye salmon in Icy Strait, and Hoktaheen Cove and Excursion Inlet (Neva), and Northern Chatham Strait, and Freshwater Bay (Pavlof), 1889 to 1927. (from Rich and Ball, 1933)

Year	Icy Strait[a]	Hoktaheen Cove	Excursion Inlet	Northern Chatham Strait[b]	Freshwater Bay
1889	51,600				
1890	144,000			4,902	
1891	91,200				
1892				21,875	
1893					
1894					
1895				4,260	
1896				36,969	
1897				566	
1898					
1899					
1900	151,901			194,200	25,000
1901	96,547			131,055	
1902	218,084			128,080	
1903	236,167			241,175	
1904	432,262			199,200	
1905	584,275	8,279		93,664	
1906	375,459	11,348		177,200	
1907	511,265	7,000		121,394	
1908	661,140	10,677		256,619	
1909	626,511	10,391		304,351	
1910	609,802	9,896		150,892	
1911	635,726	7,196		158,956	
1912	818,162	7,197		248,964	1,000
1913	686,268	5,344		208,937	
1914	1,304,877	7,686	3	223,738	
1915	768,068	8,301		241,763	
1916	679,561			127,681	560
1917	712,770		6,036	270,713	179
1918	827,768	2,519	61	242,056	
1919	822,679	5,463	385	205,552	808
1920	608,953	3,218	50,722	173,875	
1921	271,138			91,406	
1922	425,725	653	390	103,996	
1923	518,006	5,266	78	86,297	30
1924	552,789	2,310	2,382	121,589	
1925	525,391	2,335	3,039	153,412	
1926	523,110	1,834	546	140,680	
1927	345,635	2,021	2,469	102,367	
Spearman's rho non-parametric trend test (Conover 1980):					
rho	0.46	-0.85	0.35	0.22	-0.83
P-value	0.01	0.00	0.30	0.21	0.04
N	31	20	11	33	6

[a] The beach seine, purse seine, gillnet, and traps in the Icy Strait District primarily targeted passing stocks. Hoktaheen and Excursion Inlet (Neva) are in this district.

[b] The Northern Chatham Strait area includes the beach seine, purse seine, gillnet, and trap harvests north of Pt. Gardner and Takatz Bay. Freshwater Bay (Pavlof) is in this district.

Table 3. Commercial purse seine effort and harvest of sockeye salmon in waters adjacent to Neva Lake (Icy Strait and Excursion Inlet), Pavlof Lake (Upper Chatham Strait and Freshwater Bay), and Hoktaheen Lake (Hoktaheen Cove), 1960 to 2005. (from ADF&G, Division of Commercial Fisheries, Alexander Database, October 2006)

	Icy Strait (Dist. 114)		Excursion Inlet (Dist. 114-80)		Upper Chatham (Dist. 112)		Freshwater Bay (Dist. 112-50)		Hoktaheen Cove (Dist. 113-94)	
Year	Sockeye Harvest	Boat-Days	Sockeye Harvest	Boat-Days	Sockeye Harvest	Boat-Days	Sockeye Harvest	Boat-Days	Sockeye Harvest	Boat-Days
1960	136,796	1,552			12,399	236	1,046	58		
1961	213,619	2,965			45,493	726	69	15		
1962	136,712	1,208			11,148	160	114			
1963	201,535	5,440			24,268	1,312	18	4		
1964	204,304	4,162	9		34,225	1,282				
1965	280,730	4,682	1		48,756	1,383	15			
1966	216,858	2,747	12		28,737	1,363	3			
1967	160,019	3,113	306		15,891	525	17			
1968	230,741	3,004	2		41,874	3,213	448		1,073	
1969	231,624	3,627			29,563	1,610				
1970	163,224	4,384	4	190	49,598	4,844	14	27	149	6
1971	88,758	3,188	3	232	18,533	1,728			315	36
1972	96,853	3,374	13	220	33,761	2,651	528	48	8	3
1973	130,805	1,714	10	102	32,118	620			205	4
1974	20,594	656	2	184	23,639	858				
1975	2,391	226	0	110						
1976	21	303	21	303						
1977										
1978					1,261	434				
1979	3	53	2	52	1,577	261	8	4		
1980	1,792	216	1,685	198	1,300	662				
1981	10,638	596	266	238	17,188	602				
1982	234	119			26,524	3,408				
1983	2,333	135	85	28	25,979	1,001				
1984	6,882	190	1,876	138	22,208	1,548				
1985	3,638	253	919	26	37,140	2,448				
1986	1,479	69	168	35	8,391	2,181				
1987	3,793	307	396	156	44,989	1,486				
1988	1,244	135	952	73	3,927	642				
1989	6,111	164	151	2	48,985	1,653				
1990	4,161	110	2,348	52	17,477	873				
1991	4,307	208	1,153	31	40,289	2,735				
1992	6,454	180	2,584	65	54,403	1,869				
1993	9,806	249	216	1	81,676	2,989				
1994	10,536	412			76,582	4,044				
1995	264	8	264	8	20,387	2,799	1,576	54		
1996					37,482	3,102				
1997	5,123	259	518	5	25,946	2,528	1,582	46		
1998					30,820	2,546				
1999	17,301	893	105	24	55,942	3,725				
2000	1,111	99	376	77	30,594	2,538				
2001	43,739	443			64,427	1,777				
2002	4,592	262	46		24,751	1,761				
2003	11,973	288	3		68,316	1,945				
2004	35,254	427			173,008	2,366				
2005	13,354	466			116,013	3,135				

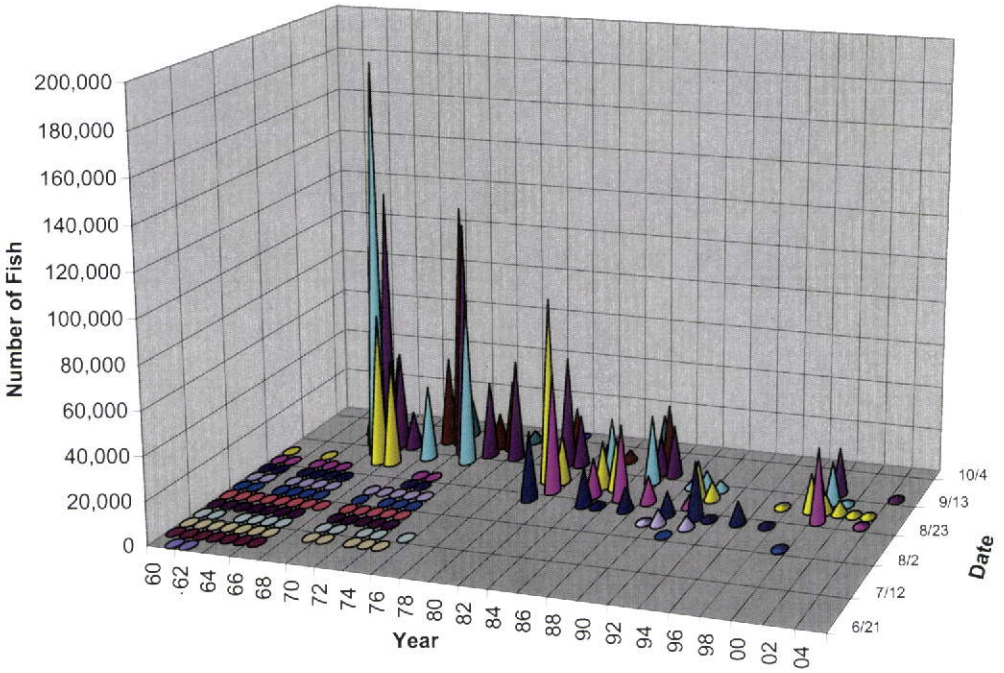


Figure 5. Weekly purse seine harvest of chum salmon in Excursion Inlet, Statistical Area 114-80, 1960 to 2005. (from ADF&G, Division of Commercial Fisheries, Alexander Database, October, 2006)

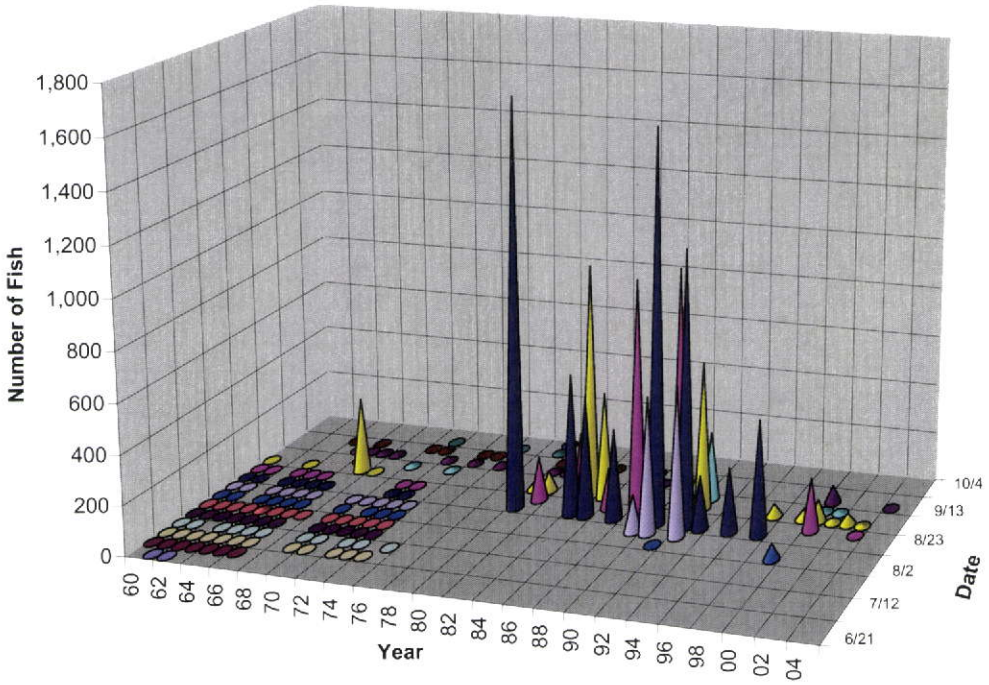


Figure 6. Weekly purse seine harvest of sockeye salmon in Excursion Inlet, Statistical Area 114-80, 1960 to 2005. (from ADF&G, Division of Commercial Fisheries, Alexander Database, October, 2006)

Table 4. Sport fish effort and harvest in Excursion Inlet and Neva Lake, 1984 to 2002. (from ADF&G, Division of Sport Fish, Statewide Harvest Database, 2005)

Year	Number of Anglers	Number of Trips	Days Fished	Coho Harvest	Sockeye Harvest	Number of Responses
1984	12	55	33	59	0	1
1985	163	130	121	50	0	3
1986	204	681	706	45	11	6
1987	225	449	444	44	110	6
1988	402	2,135	1,893	54	0	5
1989	290	273	321	152	28	10
1990	232	249	443	0	21	9
1991	724	1,252	3,164	176	0	19
1992	660	1,383	1,420	97	66	29
1993	588	1,042	1,062	163	0	24
1994	1,166	1,428	2,496	1,053	74	42
1995	1,113	1,419	3,042	290	34	40
1996	613	1,197	1,633	620	0	34
1997	1,170	1,921	2,867	840	50	52
1998	1,005	1,955	2,720	924	124	49
1999	1,257	1,675	3,357	2,762	32	51
2000	365	901	1,415	916	0	15
2001	277	234	616	1,098	0	12
2002	378	410	1,546	4,080	0	21
2003						
Average	571	989	1,542	706	29	23
Spearman's rho rank correlation trend test:						
r_s =	0.57	0.32	0.54	0.89	0.03	0.71
P =	0.01	0.18	0.02	0.00	0.89	0.00
n =	19	19	19	19	19	19

Table 5. Sport fish harvest and effort in the Sitka area (on and around Baranof and Chichagof Islands) and Glacier Bay areas, 1977 to 2005. (from ADF&G, Division of Sport Fish, Statewide Harvest Database, 2007)

		Sitka Area (includes Pavlof)[a]:					Glacier Bay Area (includes Excursion Inlet and Neva):				
Watertype	Year	Number of Anglers	Number of Trips	Days Fished	Coho Harvest	Sockeye Harvest	Number of Anglers	Number of Trips	Days Fished	Coho Harvest	Sockeye Harvest
Freshwater	1977			6,927	261	192			1,362	0	6
	1978			5,303	176	56			129	0	0
	1979			3,946	154	36			79	0	0
	1980			5,510	326	69			143	9	43
	1981			3,844	184	0			196	11	22
	1982			5,663	146	0			17	0	0
	1983			4,998	336	76			253	0	0
	1984	2,720	2,938	4,258	255	102	208	429	535	124	78
	1985	2,941	4,670	4,680	348	0	291	747	433	12	0
	1986	2,809	3,942	4,587	115	38	646	805	651	167	11
	1987	2,582	4,826	5,611	42	14	428	673	1,845	88	143
	1988	3,089	4,112	5,077	308	1,092	682	1,176	1,009	837	419
	1989	2,424	4,017	5,154	261	214	511	1,023	887	559	0
	1990	2,826	3,676	4,404	87	120	598	813	1,371	495	0
	1991	3,026	3,610	6,970	390	323	997	1,995	2,335	780	48
	1992	3,535	5,066	6,674	461	0	559	1,706	2,029	349	164
	1993	3,148	6,142	9,444	925	177	627	1,640	1,912	212	142
	1994	3,031	5,776	7,789	389	151	627	1,788	2,114	669	0
	1995	3,251	4,273	7,718	937	77	866	2,808	4,071	846	219
	1996	2,355	3,324	4,426	479	252	369	877	903	154	99
	1997	3,309	4,840	7,123	828	547	1,173	1,931	3,087	815	271
	1998	2,822	3,075	5,298	823	259	804	598	1,187	129	81
	1999	3,268	5,051	8,368	1,196	637	666	1,118	1,351	197	0
	2000	1,748	4,178	6,289	324	212	1,026	2,257	3,249	749	244
	2001	1,369	3,163	4,733	137	133	1,111	2,905	3,503	1,668	108
	2002	1,644	2,457	4,395	396	82	962	2,315	3,173	1,356	0
	2003	1,409	2,694	3,606	510	60	640	1,757	2,115	1,023	319
	2004	1,100	2,049	3,313	1,007	90	916	1,386	2,244	882	349
	2005	1,601	3,028	4,326	1,517	0	1,000	1,685	2,340	1,519	145
Spearman's rho rank correlation trend test:											
	r_s =	-0.44	-0.38	-0.05	0.64	0.30	0.67	0.57	0.80	0.85	0.50
	P =	0.04	0.08	0.79	0.00	0.11	0.00	0.01	0.00	0.00	0.01
	n =	22	22	29	29	29	22	22	29	29	29
Saltwater	1977			30,817	2,855	620			3,013	744	231
	1978			27,638	2,188	268			1,529	880	169
	1979			36,564	1,554	754			2,563	227	0
	1980			33,172	1,876	1,326			2,299	207	17
	1981			34,650	3,122	594			2,242	562	22
	1982			37,686	3,741	628			2,747	1,163	0
	1983			39,160	4,312	306			3,237	619	41
	1984	9,367	28,715	35,791	2,389	533	941	1,411	2,848	247	0
	1985	12,429	32,650	31,935	3,332	210	1,876	3,407	3,468	324	0
	1986	13,733	32,786	35,173	3,962	328	2,380	2,973	3,213	224	0
	1987	14,005	38,882	39,972	2,673	433	2,716	4,023	5,333	956	121
	1988	16,736	36,028	43,603	2,437	2,055	2,445	7,395	8,267	508	91
	1989	17,618	44,824	54,076	8,030	1,934	4,144	5,612	8,008	1,817	216
	1990	22,612	46,777	57,502	7,721	1,224	3,483	5,013	6,486	1,251	21
	1991	23,009	44,672	61,223	11,084	487	7,318	12,145	19,630	4,873	84
	1992	29,824	55,978	71,607	8,706	434	5,221	9,072	13,250	1,158	215
	1993	28,460	52,358	65,500	13,593	949	6,017	9,394	13,142	2,508	172
	1994	40,327	67,455	100,204	42,489	1,987	8,220	9,401	16,105	6,142	93
	1995	37,258	62,777	93,420	15,677	1,502	9,224	13,343	21,243	2,130	477
	1996	32,219	41,539	60,556	35,413	2,789	6,266	9,224	13,533	4,513	228
	1997	34,501	53,446	81,442	37,125	2,962	8,890	12,763	20,083	5,140	264
	1998	37,305	46,188	72,136	50,645	3,522	6,812	8,368	13,071	3,652	99
	1999	34,042	55,906	96,789	75,050	6,929	7,955	11,361	21,556	11,793	85
	2000	22,190	50,067	84,602	39,182	2,170	8,115	21,355	38,126	12,522	172
	2001	24,502	50,642	87,657	83,377	1,829	8,415	18,499	38,963	25,250	146
	2002	21,856	39,122	63,361	39,809	1,206	7,394	14,631	28,506	29,636	544
	2003	28,920	42,308	66,237	67,997	2,124	10,452	16,915	32,109	19,625	604
	2004	25,234	46,914	78,318	69,083	2,301	9,776	18,309	37,506	26,114	759
	2005	25,529	52,533	84,164	96,644	1,582	10,998	25,465	47,473	28,176	790
Spearman's rho rank correlation trend test:											
	r_s =	0.55	0.49	0.86	0.93	0.68	0.90	0.91	0.95	0.90	0.65
	P =	0.01	0.02	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	n =	22	22	29	29	29	22	22	29	29	29

[a]The Sitka Area included all of Baranof and Chichagof/Yakobi Island (Hoktaheen) prior to 2000. Starting in 2000, the sport effort and harvest in the Northern part of Chichagof Island and Yakobi Island is included with the Glacier Bay Area.

Table 6. Peak aerial, foot, or boat counts of sockeye salmon at Neva, Pavlof, and Hoktaheen, 1960 to 2003. (from ADF&G, Division of Commercial Fisheries, Alexander Database, January 2005)

	Neva Creek		Pavlof River		Hokatheen Cove	
Year	Number Counted	Number of Surveys	Number Counted	Number of Surveys	Number Counted	Number of Surveys
1960						
1961			200	1		
1962			300	1		
1963			850	1		
1964						
1965			2,500	3	3,000	1
1966			4,000	1		
1967			2,500	5		
1968			3,300	4	2,000	2
1969					1,500	2
1970						
1971						
1972					0	1
1973					500	2
1974						
1975						
1976						
1977					1,500	1
1978					500	1
1979						
1980						
1981			800	1		
1982			200	2		
1983			170	4		
1984			150	2		
1985			0	1		
1986			0	2		
1987			200	5		
1988	100	1				
1989	140	2	100	3		
1990	470	3	300	6		
1991	300	2				
1992	0	1	300	4		
1993	0	1	800	5		
1994	0	2	100	2		
1995	250	1	400	3		
1996	610	2	400	2		
1997	50	4	620	2	2	3
1998	123	10	350	5		
1999	810	4	40	3	150	2
2000	215	4	200	4	404	3
2001	1,250	4	300	2	745	3
2002	100	2	100	2		
2003	150	1			150	2

Pavlof

Pavlof Lake (57°50.605' N, 135°02.672' W) is located on the northeast side of Chichagof Island (Figure 1). Pavlof Lake empties directly into Pavlof Harbor on the southeast side of Freshwater Bay. There is a short 4 m falls on the outlet. Pavlof Harbor is about 48 km by boat from Hoonah and Angoon and 24 km from Tenakee Springs. Pavlof Lake has a surface area of 36.6 ha, a maximum depth of 8 m, a mean depth of 2.3 m, a volume of 860,000 m^3, and an elevation of 5 m (Figure 7; Barto and Cook 1999). This small, shallow lake has an extensive growth of lily pads (Nuphar spp.) and other aquatic vegetation. The small lake does little to buffer rainfall or snowmelt events and there is a wide range in daily stream flows, particularly in the fall (Figure 8).

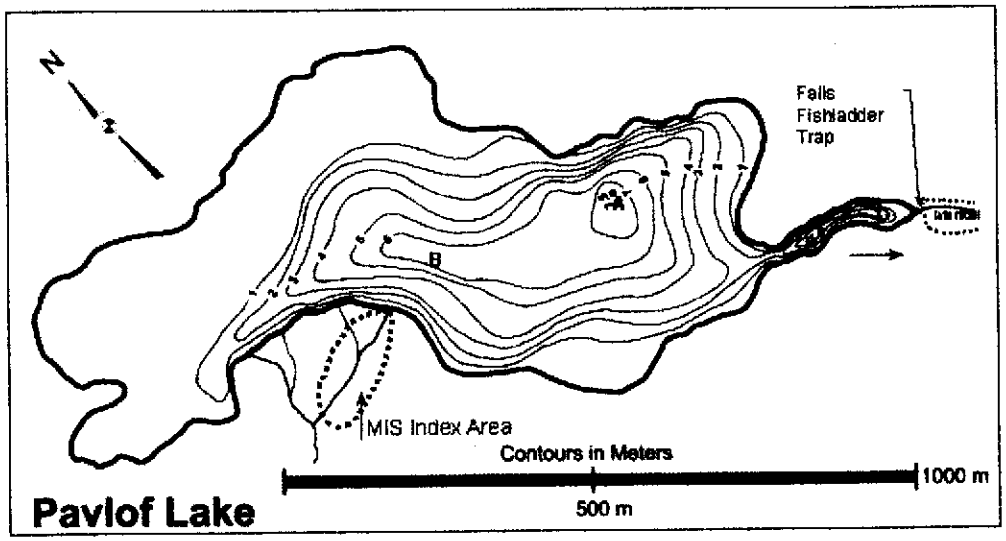


Figure 7. Bathymetric map of Pavlof Lake showing 1 m depth contours and locations of the two fixed sampling stations, the study area in the main inlet stream, and the fish pass and trap at the outlet of the lake. (from ADF&G)

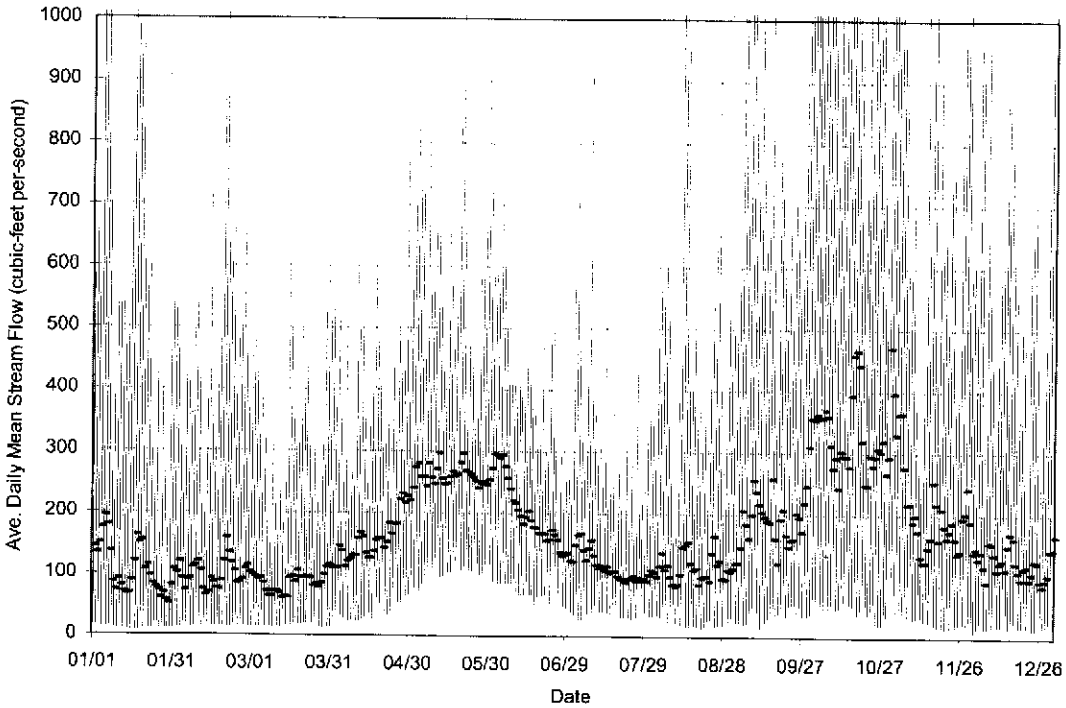


Figure 8. Average daily mean stream flow (cubic-feet per-second) and minimum and maximum (truncated at 1,000 from peaks up to 3,370) daily measurements for Pavlof River, June 1, 1957 to September 30, 1981. (from USGS)

The Pavlof Harbor area is in the traditional territory of Wooshkeetaan clan members associated with Angoon, Auk (Juneau), and Tenakee (Goldschmidt and Haas 1998). Goldschmidt and Haas reported that Wooshkeetan people from Angoon had lived for a time in a small village near Pavlof Harbor called Asaank''i and that a smoke house was located below the waterfall at the outlet of Pavlof Lake. De Laguna (1960) interviewed an elderly man in Angoon who also collaborated Goldschmidt and Haas's report. He said when he was a small boy there were two "Wuckitan" lineage houses in a small village about a mile east of "the sockeye stream in Freshwater Bay". De Laguna (1960) clarifies that this territory originally belonged to an independent division of the Wuckitan, the Freshwater Bay branch, and that they subsequently "inherited rights at Angoon when the Kootznahoo branch of this sib became extinct." A picture of a Tlingit man gaffing salmon in 1901 in a Freshwater Bay creek (believed to be Pavlof Creek with the waterfall in the background) is shown on Page 107 in the book "The Tlingit Indians" by Emmons (1991).

Shroeder and Kookesh (1990) report that a cannery was operated in Pavlof Harbor in 1889 and 1919-1923. The waterfall was incorporated into cannery operations. The Federal Works Progress Administration constructed a concrete fish ladder with 14 step pools on the left side (looking downstream) of the falls in 1935. Prior to the construction of this fish ladder it is believed that the cascading falls at the outlet of the lake was a

partial barrier to upstream migrating salmon (Barto and Cook 1999). The Forest Service installed an aluminum "Alaskan steep pass" inside the concrete fish ladder in 1986. The Forest Service also installed an "Alaskan steep pass" fishpass on a waterfall in the main inlet tributary in 1987. The intent of this upper fishpass is to provide coho salmon with better access to upriver spawning and rearing habitat.

The State of Alaska currently holds title to the land around the lake and outlet but the majority of the watershed is on National Forest System Lands. Large portions of the watershed were clearcut logged in years 1977 to 1981, 1987 and 1988, and 1991 to 1993. Roads now traverse the watershed and provide vehicle access with Hoonah. The area immediately around the lake and outlet has not been logged and it is not possible to drive to the lake or outlet.

Barto and Cook (1999) conducted a limnology and fisheries investigation of Pavlof Lake in 1997. Their study evaluated rearing conditions for sockeye salmon and applied empirical sockeye production models developed by Koenings and Burkett (1987) to identify potential management or enhancement strategies for optimizing sockeye production. They concluded that the lake's sockeye carrying capacity was relatively small, that sockeye production was near capacity, and that coho production might be compromised if the lake was fertilized in an attempt to boost sockeye production.

Coho salmon spawners from Pavlof were a brood source for an ADF&G, Fisheries Rehabilitation Enhancement and Development Division's, effort to boost recreational sport fishing opportunities in the Juneau area. Between 1987 and 1996, 109 coho salmon adults were killed during egg take operations in late-September in the upper reaches of the main inlet stream. These eggs were incubated in Juneau and the fry released into Juneau area streams.

The Pavlof area is not in either a Federal or State customary and traditional use area. Subsistence use data ranked the Pavlof Lake area as high use by residents of Tenakee Springs and middle use by residents of Hoonah and Angoon (ADF&G, Subsistence Division, Tongass Land Management Plan Revision, 1996). Pavlof has not been listed on the annual subsistence/personal use permits issued by ADF&G and sockeye harvests have only been reported in two years (Figure 9).

