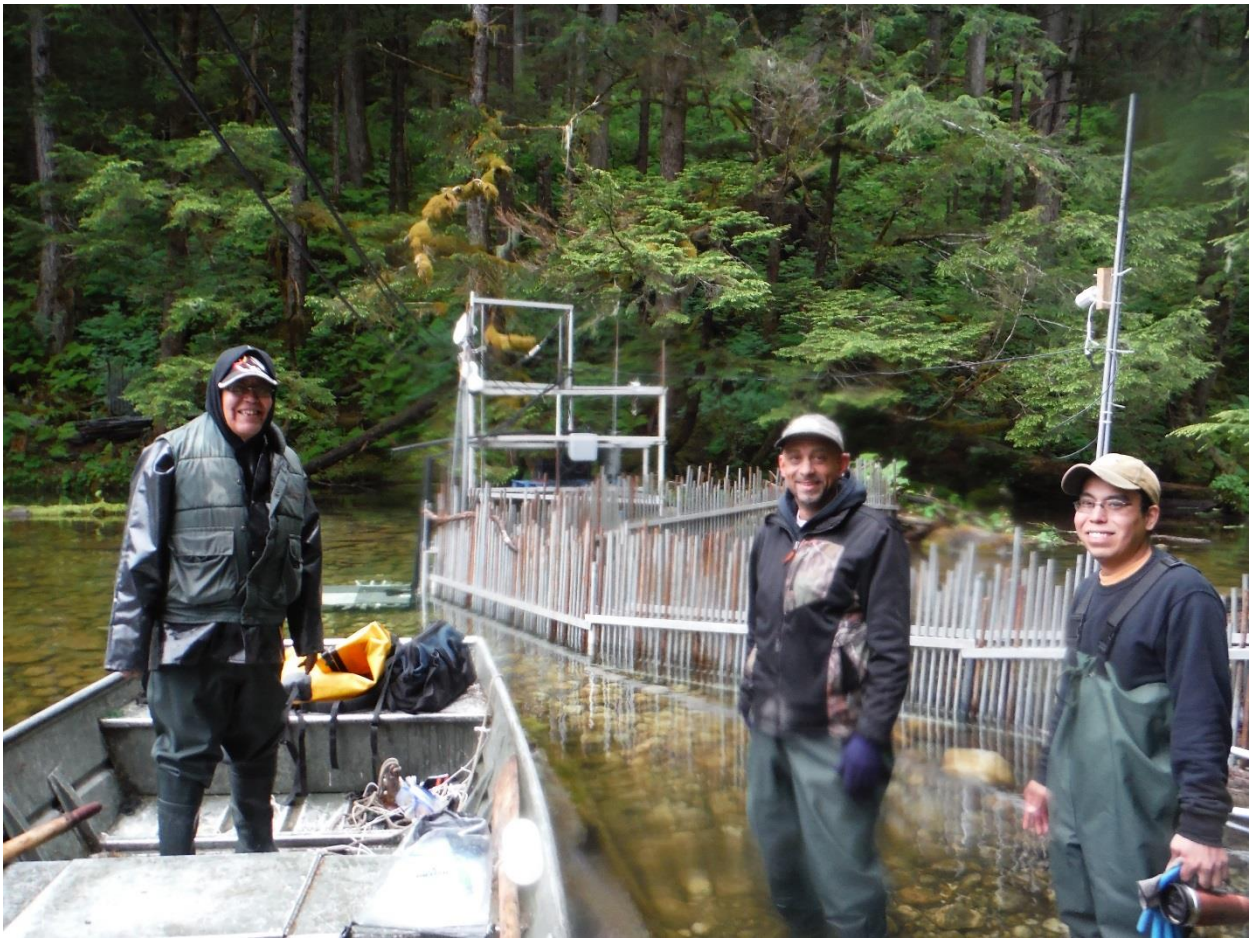
U.S. Fish and Wildlife Service
Office of Subsistence Management
Fisheries Resource Monitoring Program

Neva Lake Sockeye Salmon Stock Assessment, 2017



Final Report for Study 14-612

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(Cover photo: Hoonah Indian Association employees Gerard White Sr., Michael J. Williams, and Gerard White Jr., L-R, at the newly installed video weir at the outlet of Neva Lake, 13 June 2017.)