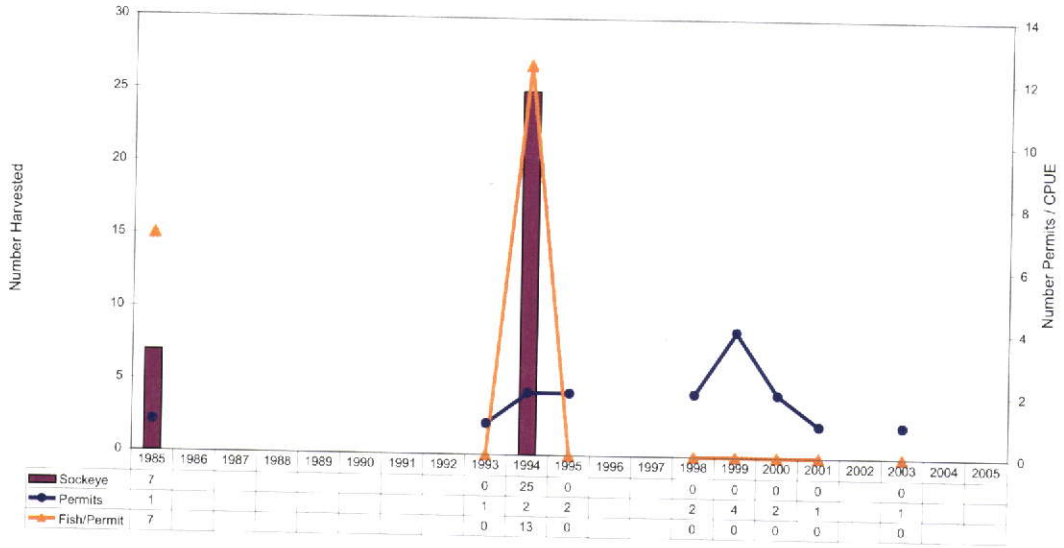


Figure 9. Subsistence/personal use effort and harvest of sockeye salmon at Pavlof from 1985 to 2005 as reported on permits returned to ADF&G. (from ADF&G, Division of Commercial Fisheries, Alexander Database, March, 2007)

Sockeye salmon returning to Pavlof Lake would be harvested in Icy Strait and Chatham Strait area fisheries. Rich and Ball (1933) reported six years of sockeye harvested in Freshwater Bay starting with 25,000 harvested in 1900 and ending with 30 in 1923 (Table 2). Sockeye harvests in Freshwater Bay since statehood (1959) are between zero and 1,582 fish (Table 3). These seine openings target pink salmon.

Pavlof Harbor is a popular anchorage for pleasure boaters and sport fishing for trout and salmon is also popular in the area. However, the sport harvest of sockeye salmon in the Pavlof area is small. Only nine sockeye salmon were reported harvested in the Pavlof Lake, Pavlof Bay, Freshwater Bay area from 1977 to 1999 (ADF&G, Division of Sport Fish, Statewide Harvest Survey database, 2002). The saltwater sport effort and harvests are trending upward in the area (Table 5).

Aerial and foot escapement surveys since 1980 have usually counted around 200 sockeye salmon in the Pavlof River (Table 6). The run timing of sockeye and pink salmon overlaps and the tannin stained water makes counting fish difficult.

Hoktaheen

Hoktaheen Lake (58°03.236' N, 136°30.381' W) is located on the northwest side of Yakobi Island, about 25 km from the community of Pelican (Figure 1). The lake is at about 51 m in elevation and drains a watershed area of about 20 km2. It has a surface area of 67 ha, an average depth of about 20 m, and a maximum depth of about 50 m (Conitz and Cartwright 2002; Figure 10). There are two lakes in the Hoktaheen Lake

system. A short, 0.5 km, stream connects the larger, upper lake to the lower lake. The outlet of the smaller lake flows about 2 km to Hoktaheen Cove on the Gulf of Alaska.

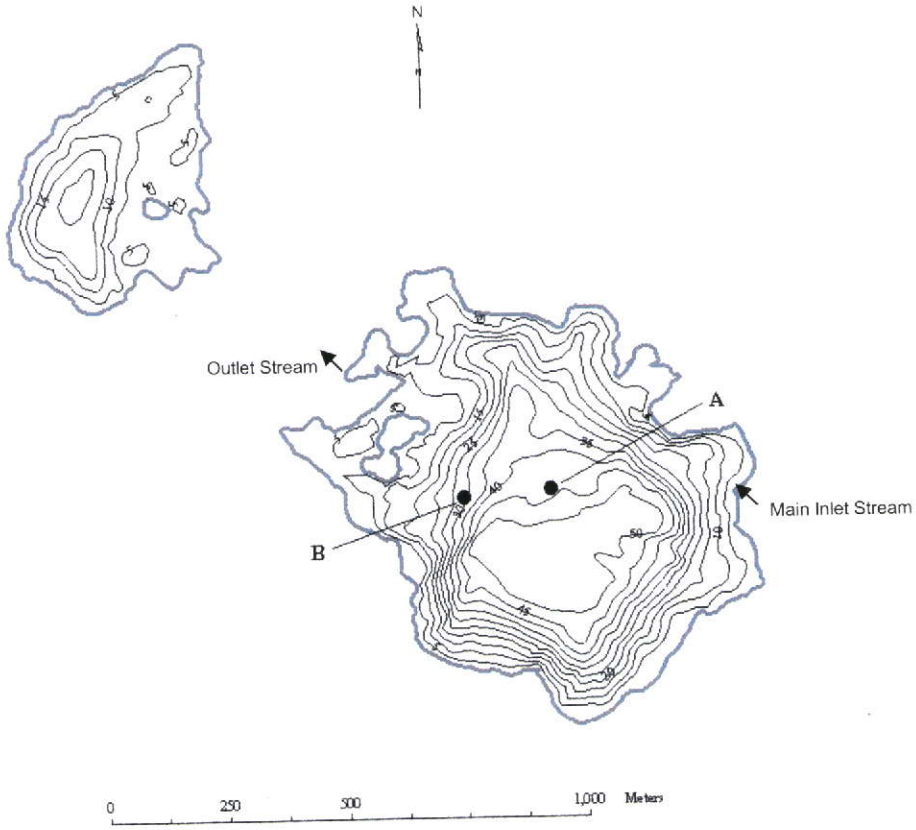
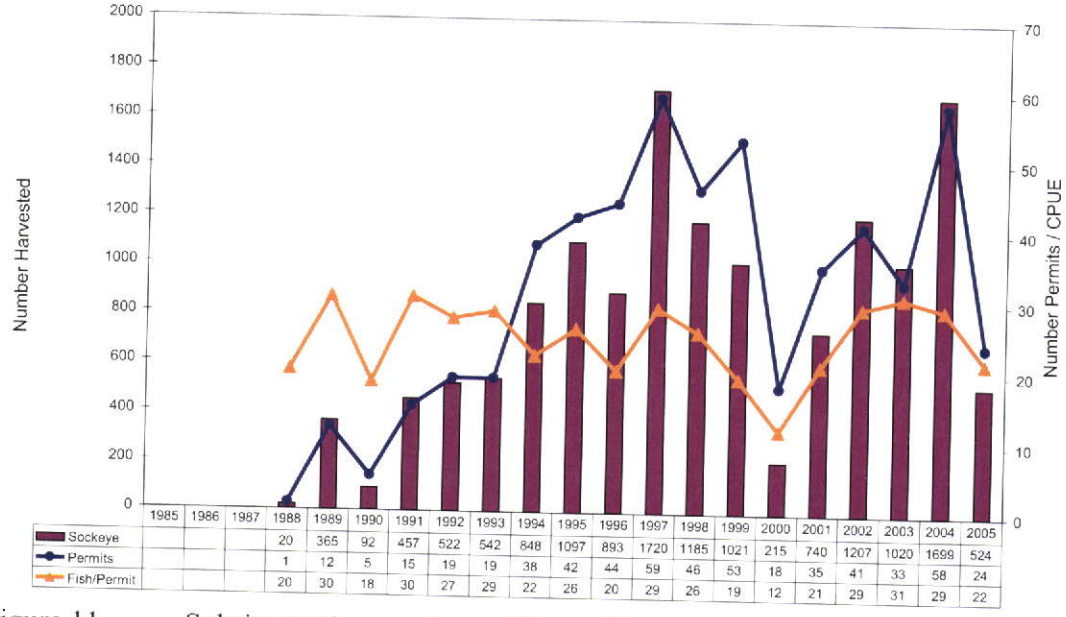


Figure 10. Bathymetric map of Hoktaheen Lakes with 5 m depth contours, location of limnology sampling stations A and B, and locations of the Main Inlet Stream and outlet.

The Hoktaheen Lake system on Yakobi Island is within the traditional subsistence harvesting and gathering area claimed by the Hoonah people. Goldschmidt and Hass (1998) believed that the Hoktaheen Cove area belonged to the T'akdeintaan clan. They reported that "Hoktaheen Creek is a good sockeye stream" and that smokehouses were located there. The summer camps and smoke houses are now gone but subsistence fishers from Hoonah, Pelican, and Elfin Cove continue to make day or overnight trips to Hoktaheen Cove. Travel is often by skiff and weather and sea conditions must be good for safe boating.

Hoktaheen Lake is in the West Chichagof Yakobi Wilderness Area. The entire watershed is on National Forest land.

The reported subsistence harvest of sockeye salmon at Hoktaheen peaked at 1,720 fish in 1997 (Figure 11). Harvests vary with effort and the fish-per-permit, a rough indicator of annual abundances, is variable but steady. The public has expressed concern about aggressive fishing and possible overharvest in the Hoktaheen subsistence and personal use fisheries (Conitz and Cartwright 2002).



	1985	1986	1987	1988	1989	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999	2000	2001	2002	2003	2004	2005
Sockeye				20	365	92	457	522	542	848	1097	893	1720	1185	1021	215	740	1207	1020	1699	524
Permits				1	12	5	15	19	19	38	42	44	59	46	53	18	35	41	33	58	24
Fish/Permit				20	30	18	30	27	29	22	26	20	29	26	19	12	21	29	31	29	22

Figure 11. Subsistence/personal use effort and harvest of sockeye salmon at Hoktaheen from 1985 to 2005 as reported on permits returned to ADF&G. (from ADF&G, Division of Commercial Fisheries database, 2007)

The historical commercial harvests of sockeye salmon in Hoktaheen Cove decreased significantly (Spearman's rho rank correlation trend test, at $\rho = 0.05$; Conover 1980) from around 10,000 fish a year in years 1905 to 1910 to around 2,000 fish a year by 1927 (Rich and Ball 1933; Table 2). We don't know what the sockeye harvest was from then to statehood but less than 1,800 have been harvested since statehood and the last time Hoktaheen Cove was open to seining was in 1973 (Table 3). There have not been seine fisheries operating in the immediate vicinity of Hoktaheen Cove in recent years, but those at the mouth of Lisianski Inlet, in Icy Straits, and southward along the outside Chichagof Island coast may incidentally harvest some sockeye salmon returning to Hoktaheen Lake.

The sport harvest of sockeye salmon from Hoktaheen is unknown; the ADF&G, Division of Sport Fish Division's statewide harvest survey has received less than three responses a year from those fishing in the Hoktaheen area. However, the area around Hoktaheen Cove has become increasingly popular for sport fishing since the late 1980s (Conitz and Cartwright 2002).

Escapement surveys have only been done in a few years at Hoktaheen. These aerial surveys have been directed at indexing escapements of pink salmon and no surveys were flown in the 1980s and early 1990s. Recent counts have been in the hundreds and historical counts were in the thousands (Table 6).

OBJECTIVES

The project objectives for 2004 were:

1) Use an outlet weir/trap and mark-recapture methods to estimate the annual escapement of sockeye salmon into Neva and Pavlof Lakes such that the estimated coefficient of variation is less than 10%.

2) Use mark-recapture methods to index the number of sockeye spawning in Neva, Pavlof, and upper Hoktaheen Lake's main inlet streams, Neva Lake's beach spawning area, and upper Hoktaheen Lake's outlet stream such that the estimated coefficient of variation is less than 20%.

3) Estimate the age, length, and sex composition of the sockeye escapements into Neva, Pavlof, and Hoktaheen Lakes such that the estimated coefficient of variation is less than 10% for the principal age class.

4) Collect baseline data on the in-lake productivity of Neva, Pavlof, and Hoktaheen Lakes using established ADF&G limnological sampling procedures which may include zooplankton sampling and vertical temperature, dissolved oxygen, and light intensity profile measurements.

The project objective for 2005 was:

1) Use an outlet weir/trap and mark-recapture methods to estimate the annual escapement of sockeye salmon into Neva Lakes such that the estimated coefficient of variation is less than 10%.

METHODS

Sockeye Escapement Assessment

Neva 2004 and 2005

In 2004 and 2005, 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 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 2003b). In both 2002 and 2003, a non-project person pulled pickets on the weir during a peak passage days and the mark-recapture studies were needed to estimate the total escapement (Van Alen 2004 and 2005).

In 2004, independent mark-recapture studies were also done to index the abundance of sockeye spawning in Neva Lake's main inlet stream (MIS) and beach spawning "study" areas. Visual counts of sockeye in, and out, of the MIS and beach study areas were also made in conjunction with these mark-recapture trips. These survey counts and mark-recapture estimates might prove to be a good predictor of the total escapement but three or more years of paired observations are needed to develop expansion factors (Heinl et al. 2000).

Weir: Upstream migrating adult salmon, trout, and char were counted as they were passed upstream out of a trap mounted on the face of a weir installed across Neva Creek. The weir was placed about 80 meters downstream from the lake. The weir was operated continuously in 2004 from June 16 through October 13 and in 2005 from June 20 through September 25. The weir trap was checked for fish early each morning and checked at other times during the day and evening as needed to pass fish without delaying their upstream migration. Separate counts were kept for adult and jack sockeye and coho salmon. Jacks were identified by their visual appearance.

The weir 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 design specifications). Seven bipods were used to support the 16.5 m wide weir. Upstream migrating salmon, trout, and char were counted and sampled from a 152.5 x 244 x 244 cm (5 x 8 x 8 ft), bear proof, trap attached to the front of the weir. 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 in the side of the trap and into quiet water created with a short sand bag and picket diversion. A plastic fish tub, 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 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.

Weir-to-Spawning Ground Mark-Recapture Escapement Estimate: The total escapement of sockeye salmon into Neva Lake was also estimated by marking fish at the

weir and sampling them for marks on the spawning grounds. In 2004, a running average of half (50%) of the adult and jack sockeye salmon counted through the weir each day were marked with an adipose fin clip and either a left axillary clip for the first third of the run, a left ventral clip for the middle third of the run, or a dorsal clip for the last third of the run. The dates for each third of the run were approximated as start-of-run to July 24, July 25 to August 12, and August 13 to end-of-run based on the average thirds of the 2002 and 2003 weir counts. These finclips involved severing the entire adipose fin, the entire 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'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.

In 2004, eight recapture "trips" on 14 different days were then made between August 11 and October 15 to examine sockeye salmon for marks in the MIS and beach spawning areas. Fish were captured in the MIS using dip nets and in the beach study areas with a 21 m long by 3.66 m deep beach seine with 3.81 cm square mesh of No. 9 knotted Nylon web. Hand punches were used to give an opercule mark to all fish examined so fish were only sampled once (i.e., sampled without replacement). The opercule marking was also part of a separate "spawning area mark-recapture" study that I describe in the next section. Again, counts were kept of the number of adult and jack sockeye salmon marked and examined for marks.

Partially stratified maximum likelihood Darroch estimates, and standard errors, were calculated with the Stratified Population Analysis System (SPAS) freeware (Arnason et al. 1995). The SPAS program also computes Darroch, Schaefer, and Pooled Peterson estimates as described in Seber (1982). The Darroch model is probably the best estimator for this type of 2-sample mark-recapture data that is stratified by both date of marking and location and date of recapture (Schaefer 1951; Seber 1982). The Darroch model provides abundance estimates for the MIS and beach recovery strata when the number of recovery strata is less than or equal to the three release strata. When the number of recovery strata exceed the number of release strata only the number in each release strata are estimated. 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 will probably be less than for the pooled Peterson estimator and the use of the Darroch model is indicated. The chi-square test statistic was used to test the hypothesis of equal probability of marked fish when pooling recovery strata (Bernard and Hansen 1992). Separate analyses were completed for adults, jacks, and adults and jacks combined. I used different combinations of pooled or dropped release strata, and comparisons with Schaefer, pooled Peterson, and independent Jolly-Seber estimates (see "Stream and Beach Mark-Recapture Escapement Indexing" section below) to examine the robustness of the Darroch abundance estimates.

In 2005, the weir-to-above-weir mark-recapture study was done specifically to validate the accuracy of the weir count. A full recapture effort would only be done 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 an 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. Plans were to finclip a running average of 25% of the adult and jack sockeye salmon passed through the weir and the weir operators succeeded in marking 22% of the adults and 28% of the jacks. All marked fish were given an adipose finclip and a left axillary, left ventral, or dorsal clip for each predicted third of the run. The middle third was July 29 to August 13 based on the 2002, 2003, and 2004 weir counts.

Stream and Beach Mark-Recapture Escapement Indexing - 2004: Mark and recapture trips were made to index jack and adult sockeye salmon in both the MIS and the beach "study" areas. The stream "study area" was between the lake and 58°24.561' N, 135°23.967' W. All the sockeye observed in the MIS stayed within the study area except for a few that eventually moved into two small side tributaries when water levels increased late in the season (Figure 12). The stream gradient is steeper and boulders and bedrock dominate the substrate upstream from the study area. The beach study area included two small (one set) beach spawning areas on the Southeast side of the lake between about 58°23.981' N, 135°24.246' W and 58°23.949' N, 135°24.348' W. We assume that the sockeye spawning in the MIS and beach study areas are separate populations given their geographic and temporal separation. In 2002, there were no sockeye salmon that were marked in the MIS and recovered in the beach study area or marked on the beach and recovered in the MIS (Van Alen 2004). In 2003, there was one fish that was marked at the beach and recovered in the MIS (Van Alen 2005).

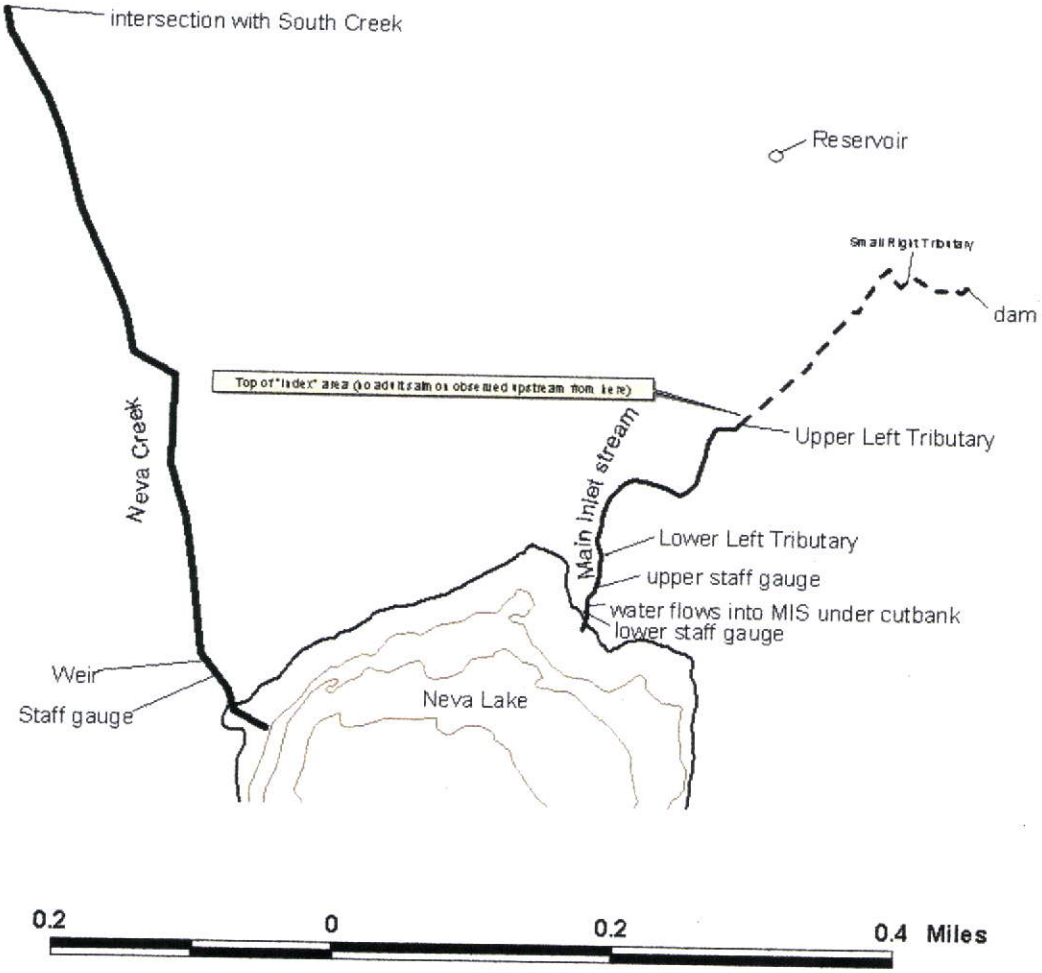


Figure 12. Map of the North end of Neva Lake showing the main inlet stream and Neva Creek.

All sockeye captured on both the marking (day 1) and recapture (day 2) days were given that trip's mark – a left opercule punch unique for that trip. Round, square, heart, rectangle, and triangle punch shapes were used. All sockeye captured on the day 2 were also given that trip's right opercule punch to facilitate sampling without replacement. Records were kept, for jacks and adults, of the number of sockeye salmon with and without opercule marks. A key to guide this sampling procedure was printed on the back of the data form (Figure 13).

Key to Spawning Mark-Recapture Sampling:

On Day One:

IF	Then	and Record
fish has the current trip's left opercule punch	Disregard	nothing
fish has no left opercule punch	mark with the current trip's left opercule punch	"New (no opercule mark)"
fish has only left opercule punch(es) from earlier trip(s)	mark with the current trip's left opercule punch	recapture in appropriate column

On Day Two:

IF	Then	and Record
fish has the current trip's right opercule punch	Disregard	nothing
fish has no left opercule punch	mark with the current trip's left **and** right opercule punch	"New (no opercule mark)"
fish has only left opercule punch(es) from earlier trip(s)	mark with the current trip's left **and** right opercule punch	recapture in appropriate column
fish has current trip's left opercule punch w/ or w/o punch(es) from earlier trip(s)	mark with the current trip's right opercule punch	recapture of current trips mark

Figure 13. Key to spawning area mark-recapture sampling procedures.

All sampling was done without replacement by disregarding a fish with that trips left opercule punch on day 1 and disregarding a fish with that trips right opercule punch on day 2. Data for both the "Weir Mark-Recapture" and "Spawning Mark-Recapture" sampling was recorded on the same data form (see Appendix A in Van Alen 2005).

A two-sample Peterson estimate was calculated for each trip and used in a modified Jolly-Seber (Schwarz et al. 1993) estimator for multiple mark-recaptures in an open population (J. Blick, ADF&G, personal communication 1998; Cook 1998; Crabtree 2001; Conitz and Cartwright 2003a). The "Blick-modified" Jolly-Seber estimator requires three or more recovery events and recaptures of fish marked from an earlier trip (Seber 1982). The notation and formulas used to calculate the Blick-modified Jolly-Seber estimates are provided in the column headings of Table 12 and the parametric bootstrap method used to calculate standard errors is detailed in Conitz and Cartwright (2005).

Visual Survey Counts: Foot and boat surveys were conducted in conjunction with the MIS and beach mark-recapture trips. Each observer had hand tally counters and kept their own counts of live sockeye salmon. In the MIS study area there were times when each observer counted live sockeye salmon when walking upstream and then when walking downstream. In the lake, each observer counted live sockeye salmon in, and out of, the beach study area from a skiff that was slowly motored around the perimeter of the

lake. Each observer's counts were recorded separately and when averaged they provide an estimate of what proportion of all the sockeye observed are in the study area(s). Separate counts were not made for adult and jack sockeye salmon.

Foot surveys were also done periodically through the summer to count the number of live sockeye and coho salmon in Neva Creek from the weir to the confluence with South Creek. We also kept counts of the number of coho salmon observed in the MIS and lake.

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). Approximately every seventh jack or adult sockeye salmon was systematically sampled through the course of the run. 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 length was measured to the nearest millimeter by laying each fish on a fixed ruler in a "measuring trough". 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).

After the scales were aged, the scale samples were stratified by age and week as described by Conitz and Cartwright (2003a). Let n be the total number of samples aged, nk be the number of samples in stratum k, and N be the estimated escapement. The proportion of each stratum k was calculated by

$$\hat{p}_k = \frac{n_k}{n} \tag{1}$$

The estimated standard error was derived from the binomial formula with correction for finite population size (Thompson 1992, p. 35-36):

$$SE(\hat{p}_k) = \sqrt{\left(1 - \frac{n}{N}\right)\frac{\hat{p}_k(1-\hat{p}_k)}{n-1}} \tag{2}$$

The estimated mean length and associated standard error for stratum k were calculated as the sample mean of a simple random sample (Thompson 1992, p. 42-43):

$$\bar{y}_k = \frac{1}{n_k}\sum_{i=1}^{n_k} y_{ki} \text{, and } SE(\bar{y}_k) = \sqrt{\frac{1}{n_k}}\sqrt{\left(\frac{1}{n_k - 1}\right)\sum_{i=1}^{n_k}(y_{ki} - \bar{y}_i)^2} \tag{3}$$

Harvest Monitoring: In 2004 and 2005, the operators of the Neva weir monitored the subsistence/personal use and sport fishing effort and harvest in the Neva Creek and South Creek area. The weir operators travel route to and from the weir site, two or more times a

day, enabled routine monitoring of fishing activities in and off the mouth of South Creek. The weir operators made an effort to get harvest and effort information by speaking directly with all individuals or groups observed fishing in the area. Fishing activities in Neva Creek were monitored during routine foot surveys of the creek (see the "Visual Survey Counts" section above) and by occasional visits to the traditional fishing site in the lower part of the creek. Basic harvest, and effort data was recorded on a daily data form (see Appendix A.3. in Van Alen 2005).

Pavlof 2004

The original project plan was to index the annual escapement of Pavlof sockeye salmon by marking and recapturing them on the spawning grounds. Plans were expanded in 2002, 2003, and 2004 to also estimate the total escapement by marking fish as they enter the lake through a trap installed at the top the existing fishpass and recapturing them on the spawning grounds. We assumed that sockeye migrate into Pavlof Lake both up the fish ladder and up the falls so the trap count was not anticipated to be the total escapement estimate.

Year 2004 was the third season of fishery technician work for the Hoonah Indian Association crew working at Pavlof Lake. Project activities focused on camp and field safety and procedures, how to capture, handle, and sample fish, and record keeping. The crew lived in a floating wall tent anchored near the outlet of Pavlof Lake (see Appendix B of Van Alen 2004 for the technical design specifications).

Trap-to-Spawning Ground Mark-Recapture Estimate: Upstream migrating salmon were captured and counted as they were passed upstream of a trap installed at the top of the outlet fishpass. Separate counts were made for adults and jacks in 2004. All trapped sockeye (and coho) salmon were marked with an adipose fin clip. The trap was in place from June 23 to August 22, 2004.

The aluminum channel and picket trap design was the same as used at the Neva weir. Salmon that ascended the fish pass were led through a "V" channel and picket entrance into the trap. The trap and V-entrance were on bedrock and sand bags were placed end-to-end around the outside of both.

The crew did boat surveys around the lake and foot surveys up the main inlet stream in 2002, 2003, and 2004 and only found sockeye spawning in the lower part of the main inlet stream. The lower approximately 300 meters of the main inlet stream, and fish schooled immediately off the mouth of the MIS, was designated the MIS study area again this season. The upper end of the study area was at 57°50.468' N, 135°03.211' where there was a logjam extending across the river. A few sockeye salmon were observed immediately upstream of the MIS study area but the highest concentration of fish was clearly within the study area. The left fork of the main inlet stream was included in the MIS study area but the stream level was only high enough to flow this way on one survey trip in 2003.

In 2004, five, two-day, mark-recapture, trips were done between July 21 and August 12 to examine sockeye salmon for marks in the MIS study area. A 21 m long by 3.66 m deep beach seine with 3.81 cm square mesh and No. 9 knotted Nylon web was used to catch the sockeye salmon in a sequence of sets from upstream to downstream. Hand punches were used to give an opercule mark to all fish examined as part of the "Stream Mark-Recapture Escapement Indexing" study (see below). These opercule marks enabled us to "sample without replacement". A simple Peterson model was used to estimate the total escapement.