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ABSTRACT

In 2017, we estimate that the escapement of adult and jack Sockeye Salmon (*Oncorhynchus nerka*) into Neva Lake was 3,898 fish. The Sockeye escapement was estimated using counts from a remotely monitored, two weir, four camera, video-weir at the outlet of the lake from 13 June to 28 September. Motion-triggered video clips from each camera were viewed simultaneously so passing fish could be seen from multiple angles and counted as accurately and efficiently as possible. We estimate that past escapements were 4,951, 11,393, 9,513, 5,255, 5,931, 5,933, 2,823, 6,166, 5,252, 7,311, 4,404, 2,931, 3,535, 1,188, and 3,021 from 2002 to 2016. In 2017, half of the Sockeye Salmon entered the lake by 3 August and 80% between 30 June and 10 September. Project personnel also counted 709 Coho Salmon, 4,715 Pink salmon, 66 Chum Salmon, 3,708 Dolly Varden, and 215 Cutthroat Trout into Neva Lake in 2017.

Key words: Sockeye Salmon, *Oncorhynchus nerka*, Neva Lake, escapement, video weir, remote monitoring, age composition

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INTRODUCTION

The Sockeye Salmon return to Neva Lake (ADF&G, Division of Commercial Fisheries stream No. 114-80-045) has long been an important subsistence fishery for Tlingit families living in Excursion Inlet, 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).

Little was known about the health of the Neva Sockeye run prior to 2002. From 2002 to 2017, the U.S. Forest Service has funded, through the U.S. Fish and Wildlife Service, Office of Subsistence Management, Fishery Resource Monitoring Program, a project to estimate the escapement and age, sex, and length composition of Sockeye Salmon into Neva Lake. This has been a cooperative project with the Hoonah Indian Association employing the field personnel, the Alaska Department of Fish and Game processing the scale (age), sex, and length data, and the U. S. Forest Service taking the lead in project planning, implementation, analysis, and reporting.

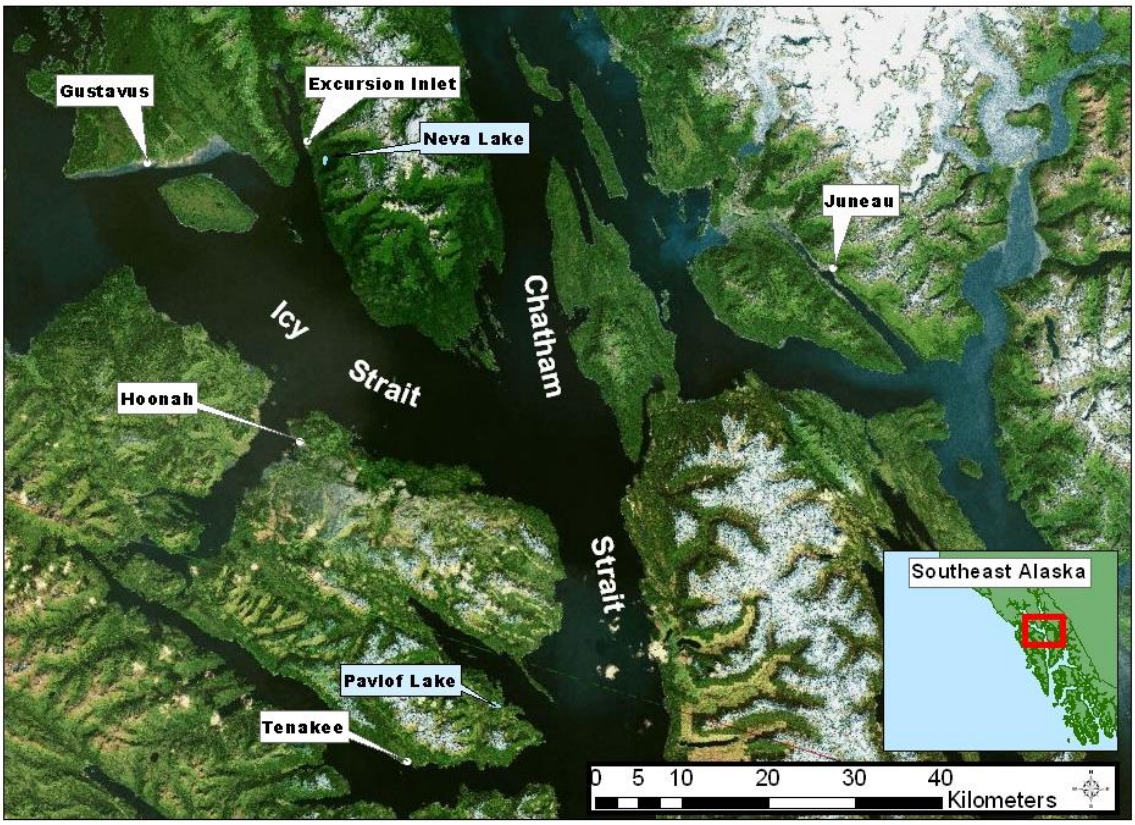


Figure 1. Map of northern southeast Alaska showing Neva Lake and surrounding area.