Stream Mark-Recapture Escapement Indexing: "Stream mark and recapture" trips were done in conjunction with the "trap to spawning ground" mark and recapture trips described above. Thus, five, two-day, mark-recapture trips were done in the MIS study area between July 21 and August 12.

All sockeye captured on both the marking (day 1) and recapture (day 2) days were given a unique opercule punch for that "trip". All sockeye captured on the day 2 were also given an opercule punch. Records were kept of the number of new fish marked on both days and the number of day 1 recaptures on day 2. All sampling was done without replacement by disregarding a fish with that trips' left opercule punch on day 1 and disregarding a fish with that trips' right opercule punch on day 2. I used the modified Jolly-Seber method described for Neva Lake to estimate the total number of sockeye spawning in the MIS study area.

Visual Survey Counts: Foot surveys were conducted in conjunction with the MIS mark-recapture indexing trips. In 2004, counts of the number of live sockeye salmon in the MIS study area were made on July 19, 21, and 30 and August 6, 11, 12, and 19. Each observer made their own counts during two passes of the MIS study area - one walking upstream and one walking downstream. Sockeye were schooled off the mouth of the MIS in July but we were unable to count them due to poor water clarity, glare, and the way they moved in and out of view. No attempt was made to count sockeye salmon outside of the MIS study area since no sockeye were observed spawning anywhere in the lake or lake outlet and it took too much time to count the few sockeye spawning upstream of the study reach.

Age, Sex, and Length Sampling: Adult sockeye salmon were sampled at the trap for age (scales), sex, and length data. The sampling plan called for the crew to sample every third sockeye salmon they passed upstream of the trap. Sampling, processing, and analysis procedures were the same as described above for the Neva Lake samples.

Hoktaheen 2004

Field studies in 2001 (Conitz and Cartwright 2002) and 2002 and 2003 (Van Alen 2004 and 2005) found sockeye spawning in an inlet stream on the East side of the upper (larger) lake (58°03.379' N, 136°30.973' W) and in the upper section of the stream that connects the two lakes. Spawning was observed in the inlet stream the first three weeks

in September and in the outlet stream the last two weeks in September. Based on this information we planned our fieldwork in 2004 for the month of September.

Stream Mark-Recapture Escapement Indexing: Project personnel camped at upper Hoktaheen Lake from September 3 to 28, 2004. They completed five, two-day, mark-recapture "trips" to the upper Hoktaheen Lake's MIS "study area" (this stream flows into the north west side of the lake) and four, two-day, mark-recapture trips to the "study area" in the upper third of the stream that connects the upper and lower lakes. The MIS study area included sockeye schooling immediately off the mouth of the stream and extended upstream to a bedrock section of the stream at 58°03.897' N, 136°30.951' W. Few sockeye were observed spawning above this MIS study area. The study area in the outlet stream extended from the outlet of the upper lake at 58°03.370' N, 136°30.939' W downstream about 0.2 km. Again few sockeye salmon were observed spawning downstream from the study area. Dip nets were used to capture sockeye salmon in the MIS and a 21 m long by 3.66 m deep beach seine with 3.81 cm square mesh of No. 9 knotted Nylon web was used to capture sockeye off the mouth of the MIS and in the outlet stream.

All sockeye captured on both the marking and recapture days were marked on the left opercule with that trip's uniquely shaped hole punch (round, square, triangle, heart, tree). All sockeye captured during the recapture day(s) were also given that trip's right opercule punch. Records were kept of the number of new fish marked on both days, the number of day 1 recaptures on day 2, and the number of recaptures from earlier trips. All sampling was done without replacement by disregarding a fish with that trip's mark on the marking day and disregarding a fish with that trip's right opercule punch on the recapture day(s).

Simple Peterson estimates were calculated for each day that fish were examined for marks. The abundance of sockeye salmon was estimated on September 4, 8, 13, 18, and 23 in the MIS study area and on September 15, 19, 24, and 28 in the outlet study area.

Visual Survey Counts: Foot and boat surveys were conducted in conjunction with the mark-recapture indexing trips. Counting procedures were the same as those used at Neva Lake.

Age, Sex, and Length Sampling: Adult sockeye salmon were sampled for age (scales), sex, and length data from both the MIS and outlet study areas. The sampling, processing, and analysis procedures were the same as described above for the Neva Lake samples.

Limnology Sampling

In 2004, limnology sampling was done four times in Neva and Pavlof Lakes and twice in Hoktaheen Lake (Table 7).

Table 7. Limnology sampling dates in Neva, Pavlof, and Hoktaheen Lakes, 2004.

Neva Lake	Pavlof Lake	Hoktaheen Lake
6/16	6/16	9/5
7/24	7/24	9/27
8/29	8/29	
10/12	10/12	

Two buoy and anchor sampling stations, "Station A" and "Station B", were setup over the deepest part of each lake (Table 8). Zooplankton samples were taken at both stations and physical data at Station A.

Table 8. Latitude and longitude coordinates for the limnological sampling stations in Neva, Pavlof, and Hoktaheen Lakes, 2002, 2003, and 2004.

Lake	Station A	Station B
Neva	58°24.219' N, 135°24.258' W	58°24.270' N, 135°24.290' W
Pavlof	57°50.605' N, 135°02.672' W	57°50.629' N, 135°02.921' W
Hoktaheen	58°03.236' N, 136°30.381' W	58°03.292' N, 136°30.630' W

Light, Temperature, and Dissolved Oxygen Profiles

The subsurface light intensity was measured at 0.5-meter intervals from just below (5 cm) the surface down to one percent of the surface light reading using a Licor LI-250 submarine photometer. Readings were in µmol s-1 m-2. The vertical light extinction coefficient (Kd) and euphotic zone depth (EZD) was calculated following procedures described by Conitz and Cartwright (2002a). The vertical light extinction coefficient (Kd) was calculated as the slope of the light intensity (natural log of percent subsurface light) versus depth. The euphotic zone depth (EZD) was calculated as EZD = 4.6205/Kd and is defined as the part of the lake where photosynthesis is possible. Water transparency was also measured with a 20 cm diameter Secchi disk (Koenings et al. 1987).

All vertical temperature and dissolved oxygen (DO) measurements were made with a Yellow Springs Instruments Model 58 DO meter and probe. The Model 58 DO meter was calibrated each trip by taking the average value of two 30 ml Winker titrations from a water sample collected at 1 m (Koenings et al. 1987). Readings were taken at one-meter intervals down to 20 meters then at five-meter intervals to within 2 m of the bottom or 50 meters, whichever is less. Dissolved oxygen (DO) readings were in mg L-1 and temperature readings were in °C. The mg L-1 DO readings were converted to percent O_2 saturation using the following formula:

$$\%O_2 saturation = (DO/(0.004399 * temp^2 - 0.381784 + 14.571252)) * 100 \qquad (4)$$

The parameters in this equation were computed from data presented in Table 6.1 of Wetzel and Likens (2000). This regression of the solubility of O_2 on temperature had a

correlation coefficient of 0.9998. No adjustment was made for altitude (barometric pressure) since Neva, Pavlof, and Hoktaheen Lakes are all at relatively low elevations of 44, 5, and 51 meters, respectively.

Zooplankton Composition and Density

A vertical zooplankton tow was made at both stations each trip. A 0.5 m diameter, 153 um mesh, 1:3 conical net was used. Vertical tows were pulled from 2 m from the bottom of the lake at 0.5 m/sec. Specimens were preserved in neutralized 10% formalin (Koenings et al. 1987). Zooplankton samples were analyzed at the ADF&G Commercial Fisheries Division Limnology Laboratory in Soldotna, Alaska. The identification to genus or species, enumeration, and density and biomass estimates were done as described by Conitz et al. 2002 and Koenings et al. 1987). The zooplankton density (individuals per m^2 surface area) and biomass (weight per m^2 surface area) were estimated by species and by the sum of all species (referred to as total zooplankton density or biomass).

RESULTS

Sockeye Escapement Assessment

Neva 2004

Weir and Weir-based Mark-Recapture Estimate of Total Escapement: In 2004, the adult salmon weir was operated continuously on the outlet of Neva Lake from June 16 to October 13 (Table 9). The weir count totaled 9,513 sockeye salmon – 9,229 adults and 284 jacks. The first sockeye passed on June 21 and there were still a few sockeye passing on October 13. Counts of other species totaled 831 coho salmon (including 100 jacks), 36 pink salmon, 2 chum salmon, 5 cutthroat trout, and 96 Dolly Varden char.

Project personnel succeeded in finclipping a running average of 50% of the adult and 49% of the jack sockeye passed upstream of the weir as part of a weir-to-spawning area mark-recapture estimate of the total escapement past the weir (Table 9). The sockeye were marked with an adipose clip and either a left axillary finclips, a left ventral finclip, or a dorsal finclip for each of three release strata – June 16 to July 24, July 25 to August 12, and August 13 to October 17. The dates for these release strata were based on the approximate thirds of the run observed in 2002 and 2003. Adult and jack sockeye salmon were sampled for the proportion of marked fish in the main inlet stream on 10 different days and in beach spawning areas on four different days. Using the SPAS program (Arnason et al. 1996), either one or both of the tests for complete mixing or equal proportions were not significant ($\alpha < 0.05$) for the stratified Darroch abundance estimates of adult, jack, and adult+jack sockeye salmon (Table 10). This suggests that the Pooled Peterson estimator is appropriate (Arnason et al. 1995). The pooled Peterson estimate of the escapement of adult sockeye salmon was 9,239 (CV=3%) which was only 10 fish greater than the weir count. There was a greater difference in the weir counts and Pooled

Peterson estimates of jack sockeye salmon, 284 versus 408 (CV=16%), respectively, but too few were recaptured (a total of 20) to know if jacks were actually undercounted at the weir. Given the relatively small number of jacks, <4.3% of the escapement, and the high variability around the estimate of jacks, I am comfortable using the weir count of 9,513 as the estimate the total sockeye escapement in 2004. Weir operations went smoothly in 2004 and there were no instances when salmon were suspected to have passed through the weir uncounted. No fresh dead (pre-spawn) salmon were observed on the face of the weir or anywhere upstream and there was no indication of any handling mortality associated with the counting, marking, and sampling of fish at the weir.

In this final report covering project results from 2002 to 2005, I seek to report the best estimates of the daily and total number of sockeye salmon that escaped into Neva Lake each year. The weir was not operated through the entire run in all years so I filled-in for missing weir counts using linear interpolation and the EM algorithm (McLachlan and Krishnan 1997) between the earliest date of weir operation (June 4, 2002 and 2003) and the latest date of weir operation (October 13, 2004; Table 11). In 2002 (Van Alen 2004) and 2003 (Van Alen 2005), I estimated the total in-lake escapement with the weir to above-weir mark-recapture study since a non-project person, or persons, had pulled pickets each year on a day when there was a high abundance of fish at the weir. In 2004, no fish were estimated to have passed before the weir was operational on June 16 (since no sockeye were counted in the first five days of weir operation), or through the weir uncounted, and the daily and total weir counts serve as the best estimates of daily and total escapements (Table 11). The midpoint of the sockeye escapement in 2004 was August 11. The middle 80% of the sockeye escapement was between July 25 and September 14.

Table 9. Weather and stream measurements and daily numbers of fish counted and finclipped at the Neva Creek weir, 2004.

	Weather and Stream Measurements:[a]					Sockeye Counted:				Sockeye Finclipped:					Number of Other Species Counted:						
Date	Weather	Water Level (cm)	Thermometer Water Temp (°C)	Air Temp (°C)	Data Logger Water Temp (oC)	Adults	Jacks	Total	Cum	Finclip Used (Adipose +)	Adults	Cum. % Adults Clipped	Jacks	Cum. % Jacks Clipped	Adult Coho	Jack Coho	Total Coho	Pink	Chum	Cutthroat	Dolly Varden
6/16						0	0	0	0.00		0		0								
6/17	Clear	25.5	16.0	12.5		0	0	0	0.00		0		0								
6/18	Clear	25.5	16.0	14.0		0	0	0	0.00		0		0								
6/19	Clear	24.0	18.5	17.0		0	0	0	0.00		0		0								
6/20	Clear	21.5	19.0	15.0		0	0	0	0.00		0		0								
6/21	Clear	20.0	19.0	14.0		22	0	22	0.00	Left Axillary	10	45%	0								
6/22	Clear	19.5	18.5	12.0		0	0	0	0.00		0	45%	0								
6/23	Clear	19.5	19.0	13.0		0	0	0	0.00		0	45%	0								
6/24	Clear	21.5	19.0	14.0		0	0	0	0.00		0	45%	0								
6/25	Clear	20.0	19.0	14.0		147	2	149	0.02	Left Axillary	75	50%	2								
6/26	Partly Cloudy	19.5	19.5	13.0		17	0	17	0.02	Left Axillary	8	50%	0								
6/27	Overcast	19.5	19.0	12.5		22	0	22	0.02	Left Axillary	11	50%	0								
6/28	Overcast	19.0	19.0	13.0		39	1	40	0.03	Left Axillary	20	50%	0								
6/29	Overcast	18.5	18.5	13.0		1	0	1	0.03		0	50%	0								
6/30	Overcast	18.0	18.0	12.5		4	0	4	0.03	Left Axillary	4	51%	0								
7/1	Showers	17.5	18.0	13.0		4	0	4	0.03		0	50%	0								
7/2	Showers	17.5	17.5	13.0		0	0	0	0.03		0	50%	0								
7/3	Showers	17.0	18.0	14.5		77	0	77	0.04	Left Axillary	37	50%	0								
7/4	Overcast	17.0	18.0	14.0		221	4	225	0.06	Left Axillary	110	50%	0							1	
7/5	Showers	16.5	17.0	12.5		87	2	89	0.07	Left Axillary	44	50%	0								
7/6	Partly Cloudy	16.5	17.0	12.0		62	1	63	0.07	Left Axillary	34	50%	0								
7/7	Partly Cloudy	16.0	18.0	13.5		2	0	2	0.08		0	50%	0								
7/8	Clear	15.5	17.5	13.0		0	0	0	0.08		0	50%	0								
7/9	Overcast	15.0	18.0	12.0		0	0	0	0.08		0	50%	0								
7/10	Rain	14.5	18.0	13.0		0	0	0	0.08		0	50%	0								
7/11	Overcast	14.5	18.0	14.0		0	0	0	0.08		0	50%	0								
7/12	Partly Cloudy	14.0	18.0	13.0		0	0	0	0.08		0	50%	0								
7/13	Partly Cloudy	13.5	18.0	13.5		0	0	0	0.08		0	50%	0								
7/14	Clear	13.5	18.5	13.0		0	0	0	0.08		0	50%	0	20%							
7/15	Clear	13.0	19.0	14.5		0	0	0	0.08		0	50%	0	20%							
7/16	Clear	13.0	19.5	14.5		0	0	0	0.08		0	50%	0	20%							

(continued)

Table 9. (page 2 of 4)

	Weather and Stream Measurements:[a]					Sockeye Counted:				Sockeye Finclipped:					Number of Other Species Counted:						
Date	Weather	Water Level (cm)	Thermometer Water Temp (°C)	Air Temp (°C)	Data Logger Water Temp (oC)	Adults	Jacks	Total	Cum	Finclip Used (Adipose +)	Adults	Cum. % Adults Clipped	Jacks	Cum. % Jacks Clipped	Adult Coho	Jack Coho	Total Coho	Pink	Chum	Cutthroat	Dolly Varden
7/17	Overcast	12.5	19.5	13.5		0	0	0	0.08		0	50%	0	20%							
7/18	Partly Cloudy	12.5	19.5	14.0		0	0	0	0.08		0	50%	0	20%							
7/19	Partly Cloudy	12.0	18.5	13.5		0	1	1	0.08	Left Axillary	0	50%	1	27%							
7/20	Partly Cloudy	12.0	19.0	15.0		0	0	0	0.08		0	50%	0	27%							
7/21	Showers	12.0	19.0	15.0		0	0	0	0.08		0	50%	0	27%							
7/22	Overcast	12.0	19.0	14.5		0	2	2	0.08	Left Axillary	0	50%	2	38%							
7/23	Partly Cloudy	12.0	19.0	14.0		0	0	0	0.08		0	50%	0	38%							
7/24	Showers	12.0	19.0	14.0		0	3	3	0.08	Left Axillary	0	50%	3	50%							1
7/25	Showers	12.5	19.0	13.5		448	26	474	0.13	Left Ventral	225	50%	16	57%							
7/26	Showers	12.5	18.0	14.0		105	6	111	0.14	Left Ventral	51	50%	2	54%							1
7/27	Rain	12.0	18.5	14.5		23	1	24	0.14	Left Ventral	11	50%	0	53%							34
7/28	Showers	15.5	18.5	14.5		1383	19	1402	0.29	Left Ventral	691	50%	6	47%							
7/29	Showers	16.0	18.0	13.0		254	2	256	0.31	Left Ventral	128	50%	0	46%							1
7/30	Showers	15.5	18.0	12.0		198	1	199	0.34	Left Ventral	96	50%	1	46%							
7/31	Partly Cloudy	15.0	18.0	14.0		57	3	60	0.34	Left Ventral	32	50%	2	47%							
8/1	Showers	14.0	18.0	13.0		33	1	34	0.34	Left Ventral	17	50%	0	47%							
8/2	Showers	14.0	17.5	13.0		28	1	29	0.35	Left Ventral	15	50%	1	47%							
8/3	Showers	14.0	17.5	13.0		20	1	21	0.35	Left Ventral	8	50%	1	48%							
8/4	Partly Cloudy	13.5	17.5	12.5		4	1	5	0.35	Left Ventral	2	50%	1	49%							
8/5	Partly Cloudy	13.5	17.5	12.0		39	5	44	0.36	Left Ventral	20	50%	4	51%							
8/6	Partly Cloudy	13.0	18.0	14.5		24	5	29	0.36	Left Ventral	12	50%	2	50%							
8/7	Partly Cloudy	12.5	18.0	15.0		6	1	7	0.36	Left Ventral	3	50%	0	49%							
8/8	Clear	13.0	18.5	15.0		0	0	0	0.36		0	50%	0	49%							
8/9	Clear	12.5	18.5	14.0		1	0	1	0.36	Left Ventral	1	50%	0	49%							
8/10	Overcast	12.0	19.0	14.5		504	18	522	0.41	Left Ventral	250	50%	9	50%				1			
8/11	Partly Cloudy	13.0	19.0	14.0		1619	14	1633	0.59	Left Ventral	811	50%	8	50%				1			
8/12	Partly Cloudy	13.0	18.5	13.0		194	3	197	0.61	Left Ventral	97	50%	1	50%							
8/13	Clear	12.0	18.5	13.0		185	13	198	0.63	Dorsal	93	50%	6	50%							
8/14		12.0	18.5	12.0		94	1	95	0.64	Dorsal	41	50%	1	50%							
8/15	Clear	11.5	19.0	16.0		25	1	26	0.64	Dorsal	19	50%	0	50%							

(continued)

Table 9. (page 3 of 4)

	Weather and Stream Measurements:[a]					Sockeye Counted:				Sockeye Finclipped:					Number of Other Species Counted:						
Date	Weather	Water Level (cm)	Thermometer Water Temp (°C)	Air Temp (°C)	Data Logger Water Temp (oC)	Adults	Jacks	Total	Cum	Finclip Used (Adipose +)	Adults	Cum. % Adults Clipped	Jacks	Cum. % Jacks Clipped	Adult Coho	Jack Coho	Total Coho	Pink	Chum	Cutthroat	Dolly Varden
8/16	Clear	11.0	19.5	16.0		20	4	24	0.64	Dorsal	15	50%	4	51%				1			
8/17	Clear	11.0	19.5	15.0		38	3	41	0.65	Dorsal	9	50%	1	51%							
8/18	Overcast	10.5	19.5	15.5		48	5	53	0.65	Dorsal	25	50%	1	50%							
8/19	Showers	10.5	19.5	15.0		15	1	16	0.65	Dorsal	9	50%	1	50%							
8/20	Overcast	11.0	19.0	15.0		60	4	64	0.66	Dorsal	29	50%	3	51%							
8/21	Partly Cloudy	11.0	19.5	15.5		3	1	4	0.66	Dorsal	3	50%	0	50%							
8/22	Clear	10.5	19.5	15.5		21	4	25	0.66	Dorsal	13	50%	1	50%							
8/23	Clear	10.5	18.0	10.0		9	2	11	0.66	Dorsal	4	50%	2	50%							
8/24	Clear	10.0	18.0	10.0		5	0	5	0.67		0	50%	0	50%							
8/25	Overcast	10.0	18.0	12.0		2	0	2	0.67	Dorsal	2	50%	0	50%							
8/26	Showers	9.5	18.0	14.0		0	2	2	0.67		0	50%	0	50%							
8/27	Showers	11.0	18.0	13.0		361	18	379	0.71	Dorsal	180	50%	12	51%	1		1				
8/28	Showers	11.5	18.0	12.0		128	5	133	0.72	Dorsal	64	50%	2	51%				1			
8/29	Overcast	11.5	18.0	12.5		29	1	30	0.72	Dorsal	20	50%	1	51%							
8/30	Partly Cloudy	11.5	17.0	10.5		10	0	10	0.72		0	50%	0	51%							
8/31	Clear	11.0	17.0	19.0		8	1	9	0.72	Dorsal	5	50%	0	51%							
9/1	Partly Cloudy	11.0	17.0	9.0		2	0	2	0.73		0	50%	0	51%							
9/2	Rain	10.5	17.0	12.0		0	0	0	0.73		0	50%	0	51%							
9/3	Rain	12.5	16.5	11.5		338	10	348	0.76	Dorsal	169	50%	4	51%		1	1	6		1	
9/4	Overcast	14.0	17.0	11.0		324	10	334	0.80	Dorsal	162	50%	3	50%	4	1	5	1			
9/5	Showers	14.0	16.5	10.0		97	7	104	0.81	Dorsal	51	50%	4	50%		3	3	1			
9/6	Rain	14.5	16.0	10.0		81	0	81	0.82	Dorsal	40	50%	0	50%	2	2	4	1			
9/7	Clear	15.5	15.0	5.5		48	1	49	0.82	Dorsal	22	50%	1	50%		1	1				
9/8	Clear	14.5	14.5	10.0		37	0	37	0.83	Dorsal	20	50%	0	50%		3	3				
9/9	Clear	14.0	14.0	5.0		35	3	38	0.83	Dorsal	16	50%	2	50%		1	1				
9/10	Partly Cloudy	13.5	13.0	4.0		23	0	23	0.83	Dorsal	10	50%	0	50%							
9/11	Overcast	12.5	13.5	8.0		14	0	14	0.83	Dorsal	11	50%	0	50%							
9/12	Rain	13.5	13.5	9.0		67	5	72	0.84	Dorsal	33	50%	3	50%	3	1	4				
9/13	Rain	17.5	13.5	9.0		444	12	456	0.89	Dorsal	215	50%	5	50%	85	16	101	1			5
9/14	Overcast	20.0	14.0	8.0		257	5	262	0.92	Dorsal	134	50%	4	51%	130	8	138	1			2

(continued)

Table 9. (page 4 of 4)

	Weather and Stream Measurements:[a]					Sockeye Counted:				Sockeye Finclipped:					Number of Other Species Counted:						
Date	Weather	Water Level (cm)	Thermometer Water Temp (°C)	Air Temp (°C)	Data Logger Water Temp (oC)	Adults	Jacks	Total	Cum	Finclip Used (Adipose +)	Adults	Cum. % Adults Clipped	Jacks	Cum. % Jacks Clipped	Adult Coho	Jack Coho	Total Coho	Pink	Chum	Cutthroat	Dolly Varden
9/15	Showers	19.0	14.0	9.0		139	4	143	0.93	Dorsal	70	50%	0	50%	25	3	28	1			
9/16	Clear	18.5	13.0	5.5		47	4	51	0.94	Dorsal	27	50%	3	50%	18	6	24	1			1
9/17	Clear	17.5	13.0	6.5		61	0	61	0.94	Dorsal	27	50%	0	50%	11	1	12	3			3
9/18	Clear	16.5	12.5	5.0		21	6	27	0.95	Dorsal	13	50%	4	51%		1	1				
9/19	Clear	15.5	12.0	4.0		31	6	37	0.95	Dorsal	15	50%	1	50%	1	2	3	2			1
9/20	Rain	15.0	12.0	8.0		10	2	12	0.95	Dorsal	2	50%	1	50%	1		1	2			
9/21	Rain	19.0	12.0	10.0		105	2	107	0.96	Dorsal	53	50%	1	50%	19	6	25	7			
9/22	Rain	23.0	12.5	9.0		72	5	77	0.97	Dorsal	27	50%	2	50%	48	1	49	3			8
9/23	Rain	29.5	13.0	10.0		113	1	114	0.98	Dorsal	47	50%	0	49%	133	8	141	1			7
9/24	Showers	37.5	12.5	8.5		43	4	47	0.99	Dorsal	34	50%	2	49%	84	6	90				6
9/25	Overcast	40.0	12.0	6.0		13	1	14	0.99	Dorsal	10	50%	1	50%	32	5	37				1
9/26	Rain	38.5	12.0	9.0		6	0	6	0.99	Dorsal	5	50%	0	50%	16		16				2
9/27	Overcast	41.5	11.5	11.0		38	3	41	0.99	Dorsal	13	50%	0	49%	57	8	65	1			1
9/28	Overcast	40.5	11.0	8.0		3	0	3	0.99	Dorsal	3	50%	0	49%	8	2	10				
9/29	Showers	39.5	11.0	9.0		13	1	14	1.00	Dorsal	13	50%	1	49%	5	1	6				1
9/30	Rain	38.0	11.0	9.0		10	0	10	1.00	Dorsal	4	50%	0	49%	14	3	17				2
10/1	Showers	36.0	11.0	10.0		5	0	5	1.00	Dorsal	3	50%	0	49%	1	2	3				2
10/2	Overcast	36.5	11.0	10.0		4	0	4	1.00		0	50%	0	49%	4	1	5				
10/3	Overcast	35.0	11.0	9.0		0	0	0	1.00		0	50%	0	49%	4		4				
10/4	Showers	34.5	11.0	9.5		6	1	7	1.00	Dorsal	5	50%	1	49%	3	4	7			1	4
10/5	Overcast	39.0	10.5	10.0		4	0	4	1.00	Dorsal	2	50%	0	49%	10	1	11				2
10/6	Rain	40.5	10.5	7.5		3	0	3	1.00	Dorsal	1	50%	0	49%	6	1	7		2		4
10/7	Overcast	40.5	10.0	7.5		3	1	4	1.00	Dorsal	2	50%	0	49%	1		1			1	
10/8	Showers	39.0	10.0	7.0		0	0	0	1.00		0	50%	0	49%	1		1				2
10/9	Showers	38.0	10.0	8.0		0	0	0	1.00		0	50%	0	49%	1		1				2
10/10	Overcast	36.5	10.0	8.0		4	0	4	1.00	Dorsal	2	50%	0	49%							1
10/11	Partly Cloudy	35.0	10.0	4.5		0	0	0	1.00		0	50%	0	49%	1	1	2				
10/12	Rain	33.5	10.0	4.5		1	0	1	1.00	Dorsal	0	50%	0	49%						1	2
10/13	Overcast	35.5	10.0	9.0		1	0	1	1.00		0	50%	0	49%	2		2				
Totals						9,229	284	9,513			4,615		140		731	100	831	36	2	5	96

[a] Observations were made about 0900 hour.

Table 10. Mark and recapture data, and abundance estimates, for sockeye salmon marked at the Neva Creek weir, 2004.