From 2002 to 2008, the total Sockeye escapement was estimated using weir-to-spawning area mark-recapture studies (Van Alen 2004, 2005, 2008b, and 2009). The weir was a standard channel and picket weir with trap that was set across Neva Creek just below the outlet of Neva Lake. In 2002 to 2005 and 2008, the mark-recapture estimates validated the weir counts that were used to estimate the daily migration of Sockeye Salmon into the lake. In 2008, video technology (see Appendix F in Van Alen 2008a) was used to passively and remotely estimate the proportion of marked (adipose-clipped) fish entering the main inlet stream so these fish did not have to be physically captured and sampled (Van Alen 2009). In 2009, a "video weir" was installed at the outlet of the lake (upstream from the picket weir) and video technology was used to estimate the proportion of marked fish entering the lake and to get a second count of the daily escapement (Van Alen and Mahara 2011b). In 2010 (Van Alen and Mahara 2011b), 2011 (Van Alen and Mahara 2011c), 2012 (Van Alen and Mahara 2012), 2013 (Van Alen, Eide, and Mahara 2013), 2014 (Van Alen and Musslewhite 2014), 2015 (Van Alen and Musslewhite 2015), 2016 (Van Alen and Musslewhite 2016), and 2017 the upstream picket weir was not operated at all. Instead, the fish were counted, and counts were validated, as they swam unimpeded through a double video weir placed at the outlet of the lake. This paper summarizes the project results through 2017.

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 (Figure 1). 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 is at an elevation of 44m, has a surface area of 36.1ha, and has a maximum depth of 19m (Figure 2). The main inlet stream flows into the northeast portion of the lake at 58˚24.352’N, 135˚24.243’W. Neva Creek, the outlet of Neva Lake, flows 1.2 km to South Creek, then 1 km to Excursion Inlet on the south side of the Ocean Beauty Seafoods cannery complex.

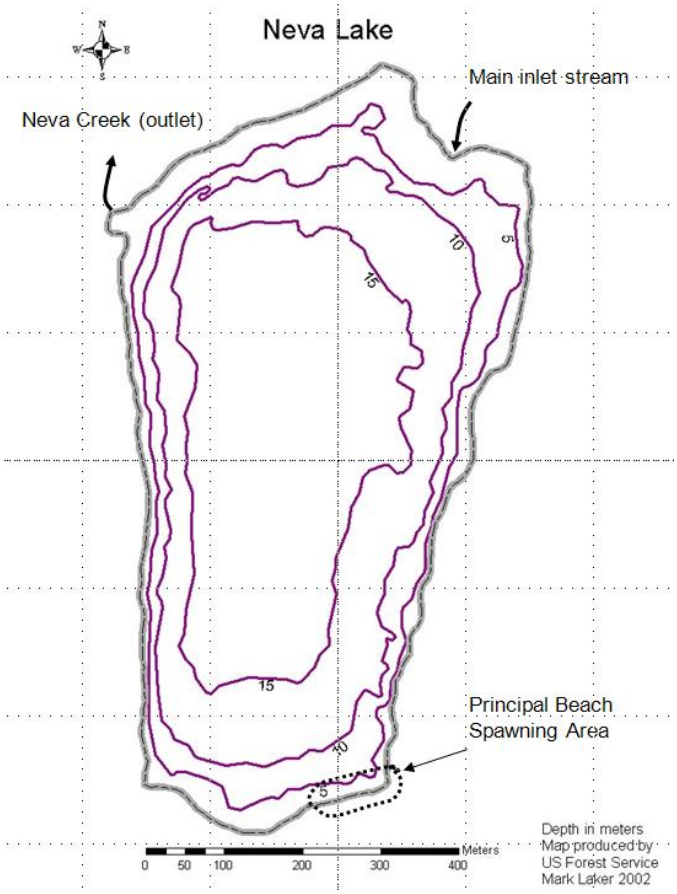


Figure 2. Bathymetric map of Neva Lake showing the outlet stream, the main inlet stream, and the principal beach spawning area.

Any resident of the State of Alaska can subsistence fish in fresh or marine waters for Neva Sockeye Salmon under the authority of a State subsistence/personal use permit. Federal subsistence fishing permits are also available but can only be used by rural residents in the area and only used for fishing in freshwater. The daily and annual harvest limits on the Federal permits is the same as those listed on the State permits. Daily and annual harvest limits were 10 Sockeye Salmon per household prior to 2002, 25 Sockeye Salmon per household in 2003, 40 per household from 2004 through 2015, and back to 10 per household in 2016 and 2017. In 2004, the State extended the subsistence fishing season from 1 June-31 July to 1 June-15 August. Federal

permits do not list season dates. Both State and Federal subsistence fishing regulations allow take by gill net, seine, dip net, hand lines, and gaffs but the Federal permits also allow the use of rod and reel. Harvest and effort data is available from State permits starting in 1985 and from Federal permits starting in 2002 (Table 1). 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). There was no reported subsistence effort at Neva from 1985 to 1989.

Table 1. Subsistence effort and harvest of salmon at Neva from 1985 to 2016 as reported on State and Federal subsistence fishing permits.

	State Subsistence/Personal Use Permits[a]						Federal Subsistence Permits[b]		
Year	Permits Fished	Chinook	Sockeye	Coho	Pink	Chum	Permits Fished	Sockeye	Coho
1985	0	0	0	0	0	0			
1986	0	0	0	0	0	0			
1987	0	0	0	0	0	0			
1988	0	0	0	0	0	0			
1989	0	0	0	0	0	0			
1990	1	0	25	0	0	0			
1991	2	0	40	0	0	0			
1992	16	0	348	0	0	14			
1993	8	0	127	0	0	201			
1994	5	0	151	0	52	0			
1995	6	0	90	0	247	28			
1996	19	0	411	0	216	872			
1997	9	0	126	5	13	1156			
1998	4	0	25	0	89	50			
1999	5	0	50	0	46	73			
2000	22	0	197	0	23	53			
2001	7	0	157	30	15	23			
2002	6	0	36	0	0	0	0	0	0
2003	6	0	87	12	0	0	0	0	0
2004	23	0	397	0	6	3	0	0	0
2005	14	0	276	0	23	10	1	34	0
2006	11	0	140	0	23	12	0	0	0
2007	11	0	219	31	0	0	2	50	36
2008	26	0	601	113	5	14	0	0	0
2009	39	0	780	34	31	8	0	0	0
2010	26	1	329	29	6	1	1	13	2
2011	31	0	448	110	59	1	1	10	10
2012	38	0	607	42	66	23	1	20	18
2013	39		510				1	21	36
2014	36	0	459	66	4	4	2	6	32
2015	40	0	312	58	195	2	0	0	0
2016	24	0	136	23	0	3	1	8	0
Spearman's rho non-parametric trend test (Conover 1980):									
rho	0.8813	0.20412	0.75328	0.76594	0.39523	0.23418	0.45318	0.27105	0.39127
P-value	0.0001	0.2707	0.0001	0.0001	0.0278	0.2048	0.0898	0.3285	0.1493
N	32	31	32	31	31	31	15	15	15

[a]State subsistence data from ADF&G October 2017.

[b]Federal subsistence fishing permits were not issued before 2002.

The effort and Sockeye harvest has peaked every four to five years – 1992, 1996, 2000, 2004, 2009, and 2013 (Table 1; Figure 3). There has been a significant increase in permits fished and harvests of Sockeye and Coho Salmon over these years (Spearman's Rho non-parametric trend test, p-value < 0.05, Conover 1980).