Marking Data: At the Neva Creek weir:				Recapture Data: Main Inlet Stream						Beach				Darroch Abundance Estimate:				Pooled Peterson Estimate:	
Marking Dates	Finclip Strata	Weir Count	Number Marked	Aug. 11	Aug. 27-28	Sept. 8-9	Sept. 14-15	Sept. 22	Oct. 8 9	Oct. 10-11	Oct. 14 15	Total	% Recaptured	Number	S.E. (Number)	Prob. of Capture	S.E. (Prob. Capture)	Number	S.E. (Number)
Adults																			
				Number recaptured:										(Complete mixing Significance = 0.00, Equal prop. significance = 0.19)					
June 16 to July 24	Left Axillary	705	353	1	12	39	13	0	0	0	0	65	18%	1,261	289	0.28	0.06		
July 25 to Aug. 12	Left Ventral	4,940	2,470	0	7	119	59	30	2	71	63	351	14%	3,918	725	0.63	0.12		
Aug. 13 to Oct. 13	Dorsal	3,584	1,792	0	0	7	9	11	3	46	58	134	7%	4,186	798	0.43	0.08		
	Total	9,229	4,615	1	19	165	81	41	5	117	121	550		9,365	421			9,239	261
				Number examined for marks and Percent Marked:										(CV = 4%)				(CV = 3%)	
				5	45	341	177	69	14	215	236	1,102							
				20%	42%	48%	46%	59%	36%	54%	51%	50%							
Jacks																			
				Number recaptured:										Release stratas 1 and 2 pooled and recovery stratas 1-3 and 4-6 pooled:					
June 16 to July 24	Left Axillary	16	8	0	0	0	0	0	0	0	0	0	0%	(Complete mixing Significance = 0.13, Equal prop. significance = 0.05)					
July 25 to Aug. 12	Left Ventral	108	54	0	0	9	2	0	0	1	0	12	22%	254	64	0.24	0.06		
Aug. 13 to Oct. 13	Dorsal	160	78	0	0	0	1	0	0	2	5	8	10%	107	25	0.73	0.17		
	Total	284	140	0	0	9	3	0	0	3	5	20		360	60			408	65
				Number examined for marks and Percent Marked:										(CV = 17%)				(CV = 16%)	
				0	5	30	9	4	0	5	7	60							
					0%	30%	33%	0%		60%	71%	33%		Total adults and jacks from above 3x11 Darroch estimates:					
														9,725	425			9,647	269
														(CV = 4%)				(CV = 3%)	
Adults and Jacks Combined																			
				Number recaptured:										(Complete mixing Significance = 0.00, Equal prop. significance = 0.11)					
June 16 to July 24	Left Axillary	721	361	1	12	39	13	0	0	0	0	65	18%	1,353	307	0.27	0.06		
July 25 to Aug. 12	Left Ventral	5,048	2,524	0	7	128	61	30	2	72	63	363	14%	4,214	714	0.60	0.10		
Aug. 13 to Oct. 13	Dorsal	3,744	1,870	0	0	7	10	11	3	48	63	142	8%	4,113	761	0.45	0.08		
	Total	9,513	4,755	1	19	174	84	41	5	120	126	570		9,680	413			9,686	271
				Number examined for marks and Percent Marked:										(CV = 4%)				(CV = 3%)	
				5	50	371	186	73	14	220	243	1,162							
				20%	38%	47%	45%	56%	36%	55%	52%	49%							

Table 11. Estimated daily escapement of adult and jack sockeye salmon into Neva Lake, June 4 to October 13, 2002 to 2005.

	2002				2003				2004				2005				Average
Date	Adults	Jacks	Total	Cum. Prop.	Adults	Jacks	Total	Cum. Prop.	Adults	Jacks	Total	Cum. Prop.	Adults	Jacks	Total	Cum. Prop.	Cum. Prop.
6/4	0	0	0	0.000	0	0	0	0.000				0.000				0.000	0.000
6/5	0	0	0	0.000	0	0	0	0.000				0.000				0.000	0.000
6/6	0	0	0	0.000	0	0	0	0.000				0.000				0.000	0.000
6/7	0	0	0	0.000	0	0	0	0.000				0.000				0.000	0.000
6/8	0	0	0	0.000	0	0	0	0.000				0.000				0.000	0.000
6/9	0	0	0	0.000	0	0	0	0.000				0.000				0.000	0.000
6/10	1	0	1	0.000	0	0	0	0.000				0.000				0.000	0.000
6/11	0	0	0	0.000	0	0	0	0.000				0.000				0.000	0.000
6/12	0	0	0	0.000	0	0	0	0.000				0.000				0.000	0.000
6/13	0	0	0	0.000	0	0	0	0.000				0.000				0.000	0.000
6/14	0	0	0	0.000	0	0	0	0.000				0.000				0.000	0.000
6/15	0	0	0	0.000	0	0	0	0.000				0.000				0.000	0.000
6/16	0	0	0	0.000	0	0	0	0.000	0	0	0	0.000				0.000	0.000
6/17	1	0	1	0.000	0	0	0	0.000	0	0	0	0.000				0.000	0.000
6/18	2	0	2	0.001	0	0	0	0.000	0	0	0	0.000				0.000	0.000
6/19	0	0	0	0.001	0	0	0	0.000	0	0	0	0.000				0.000	0.000
6/20	1	0	1	0.001	0	0	0	0.000	0	0	0	0.000	0	0	0	0.000	0.000
6/21	0	0	0	0.001	0	0	0	0.000	22	0	22	0.002	0	0	0	0.000	0.001
6/22	1	0	1	0.001	1	0	1	0.000	0	0	0	0.002	0	0	0	0.000	0.001
6/23	1	0	1	0.001	4	1	5	0.001	0	0	0	0.002	0	0	0	0.000	0.001
6/24	0	0	0	0.001	0	0	0	0.001	0	0	0	0.002	0	0	0	0.000	0.001
6/25	0	0	0	0.001	5	1	6	0.001	147	2	149	0.018	0	0	0	0.000	0.005
6/26	1	0	1	0.002	2	0	2	0.001	17	0	17	0.020	48	1	49	0.009	0.008
6/27	62	0	62	0.014	0	0	0	0.001	22	0	22	0.022	18	0	18	0.013	0.013
6/28	35	0	35	0.021	0	0	0	0.001	39	1	40	0.026	26	1	27	0.018	0.017
6/29	0	0	0	0.021	4	2	6	0.002	1	0	1	0.026	42	2	44	0.026	0.019
6/30	31	0	31	0.027	1	1	2	0.002	4	0	4	0.027	61	5	66	0.039	0.024
7/1	188	0	188	0.065	0	0	0	0.002	4	0	4	0.027	32	2	34	0.045	0.035
7/2	333	7	340	0.133	15	11	26	0.004	0	0	0	0.027	29	2	31	0.051	0.054
7/3				0.174	29	14	43	0.008	77	0	77	0.035	56	4	60	0.063	0.070
7/4	28	0	28	0.180	63	36	99	0.017	221	4	225	0.059	18	5	23	0.067	0.081
7/5	83	1	84	0.196	21	11	32	0.019	87	2	89	0.068	0	0	0	0.067	0.088
7/6	12	0	12	0.199	2	4	6	0.020	62	1	63	0.075	0	0	0	0.067	0.090
7/7	11	3	14	0.201	0	3	3	0.020	2	0	2	0.075	18	0	18	0.070	0.092
7/8	8	0	8	0.203	0	0	0	0.020	0	0	0	0.075	0	0	0	0.070	0.092
7/9	18	3	21	0.207	0	0	0	0.020	0	0	0	0.075	22	5	27	0.075	0.095
7/10	8	0	8	0.209	0	0	0	0.020	0	0	0	0.075	6	3	9	0.077	0.095
7/11	11	0	11	0.211	0	0	0	0.020	0	0	0	0.075	1	1	2	0.078	0.096
7/12	9	2	11	0.213	0	0	0	0.020	0	0	0	0.075	60	5	65	0.090	0.100
7/13	0	4	4	0.214	0	0	0	0.020	0	0	0	0.075	4	0	4	0.091	0.100
7/14	28	9	37	0.221	8	11	19	0.022	0	0	0	0.075	2	0	2	0.091	0.102
7/15	22	18	40	0.229	1	2	3	0.022	0	0	0	0.075	2	0	2	0.091	0.105
7/16	11	10	21	0.234	0	0	0	0.022	0	0	0	0.075	0	0	0	0.091	0.106
7/17	4	6	10	0.236	0	0	0	0.022	0	0	0	0.075	1165	20	1185	0.317	0.162
7/18	28	15	43	0.244	359	137	496	0.066	0	0	0	0.075	87	18	105	0.337	0.180
7/19	35	17	52	0.255	225	136	361	0.097	0	1	1	0.075	74	14	88	0.353	0.195
7/20	1	4	5	0.256	21	24	45	0.101	0	0	0	0.075	58	3	61	0.365	0.199
7/21	0	2	2	0.256	914	221	1135	0.201	0	0	0	0.075	49	0	49	0.374	0.227
7/22	13	18	31	0.262	61	31	92	0.209	0	2	2	0.075	6	1	7	0.375	0.231
7/23	1	3	4	0.263	3	4	7	0.210	0	0	0	0.075	0	0	0	0.375	0.231
7/24	190	49	239	0.311	0	0	0	0.210	0	3	3	0.076	10	0	10	0.377	0.243
7/25	79	24	103	0.331	1	0	1	0.210	448	26	474	0.126	56	1	57	0.388	0.264
7/26	247	26	273	0.366	2	4	6	0.210	105	6	111	0.137	0	0	0	0.388	0.280
7/27	81	13	94	0.405	1	3	4	0.211	23	1	24	0.140	230	9	239	0.434	0.297
7/28	94	16	110	0.427	49	18	67	0.217	1383	19	1402	0.287	141	5	146	0.461	0.348
7/29	25	14	39	0.435	1758	156	1914	0.385	254	2	256	0.314	35	3	38	0.469	0.400
7/30	15	8	23	0.439	217	14	231	0.405	198	1	199	0.335	55	2	57	0.479	0.415
7/31	25	24	49	0.449	59	17	76	0.411	57	3	60	0.341	40	1	41	0.487	0.422
8/1	49	47	96	0.468	122	20	142	0.424	33	1	34	0.345	52	7	59	0.498	0.434
8/2	12	13	25	0.473	170	22	192	0.441	28	1	29	0.348	42	5	47	0.507	0.442
8/3	3	5	8	0.475	8	1	9	0.442	20	1	21	0.350	49	1	50	0.517	0.446
8/4	3	14	17	0.478	4	7	11	0.443	4	1	5	0.351	92	2	94	0.535	0.452
8/5	32	32	64	0.491	333	34	367	0.475	39	5	44	0.355	5	0	5	0.536	0.464
8/6	3	4	7	0.492	112	13	125	0.486	24	5	29	0.358	94	3	97	0.554	0.473
8/7	10	13	23	0.497	71	8	79	0.493	6	1	7	0.359	67	3	70	0.567	0.479
8/8	297	64	361	0.569	279	32	311	0.520	0	0	0	0.359	81	3	84	0.583	0.508
8/9	176	30	206	0.610	91	12	103	0.529	1	0	1	0.359	74	4	78	0.598	0.524
8/10	92	54	146	0.639	4	3	7	0.530	504	18	522	0.414	33	8	41	0.606	0.547
8/11	74	42	116	0.663	4	0	4	0.530	1619	14	1633	0.586	30	3	33	0.612	0.598
8/12	177	29	206	0.704	195	29	224	0.550	194	3	197	0.606	23	2	25	0.617	0.619
8/13	25	12	37	0.711	131	12	143	0.562	185	13	198	0.627	11	2	13	0.619	0.630
8/14	26	9	35	0.718	580	73	653	0.620	94	1	95	0.637	40	3	43	0.628	0.651
8/15	38	42	80	0.734	632	84	716	0.682	25	1	26	0.640	40	2	42	0.636	0.673

(continued)

Table 11. (Page 2 of 2)

	2002				2003				2004				2005				Average
Date	Adults	Jacks	Total	Cum. Prop.	Adults	Jacks	Total	Cum. Prop.	Adults	Jacks	Total	Cum. Prop.	Adults	Jacks	Total	Cum. Prop.	Cum. Prop.
8/16	26	15	41	0.742	201	32	233	0.703	20	4	24	0.642	60	1	61	0.647	0.684
8/17	33	19	52	0.753	67	17	84	0.710	38	3	41	0.647	0	0	0	0.647	0.689
8/18	54	20	74	0.768	6	2	8	0.711	48	5	53	0.652	0	0	0	0.647	0.695
8/19	24	21	45	0.777	2	1	3	0.711	15	1	16	0.654	55	2	57	0.658	0.700
8/20	22	18	40	0.785	3	3	6	0.712	60	4	64	0.661	65	0	65	0.670	0.707
8/21	31	25	56	0.796	40	8	48	0.716	3	1	4	0.661	65	0	65	0.683	0.714
8/22	54	25	79	0.812	58	25	83	0.723	21	4	25	0.664	131	2	133	0.708	0.727
8/23	39	8	47	0.821	48	19	67	0.729	9	2	11	0.665	113	11	124	0.732	0.737
8/24	15	14	29	0.827	13	4	17	0.731	5	0	5	0.666	28	1	29	0.737	0.740
8/25	20	20	40	0.835	47	17	64	0.736	2	0	2	0.666	0	0	0	0.737	0.743
8/26	16	11	27	0.840	54	13	67	0.742	0	2	2	0.666	50	2	52	0.747	0.749
8/27	19	16	35	0.847	29	16	45	0.746	361	18	379	0.706	50	0	50	0.756	0.764
8/28	28	12	40	0.855	36	14	50	0.750	128	5	133	0.720	85	8	93	0.774	0.775
8/29	17	10	27	0.861	10	5	15	0.752	29	1	30	0.723	60	1	61	0.786	0.780
8/30	30	16.5	46.5	0.870	524	97	621	0.806	10	0	10	0.724	47	0	47	0.795	0.799
8/31	43	23	66	0.883	138	35	173	0.821	8	1	9	0.725	113	7	120	0.817	0.812
9/1	16	10	26	0.888	292	98	390	0.856	2	0	2	0.725	55	1	56	0.828	0.824
9/2	45	35	80	0.904	514	53	567	0.905	0	0	0	0.725	27	4	31	0.834	0.842
9/3	13	14	27	0.910	81	28	109	0.915	338	10	348	0.762	35	1	36	0.841	0.857
9/4	22	9	31	0.916	34	15	49	0.919	324	10	334	0.797	30	3	33	0.847	0.870
9/5	18.8	9	27.8	0.921	39	18	57	0.924	97	7	104	0.808	39	0	39	0.854	0.877
9/6	15.6	9	24.6	0.926	41	14	55	0.929	81	0	81	0.816	89	2	91	0.872	0.886
9/7	12.4	9	21.4	0.931	36	13	49	0.933	48	1	49	0.821	109	2	111	0.893	0.895
9/8	9.2	9	18.2	0.934	49	20	69	0.939	37	0	37	0.825	0	0	0	0.893	0.898
9/9	6	9	15	0.937	53	23	76	0.946	35	3	38	0.829	0	0	0	0.893	0.901
9/10	28	7	35	0.944	21	17	38	0.949	23	0	23	0.832	190	7	197	0.930	0.914
9/11	0	5	5	0.945	18	7	25	0.952	14	0	14	0.833	45	1	46	0.939	0.917
9/12	5	0	5	0.946	17	7	24	0.954	67	5	72	0.841	17	5	22	0.943	0.921
9/13	4	9	13	0.949	62	13	75	0.960	444	12	456	0.889	46	1	47	0.952	0.937
9/14	3	0	3	0.949	38	10	48	0.965	257	5	262	0.916	17	0	17	0.955	0.946
9/15	1	11	12	0.952	25	6	31	0.967	139	4	143	0.931	0	0	0	0.955	0.951
9/16	9.0	2.8	11.9	0.954	7	4	11	0.968	47	4	51	0.937	0	0	0	0.955	0.954
9/17	14.3	4.4	18.7	0.958	9	7	16	0.970	61	0	61	0.943	19	2	21	0.959	0.957
9/18	9.6	3.0	12.6	0.960	2	2	4	0.970	21	6	27	0.946	32	3	35	0.966	0.961
9/19	8.2	2.5	10.7	0.963	3	4	7	0.971	31	6	37	0.950	12	0	12	0.968	0.963
9/20	5.4	1.7	7.1	0.964	7	6	13	0.972	10	2	12	0.951	8	4	12	0.971	0.964
9/21	23.2	7.2	30.4	0.970	31	8	39	0.975	105	2	107	0.962	11	2	13	0.973	0.970
9/22	18.7	5.8	24.5	0.975	14	3	17	0.977	72	5	77	0.970	34	0	34	0.980	0.975
9/23	21.6	6.7	28.3	0.981	0	2	2	0.977	113	1	114	0.982	28	4	32	0.986	0.981
9/24	11.1	3.4	14.5	0.983	14	3	17	0.978	43	4	47	0.987	11	1	12	0.988	0.984
9/25	26.1	8.1	34.2	0.990	139	13	152	0.992	13	1	14	0.989	10	3	13	0.990	0.990
9/26	4.0	1.2	5.3	0.991	15	1	16	0.993	6	0	6	0.989	5.3	0.3	5.5	0.991	0.991
9/27	13.7	4.2	17.9	0.995	32	2	34	0.996	38	3	41	0.994	18.0	0.9	18.9	0.995	0.995
9/28	3.5	1.1	4.5	0.996	13	3	16	0.997	3	0	3	0.994	4.6	0.2	4.8	0.996	0.996
9/29	4.7	1.5	6.2	0.997	8	4	12	0.999	13	1	14	0.995	6.2	0.3	6.5	0.997	0.997
9/30	2.4	0.7	3.1	0.998	2	1	3	0.999	10	0	10	0.997	3.1	0.2	3.3	0.998	0.998
10/1	1.3	0.4	1.7	0.998	2	0	2	0.999	5	0	5	0.997	1.7	0.1	1.8	0.998	0.998
10/2	1.6	0.5	2.2	0.999	5	0	5	0.999	4	0	4	0.997	2.2	0.1	2.3	0.999	0.998
10/3	0.0	0.0	0.0	0.999	0	0	0	0.999	0	0	0	0.997	0.0	0.0	0.0	0.999	0.998
10/4	1.6	0.5	2.2	0.999	2	0	2	1.000	6	1	7	0.998	2.2	0.1	2.3	0.999	0.999
10/5	1.3	0.4	1.7	0.999	3	0	3	1.000	4	0	4	0.999	1.7	0.1	1.8	0.999	0.999
10/6	0.5	0.2	0.7	0.999	0	0	0	1.000	3	0	3	0.999	0.7	0.0	0.8	0.999	0.999
10/7	0.7	0.2	1.0	1.000	0	0	0	1.000	3	1	4	0.999	1.0	0.0	1.0	1.000	1.000
10/8	0.4	0.1	0.5	1.000	2	0	2	1.000	0	0	0	0.999	0.5	0.0	0.5	1.000	1.000
10/9	0.0	0.0	0.0	1.000	0	0	0	1.000	0	0	0	0.999	0.0	0.0	0.0	1.000	1.000
10/10	0.7	0.2	1.0	1.000	0	0	0	1.000	4	0	4	1.000	1.0	0.0	1.0	1.000	1.000
10/11	0.0	0.0	0.0	1.000	0	0	0	1.000	0	0	0	1.000	0.0	0.0	0.0	1.000	1.000
10/12	0.2	0.1	0.2	1.000	0	0	0	1.000	1	0	1	1.000	0.2	0.0	0.3	1.000	1.000
10/13	0.2	0.1	0.2	1.000	0	0	0	1.000	1	0	1	1.000	0.2	0.0	0.3	1.000	1.000
Total	**3,818**	**1,185**	**5,003**		**9,468**	**1,925**	**11,393**		**9,229**	**284**	**9,513**		**5,018**	**244**	**5,263**		
Weir Count	3,397	1,074	4,656		9,248	1,851	11,099		9,229	284	9,513		4,970	242	5,212		
Difference	421	111	347		220	74	294		0	0	0		48	2	51		

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

The boxed areas in the Cumulative Proportion columns show the median and second and third quartiles and 80% of the fish escaped between the lines.

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 E-M Algorithm would have increased this number by 7 fish).

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.

Stream and Beach Mark-Recapture for Indexing Escapement: In 2004, five mark-recapture trips were successfully accomplished in the MIS study area and two in the beach study areas in conjunction with the weir mark-recapture study (Table 12). Unfortunately, I was unable to compute modified Jolly-Seber estimates of the abundance of adult sockeye salmon in the MIS due to no recaptures from the first sampling trip (Table 12). For this dataset the first sampling trip was August 27-28 which was a couple of weeks later than the first sampling trips in 2002 and 2003. A sampling trip was initially done on August 11 but only five sockeye were captured and marked so this trip has already been excluded from the model. There were few live but many dead sockeye salmon in the main inlet stream prior to the August 27-28 trip. Water levels were quite low in the stream during August. Too few recaptures of jacks also precluded estimating the number of jacks in the main inlet stream study area (Table 12). More than two trips are needed to use the Jolly-Seber method and harsh weather after mid-October limited us to only two mark-recapture trips in the beach study area. Despite the inability to compute Jolly-Seber estimates of the abundance of adult and jack sockeye salmon in the MIS and beach study areas, these mark-recapture trips yielded the Peterson estimates of the abundance of live sockeye salmon in these locations each trip (Table 12) and these estimates can be compared with similar estimates in other years.

Table 12. Data collected for modified Jolly-Seber estimates of the abundance of adult and jack sockeye salmon in Neva Lake's main inlet stream (MIS) and beach study areas, 2004.

			Peterson Estimates for each Trip:							Modified Jolly-Seber Estimates:											
Index Area, Adults or Jacks	Trip No.	Dates	Number of New Fish Marked on Day 1 (M)	Number of New Fish Marked on Day 2	Number of Recaptures on Day 2 (R)	Total Number Caught on Day 2 (C)	Peterson Estimate for Trip (N*)	SE (N*)	CV (N*)	Marks from Trip 1	Marks from Trip 2	Marks from Trip 3	Marks from Trip 4	n = Total Number Caught this Trip	m = Total Number Recaps. this Trip	Ni = Peterson Est. for this Trip	M = m*N/n	$\phi = M_{i+1} / (M-m+n)$	B = N_{i+1} - ϕN	B* = B log(ϕ)/(ϕ-1)
MIS, Adults	1	Aug. 27-28	18	27	13	31	55	6	11%					45	0	55	0	0.000	391	a
	2	Sept. 8-9	254	87	161	415	391	11	3%		84			341	0	391	0	0.268	93	168
	3	Sept. 14-15	128	54	99	227	198	6	3%			32		182	84	198	91	0.176	37	78
	4	Sept. 22	51	18	44	95	72	2	3%				8	69	32	72	33	0.201	10	21
	5	Oct. 8-9	10	4	2	12	25	8	34%					14	8	25	14			
																		Total = sum(B*) =		a
																		SE, CV =		a
MIS, Jacks	1	Aug. 27-28	1	4	0	4	9	4	50%					5	0	9	0	0.000	38	a
	2	Sept. 8-9	23	7	10	17	38	5	14%		6			30	0	38	0	0.340	4	7
	3	Sept. 14-15	3	7	1	8	17	6	38%					10	6	17	10	0.000	5	a
	4	Sept. 22	3	1	1	2	5	1	28%					4	0	5	0			
	5	Oct. 8-9	0	0	0	0														
																		Total = sum(B*) =		a
																		SE, CV =		a
MIS, Adults and Jacks	1	Aug. 27-28	19	31	13	44	63	8	12%					50	0	63	0	0.000	429	a
	2	Sept. 8-9	277	94	171	265	429	12	3%		90			371	0	429	0	0.266	97	174
	3	Sept. 14-15	131	61	100	161	211	6	3%			32		192	90	211	99	0.167	41	89
	4	Sept. 22	54	19	45	64	77	2	3%				8	73	32	77	34	0.189	10	21
	5	Oct. 8-9	10	4	2	6	25	8	34%					14	8	25	14			
																		Total = sum(B*) =		a
																		SE, CV =		a
Beach, Adults	1	Oct. 10-11	124	89	29	118	495	67	14%					213	0	495	0	0.475	175	581
	2	Oct. 14-15	120	115	47	162	410	38	9%	58				235	58	410	101			a
																		Total = sum(B*) =		a
																		SE, CV =		a
Beach, Jacks	1	Oct. 10-11	2	3	0	3	11	6	55%					5	0	11	0	0.221	5	15
	2	Oct. 14-15	4	3	3	6	8	1	15%	1				7	1	8	1			a
																		Total = sum(B*) =		a
																		SE, CV =		a
Beach, Adults and Jacks	1	Oct. 10-11	126	92	29	121	515	70	14%					218	0	515	0	0.462	175	593
	2	Oct. 14-15	124	118	50	168	413	37	9%	59				242	59	413	101			a
																		Total = sum(B*) =		a
																		SE, CV =		a

[a]No estimate possible due to lack of recoveries or less than three trips.

Visual Survey Counts: In 2004, counts of live sockeye salmon peaked in the MIS in mid-September and were still high in the lake when the last surveys were done in mid-October (Table 13). When counts are summed across all the MIS and Lake survey areas, the highest counts were obtained on September 15. The 958 average count on September 15 was 10% of the 9,513 escapement into the lake.

On August 7, partially spawned sockeye salmon were observed among 49 dead sockeye salmon observed in the MIS, an unusual sighting attributed to the low flows and warm water that persisted through July and August. The 51 live sockeye counted in the MIS on August 7 and the 7 sockeye counted in the MIS on August 11 were pale and appeared stressed by the low flow conditions.

On August 13, 130 dead, un-spawned, adult sockeye salmon were found stranded in the shallow, braided, section of the outlet stream several hundred feet below the weir. It appeared that this die-off resulted when they tried to ascend the stream during a period of low flows and warm water.

On October 14, the day after the weir was pulled for the season, we observed 161 sockeye in the outlet stream in the vicinity of the lower fishing hole. A few sockeye salmon were also observed spawning in the outlet above the weir in October and there were six sockeye observed a short distance below the weir when it was pulled on October 13. I assume that the sockeye spawning above the weir are natural outlet spawners but the sockeye observed below the weir might be either there because they have yet to migrate to the lake or will be spawning in the outlet stream.

We found it difficult to count sockeye salmon on and off the beach study areas since they would spook offshore and mix with sockeye milling in the lake and both groups had to be counted simultaneously. This makes expanding the abundance estimate for the beach study areas to an abundance estimate for the entire lake difficult.

Table 13. Visual counts of sockeye salmon in Neva Lake's outlet and main inlet stream (foot surveys) and lake (boat surveys), 2004.

Date	Observer	Outlet Fish Hole[a]	MIS	Lake: Index Area	Lake: Off MIS	Lake: Other	Lake: Total
6/24	Lonn	100					
6/25	Lonn	60					
6/26	Lonn	30					
6/27	Lonn	50					
6/28	Lonn	35					
6/29	Lonn	15					
6/30	Lonn	15					
7/1	Lonn	8					
7/2	Lonn	5					
7/3	Lonn	70					
7/4	Lonn	35					
7/5	Lonn	60					
7/6	Lonn	10					
7/7	Lonn	1					
7/10	Lonn	0					
7/11	Lonn	0					
7/13	Lonn	0					
8/7	Lonn		52		40		40
8/11	Brownlee		7				
	Van Alen		7				
	Average		7				
8/13	Lonn		17		40		40
8/15	Lonn		13		26		26
8/17	Lonn		5		26		26
8/19	Lonn		9		7		7
8/21	Lonn		3		40		40
8/23	Lonn		8		40		40
8/25	Lonn		14		55		55
8/27	Abbott		29		48		48
	Lonn		29		7		7
	Murphy		26		13		13
	Average		28		23		23
8/28	Abbott		48		69		69
	Lonn		52		75		75
	Murphy		56		59		59
	Average		52		68		68
9/1	Lonn		97		100		100
9/6	Lonn		350		60		60
9/8	Lonn		323				
	McBride		299				
	Van Alen		296				
	Average		306				
9/9	Lonn		283	40	40	230	310
	McBride		260	40	50	303	393
	Van Alen		291	40	50	333	423
	Average		278	40	47	289	375
9/14	Lagoudakis		211				
	Lonn		249				
	Van Alen		289				
	Average		250				
9/15	Lagoudakis		165	100	50	570	720
	Lonn		230	70	130	820	1020
	Van Alen		229	60	40	410	510
	Average		208	77	73	600	750
9/20	Lonn		64			40	40
9/22	Lonn		86	140	40	480	660
	Van Alen		99	140	40	440	620
	Average		93	140	40	460	640
10/5	Lonn		33				
10/8	Lonn		26				
	Murphy		18				
	Sheakley		15				
	Average		20				
10/9	Lonn		28	250	50	365	665
	Murphy		30	210	66	439	715
	Sheakley		29	300	64	529	893
	Average		29	253	60	444	758
10/10	Lonn		44	300	60	466	826
	Murphy		20	250	28	450	728
	Sheakley		58	290	27	599	916
	Average		41	280	38	505	823
10/11	Lonn		30	200	100	424	724
	Murphy		27	190	120	454	764
	Sheakley		31	170	70	396	636
	Average		29	187	97	425	708
10/14	Lonn	171		280	110	455	845
	Murphy	150		160	31	361	552
	Sheakley			360	25	472	857
	Average	161		267	55	429	751
10/15	Lonn		46	230	70	478	778
	Murphy		31	200	60	359	619
	Sheakley		41	270	40	367	677
	Van Alen		44	280	80	426	786
	Average		41	245	63	408	715

[a]A traditional subsistence fishing site in lower Neva Creek.

Age, Sex, and Length Composition: In 2004, based on a sample of 480 fish with ageable scales, ninety-six percent of the Neva sockeye escapement were "one check", age-1.-, fish aged 1.2 (70%), 1.3 (16%), and 1.1 (jacks, 10%, Table 14). The sex composition was 45% males.

Table 14. Age composition of sockeye salmon in the Neva Lake escapement, 2004.

	Brood Year and Age Class					
	2001	2000	2000	1999	1999	
	1.1	1.2	2.1	1.3	2.2	Total
Percentages are weighted by the weekly weir counts						
Male						
Sample Size	38	142	3	36	8	227
Percent	9.7	26.8	0.2	6.3	2.4	45.4
Std. Error	2.2	2.8	0.2	1.4	1.5	3.1
Escapement	922	2,547	24	600	227	4,320
Female						
Sample Size		203		44	6	253
Percent		43.5		9.4	1.8	54.6
Std. Error		3.2		1.7	0.8	3.1
Escapement		4,136		889	168	5,193
All Fish						
Sample Size	38	345	3	80	14	480
Percent	9.7	70.3	0.2	15.7	4.2	100.0
Std. Error	2.2	3.1	0.2	2.1	1.7	
Escapement	922	6,683	24	1,489	395	9,513

The average mid-eye-to-fork length was 360 mm for the age-1.1 jacks, 499 mm for the age-1.2 fish, and 557 mm for the age-1.3 fish (Table 15).

Table 15. Length composition (mm) of sockeye salmon in the Neva Lake escapement, 2004.

		Brood Year and Age Class					
		2001	2000	2000	1999	1999	
		1.1	1.2	2.1	1.3	2.2	Total
Combined Periods (Lengths weighted by period escapements)							
Male	Avg. Length	360	496	402	562	509	454
	Std. Error	2.7	2.1	13.0	3.7	5.0	4.5
	Sample Size	38	142	3	36	8	227
Female	Avg. Length		502		557	497	512
	Std. Error		1.4		3.3	9.3	1.9
	Sample Size		203		44	6	253
All Fish	Avg. Length	360	499	402	557	504	495
	Std. Error	2.7	1.2	13.0	2.5	5.1	2.4
	Sample Size	38	345	3	80	14	480

Harvest Monitoring: In 2004, the State subsistence fishery for "Neva Creek" sockeye salmon was open from June 1 to through August 15 with a possession and annual limit of 40 fish per household. The subsistence fishery had been open from June 1 through July 31 in past years. In 2003, the possession and annual limit was 25 sockeye salmon and in 2002 and prior years had been 10 sockeye salmon. The State fishery was open to any Alaskan resident who obtained a permit. The permits were issued by the ADF&G, Division of Commercial Fisheries. Federal regulations provide Hoonah area residents with a "Customary and Traditional Use Determination" for the subsistence harvest of salmon in this area. This distinction allows residents of Hoonah to also use rod and reel gear to take salmon in freshwater. A special condition on the 2004 Federal Subsistence Fishing Permit for salmon, trout, and char stated "The harvest limit and seasons for sockeye salmon is the same as listed on ADF&G subsistence and personal use fishing permits." In 2004, all subsistence fishing was done by people with a State subsistence/personal use permit.

From June 16 to August 17, 2004, the weir operator interviewed sport and subsistence fishers observed in his multiple daily trips back and forth to the weir site. He was able to look for, and talk with, people fishing in and off the mouth of South Creek, in South Creek, and at the subsistence fishing sites in lower Neva Creek. He observed a sport fish harvest of 64 sockeye salmon and a subsistence/personal use harvest of 312 sockeye salmon (Table 16). The subsistence harvest reported on State permits in 2004 was 397 sockeye salmon (Figure 3).

Table 16. Observed sport and subsistence effort and harvest of salmon in the Neva Creek/South Creek area, June 24 to August 17, 2004.

Date	Hour	No. in Party	User Group	Location Fished (Saltwater, Intertidal, South Creek, Neva Creek)	Gear (BS=beach seine, GN=gillnet, S=spear, G=gaff, D=dipnet, R=rod&reel)	Units of Gear	Hours Fished per Units of Gear	Total Hours Fished (gear x hrs)	Sockeye Harvest	Coho Harvest	Chum Harvest	Pink Harvest
Jun-24	9:00	4	Subsistence	Saltwater	GN	1	13	13	75	1	5	0
Jun-27	9:00	1	Subsistence	Neva Creek	G	1	0.25	0.25	6	0	0	0
Jun-29	10:00	1	Subsistence	Neva Creek	G	1	0.25	0.25	8	0	0	0
Jul-01	10:45	6	Sport	Intertidal	R	6	2.5	15	4	0	0	0
Jul-02		3	Sport	Intertidal	R	3	2	6	2	0	0	0
Jul-04		2	Subsistence	Neva Creek	G				20	0	0	0
Jul-05	10:30	5	Sport	Intertidal	R	5	1.5	7.5	3	0	0	0
Jul-08	11:00	4	Sport	Intertidal	R	4	2	8	2	0	0	0
Jul-11	19:15	4	Subsistence	Saltwater	BS	1	3	3	12	0	0	0
Jul-12	13:30	5	Subsistence	Saltwater	GN	1	1	1	0	0	0	0
Jul-12		5	Subsistence	Intertidal	GN	1	3	3				
Jul-13	11:00	5	Sport	Intertidal	R	5	2	10	6	0	0	0
Jul-14	11:00	4	Sport	Intertidal	R	4	2	8	1	0	0	0
Jul-15	12:30	5	Subsistence	Neva Creek	G	2	1	2	2	0	0	0
Jul-15	14:00	3	Subsistence	Saltwater	GN	1	3.5	3.5	24	0	0	0
Jul-15	17:00	3	Sport	Intertidal	R	3	4	12	1	0	0	0
Jul-17	11:45	3	Subsistence	Saltwater	GN	1	1	1	35	0	0	0
Jul-17	13:00	4	Subsistence	South Creek	G & D	2			7	0	0	0
Jul-17	17:00	3	Subsistence	Intertidal	GN	1	4	4	0	0	0	0
Jul-17	17:30	2	Sport	Intertidal	R	2	3	6	3	0	0	0
Jul-20	11:00	1	Sport	Intertidal	R	1	2.5	2.5	3	0	0	0
Jul-21	14:10	6	Sport	Intertidal	R	6	5	30	20	0	0	0
Jul-21	14:30	2	Sport	Intertidal	R	2	1	2	2	0	0	0
Jul-25	11:35	1	Subsistence	Neva Creek	G	1	0.3	0.3	30	0	0	0
Jul-25		3	Sport	Intertidal	R	3	2.5	7.5				
Jul-29			Subsistence	Neva Creek	G				12	0	0	0
Jul-29	19:10	2	Subsistence	Neva Creek	S	1	1	1	30	0	0	0
Jul-31			Subsistence	Neva Creek	G				8	0	0	0
Jul-31	10:20	2	Sport	Intertidal	R	2	0.75	1.5	1	0	0	1
Jul-31	14:15	3	Sport	Intertidal	R	3	4	12	6	0	0	0
Jul-31	14:15	4	Sport	Intertidal	R	4	4	16	8			
Aug-04			Subsistence	Neva Creek	G				11	0	0	0
Aug-11	8:45	1	Subsistence	Neva Creek	G	1			17	0	0	0
Aug-16	14:00	4	Sport	Intertidal	R	4	5	20	2	0	0	0
Aug-17	18:40	1	Subsistence	Neva Creek	G	1	2	2	15	0	0	0
Totals:			Sport	Intertidal	R	57	43.75	164	64	0	0	1
			Subsistence	Saltwater	BS	1	3	3	12	0	0	0
					GN	4	18.5	18.5	134	1	5	0
				Intertidal	GN	2	7	7	0	0	0	0
				South Creek	G & D	2	0		7	0	0	0
				Neva Creek	G	7	3.8		129	0	0	0
					S	1	1	1	30	0	0	0
				Subtotal Subsistence =		17	33.3	29.5	312	1	5	0
				Total Sport and Subsistence =		74	77.05	193.5	376	1	5	1

Neva 2005

Weir and Weir-based Mark-Recapture Estimate of Total Escapement: In 2005, the Neva weir was operated from June 20 through September 25 (Table 17). The weir count totaled 5,212 sockeye salmon – 4,970 adults and 242 jacks. The first sockeye passed on June 26 and there were still a few sockeye passing when the weir was pulled. An estimated 51 sockeye (48 adults and 2 jacks) entered the lake after the weir was pulled (Table 11) bringing the 2005 sockeye escapement estimate to 5,263 (5,018 adults and 244 jacks). The midpoint of the sockeye escapement was August 2. The middle 80% of the sockeye escapement was between July 17 and September 10. Weir counts of other species totaled 301 coho salmon (including 157 jacks), 158 pink salmon, 0 chum salmon, 8 cutthroat trout, and 390 Dolly Varden char.

Weir operations went relatively smooth in 2005. There were nine days over the course of the summer that the weir operator closed the weir when he was attending to other business. There were no instances when salmon were suspected to have passed through the weir uncounted although there was a lot of black and brown bear activity and wolf activity at the weir and evidence of people fishing at the weir this year.

Many of the sockeye salmon observed at the weir this year appeared stressed by warm water temperatures and low flow conditions that persisted through much of the summer. On July 17, 2005, there was a rush of 1,165 adult sockeye salmon through the weir and an additional 18 sockeye died at the weir before the operator pulled pickets and counted them through in batches. Other occasions with adult sockeye dying at the weir were 1 on July 21, 14 on August 10, 19 on August 11, 5 on August 31, 1 on September 2, 8 on September 10, 2 on September 11, 3 on September 14, 3 on September 17, 2 on September 22, and 3 on September 24. Thus, a total of 79 adult sockeye salmon died at the weir in 2005 which is an unusually high number compared to other years and is apparently related to the stress of low flows and warm water. A die-off of 100 or more pre-spawned sockeye salmon was observed in Neva Creek on August 14 and 15. These fish were stranded and died in the shallow, braided, section of Neva Creek several hundred feet below the weir. This is the same area that a die-off of 130 sockeye salmon was observed on August 13, 2004.

The weir-to-spawning area mark-recapture study to validate the accuracy of the weir counts was limited to one recapture trip in 2005 due to limited funds and funding that ended in September. The weir operator finclipped 22 percent of the adult and 28 percent of the jack sockeye salmon counted through the weir (Table 17). On August 31, 19 percent of the adults (63 of 326) and 30 percent of the jacks (3 of 10) were found to have been marked at the weir. There was not less than a 5% probability that the proportion of marked fish in the inlet stream (66 of 336, 19.6%) was less than that marked at the weir (1,148 of 5,212, 22.0%). The one-tailed exact binomial test for goodness-of-fit (Sokal and Rohlf, 1995) p-value was 0.1615. Thus, the 5,263 expanded weir count (Table 11) is considered to be the best estimate of the escapement of adult and jack sockeye salmon into Neva Lake in 2005.

Table 17. Weather and stream measurements and daily numbers of fish counted and finclipped at the Neva Creek weir, 2005.

	Weather and Stream Measurements:[a]				Sockeye Counted:				Sockeye Finclipped:								
Date	Weather	Water Level (cm)	Therm-ometer Water Temp (°C)	Air Temp (°C)	Adults	Jacks	Total	Cum. Prop.	Finclip Used (Adipose +)	Adults	Cum. % Adults Clipped	Jacks	Cum. % Jacks Clipped	Coho	Pink	Cutthroat	Dolly Varden
6/20					0	0	0	0.00									
6/21					0	0	0	0.00									
6/22					0	0	0	0.00									
6/23					0	0	0	0.00									
6/24	clear				0	0	0	0.00									
6/25	partly cloudy				0	0	0	0.00									
6/26	partly cloudy				48	1	49	0.01	Left axillary	12	25%	1	100%				
6/27	clear	17.5	19.0	18.0	18	0	18	0.01	Left axillary	5	26%	0	100%				
6/28	overcast	19.5	18.0	14.5	26	1	27	0.02	Left axillary	6	25%	0	50%				
6/29	cloudy	18.0	17.0	13.0	42	2	44	0.03	Left axillary	10	25%	0	25%				
6/30		19.0	17.0	14.0	61	5	66	0.04	Left axillary	13	24%	1	22%				1
7/1	cloudy	17.5	17.5	14.0	32	2	34	0.05	Left axillary	8	24%	0	18%				
7/2	cloudy	17.0	17.0	12.0	29	2	31	0.05	Left axillary	12	26%	0	15%				
7/3	rain	17.5	17.0	15.0	56	4	60	0.06	Left axillary	24	29%	0	12%				3
7/4	showers	19.0	17.0	12.0	18	5	23	0.07	Left axillary	6	29%	2	18%				2
7/5					trap closed		0	0.07	Left axillary		29%		18%				
7/6	cloudy	18.3	17.0	12.0	0	0	0	0.07	Left axillary	0	29%	0	18%				1
7/7	showers	17.5	17.0	12.3	18	0	18	0.07	Left axillary	5	29%	0	18%				
7/8					trap closed		0	0.07			29%		18%				
7/9	partly cloudy	17.0	18.0	14.0	22	5	27	0.08	Left axillary	5	29%	0	15%				4
7/10	showers	16.5	17.0	14.5	6	3	9	0.08	Left axillary	3	29%	0	13%				
7/11	showers		17.0	13.0	1	1	2	0.08	Left axillary	1	29%	1	16%				
7/12		17.0	17.0	14.0	60	5	65	0.09	Left axillary	4	26%	0	14%				3
7/13	showers	16.0	17.0	14.0	4	0	4	0.09	Left axillary	0	26%	0	14%				
7/14	rain	15.0	17.0	12.0	2	0	2	0.09	Left axillary	2	26%	0	14%				
7/15	rain	15.0	17.0	13.0	2	0	2	0.09	Left axillary	0	26%	0	14%				
7/16	clear	14.8	17.0	12.0	0	0	0	0.09	Left axillary	0	26%	0	14%				
7/17	rain	17.5	17.0	12.0	1165	20	1185	0.32	Left axillary	60	11%	0	9%				1
7/18		19.0	16.0	13.0	87	18	105	0.34	Left axillary	26	12%	0	7%				14
7/19	partly cloudy	19.0	17.0	12.0	74	14	88	0.36	Left axillary	50	14%	4	10%				36
7/20	overcast	18.5	17.0	13.5	58	3	61	0.37	Left axillary	19	15%	1	11%				11
7/21	overcast	18.0	17.0	15.0	49	0	49	0.38	Left axillary	6	15%	0	11%				1
7/22		17.5	17.0	13.0	6	1	7	0.38	Left axillary	6	15%	1	12%		1		3
7/23	overcast	17.0	17.0	13.0	0	0	0	0.38	Left axillary	0	15%	0	12%				

(continued)

Table 17. (page 2 of 3)

	Weather and Stream Measurements:[a]				Sockeye Counted:				Sockeye Finclipped:								
Date	Weather	Water Level (cm)	Therm-ometer Water Temp (°C)	Air Temp (°C)	Adults	Jacks	Total	Cum. Prop.	Finclip Used (Adipose +)	Adults	Cum. % Adults Clipped	Jacks	Cum. % Jacks Clipped	Coho	Pink	Cutthroat	Dolly Varden
7/24	overcast	16.0	17.0	14.0	10	0	10	0.38	Left axillary	5	15%	0	12%				
7/25	overcast	16.5	17.0	15.0	56	1	57	0.39	Left axillary	10	15%	0	12%				1
7/26		16.0	16.0	12.0	0	0	0	0.39	Left axillary	0	15%	0	12%				
7/27	rain	18.5	17.0	14.0	230	9	239	0.44	Left axillary	70	17%	1	12%		4		7
7/28	rain	19.5	17.0	13.0	141	5	146	0.47	Left axillary	30	17%	1	12%		7		17
7/29	overcast	19.0	18.0	12.0	35	3	38	0.47	Left ventral	18	18%	1	13%		7		
7/30	partly cloudy	19.0	16.0	12.0	55	2	57	0.48	Left ventral	0	17%	0	13%		3		2
7/31		18.5	17.0	10.0	40	1	41	0.49	Left ventral	10	17%	0	12%		5		7
8/1	overcast	18.0	17.0	11.0	52	7	59	0.50	Left ventral	20	18%	2	13%		10	1	12
8/2	overcast	17.5	17.0	14.0	42	5	47	0.51	Left ventral	20	18%	0	13%		8		9
8/3	rain	17.5	16.5	12.0	49	1	50	0.52	Left ventral	10	18%	0	13%				
8/4	rain	17.0	17.0	13.0	92	2	94	0.54	Left ventral	7	18%	0	13%		4		
8/5	rain	17.0	17.0	14.0	5	0	5	0.54	Left ventral	0	18%	0	13%				
8/6	overcast	19.8	17.5	14.0	94	3	97	0.56	Left ventral	14	18%	3	15%		9		3
8/7	partly cloudy	19.5	17.0	13.0	67	3	70	0.57	Left ventral	20	18%	3	16%		9		13
8/8	overcast	19.0	17.0	14.0	81	3	84	0.59	Left ventral	30	19%	3	18%		7		4
8/9	clear	18.8	17.5	14.0	74	4	78	0.60	Left ventral	38	19%	3	20%		3		9
8/10	clear	18.5	18.0	14.0	33	8	41	0.61	Left ventral	20	20%	8	24%		3		
8/11	clear	18.0	21.0	20.0	30	3	33	0.62	Left ventral	0	20%	0	24%		2		3
8/12	clear	17.5	21.0	14.0	23	2	25	0.62	Left ventral	0	20%	0	23%				2
8/13	clear	18.0	19.0	14.0	11	2	13	0.63	Left ventral	0	19%	0	23%		1	1	2
8/14	clear	16.8	20.5	20.0	40	3	43	0.63	Dorsal	0	19%	0	23%		1		
8/15	clear	16.5	19.0	14.0	40	2	42	0.64	Dorsal	0	19%	0	22%		3	1	
8/16	overcast	16.0	18.0	13.0	60	1	61	0.65	Dorsal	10	19%	0	22%				
8/17					trap closed		0	0.65	Dorsal		19%		22%				
8/18					trap closed		0	0.65	Dorsal		19%		22%				
8/19	overcast	18.0	18.0	15.0	55	2	57	0.66	Dorsal	0	19%	0	22%		3		
8/20	showers	18.0	18.0	14.0	65	0	65	0.68	Dorsal	12	19%	0	22%		5		1
8/21	partly cloudy	17.5	17.5	12.5	65	0	65	0.69	Dorsal	29	19%	0	22%		5	1	1
8/22	partly cloudy	19.5	18.0	14.0	131	2	133	0.71	Dorsal	25	19%	0	22%		5		
8/23	partly cloudy	20.5	17.5	12.0	113	11	124	0.74	Dorsal	48	20%	3	22%	3	5		
8/24	overcast	19.5	17.0	12.0	28	1	29	0.74	Dorsal	4	20%	0	22%	0	2		
8/25					trap closed		0	0.74	Dorsal		20%		22%	0			

(continued)

Table 17. (page 3 of 3)

	Weather and Stream Measurements:[a]				Sockeye Counted:				Sockeye Finclipped:								
Date	Weather	Water Level (cm)	Therm-ometer Water Temp (°C)	Air Temp (°C)	Adults	Jacks	Total	Cum. Prop.	Finclip Used (Adipose +)	Adults	Cum. % Adults Clipped	Jacks	Cum. % Jacks Clipped	Coho	Pink	Cutthroat	Dolly Varden
8/26	overcast	19.0	18.0	12.0	50	2	52	0.75	Dorsal	30	20%	2	23%	1	1		
8/27	partly cloudy	19.0	18.0	13.0	50	0	50	0.76	Dorsal	20	21%	0	23%	2	2		
8/28	clear	19.5	18.0	14.0	85	8	93	0.78	Dorsal	33	21%	3	23%	4	1		1
8/29	overcast	19.5	16.5	12.0	60	1	61	0.79	Dorsal	23	21%	1	24%	5			
8/30	overcast	20.0	16.0	10.0	47	0	47	0.80	Dorsal	10	21%	0	24%	4	3		
8/31	rain	23.0	16.0	12.0	113	7	120	0.83	Dorsal	72	22%	7	27%	0	1		
9/1	rain	19.0	16.0	13.0	55	1	56	0.84	Dorsal	8	22%	1	27%	4	1		
9/2	rain	21.5	15.0	12.0	27	4	31	0.84	Dorsal	4	22%	0	26%	3	3		
9/3	overcast	25.0	15.5	10.0	35	1	36	0.85	Dorsal	8	22%	0	26%	6	2		1
9/4	rain	24.5	15.0	9.5	30	3	33	0.86	Dorsal	10	22%	0	26%	9	3	1	
9/5	rain	24.0	15.5	12.0	39	0	39	0.86	Dorsal	6	22%	0	26%	0	2		2
9/6	rain	25.5	15.0	11.0	89	2	91	0.88	Dorsal	20	22%	0	26%	40	7	2	7
9/7	rain	31.0	15.0	12.0	109	2	111	0.90	Dorsal	28	22%	2	26%	21	3	1	23
9/8					trap closed		0	0.90	Dorsal		22%		26%	0			
9/9					trap closed		0	0.90	Dorsal		22%		26%	0			
9/10		32.0	15.0	13.0	190	7	197	0.94	Dorsal	40	22%	4	27%	23	4		10
9/11	showers	33.0	15.5	12.0	45	1	46	0.95	Dorsal	7	22%	0	27%	9	3		13
9/12	rain	31.0	15.0	11.0	17	5	22	0.95	Dorsal	4	22%	2	27%	3	2		7
9/13		31.0	15.0	12.0	46	1	47	0.96	Dorsal	8	22%	0	27%	8	1		5
9/14		30.0	14.0	12.0	17	0	17	0.96	Dorsal	1	22%	0	27%	18	4		8
9/15					trap closed		0	0.96	Dorsal		22%		27%	0			
9/16					trap closed		0	0.96	Dorsal		22%		27%	0			
9/17		37.0	13.0	10.0	19	2	21	0.97	Dorsal	3	22%	1	28%	2	0		5
9/18					32	3	35	0.98	Dorsal		22%		27%	6	1		3
9/19	rain	31.0	14.0	12.0	12	0	12	0.98	Dorsal	1	22%	0	27%	7	0		6
9/20	rain	27.0	12.0	10.0	8	4	12	0.98	Dorsal	0	22%	0	27%	23	0		10
9/21	rain	30.0	13.0	10.0	11	2	13	0.98	Dorsal	0	22%	2	27%	29	1		19
9/22	rain	45.0	13.0	12.0	34	0	34	0.99	Dorsal	5	22%	0	27%	13	0		17
9/23	rain	43.0	13.0	10.0	28	4	32	1.00	Dorsal	4	22%	2	28%	12	1		15
9/24	rain	43.0	12.5	9.0	11	1	12	1.00	Dorsal	1	22%	0	28%	32	0		43
9/25	rain	42.0	15.0	12.0	10	3	13	1.00	Dorsal	2	22%	1	28%	14	0		22
9/26																	
Totals					4,970	242	5,212			1,081		67		301	158	8	390

[a] Observations were made about 0900.

Visual Survey Counts: In 2005, regular surveys were not done to count sockeye salmon in the outlet (Neva Creek), inlet, or lake beyond those reported above in the "Weir and Weir-based Mark-Recapture Estimate of Total Escapement" section.

Age, Sex, and Length Composition: In 2005, over 1,200 sockeye salmon were sampled for age, sex, and length through the course of weir operation. This sample size exceeded the study plan for a seasonal total of 600 fish sampled with weekly sampling goals based on the historical weekly proportion of the 2002 to 2004 escapement. For this analysis we report on an escapement-weighted subset of 600 of the fish sampled.

In 2005, based on a sample of 444 fish with ageable scales, and percentages weighted by the weekly escapement, we found that 86% of the sockeye escapement were "one check", age-1., fish. The main age classes were age-1.2 (43%), age-1.3 (40%), and age-2.2 (11%; Table 18). The sex composition was 40% males.

Table 18. Age composition of sockeye salmon in the Neva Lake escapement, 2005.

	Brood Year and Age Class						
	2002	2001	2001	2000	2000	1999	
	1.1	1.2	2.1	1.3	2.2	2.3	Total
Percentages are weighted by the weekly weir counts							
Male							
Sample Size	12	89	8	87	8	1	205
Percent	3.3	15.8	1.6	16.1	3.2	0.4	40.4
Std. Error	1.3	2.0	0.6	2.1	1.6	0.4	3.1
Escapement	174	831	86	845	167	23	2,127
Female							
Sample Size		124		102	12	1	239
Percent		26.9		23.8	7.7	1.2	59.6
Std. Error		2.8		2.6	2.3	1.2	3.1
Escapement		1,413		1,254	406	63	3,136
All Fish							
Sample Size	12	213	8	189	20	2	444
Percent	3.3	42.7	1.6	39.9	10.9	1.6	100.0
Std. Error	1.3	3.1	0.6	3.0	2.5	1.3	
Escapement	174	2,245	86	2,099	573	86	5,263

The average mid-eye-to-fork length was 358 mm for the age-1.1 jacks, 499 mm for the age-1.2 fish, and 557 mm for the age-1.3 fish (Table 19).

Table 19. Length composition (mm) of sockeye salmon in the Neva Lake escapement, 2005.

		Brood Year and Age Class						
		2002	2001	2001	2000	2000	1999	
		1.1	1.2	2.1	1.3	2.2	2.3	Total
Combined Periods (Lengths weighted by period escapements)								
Male	Avg. Length	358	500	395	564	525	565	503
	Std. Error	4.9	3.7	8.3	3.1	15.5		4.4
	Sample Size	12	89	8	87	8	1	205
Female	Avg. Length		499		550	519	565	522
	Std. Error		2.7		2.5	7.7		2.5
	Sample Size		124		102	12	1	239
All Fish	Avg. Length	358	499	395	557	521	565	520
	Std. Error	4.9	2.2	8.3	2.0	7.5	<0.1	2.4
	Sample Size	12	213	8	189	20	2	444

Age-1. fish dominated the escapement all four years (Table 20). The relatively high proportion of one-ocean fish in 2002 and 2003 contributed to the higher proportions of two-ocean fish and three-ocean fish in subsequent years.

Table 20. Age composition of the sockeye salmon escapement into Neva Lake, 2002 through 2005.

		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%

Harvest Monitoring: In 2005, as in 2002, 2003, and 2004, the weir operator monitored subsistence effort and harvest in the Neva Creek and South Creek area by meeting with fishers he observed in the area on his multiple daily trips between Excursion Inlet and the weir site. He documented a subsistence harvest of at least 590 sockeye salmon in 2005 (Table 21). The reported harvest on State subsistence/personal use permits was 276 sockeye salmon in 2005 (Table 22). A harvest of 34 sockeye salmon was also reported on Federal subsistence fishing permits in 2005. This was the first reported harvests on Federal permits.

Table 21. Observed subsistence effort and harvest of salmon in the Neva Creek/South Creek area, July 3 to August 13, 2005.