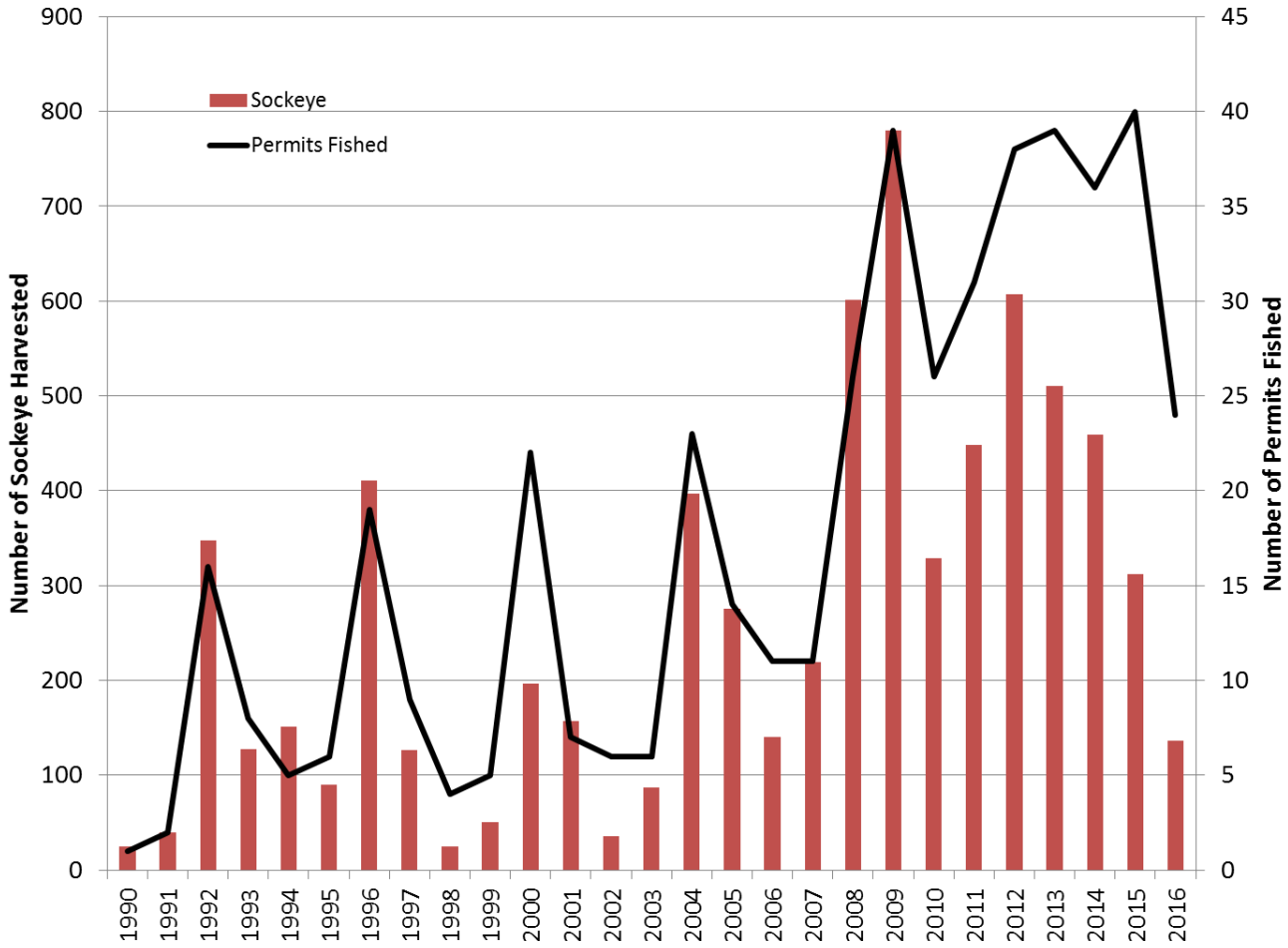


Figure 3. Subsistence effort and harvest of Sockeye Salmon at Neva from 1990 to 2016 as reported on permits returned to ADF&G.

Subsistence fishing in the Neva area is done in both the freshwater and saltwater (Van Alen 2004, 2005, 2008b). Most of the subsistence harvest of Neva Sockeye Salmon is done with seines or gill nets in the intertidal area at the outlet of South Creek from early-July to the end of the State season on 15 August. (Figure 4). A pool in the lower part of Neva Creek is a traditional site for taking Sockeye Salmon with a gaff (Langdon 2006).