Date	Hour	No. in Party	Location Fished (Saltwater, Intertidal, South Creek, Neva Creek)	Gear (BS=beach seine, GN=gillnet, S=spear, G=gaff, D=dipnet, R=rod&reel)	Units of Gear	Hours Fished per Units of Gear	Total Hours Fished (gear x hrs)	Sockeye Harvest	Coho Harvest	Chum Harvest	Pink Harvest
7/3	10:00	2	Intertidal	GN	1	2	2	30	0	0	0
7/7	11:50	2	Intertidal	BS	1	2	2	80	0	0	0
7/11	14:00	2	Intertidal	Cast Net	2	2	4	30	0	0	0
7/16	10:00	3	Intertidal	GN	1	?		120	0	0	0
7/17	13:00	2	Intertidal	GN	1	2	2	30	0	0	0
7/22	10:00	2	Intertidal	GN	1	2	2	30	0	0	0
7/23	13:00	2	Intertidal	GN	1	2	2	80	0	0	0
7/29	15:00	2	Intertidal	BS	1	2	2	80	0	0	0
8/5	10:00	2	Neva Creek	G	2	0.5	1	11	0	0	0
8/5	11:00	2	Neva Creek	G	2	0.3	0.6	21	0	0	0
8/5	13:00	3	Intertidal	BS	1	3	3	40	0	0	0
8/9	15:00	2	Neva Creek	G	1	2	2	6	0	0	0
8/10	16:30	2	Neva Creek	D	2	0.5	1	10	0	0	0
8/13	13:00	3	Intertidal	BS	1	3	3	22	0	0	0
Total					18	23.3	26.6	590	0	0	0

Table 22. Observed and reported subsistence harvest of sockeye salmon in the Neva Creek and South Creek area, 2002 to 2005.

Year	Observed During Onsite Harvest Monitoring	Reported on State Subsistence and Personal Use Permits	Reported on Federal Subsistence Permits
2002	44	36	0
2003	278	87	0
2004	312	397	0
2005	590	276	34

Pavlof 2004

Trap-to-Spawning Ground Mark-Recapture Estimate of Total Escapement: The trap was operated at the top of the fishpass at the outlet of Pavlof Lake from June 23 to August 22, 2004. All the salmon, trout, and char that ascended the fish pass on these dates were counted. Counts totaled 234 sockeye, 867 coho, 799 pink, and 42 chum salmon (Table 23). Eight hundred and fifty five Dolly Varden char and 23 cutthroat trout were also counted. Jacks comprised 9% (21) of the 234 sockeye salmon passed through the trap. There were no sockeye salmon that died in the trap in 2004.

Table 23. Daily counts of upstream migrating salmon, Dolly Varden char, and cutthroat trout passed through the trap at the top of Pavlof Lake's outlet fishpass, 2004.

Date[a]	Weather (at ~0800hr)	Water Level (inches)	Water Temp. (°C)	Air Temp. (°C)	Daily Sockeye Adults	Daily Sockeye Jacks	Total Sockeye	Cum. Sockeye	Cum. Percent Sockeye	Daily Coho Adults	Daily Coho Jacks	Daily Coho	Daily Pink	Daily Chum	Daily Dolly Varden	Daily Cutthroat
Jun-23	clear	8.5	17	17	0	0	0	0	0%	0	0	0	0	0	0	0
Jun-24	clear	8.5	17	17	0	0	0	0	0%	0	0	0	0	0	0	0
Jun-25	clear	8.5	17.5	18	0	0	0	0	0%	0	0	0	0	0	5	0
Jun-26	overcast	8.5	18		11	0	11	11	5%	0	0	0	0	0	35	0
Jun-27	showers	10.0	17		3	0	3	14	6%	0	0	0	0	0	64	0
Jun-28	overcast	10.5	17	17	2	0	2	16	7%	0	0	0	0	0	73	2
Jun-29	overcast	10.5	17	15	0	0	0	16	7%	0	0	0	0	0	72	0
Jun-30	overcast	10.5	17	18	1	0	1	17	7%	0	0	0	0	0	17	0
Jul-01	overcast	7.5	15	16	0	0	0	17	7%	0	0	0	0	0	35	0
Jul-02	rain	6.5	17	18	0	0	0	17	7%	0	0	0	0	0	66	2
Jul-03	overcast	6.5	15	16	9	0	9	26	11%	0	0	0	0	0	79	0
Jul-04	overcast	6.5	15	15	29	0	29	55	24%	0	0	0	0	0	65	0
Jul-05	overcast	6.0	15	13	7	0	7	62	26%	0	0	0	0	0	108	0
Jul-06	overcast	7.0	15	16	9	0	9	71	30%	0	0	0	0	0	66	3
Jul-07	partly cloudy	8.0	15	22	3	0	3	74	32%	0	0	0	0	0	29	0
Jul-08	clear	7.0	17	26	5	0	5	79	34%	0	0	0	0	0	35	0
Jul-09	overcast	6.5	15	18	1	0	1	80	34%	0	0	0	0	0	2	0
Jul-10	showers	6.5	15	16	25	5	30	110	47%	1	0	0	0	0	15	0
Jul-11	overcast	6.0	15	16	1	0	1	111	47%	0	0	0	0	0	3	0
Jul-12	clear	5.5	15	19	4	0	4	115	49%	0	0	0	0	0	0	0
Jul-13	clear	5.5	15	21.4	11	1	12	127	54%	2	0	0	0	0	2	0
Jul-14	partly cloudy	5.0	17	21.5	35	5	40	167	71%	2	2	0	0	0	26	2
Jul-15	clear	5.0	16	22.2	0	1	1	168	72%	0	0	0	0	0	3	1
Jul-16	clear	5.5	18.5	21.7	15	7	22	190	81%	0	0	0	0	0	5	1
Jul-17	partly cloudy	4.5	18	14	7	0	7	197	84%	1	0	0	0	0	5	1
Jul-18	partly cloudy	5.0	17	22.5	0	0	0	197	84%	1	0	0	0	0	4	1
Jul-19	clear	4.5	18	22	0	0	0	197	84%	1	0	0	0	0	14	0
Jul-20	showers	4.0	17	16	0	0	0	197	84%	0	0	0	0	0	1	0
Jul-21	overcast	5.5	17	15	3	0	3	200	85%	0	0	0	0	0	0	0
Jul-22	partly cloudy	5.5	17	15	1	0	1	201	86%	0	0	0	0	0	0	0
Jul-23	partly cloudy	4.5	18	24.3	4	0	4	205	88%	0	0	0	0	1	0	0
Jul-24	rain	5.0	17	20.6	0	0	0	205	88%	0	0	0	0	1	3	0
Jul-25	partly cloudy	5.5	17	18.9	1	0	1	206	88%	10	2	0	1	0	0	0
Jul-26	overcast	5.0	17	15.9	0	0	0	206	88%	6	0	0	0	0	1	0
Jul-27	partly cloudy	5.0	16	18.2	0	0	0	206	88%	0	0	0	0	1	0	0
Jul-28	overcast	6.0	16		15	1	16	222	95%	114	9	0	8	6	8	1
Jul-29	showers	8.5	15		4	0	4	226	97%	31	1	0	80	14	1	0
Jul-30	overcast	7.0	15	12	0	0	0	226	97%	41	0	0	94	5	1	2
Jul-31	clear		14.5	15	0	0	0	226	97%	28	0	0	36	0	2	1
Aug-01	showers		14.5	13.5	0	0	0	226	97%	15	2	0	54	0	1	2
Aug-02	overcast		14	13	1	0	1	227	97%	20	3	0	26	1	0	1
Aug-03	overcast		15	13	0	0	0	227	97%	32	5	0	23	2	0	0
Aug-04	partly cloudy		14.5	17	1	0	1	228	97%	50	1	0	30	0	1	0
Aug-05	partly cloudy		15	17	1	0	1	229	98%	59	5	0	16	0	1	1
Aug-06	overcast	5.0	15	14	0	0	0	229	98%	25	0	0	6	0	1	0
Aug-07	overcast	5.0	15	13	2	1	3	232	99%	26	0	0	43	1	1	0
Aug-08	clear	4.5	16	20	0	0	0	232	99%	1	0	0	5	0	0	0
Aug-09	clear	4.0	17	19	0	0	0	232	99%	36	1	0	12	2	1	0
Aug-10	partly cloudy	4.0	17	22	0	0	0	232	99%	42	0	0	31	5	2	2
Aug-11	partly cloudy	3.5	17	18	0	0	0	232	99%	57	2	0	32	3	1	0
Aug-12	overcast	4.0	16.5	14	0	0	0	232	99%	24	1	0	33	0	1	0
Aug-13	partly cloudy	4.0	17		1	0	1	233	100%	44	4	0	61	0	0	0
Aug-14	clear	4.0	18	17	1	0	1	234	100%	29	1	0	51	0	0	0
Aug-15	partly cloudy	4.0	17.5	20	0	0	0	234	100%	22	1	0	29	0	0	0
Aug-16	clear	3.5	17	18	0	0	0	234	100%	25	0	0	26	0	0	0
Aug-17	partly cloudy	4.0	18.5	22	0	0	0	234	100%	16	0	0	24	0	0	0
Aug-18	clear	3.0	17	18	0	0	0	234	100%	11	1	0	22	0	0	0
Aug-19	showers	3.0	18	18.5	0	0	0	234	100%	4	1	0	15	0	0	0
Aug-20	partly cloudy	4.0	18	18.5	0	0	0	234	100%	8	1	0	0	0	0	0
Aug-21	clear	3.0	18	18	0	0	0	234	100%	26	0	0	26	0	0	0
Aug-22	clear	3.5	17	18	0	0	0	234	100%	11	3	0	15	0	0	0
Total					213	21	234			821	46	0	799	42	855	23

[a] The trap was operated continuously from 1900hr on June 23 to 0900hr on August 22.

In 2004, the first sockeye salmon passed on June 26 and the last on August 14. The midpoint of the sockeye run was on July 13 and half of the sockeye escaped between July 3 and 15. The timing of the 2004 run was later than in 2003 and 2002 (Figure 14).

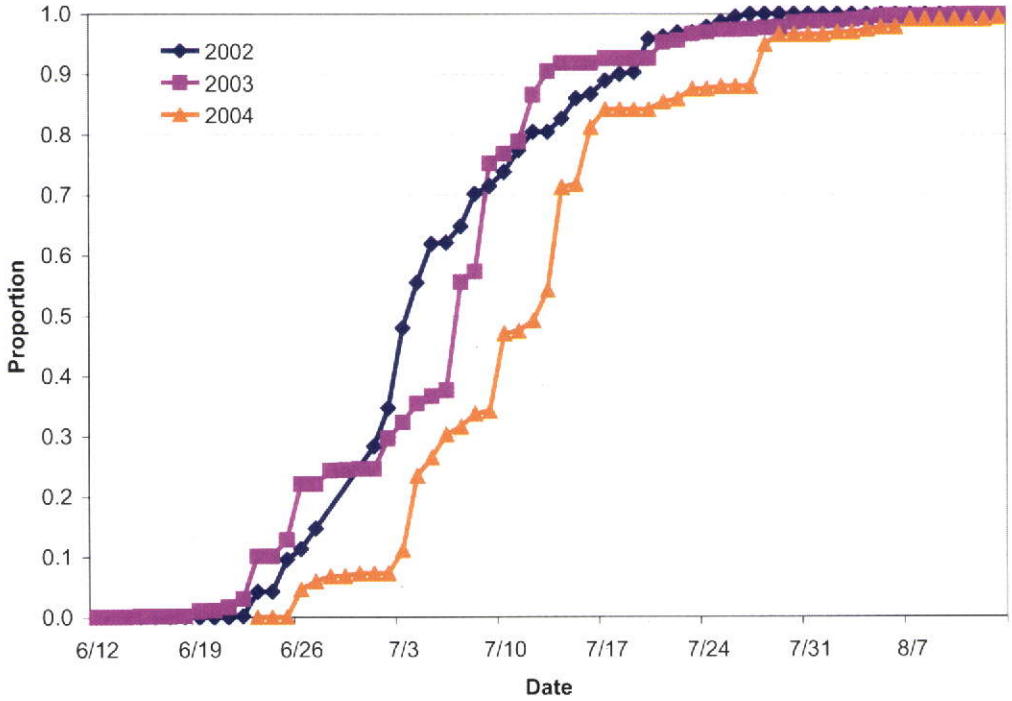


Figure 14. Cumulative proportion of sockeye salmon counted through the Pavlof outlet fishpass, 2002, 2003, and 2004.

All (100%) of the sockeye passed upstream of the trap were marked with an adipose finclip clip as part of the trap to spawning ground mark-recapture study. Two marked fish were recaptured in the trap and re-released – these fish had dropped back over the falls and re-ascended the fish pass.

Between July 21 and August 12, five mark-recapture trips were made to the main inlet stream "study area" (Table 24). The study area includes the fish schooled off the mouth of the main inlet stream as well as those in the stream. All the sockeye sampled and marked on the July 21-22 and July 25-26 dates were caught in a beach seine fished at the mouth of the main inlet stream. One hundred and sixty-six (33%) of the 508 sockeye examined on these trips had adipose fin clip yielding a simple Peterson escapement estimate of 715 (CV 3%) sockeye salmon into Pavlof Lake (Table 24). Thus, thirty percent (213 of 715) of the sockeye salmon used the fish pass to migrate into the lake in 2004.

Table 24. Mark-recapture estimate of the escapement of adult and jack sockeye salmon in Pavlof Lake, 2004.

Marking Data - from Trap on Outlet Fishpass:			
Release Period	Trap Count	Total Marked	
Total	234	234	
Recapture Data - from MIS Index Area:			
Date	Number Examined	Number with Marks	Percent Marked
7/21	173	45	26%
7/22	31	11	35%
7/25	96	20	21%
7/26	73	16	22%
7/29	69	37	54%
7/30	42	20	48%
8/6	9	8	89%
8/7	5	3	60%
8/11	6	4	67%
8/12	4	2	50%
Total	508	166	33%
Peterson Estimate[a]:			
Number	S.E.	CV	
715	24	3%	

[a] Chapman's modification (Seber 1982):

$$\hat{N} = \frac{(M+1)(C+1)}{(R+1)} - 1 \qquad \mathrm{var}(\hat{N}) = \frac{(M+1)(C+1)(M-R)(C-R)}{(R+1)^2(R+2)}$$

Stream Mark-Recapture for Indexing Escapement: In 2004, project personnel completed the five, two-day, mark recapture trips to the study area in the main inlet stream described above. The modified Jolly-Seber estimate of sockeye spawning in the main inlet stream study area was 701 (Table 25). Standard errors could not be calculated since estimates of survival (Φ) were greater than one in trips 2 and 4. I do not know if this is due to errors in our record keeping or methods. Most of these fish were in and off the mouth of the main inlet stream during the first trip on July 21-22. Based on these estimates, 98% (701 of the 715 escapement) spawned in the study area in the lower part of the main inlet stream from late-July to early-August.

Table 25. Mark-recapture index of the abundance of adult and jack sockeye salmon in Pavlof Lake's main inlet stream study area, 2004.

Peterson Estimates for each Trip:

Trip No.	Dates	Number of New Fish Marked on Day 1 (M)	Number of New Fish Marked on Day 2	Number of Recaptures on Day 2 (R)	Total Number Caught on Day 2 (C)	Peterson Estimate for Trip (N*)	SE (N*)	CV (N*)
1	July 21-22	173	31	10	41	663	159.47	24.0%
2	July 25-26	158	63	24	87	415	44.89	10.8%
3	July 29-30	109	139	27	166	655	95.96	14.6%
4	Aug. 6-7	36	27	12	39	113	20.13	17.8%
5	Aug. 11-12	38	27	9	36	143	32.05	22.4%

Modified Jolly-Seber Estimates:

Trip No.	Dates	Marks from Trip 1	Marks from Trip 2	Marks from Trip 3	Marks from Trip 4	n = Total Number Caught this Trip	m = Total Number Recaps. this Trip	Ni = Peterson Est. for this Trip	M = m*N/n	ϕ = Mi+1 / (M− μ+v)	B = Ni+1 - fN	B* = B log(f)/ (f-1)
1	July 21-22					204	0	663	0	0.471	246	795
2	July 25-26	38				221	38	559	96	1.363	-106	-91
3	July 29-30	40	104			248	144	655	380	0.178	-3	-7
4	Aug. 6-7	3	17	28		63	48	113	86	1.179	10	9
5	Aug. 11-12	2	7	38	7	65	54	143	119	0.000	0	
										Total = sum(B*) =		707
										SE, CV =		[a]

[a]No standard error estimates could be calculated since survival rates in trips 2 and 4 were greater than one.

Foot/Boat Survey Counts: No beach spawning sockeye salmon were observed in the lake. Sockeye salmon were observed milling off the main inlet stream in mid- to late-July. These fish were difficult to see and no counts were attempted. Formal foot survey counts were conducted in the main inlet stream on July 19, 21, 30, August 6, 11, 12, and 19 (Table 26). The highest count of sockeye salmon in the MIS study area was 171 sockeye salmon (averaged across three observers) on July 30. This peak survey count was 24% of the 715 fish escapement. The sockeye salmon appeared to have moved from the lake to the main inlet stream on July 28 or 29. The run was essentially over on August 19.

Table 26. Foot survey counts of sockeye salmon in the main inlet stream study area, Pavlof Lake, 2004.

Date	Observer	Upstream Count	Downstream Count	Average
Jul-19	Jerome Abbott	0	0	0
	Myron Murphy	0	0	0
	Average	0	0	0
Jul-21	Ben Van Alen	2	2	2
	Myron Murphy	2	2	2
	Average	2	2	2
Jul-25		- no counts made/recorded -		
Jul-26		- no counts made/recorded -		
Jul-30	Ben Van Alen	190	184	187
	Bill Dalton, Jr.	128	126	127
	Jerome Abbott	206	192	199
	Average	175	167	171
Aug-06	Jerome Abbott	115	122	119
	Myron Murphy	110	112	111
	Average	113	117	115
Aug-11	Eli Sheakley	93	101	97
	Jerome Abbott	89	96	93
	Average	91	99	95
Aug-12	Ben Van Alen	43	53	48
	Eli Sheakley	62	82	72
	Jerome Abbott	55	68	62
	Kyle Brownlee	50	61	56
	Average	53	66	59
Aug-19	Bill Dalton, Jr.	4	4	4
	Eli Sheakley	3	5	4
	Jerome Abbott	4	4	4
	Myron Murphy	4	4	4
	Average	4	4	4

Age, Sex, and Length Composition: Sixty-three percent of the 82 ageable sockeye salmon sampled at the trap were age-1.3 and 35% were age-1.2 (Table 27). Age-1.3 fish were the dominant age class all three years (Table 28). The average length of the age-1.3 fish was 576 mm (Table 29).

Table 27. Age and sex composition of sockeye salmon sampled from the trap at the top of the outlet fishpass at Pavlof Lake, 2004.

	Brood Year and Age Class			
	2000	1999	1998	
	1.2	1.3	1.4	Total
Male				
Sample Size	7	30	1	38
Percent	9.1	41.6	1.9	52.6
Std. Error	3.5	7.4	1.9	7.6
Female				
Sample Size	20	24		44
Percent	25.8	21.6		47.4
Std. Error	7.2	4.3		7.6
All Fish				
Sample Size	27	54	1	82
Percent	34.9	63.2	1.9	100.0
Std. Error	7.4	7.4	1.9	

Table 28. Age composition of sockeye salmon sampled from the trap at the top of the outlet fishpass at Pavlof Lake, 2002, 2003, and 2004.

		Age						
Year	Sample Size	1.1	1.2	1.3	1.4	2.2	2.3	Total
2002	49		2%	94%		4%		100%
2003	233	0%	5%	92%			3%	100%
2004	82		33%	66%	1%			100%

Table 29. Length composition (mm), by sex, of sockeye salmon sampled from the trap at the top of the outlet fishpass at Pavlof Lake, 2004.

		Brood Year and Age Class			
		2000	1999	1998	
		1.2	1.3	1.4	Total
Combined Periods					
Male	Avg. Length	539	586	565	574
	Std. Error	4.7	4.2		4.6
	Sample Size	7	30	1	38
Female	Avg. Length	507	565		531
	Std. Error	7.7	4.0		6.0
	Sample Size	20	24		44
All Fish	Avg. Length	513	576	565	553
	Std. Error	6.5	3.4		4.5
	Sample Size	27	54	1	82

Hoktaheen 2004

Stream Mark-Recapture for Indexing Escapement: Between September 3 and 23, 2004, five independent, two day, mark-recapture trips were made to the study area in upper Hoktaheen Lake's main inlet stream. Sockeye salmon were caught using seines at the mouth and dipnets in the stream. When summed across all trips, 727 sockeye salmon were marked, 359 were examined for marks, and 144 marked fish were recaptured. The modified Jolly-Seber estimate of the total sockeye abundance in the main inlet stream study area was 565 (CV 4.4%; Table 30). Most of the sockeye salmon that spawned in the main inlet stream were in or off the mouth of the stream in early-September as we observed in 2002 and 2004.

Table 30. Modified Jolly-Seber estimate of the abundance of adult sockeye salmon in upper Hoktaheen Lake's main inlet stream study area, 2004.

Peterson Estimates for each Trip:

Trip No.	Dates	Number of New Fish Marked on Day 1 (M)	Number of New Fish Marked on s on Day 2	Number of Recapture (R)	Total Number Caught on Day 2 (C)	Peterson Estimate for Trip (N*)	SE (N*)	CV (N*)
1	Sept. 3-4	202	99	67	166	498	37.68	7.6%
2	Sept. 7-8	149	56	34	90	389	44.65	11.5%
3	Sept. 12-13	106	38	19	57	309	49.42	16.0%
4	Sept. 17-18	47	17	22	39	82	8.02	9.7%
5	Sept. 22-23	8	5	2	7	23	7.75	33.7%

Modified Jolly-Seber Estimates:

Trip No.	Dates	Marks from Trip 1	Marks from Trip 2	Marks from Trip 3	Marks from Trip 4	n = Total Number Caught this Trip	m = Total Number Recaps. this Trip	Ni = Peterson Est. for this Trip	M = m*N/n	ϕ = Mi+1 / (M−μ+v)	B = Ni+1 - fN	B* = B log(f)/(f-1)
1	Sept. 3-4					301	0	498	0	0.706	38	461
2	Sept. 7-8	112				205	112	389	213	0.654	55	67
3	Sept. 12-13	32	61			144	93	309	200	0.206	19	38
4	Sept. 17-18	11	4	25		64	40	82	52	0.281	0	0
5	Sept. 22-23	0	3	1	8	13	12	23	21	0.000	0	
											Total = sum(B*) =	565
											SE, CV =	25, 4.4%

Four mark-recapture trips were completed in 2004 in the study area in the upper third of upper Hoktaheen Lake's outlet stream. Between September 14 and 28, 241 were marked, 139 were examined for marks, and 43 were recaptured. The modified Jolly-Seber estimate of sockeye spawning in this outlet stream study area was 251 (CV = 6.8%; Table 31). As in the main inlet stream, there did not appear to be many new fish arriving in the study area after the first mark-recapture trip.

Table 31. Modified Jolly-Seber estimate of the abundance of adult sockeye salmon in upper Hoktaheen Lake's outlet stream study area, 2004.

Peterson Estimates for each Trip:

Trip No.	Dates	Number of New Fish Marked on Day 1 (M)	Number of New Fish Marked on Day 2	Number of Recaptures on Day 2 (R)	Total Number Caught on Day 2 (C)	Peterson Estimate for Trip (N*)	SE (N*)	CV (N*)
1	Sept. 14-15	41	48	17	65	153	22.78	14.9%
2	Sept. 18-19	53	25	15	40	137	21.98	16.0%
3	Sept. 23-24	28	14	6	20	86	21.87	25.4%
4	Sept. 27-28	23	9	5	14	59	15.21	25.8%

Modified Jolly-Seber Estimates:

Trip No.	Dates	Marks from Trip 1	Marks from Trip 2	Marks from Trip 3	n = Total Number Caught this Trip	m = Total Number Recaps. this Trip	Ni = Peterson Est. for this Trip	M = m*N/n	ϕ = Mi+1 / (M−μ+v)	B = Ni+1 - fN	B* = B log(f)/(f-1)
1	Sept. 14-15				89	0	153	0	0.732	25	160
2	Sept. 18-19	37			78	37	137	65	0.347	38	62
3	Sept. 23-24	6	12		42	18	86	37	0.454	20	29
4	Sept. 27-28	1	1	13	32	15	59	28			
										Total = sum(B*) =	251
										SE, CV =	17, 6.8%

Comparison of Abundance Indices - 2001 to 2004: The Peterson abundance estimate of sockeye salmon in the main inlet stream study area in early September was 498 in 2004 compared to 1,840 in 2003, 737 in 2002, and 660 in 2001 (Table 32). In the outlet stream study area, the abundance index was 137 fish in 2004 compared to 210 in 2003 and 233 in 2002 (Table 33).

Table 32. Abundance index of sockeye salmon in Hoktaheen Lake's main inlet stream from the first two-day mark-recapture trip made in early-September in 2001, 2002, 2003, and 2004.

Year	Date Marked	Number Marked	Date Examined	Number Examined for Marks	Number Recaptured	Peterson Estimate	SE	CV%
2001	9/3	178	9/4	132	35	660	83	13%
2002	9/5	312	9/6	242	102	737	45	6%
2003	9/4	425	9/5	496	114	1840	128	7%
2004	9/3	202	9/4	166	67	498	38	8%

Table 33. Abundance index of sockeye salmon in upper Hoktaheen Lake's outlet stream study area from mid-September two-day mark-recapture trips in 2002, 2003, and 2004.

Year	Date Marked	Number Marked	Date Examined	Number Examined for Marks	Number Recaptured	Peterson Estimate	SE	CV%
2002	9/17	140	9/18	62	37	233	20	9%
2003	9/17	42	9/18	48	9	210	50	24%
2004	9/18	53	9/19	40	15	137	22	16%

Foot/Boat Survey Counts: In 2004, boat and foot surveys were made to count live sockeye adults in the main inlet stream and outlet study areas on days when mark-recapture sampling was done (Table 34). As in 2002 and 2003, we observed adult sockeye spawning only in the upper lake's main inlet stream and outlet. No sockeye salmon were observed in lower Hoktaheen Lake in a boat survey around the lake on September 17, 2004. Thirty three sockeye salmon were observed swimming along the southeast shore of upper Hoktaheen Lake during a boat survey on September 27, 2004, the projects last day in the field. The lake is stained dark from tannin and it is difficult to see salmon if they are more than one or two meters deep. We did not attempt to count the sockeye schooled off the mouth of the main inlet stream since they are difficult to see and swim in and out of view yielding variable and unreliable counts.

Table 34. Boat and foot survey counts of live adult sockeye salmon in the Hoktaheen Lake system, 2004.

	Upper Lake's Main Inlet Stream		Outlet of Upper Lake					
Date	Above Index Area	Index Area	Below Index Area	Index Area	Upper Lake[a]	Lower Lake Total	Hoktaheen Creek Total	Total
9/4	91	214						304
9/7	33	209						242
9/8	25	192						217
9/12	23	141						165
9/13	8	108						116
9/14			7	62				69
9/15			12	75				87
9/17	3	54				0	0	58
9/18		41	5	49	0			95
9/19			9	78				87
9/22	4	19						23
9/23		15	6	46				66
9/24			7	72				79
9/27			7	85	33			124

[a]These fish were all observed along the Southeast shore of the lake.

Consistent with the mark-recapture estimates (Tables 30 and 31), the survey counts were higher in the main inlet stream than in the outlet until late in September (Table 34).

Adult Age, Sex, and Length: Sockeye salmon were sampled for scales (age), sex, and length data both from the main inlet stream (147 ageable scales) and the outlet (95 ageable scales) study areas. In the main inlet stream, age-1. fish comprised 96% of the sample and 53% were age-1.3 (Table 35). In the outlet stream, age-1. fish also comprised 96% of the sample but 55% were age-1.2 (Table 36). The inlet stream sample included only two age-1.1 jacks and few were observed in our mark-recapture sampling.

Table 35. Age and sex composition of sockeye salmon sampled in the main inlet stream to upper Hoktaheen Lake from September 3 to 17, 2004.

	Brood Year and Age Class					
	2001	2000	1999	1999	1998	
	1.1	1.2	1.3	2.2	2.3	Total
Male						
Sample Size	2	33	36		3	74
Percent	2.5	18.1	25.4		1.9	47.9
Std. Error	1.7	4.0	5.2		1.3	5.7
Female						
Sample Size		34	33	2	3	72
Percent		22.0	27.6	0.6	1.9	52.1
Std. Error		5.0	5.5	0.4	1.3	5.7
All Fish						
Sample Size	2	68	69	2	6	147
Percent	2.5	40.3	52.8	0.6	3.7	100.0
Std. Error	1.7	5.7	5.7	0.4	1.8	

Table 36. Age and sex composition of sockeye salmon sampled in the outlet stream of upper Hoktaheen Lake from September 14 to 27, 2004.

	Brood Year and Age Class			
	2000	1999	1998	
	1.2	1.3	2.3	Total
Male				
Sample Size	30	30	1	61
Percent	27.4	24.5	0.5	52.4
Std. Error	6.5	3.9	0.5	6.7
Female				
Sample Size	17	14	3	34
Percent	27.8	17.3	2.4	47.6
Std. Error	7.0	6.1	1.6	6.7
All Fish				
Sample Size	47	44	4	95
Percent	55.3	41.7	3.0	100.0
Std. Error	6.8	6.8	1.7	

About half the fish were age-2. in 2001 and 2002 but age-1. fish dominated the samples from the main inlet stream in 2003 and 2004 (Table 37).

Table 37. Age composition of sockeye salmon sampled in the main inlet stream and outlet of upper Hoktaheen Lake from 2001 to 2004.

		Age					
Year	Sample Size	1.1	1.2	1.3	2.2	2.3	Total
Main Inlet Stream:							
2001	95	4%	19%	29%	18%	29%	100%
2002	218		25%	24%	44%	7%	100%
2003	262	1%	5%	90%	1%	2%	100%
2004	147	1%	46%	47%	1%	4%	100%
Outlet:							
2001			- not sampled-				
2002	213	0%	37%	37%	16%	9%	100%
2003	149		18%	77%	2%	3%	100%
2004	95		49%	46%		4%	100%

The average length of sockeye sampled from the main inlet stream was 525mm and from the outlet stream was 524mm (Tables 38 to 39).

Table 38. Length composition (mm), by sex, of adult sockeye salmon sampled in Hoktaheen Lake's main inlet stream from September 3 to 17, 2004.

		Brood Year and Age Class					
		2001	2000	1999	1999	1998	
		1.1	1.2	1.3	2.2	2.3	Total
Male	Avg. Length	355	489	566		569	531
	Std. Error	15.0	6.1	3.7		7.3	6.4
	Sample Size	2	33	36		3	74
Female	Avg. Length		483	554	498	538	521
	Std. Error		4.1	3.9	22.5	3.3	4.6
	Sample Size		34	33	2	3	72
All Fish	Avg. Length	355	486	559	498	553	525
	Std. Error	15.0	3.5	2.8	22.5	8.6	3.9
	Sample Size	2	68	69	2	6	147

Table 39. Length composition (mm), by sex, of sockeye salmon sampled in the outlet stream of upper Hoktaheen Lake from September 14 to 27, 2004.

		Brood Year and Age Class			
		2000	1999	1998	
		1.2	1.3	2.3	Total
Male	Avg. Length	506	568	550	530
	Std. Error	4.1	3.8		4.6
	Sample Size	30	30	1	61
Female	Avg. Length	482	549	558	513
	Std. Error	4.5	5.8	5.0	6.7
	Sample Size	17	14	3	34
All Fish	Avg. Length	496	558	558	524
	Std. Error	3.6	3.4	3.8	4.0
	Sample Size	47	44	4	95

Limnology 2004

Light, Temperature, and Dissolved Oxygen Profiles

An underwater photometer was used to record the incident light levels in Neva, Pavlof, and Hoktaheen Lakes at 0.5 m intervals from just below the lake surface (depth 0.0) to the depth with about 1% of this subsurface reading (Table 40).

Table 40. Light meter and secchi disk readings at Stations A in Neva, Pavlof, and Hoktaheen Lakes, 2004.

Light Meter Readings ($\mu mol\ s^{-1}\ m^{-2}$):

	Neva				Pavlof				Hoktaheen	
Depth (m)	Jun-16	Jul-24	Aug-29	Oct-12	Jun-16	Jul-24	Aug-29	Oct-12	Sep-05	Sep-27
0.0	- meter problems -	-931.9	-304.3	-64.2	-1370.7	-32.6	-161.2	-377.2	-40.9	-23.4
0.5		-750.1	-252.9	-38.4	-1051.2	-2.7	-83.3	-90.8	-11.7	-23.4
1.0		-675.7	-280.8	-30.1	-847.7	-2.0	-73.9	-54.7	-6.0	-13.2
1.5		-558.6	-251.6	-23.3	-655.0	-1.5	-49.5	-21.9	-2.8	-13.0
2.0		-478.3	-231.5	-17.1	-540.7	-1.2	-42.4	-5.0	-2.0	-3.9
2.5		-463.2	-221.0	-14.3	-444.8	-1.0	-29.5	-3.3	-1.2	-0.4
3.0		-488.3	-211.2	-12.9	-352.9	-0.9	-23.3	-3.8	-0.6	
3.5		-489.6	-197.4	-10.3	-294.7	-0.7	-16.8	-3.6	-0.4	
4.0		-440.0	-197.5	-8.1	-228.8	-0.6	-17.9	-2.5	-0.2	
4.5		-361.1	-180.8	-6.4	-182.7	-0.5	-7.0	-1.8	-0.1	
5.0		-279.0	-162.3	-5.4	-151.7	-0.3	-4.6	-1.7	-0.1	
5.5		-227.0	-148.8	-3.0	-129.1	-0.2	-2.2		-0.1	
6.0		-216.6	-138.6	-2.3	-94.8	-0.2	-1.2		-0.1	
6.5		-150.4	-122.7	-1.8	-74.1	-0.1	-0.8		-0.1	
7.0		-116.6	-107.8	-1.7	-52.0				0.0	
7.5		-85.8	-92.8	-1.5					0.0	
8.0		-79.5	-83.1	-1.3					0.0	
8.5		-55.4	-78.4	-1.1						
9.0		-53.5	-64.1	-1.0						
9.5		-51.0	-55.6	-0.8						
10.0		-31.3	-50.2	-0.7						
10.5		-22.5	-47.8	-0.6						
11.0		-17.5	-42.2	-0.6						
11.5		-12.8	-38.5	-0.5						
12.0		-9.8	-35.6	-0.5						
12.5		-7.0	-32.9	-0.5						
13.0		-5.6	-31.1	-0.5						
13.5		-5.5	-29.1	-0.4						
14.0		-3.6								
14.5		-1.8								
15.0		-1.4								
15.5		-1.2								
16.0		-1.1								
16.5		-0.7								
Secchi Disk (averaged depth of disappear/reappear readings in meters):										
	7.8	6.8	7.0	3.9	6.3	3.8	3.3	1.8	2.6	2.5

The mean euphotic zone depths (EZD) were 15.8 m in Neva Lake, 7.1 m in Pavlof Lake, and 4.1 m in Hoktaheen Lake (Table 41). These EZD's were similar to those observed in these lakes in 2002 and 2003.

Table 41. Euphotic zone depths in Neva, Pavlof, and Hoktaheen Lakes, 2004.

Lake	Sample Date	EZD (m)
Neva	Jul-24	10.5
	Aug-29	24.8
	Oct-12	12.3
	Average	15.8
Pavlof	Jun-23	10.4
	Jul-17	7.3
	Aug-18	6.0
	Oct-15	4.6
	Average	7.1
Hoktaheen	Sep-05	5.1
	Sep-27	3.2
	Average	4.1

Vertical temperature stratification was evident in Neva Lake from the first sampling on June 16 to the last sampling on October 12 (Table 42). The epilimnion extended down to about 6 m on the July 24 and August 29 sampling dates. The lowest reading in the hypolimnion was 4.5 °C. The percent O_2 saturation was above 80% at all depths down to 8 m in the June, July, and August trips (Table 36).

Vertical stratification in temperature or dissolved oxygen was evident but less pronounced in the 8 m deep Pavlof Lake (Table 43). The temperature averaged 14.4, 16.4, and 16.3 °C on the June, July, and August trips. The percent O_2 saturation increased from June to August.

Vertical temperature stratification was evident in Hoktaheen Lake in early-September but not in late-September (Table 44). The epilimnion extended down to about 7 m on September 5. The hypolimnion remained below 6 °C in September. Compared to Neva Lake, the percent O_2 saturation was lower near the surface but higher at depths.

Table 42. Temperature and dissolved oxygen profiles for Neva Lake, 2004.

	Temperature (°C)				Dissolved Oxygen (mg L^{-1})				Percent O_2 Saturation[a]			
Depth (m)	Jun-16	Jul-24	Aug-29	Oct-12	Jun-16	Jul-24	Aug-29	Oct-12	Jun-16	Jul-24	Aug-29	Oct-12
1	14.6	19.5	18.7	10.0	8.4	8.1	8.1	9.6	83%	88%	87%	85%
2	14.5	19.6	18.7	10.0	8.6	7.8	8.0	9.6	84%	85%	86%	85%
3	14.4	19.6	18.7	10.0	8.5	7.5	7.9	9.5	83%	82%	85%	84%
4	13.2	19.2	18.6	10.0	8.9	7.0	7.8	9.0	85%	76%	84%	79%
5	12.7	17.0	18.6	10.0	8.8	11.1	7.6	8.8	83%	115%	82%	78%
6	12.1	15.0	17.6	10.0	9.3	12.2	10.9	8.3	86%	121%	115%	73%
7	9.9	12.3	14.3	10.0	10.3	12.1	10.8	7.8	91%	113%	106%	69%
8	8.0	10.3	11.5	9.8	10.3	11.1	9.7	7.1	87%	99%	89%	62%
9	6.9	8.7	9.7	9.6	8.9	8.8	8.4	6.3	73%	76%	74%	55%
10	6.2	7.4	8.3	9.4	8.1	6.5	7.7	5.3	65%	54%	66%	46%
11	5.6	6.5	7.3	8.7	7.2	7.5	6.6	4.0	57%	61%	55%	34%
12	5.3	6.0	6.7	7.5	6.3	6.0	4.9	2.8	49%	48%	40%	23%
13	4.9	5.7	6.3	6.9	4.2	3.2	2.6	1.8	33%	25%	21%	15%
14	4.8	5.3	6.0	6.4	3.3	-0.1	1.3	0.1	25%	-1%	11%	1%
15	4.7	5.1	5.6	5.9	2.5	-2.4	-1.1	-0.9	19%	-19%	-9%	-7%
16	4.6		5.3	5.7	1.2		-1.8	-0.9	9%		-14%	-7%
17	4.5		5.3	5.7	-0.2		-2.1	-0.9	-1%		-16%	-7%

[a] $\%O_2$ saturation = (dissolved oxygen) / (0.005399 * temperature^2 - 0.381784 * temperature + 14.571252)

Table 43. Temperature and dissolved oxygen profiles for Pavlof Lake, 2004.

	Temperature (°C)			Dissolved Oxygen (mg L^{-1})			Percent O_2 Saturation[a]		
Depth (m)	Jun-23	Jul-17	Aug-18	Jun-23	Jul-17	Aug-18	Jun-23	Jul-17	Aug-18
1	16.9	19.4	18.7	7.5	7.8	9.3	78%	85%	100%
2	16.0	18.2	17.5	7.3	6.5	9.0	74%	69%	94%
3	15.3	17.2	16.1	6.9	5.7	6.1	69%	59%	62%
4	14.8	15.8	16.1	5.5	5.1	6.1	55%	52%	62%
5	12.0	14.3	15.2	5.0	2.8	4.5	46%	28%	45%
6	11.2	13.5	13.9	4.2	-1.1	0.1	38%	-10%	1%
7	10.9			3.5			32%		

[a] $\%O_2$ saturation = (dissolved oxygen) / (0.005399 * temperature^2 - 0.381784 * temperature + 14.571252)

Table 44. Temperature and dissolved oxygen profiles for Hoktaheen Lake, 2004.

	Temperature (°C)		Dissolved Oxygen (mg L^{-1})		Percent O_2 Saturation[a]	
Depth (m)	Sep-05	Sep-27	Sep-05	Sep-27	Sep-05	Sep-27
1	14.5	9.7	8.1	9.3	80%	82%
2	14.4	9.7	8.0	9.1	79%	80%
3	14.4	9.7	8.1	8.9	80%	78%
4	13.7	9.7	8.0	8.9	77%	78%
5	12.2	9.7	8.0	8.7	75%	76%
6	9.4	9.6	8.7	8.4	76%	74%
7	8.1	9.5	9.1	8.2	77%	72%
8	6.9	9.2	9.7	8.0	80%	70%
9	5.9	8.9	10.1	7.6	81%	65%
10	5.5	8.6	10.2	7.2	81%	62%
11	5.2	8.1	10.4	6.9	82%	59%
12	4.9	7.1	10.7	6.9	84%	56%
13	4.7	6.3	10.9	6.7	85%	54%
14	4.6	5.8	10.7	6.6	83%	53%
15	4.6	5.4	10.6	6.5	82%	51%
16	4.5	5.0	10.5	6.4	81%	50%
17	4.5	4.7	10.4	6.4	80%	49%
18	4.5	4.6	10.4	6.1	80%	47%
19	4.5	4.6	10.3	5.9	80%	45%
20	4.4	4.5	10.3	5.5	79%	42%
25	4.4	4.5	6.8	3.8	52%	30%
30	4.5	4.5	3.1	2.5	24%	19%
35	4.5	4.6	1.7	1.5	13%	11%
40	4.5	4.6	1.6	0.9	12%	7%
45	4.5	4.6	1.2	0.6	9%	4%
50	4.6	4.6	0.1	0.3	1%	2%

[a] $\%O_2$ saturation = (dissolved oxygen) / (0.005399 * temperature^2 - 0.381784 * temperature + 14.571252)

Secondary Production

The seasonal mean density (number m-2) of macro zooplankton from vertical tows at Stations A and B in Neva, Pavlof, and Hoktaheen Lakes was 311,311, 16,022, and 153,698 (Tables 45, 46, and 47). The weighted biomass (mg m-2) was 582, 13, and 463, respectively (Tables 45, 46, and 47). The samples were dominated by Daphnia in Neva Lake, Bosmina in Pavlof Lake, and Cyclops in Hoktaheen Lake. The density and biomass of zooplankton in Pavlof Lake was extremely low but the lake is only 7.5 m deep.

Table 45. Density, size, and biomass of zooplankton in Neva Lake, June to October, 2004.

	Macrozooplankton Density (no./m^2), by date								
Taxa	6/16	7/24	8/29	10/12	Seasonal Mean	%	Weighted Mean Wet Length (mm)	Weighted Biomass (mg/m^2)	%
Station A:									
Ergasilis									
Epischura									
Ovig. *Epischura*									
Diaptomus									
Ovig *Diaptomus*									
Cyclops	184,921	35,660	7,641	84,055	78,069	26%	0.84	193.37	32%
Ovig. *Cyclops*	14,264	4,160	509	509	4,861	2%	1.10	21.48	4%
Harpaticus									
Nauplii	3,057	4,755	3,566	1,528	3,227	1%			
Bosmina	108,507	12,481	12,736	16,811	37,634	13%	0.40	55.37	9%
Ovig. *Bosmina*	1,019	0	0	5,094	1,528	1%	0.52	3.87	1%
Daphnia l.	116,149	79,640	152,827	225,166	143,446	48%	0.73	331.32	54%
Ovig. *Daphnia l.*	2,038	594	509	2,547	1,422	0%	0.94	5.74	1%
Daphnia r.	509	0	509	0	255	0%	1.05	1.03	0%
Holopedium									
Ovig. *Holopedium*									
Chydorinae									
Polyphemus									
Immature Cladocera	40,754	17,236	32,094	29,037	29,780	10%			
Totals					300,221			612.18	
Tow Depth (m)	16.0	15.0	16.0	16.0					
Station B:									
Ergasilis									
Epischura									
Ovig. *Epischura*									
Diaptomus									
Ovig *Diaptomus*									
Cyclops	259,722	67,159	13,075	87,961	106,979	36%	0.83	259.71	42%
Ovig. *Cyclops*	20,801	11,887	0	0	8,172	3%	1.06	33.27	5%
Harpaticus									
Nauplii	5,943	9,509	7,132	2,377	6,240	2%			
Bosmina	115,894	28,528	70,131	20,801	58,839	20%	0.39	83.75	14%
Ovig. *Bosmina*	1,783	594	0	7,132	2,377	1%	0.47	4.94	1%
Daphnia l.	120,054	131,347	255,561	273,391	195,088	65%	0.76	493.39	81%
Ovig. *Daphnia l.*	1,783	0	1,189	0	743	0%	1.05	3.00	0%
Daphnia r.	594	0	0	0	149	0%			0%
Holopedium									
Ovig. *Holopedium*									
Chydorinae	0	0	594	0	149		0.32	0.14	
Polyphemus									
Immature Cladocera	36,848	33,282	61,810	61,810	48,438	16%			
Totals					427,173			878.20	
Tow Depth (m)	16.0	15.5	16.0	16.0					
Average of Stations A and B					363,697			745.19	

Table 46. Density, size, and biomass of zooplankton in Pavlof Lake, June to October, 2004.

Taxa	Macrozooplankton Density (no./m^2), by date 6/23	7/17	8/18	10/15	Seasonal Mean	%	Weighted Mean Wet Length (mm)	Weighted Biomass (mg/m^2)	%
Station A:									
Ergasilis									
Epischura									
Ovig. *Epischura*									
Diaptomus									
Ovig *Diaptomus*									
Cyclops	2,717	1,494	7,429	34	2,919	2%	0.49	2.32	3%
Ovig. *Cyclops*									
Harpaticus	34	0	0	0	9	0%	0.70	0.01	0%
Nauplii	306	2,140	9,212	0	2,915	2%			
Bosmina	883	6,079	380,073	102	96,784	80%	0.31	83.31	93%
Ovig. *Bosmina*	0	0	11,292	0	2,823	2%	0.36	3.34	4%
Daphnia l.	0	0	1,189	170	340	0%	0.73	0.79	1%
Ovig. *Daphnia l.*									
Daphnia r.									
Holopedium									
Ovig. *Holopedium*									
Chydorinae	0	0	1,189	0	297	0%	0.31	0.26	0%
Polyphemus									
Immature Cladocera	0	238	58,244	0	14,621	12%			
Totals					120,706			90.02	
Tow Depth (m)	5.5	5.0	6.5	5.0					
Station B:									
Ergasilis									
Epischura									
Ovig. *Epischura*									
Diaptomus	0	0	0	85	21		0.72	0.04	0%
Ovig *Diaptomus*									
Cyclops	10,953	764	2,717	0	3,609	3%	0.48	2.73	8%
Ovig. *Cyclops*						0%			
Harpaticus	0	0	340	0	85		0.47	0.06	0%
Nauplii	934	594	1,019	0	637	1%			
Bosmina	14,264	29,716	104,262	85	37,082	31%	0.31	31.73	88%
Ovig. *Bosmina*	85	679	3,057	0	955	1%	0.37	1.19	3%
Daphnia l.	0	0	0	340	85	0%	0.60	0.13	0%
Ovig. *Daphnia l.*						0%			
Daphnia r.						0%			
Holopedium									
Ovig. *Holopedium*									
Chydorinae	255	255	0	0	128		0.28	0.09	0%
Polyphemus									
Immature Cladocera	6,792	1,274	5,094	85	3,311	3%			
Totals					45,912			35.96	
Tow Depth (m)	3.5	2.3	3.5	5.0					
Average of Stations A and B					83,309			62.99	

Table 47. Density, size, and biomass of zooplankton in Hoktaheen Lake, September 2004.

Taxa	Macrozooplankton Density (no./m^2), by date 9/5	9/27	Sept. Mean	%	Weighted Mean Wet Length (mm)	Weighted Biomass (mg/m^2)	%
Station A:							
Ergasilis							
Epischura							
Ovig. *Epischura*							
Diaptomus							
Ovig *Diaptomus*							
Cyclops	356,597	412,464	384,531	80%	0.76	777.94	82%
Ovig. *Cyclops*	4,160	2,972	3,566	1%	1.22	19.56	2%
Harpaticus							
Nauplii	3,566	13,075	8,321	2%			
Bosmina	41,603	90,338	65,971	14%	0.47	134.87	14%
Ovig. *Bosmina*	1,189	7,132	4,161	1%	0.58	13.45	1%
Daphnia l.							
Ovig. *Daphnia l.*							
Daphnia r.							
Holopedium							
Ovig. *Holopedium*							
Chydorinae							
Polyphemus							
Immature Cladocera	13,670	11,887	12,779	3%			
Totals			479,327			945.81	
Tow Depth (m)	48.0	48.0					
Station B:							
Ergasilis							
Epischura							
Ovig. *Epischura*							
Diaptomus							
Ovig *Diaptomus*							
Cyclops	- Not Sampled -	468,925	468,925	98%	0.76	938.31	91%
Ovig. *Cyclops*		1,189	1,189	0%	1.26	7.02	1%
Harpaticus							
Nauplii		4,755	4,755	1%			
Bosmina		46,952	46,952	10%	0.44	84.71	8%
Ovig. *Bosmina*		1,783	1,783	0%	0.59	5.97	1%
Daphnia l.							
Ovig. *Daphnia l.*							
Daphnia r.							
Holopedium							
Ovig. *Holopedium*							
Chydorinae							
Polyphemus							
Immature Cladocera		1,783	1,783	0%			
Totals			525,387			1036.02	
Tow Depth (m)		45.0					
Average of Stations A and B			502,357			990.91	

DISCUSSION

Neva Lake is a relatively small 36.1 ha lake, but the Neva sockeye run has certainly been larger than expected with escapements of 5,002 in 2002, 11,393 in 2003, 9,513 in 2004, and 5,263 in 2005 (Table 11). These are the first estimates on record of the escapement of sockeye salmon into Neva Lake.

The subsistence and sport harvest of Neva sockeye salmon was relatively modest. Project personnel observed subsistence harvests of only 278, 312, and 598 sockeye salmon in 2003, 2004, and 2005, respectively, and a sport harvest of only 53 and 64 sockeye salmon in 2003 and 2004. The harvests reported on the State subsistence/personal use permits were 87, 397, and 276 in these years (Table 22) which suggests a tendency to underreport harvests on permits but more studies are needed to quantify any differences between actual and reported harvests. The harvest monitoring done by personnel operating the weir documents the observed harvest and effort but a formal stratified sampling design (Cochran 1977) would be needed to estimate the total harvest and effort.

The commercial purse seine harvest of Neva sockeye salmon is unknown but few were likely harvested in 2002 to 2005 since there were no seine openings to the West in Icy Strait, sub-Districts 114-21 and 114-23 (Figure 4), less than 300 sockeye harvested in a 1-day opening at Homeshore (114-25) in 2005, and less than 50 sockeye harvested in these years in four 1-day openings in Excursion Inlet (114-80). I would not expect many Neva sockeye to be harvested in seine openings across Icy Strait in the Port Althorp (114-50), Idaho Inlet (114-40), or Point Sophia (114-27) areas or in the Point Augusta (112-14) area. However, in 2001 to 2005 relatively large runs of pink salmon in northern inside areas of Southeast Alaska resulted in an increase in days and boats that fished in the Point Sophia and Point Augusta areas. A few Neva sockeye salmon might migrate through these areas in route to Neva Lake. The commercial seine harvest of Neva sockeye salmon is probably greatest when Excursion Inlet is opened in August to target chum salmon returning to the Excursion River as was done in the 1980s and 1990s (Figure 6). The Excursion River chum stock has declined since the mid-1960s (Figure 5) and it is unlikely that runs will be large enough in the next few years to support a directed seine fishery.

Annual troll harvests of sockeye salmon in District 114 has averaged less than 2,000 fish since the 1998; some are returning to Neva Lake and other small island and coastal systems in the northern inside area of Southeast Alaska, but most are probably returning to the large mainland rivers in Lynn Canal and Taku Inlet. Beginning in 2000, the Snettisham Hatchery has also had total returns of 100,000 to 500,000 sockeye salmon.

The Neva sockeye stock appears quite healthy the past four years given the low exploitation rate and relatively good escapements in such a small lake. Factors contributing to 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. Over 95% of the run has been composed of age-1. fish suggesting that the sockeye juveniles are attaining the threshold size to smolt after their first year of rearing in the lake and that the fry production is not exceeding the lake's rearing capacity. The relatively high zooplankton biomass and proportion of Daphnia in the lake is certainly good for sockeye production. 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. The liberalization in harvest limits and season did not result in any obvious increase in subsistence effort and harvest. However, if effort and harvest increases so will the need to monitor escapements. Federal subsistence harvest limits default to these State limits so nearly all subsistence fishing is done under authority of State subsistence/personal use permits. The first reported harvests on Federal subsistence permits were 34 sockeye salmon in 2005.

The migration of sockeye salmon into the lake is timed with increases in stream flow. This was particularly evident in 2004 when water levels were low well into September and there were distinct pulses of fish through the weir with any increase in water level (Figure 15). 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. Between June 20 and September 2, 2004 the temperature of Neva Creek around 0900 hour never got below 17°C (Figure 16). In 2005, the water levels did not get as low as in 2004, nor tend to be as warm, but water temperatures did peak between 18 to 21°C in mid-August (Figure 17). Bjornn and Reiser (1991) reported that the preferred migration temperatures for sockeye salmon are between 7.2 and 15.6 °C and McCullough (1999) reported the upper thermal tolerance for spawning sockeye salmon to be 14.4 to 16.1 °C.

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.

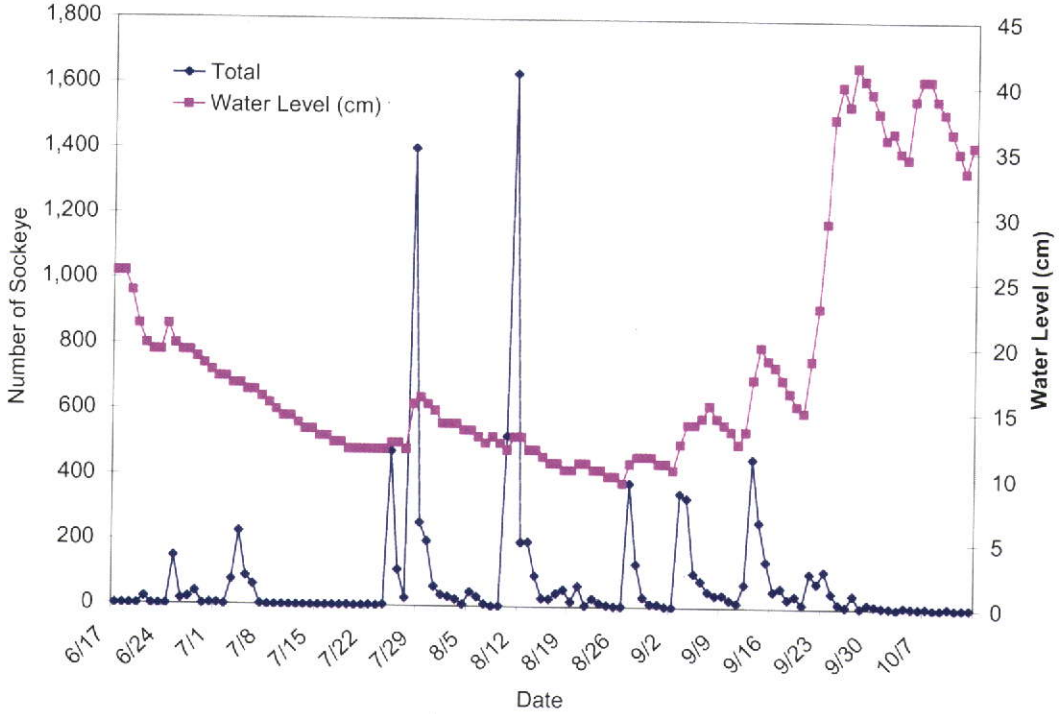


Figure 15. Daily sockeye migration and stream depth at the Neva weir, 2004.

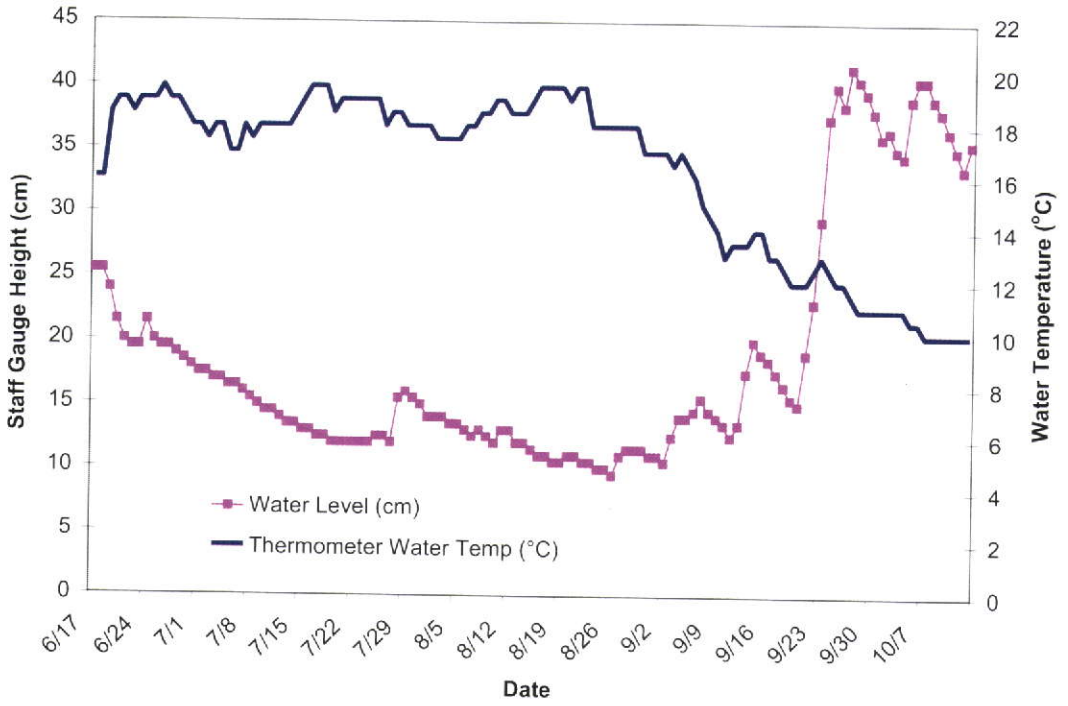


Figure 16. Daily stream depth and temperature at the Neva weir, 2004.

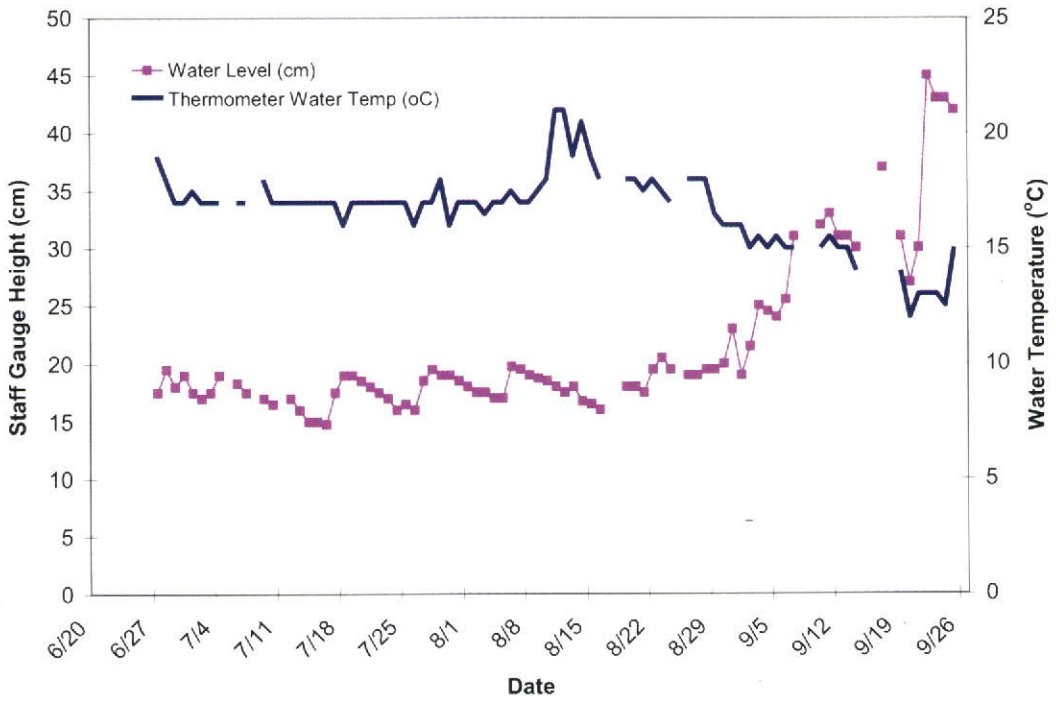


Figure 17. Daily stream depth and temperature at the Neva weir, 2005.

The weir-to-spawning ground mark-recapture estimates were the same as the weir counts in 2004 and 2005 but in 2002 and 2003 I relied on the mark-recapture studies to estimate the total sockeye escapement into Neva Lake. The weir is overbuilt for this small stream (Figure 18) but pickets were pulled and fish were passed by a non-project person during peak sockeye passage days. This weir tampering reflects a complication of operating a weir in a semi-remote location and the value of the back-up mark-recapture study for assuring a reliable estimate of the total escapement

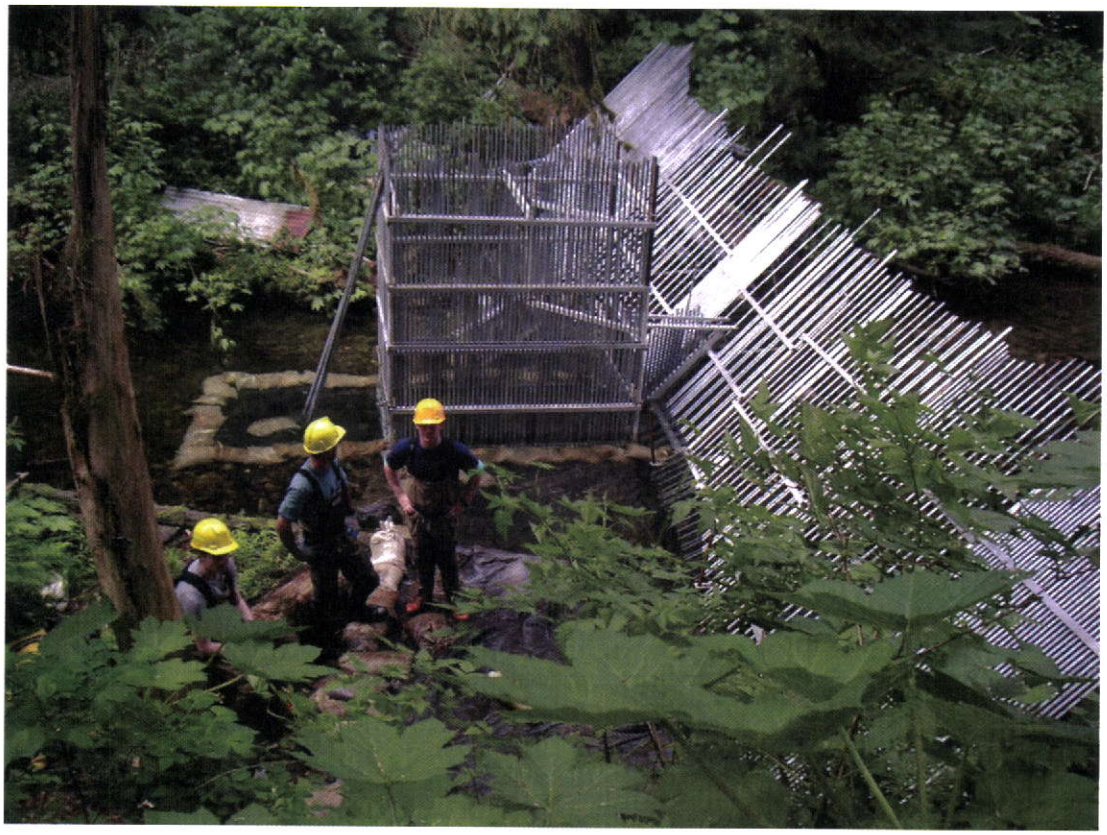


Figure 18. Photo of the Neva Creek weir and trap, under construction, June 2003.

Pavlof Lake proved to be a relatively small producer of sockeye salmon. Sockeye escapements were 1,350 in 2002, 1,474 in 2003, and 715 in 2004. Sockeye escaped into the lake from late-June through early/mid-August. A radio tagging study (Van Alen 2005) and mark-recapture studies in 2002 (Van Alen 2004), 2003 (Van Alen 2005) and 2004 (this paper) confirmed that most sockeye spawn in the lower part of the lake's main inlet stream from late-July to mid-August. The percentage of sockeye salmon that used the fish pass to migrate into the lake was <50% in 2002, 69% in 2003, and 30% in 2004. This variability in percent of fish using the fishpass makes it difficult to extrapolate the count of fish through the fishpass to an estimate of the total escapement into the system.

There has not been any appreciable directed subsistence or sport fishing on Pavlof sockeye salmon for over 30 years and the only appreciable harvest occurs in commercial purse seine fisheries in Icy Strait and Chatham Strait. The Pavlof system is a better producer of coho salmon than sockeye salmon. There are too few sockeye salmon to support directed subsistence fishing by more than a few families.

At Hoktaheen Lake, we were able to build on experiences in 2001 and 2002 to know where and when to mark-recapture sockeye spawners (Conitz and Cartwright 2002; Van Alen 2004). Keeping the fisheries crew at Hoktaheen during the month of September worked well in 2003 and 2004 since weather conditions in September are often too poor

to safely fly in and out of this small lake as needed for the multiple mark-recapture trips. With the fisheries crew on-site they were able to make the multiple trips needed for modified Jolly-Seber estimates of the sockeye escapement in the upper lakes main inlet stream and outlet stream study areas. These were the only two areas with any appreciable numbers of spawning sockeye observed. There might be areas of beach spawning but the dark, tannin stained, water made it difficult to see fish in the lake. The sockeye escapement in 2004 was certainly the smallest observed from 2001 to 2004 (Tables 32 and 33). Only 565 sockeye salmon were estimated spawning in Hoktaheen Lakes main inlet stream study area in 2004 (Table 30) compared to 3,438 in 2003 (Van Alen 2005).

The production of sockeye salmon from Hoktaheen Lakes certainly appears to be moderate and limited by escapements and system productivity. Sockeye salmon likely have a difficult time migrating from the bay to the lower lake during low flow conditions since there are times when a relatively high proportion of the run appears to be milling in Hoktaheen Cove waiting a freshet to raise water levels (B. Davidson, ADF&G, personal communication 2004). There has been no commercial purse seining along outer Yakobi Island since 1973 (Table 3) so the only targeted fishing on this stock in recent years is by subsistence users and, to a lesser extent, sport users. The habitat is pristine and protected as part of the West Chichagof Yakobi Wilderness area. Perhaps the rearing capacity of this tannin-stained lake is limited because most of the zooplankton are in an epilimnion that is too warm for juvenile growth in some years (Table 43). The euphotic zone depths averaged 3.9 to 4.2 meters in 2002 to 2004 compared to euphotic zone depths of 10.6 to 15.8 at Neva Lake (Table 4). The high proportion of age-2. fish observed in 2001 and 2002 (Table 37) reflects slow juvenile growth that is most likely a result of poor lake productivity than of high escapements and overcrowding by abundant fry and juveniles.

CONCLUSIONS

1. Sockeye salmon runs to Neva, Pavlof, and Hoktaheen Lakes have 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 U.S. Forest Service study. This project used a weir and mark-recapture methods to estimate the sockeye escapement into Neva Lake in 2002-2005, a fishpass trap and mark-recapture to estimate the sockeye escapement into Pavlof Lake in 2002-2004, and mark-recapture to index the sockeye escapement in Hoktaheen Lake in 2002-2004. Age, sex, and length data and limnological data were also collected to help assess the status of these stocks. This is the third and final report for the project FIS02-012; annual reports summarizing project findings for 2002 and 2003 are reported in Van Alen (2004 and 2005), respectively.

3. At Neva in 2004, the sockeye escapement into the lake was estimated to be 9,513 – 9,229 adults and 284 jacks – based on weir counts and validated with weir-to-spawning area mark-recapture studies. In 2005, the sockeye escapement into Neva Lake was estimated to be 5,263 – 5,018 adults and 244 jacks. For comparison, the Neva sockeye escapement was 5,003 (3,818 adults and 1,185 jacks) in 2002 and 11,393 (9,468 adults and 1,925 jacks) in 2003. Weir counts of coho salmon were 581, 1,691, 831, and 301, and Dolly Varden were 287, 279, 96, and 390, in 2002, 2003, 2004, and 2005.

4. 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. The midpoint of the escapement through the weir was August 11 in 2004 and August 2 in 2005. Averaged across 2002-2005, the mid-point of the run was August 8 and 80% of the run passed from July 12 to September 9. Sockeye salmon passed through the weir as early as June 10 and as late as October 13, the latest date the weir was operated. The sockeye migration into the lake was timed with rainfall events during the early/mid-summer low-flow periods. Die-offs of pre-spawned sockeye salmon were observed during low flow conditions in July and August in both the inlet stream and at a shallow braided section in the upper part of the outlet stream.

5. The age composition of Neva sockeye salmon was mostly, 95+%, age-1. fish in all years. Jack (age-.1) sockeye comprised up to 24% of the escapement.

6. The observed subsistence harvest of Neva Lake sockeye salmon was 44, 278, 312, and 590 in 2002, 2003, 2004, and 2005. Subsistence fishers reported harvests of 36, 87, 397, and 276 sockeye salmon on State permits. The first year Federal subsistence fishing permits were fished was in 2005 and 34 sockeye were reported harvested by two households The observed sport harvest was 53 and 64 sockeye salmon in 2003 and 2004.

7. The Neva sockeye stock appears healthy in 2002 to 2005. There is a good temporal and spatial distribution and abundance of spawners, relatively low harvest by commercial, sport, and subsistence users, and the freshwater habitat is relatively undisturbed and protected.

8. Results from the Neva weir project were used to justify increases in subsistence harvest limits and season dates on State subsistence/personal use harvest permits. Annual escapements need to be monitored if subsistence effort increases in response to the increased subsistence fishing opportunity.

9. At Pavlof in 2004, the sockeye escapement into the lake was 715 (CV = 3%) based on sockeye marked at the outlet fishpass and examined for marks in, and off the mouth, of the main inlet stream. The sockeye escapement into the lake was 1,350 (CV=6%) in 2002 and 1,474 (CV=2%) in 2003. Between 30 and 69 percent of the sockeye salmon used the fishpass to migrate into the lake in years

2002 to 2004. The sockeye migrated into the lake from the third week in June to early/mid-August. Age-1.3 fish dominated the escapement in all years. A radio tagging study in 2003 found that the sockeye spawn in the lower part of the main inlet stream from late-July to mid-August. This was supported by modified Jolly-Seber mark-recapture studies that estimated 1,452 and 707 fish in the main inlet stream study area in 2003 and 2004. The Pavlof system appears to be a better producer of coho salmon than sockeye salmon. There are too few sockeye salmon to support directed subsistence fishing by more than a few families.

10. At Hoktaheen in 2004, 565 (CV = 4.4%) sockeye salmon spawned in upper Hoktaheen Lake's main inlet stream study area and 251 (CV = 6.8%) spawned in upper Hoktaheen Lake's outlet stream study area. Few sockeye salmon were observed outside of these two study areas. These were the smallest escapements observed in the past four years. In 2003, the number of sockeye spawning in these two areas was 3,438 (CV=3%) and 325. From 2001 to 2004, the simple Peterson estimate of the abundance of sockeye salmon in the main inlet stream study area in early September was 498 in 2004 compared to 1,840 in 2003, 737 in 2002, and 660 in 2001. In the outlet stream study area, the abundance index was 137 fish in 2004 compared to 210 in 2003 and 233 in 2002. In 2001 and 2002, half of the sockeye sampled from the main inlet stream were age-2.-. This high proportion of 2-check fish reflects slow growth conditions due more likely to poor lake rearing conditions than abundant spawners and fry.

11. In 2004, the dominant macrozooplankton was *Daphnia* sp. in Neva Lake, *Bosmina* sp. in Pavlof, and *Cyclops* sp. in Hoktaheen. The weighted "seasonal" biomass of zooplankton was 612, 90, and 946 mg/m^2, respectively, in Neva, Pavlof, and Hoktaheen Lakes and the euphotic zone depths were 15.8, 7.1, and 4.1 m, respectively.

RECOMMENDATIONS

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 with out the aid of a weir project. There is no point in the season when a high proportion of the escapement can be reliably counted during foot or boat surveys. If only two surveys are possible then surveys in mid-August and mid-October would yield the best assessment of the annual escapements to the main inlet stream and beach spawning areas, respectively. If only one survey is possible, then a stream and lake survey in mid-September would probably be the best opportunity to see the highest proportion of the escapement. Counting sockeye salmon in the lake is always challenging and prone to high observer variability. The fish readily swim in and out of view in schools too dense to count individual fish. Counting by 10s, 25s, and 100s is often needed but standardizing counts among observers and trips can be a problem. The person standing in the bow of the boat usually has the best opportunity to see fish while

the person running the outboard has the worst. Given these survey considerations, and the relatively low cost of operating a weir at this semi-remote location, I recommend continuation of a weir/mark-recapture project to estimate annual escapements. We need to know that the good distribution and abundance of escapement is being maintained following the liberalized subsistence harvest limits and season.

At Pavlof Lake this project found a high proportion of the annual escapement in and off the mouth of the main inlet stream in late-July and early-August. Thus, the annual escapement could be roughly indexed by a three or four person crew using a beach seine to mark as many fish as possible on one day and examining as many fish as possible the next. Mark-recapture trips the first week in August yielded Peterson estimates of 326, 437, and 113 in 2002, 2003, and 2004 compared to annual escapement estimates of 1,350, 1,474, and 715. An even rougher, but potentially useful, index of the annual escapement could be obtained from a single foot survey count of sockeye salmon in the lower part of the main inlet stream on, or about, August 5. The average count among observers on August 5 or 6 in 2002, 2003, and 2004 was 182, 295, and 115. These counts tracked with the actual 2002-2004 escapements and the adequacy of sockeye escapements in future years could be questioned if fewer fish are counted.

At Hoktaheen Lake, the only concentrations of sockeye salmon observed were in and off the mouth of the upper lake's main inlet stream in early September and in the upper third of the stream connecting the upper and lower lakes in mid-to-late September. The two day mark-recapture estimates presented in Table 32 appeared to track annual escapements as did a single foot survey count in the main inlet stream on, or about, September 6. Sockeye salmon are readily flushed out or obscured by high water events in the inlet streams for both Pavlof and Hoktaheen Lakes so relying on once-a-season surveys is always a risk.

ACKNOWLEDGEMENTS

This study is a cooperative effort among the Hoonah Indian Association (HIA), the Alaska Department of Fish and Game (ADF&G), and the U.S. Forest Service. Thanks to David Belton for coordinating HIA's project activities and to HIA's Johanna Dybdall and Liv Gray for their help administering this multi-year project. It was a pleasure working with HIA's employees – Jerome Abbott, Bill Dalton, Jr., Frederick Gallant, Lyle James, Tom Mills, Sr., Myron Murphy, Sam Post, and Elijah Sheakley. Their enjoyment with living and working in the field on this project was obvious. We've had safe and productive field seasons that extended well into October's and November's cold and rain.

A number of ADF&G folks were instrumental to the success of this project. Meg Cartwright and Jan Conitz helped administratively, technically, and logistically. Jan's help with deriving standard error estimates for the modified Jolly-Seber estimates was most appreciated. Renate Riffe helped with limnology supplies, procedures, and

sampling. Richard Bloomquist, Mark Olsen, and Iris Frank aged and tabulated our scale, sex, and length samples. John Edmondson and the ADF&G Soldotna Limnology Lab crew processed the zooplankton samples. Lastly, Wayne Lonn's work at the Neva Creek weir in 2002, 2003, and 2004 was outstanding. His career of experience with salmon projects was apparent and appreciated.

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Sitka Herring Research Planning Group
Hosted by Sitka Tribe of Alaska
August 27, 2010
9:00 AM-11:00 AM

1-800-511-7985
Access Code: 701265

Agenda

1. Introductions
2. Background and expected outcome of planning group
3. Brief overview of Sitka Sound herring
4. Topics to discuss (on-going)
    a. Brainstorm list of all the factors that limit the production of herring in Sitka Sound
    b. Assessment of the current status of herring in Sitka Sound
    c. State's needs
        i. Movement
        ii. Migration
        iii. Stock ID
        iv. Maturation
        v. Juvenile surveys
        vi. Fecundity Estimates
        vii. Improve spawn deposition estimates
            1. Macrocystis
            2. Diver calibration
    d. Predation
        i. Marine mammals
        ii. Hatchery
    e. Spawn distribution
    f. Disease
    g. Larval distribution and retention
    h. Climate change
    i.

Sp

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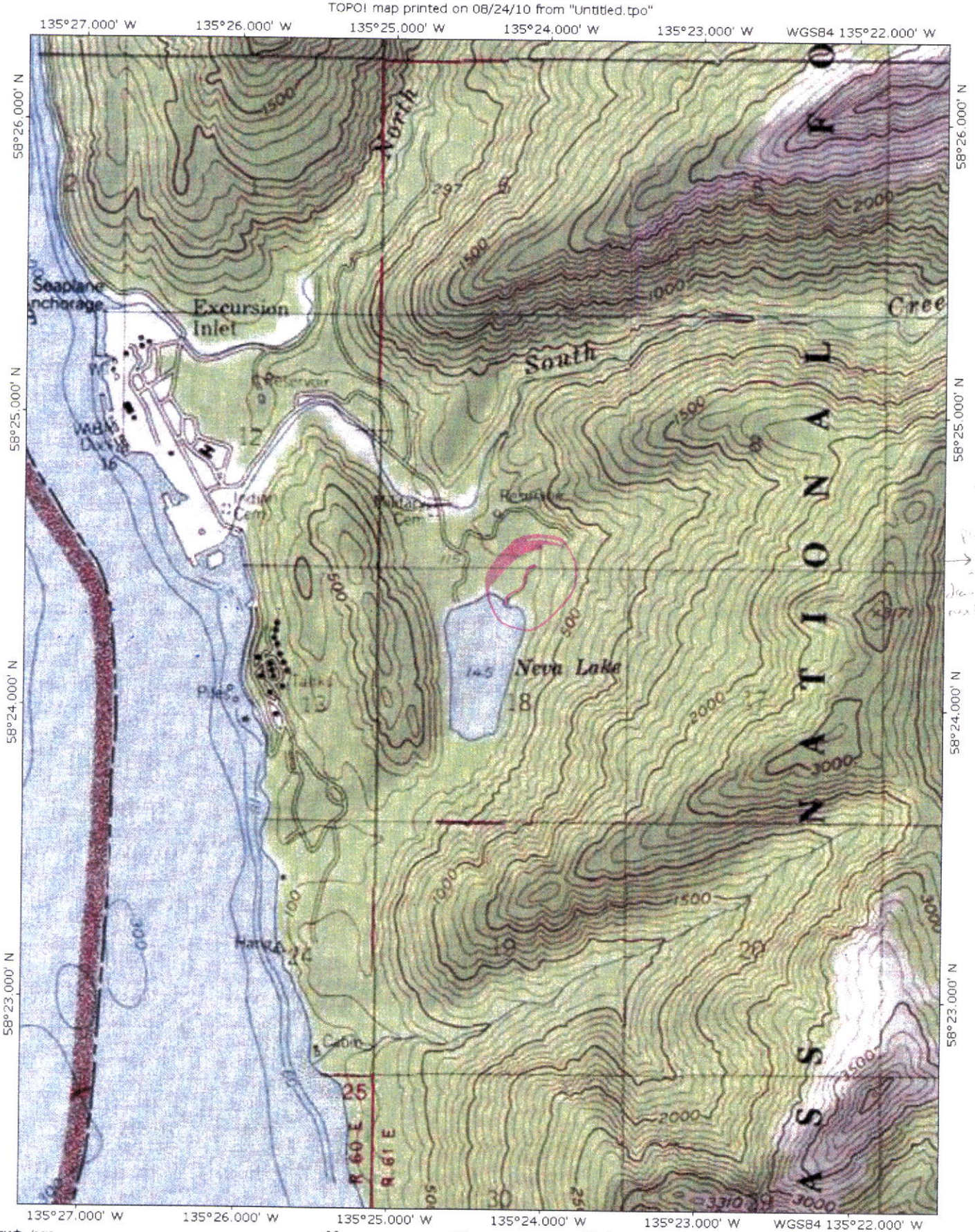

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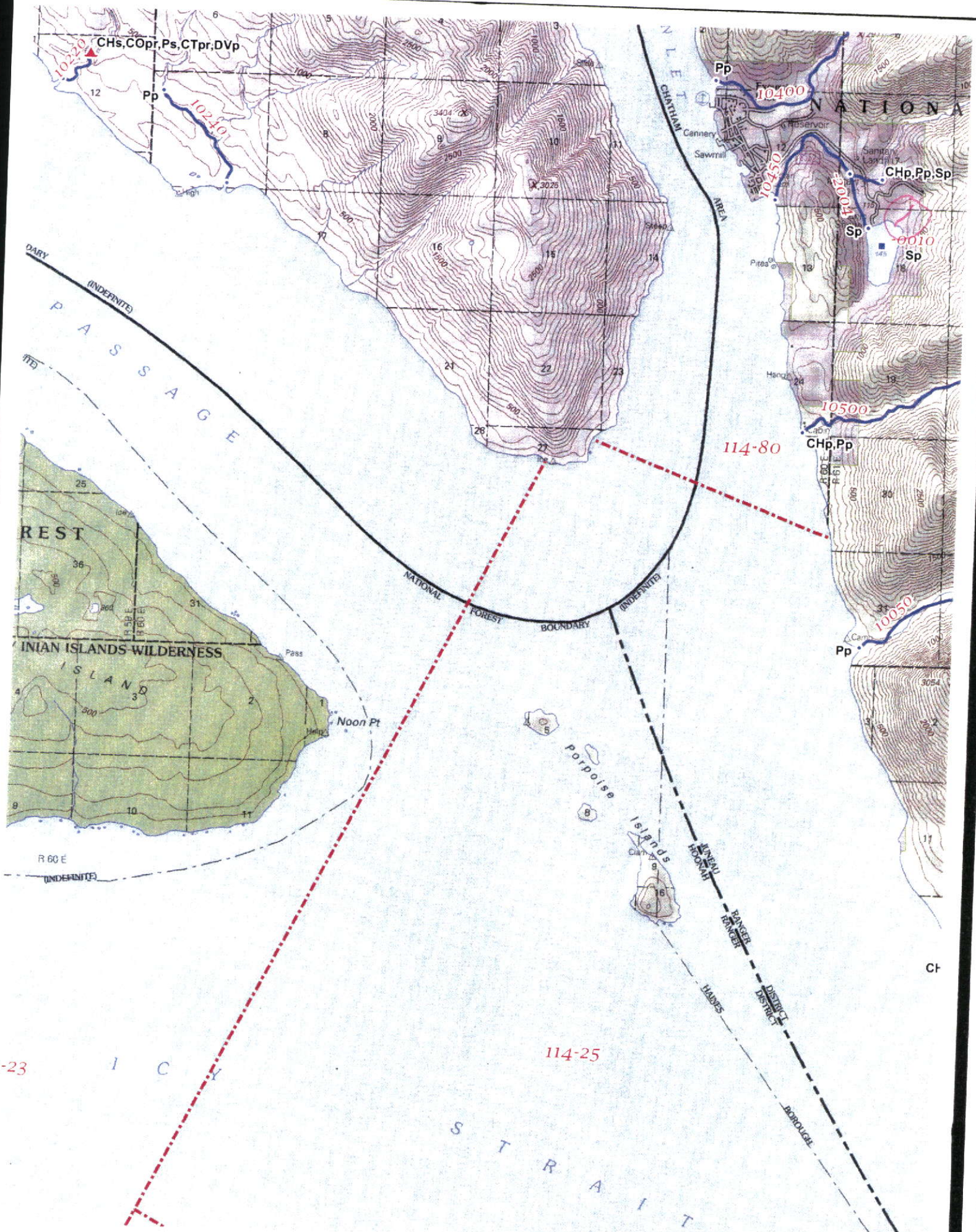
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