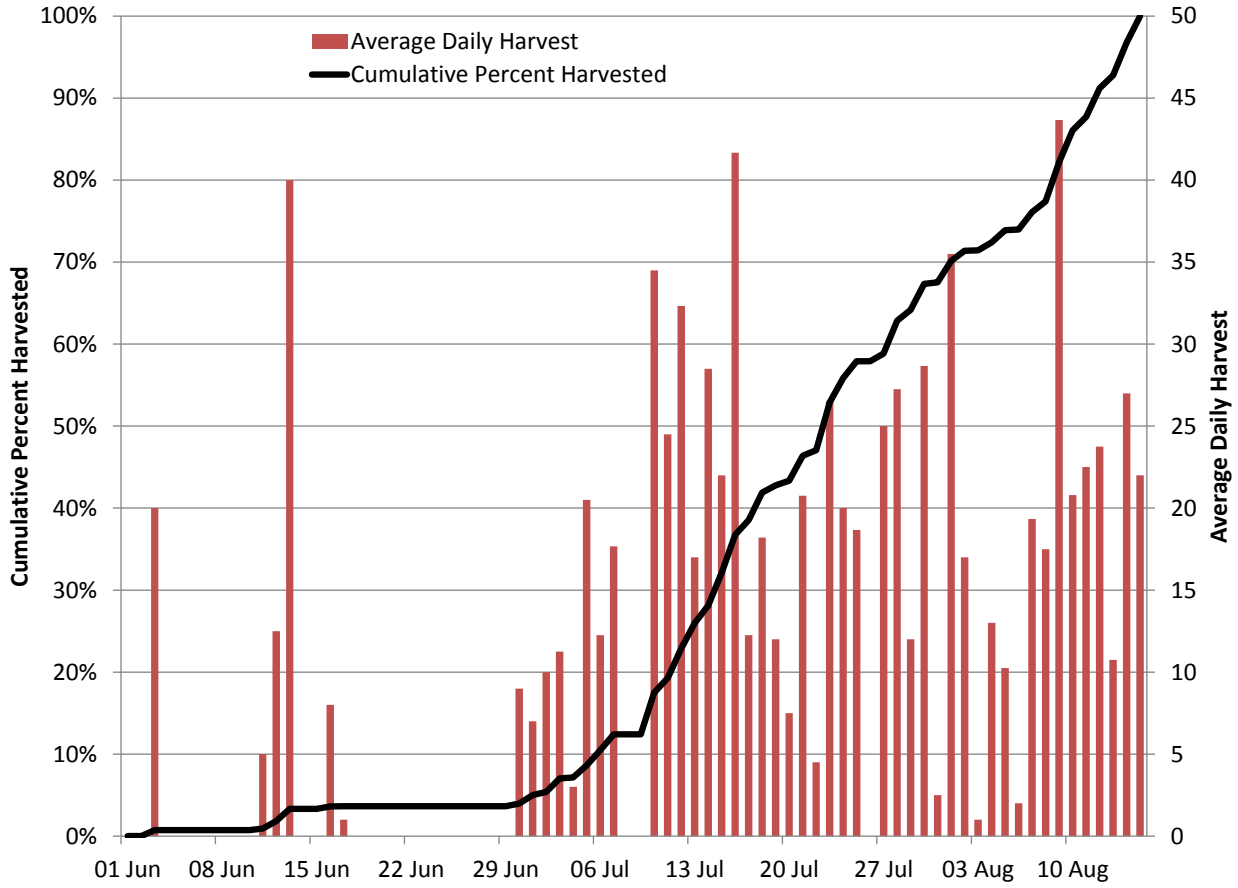


Figure 4. Cumulative percent harvest, and average daily harvest, of Sockeye Salmon reported on State subsistence/personal use permits at Neva during the 1 June to 15 August State subsistence season, 2005 to 2011.

The harvest of Neva Sockeye Salmon in sport and commercial fisheries is unknown. Most sport fishing for Neva Sockeye Salmon is done in the intertidal area. Commercial purse seine openings in Excursion Inlet and Icy Strait harvest Sockeye Salmon bound for Neva Lake and other systems in northern inside waters.

OBJECTIVES

1) Estimate the total escapement of adult and jack Sockeye Salmon into Neva Lake using a double-redundant video weir system.

2) Estimate the age, length, and sex composition of the Sockeye escapement into Neva Lake with a coefficient of variation less than 10% for each age class.

METHODS

Sockeye Escapement Assessment

In 2017, as in 2010 through 2016, we used a "double redundant" two-weir, four-camera video system (Van Alen 2008a; Van Alen and Mahara 2011a, 2011b, 2011c, and 2012; Van Alen, Eide, and Mahara 2013, Van Alen and Musslewhite 2014, 2015, 2016) to get a validated estimate of the escapement of Sockeye Salmon into Neva Lake (Figure 5). In 2016 and 2017, the underwater video chute cameras and surveillance cameras were wirelessly linked to an off-site computer so project personnel could remotely monitor the project site and simultaneously review the motion-triggered video files of fish passing through the weir.

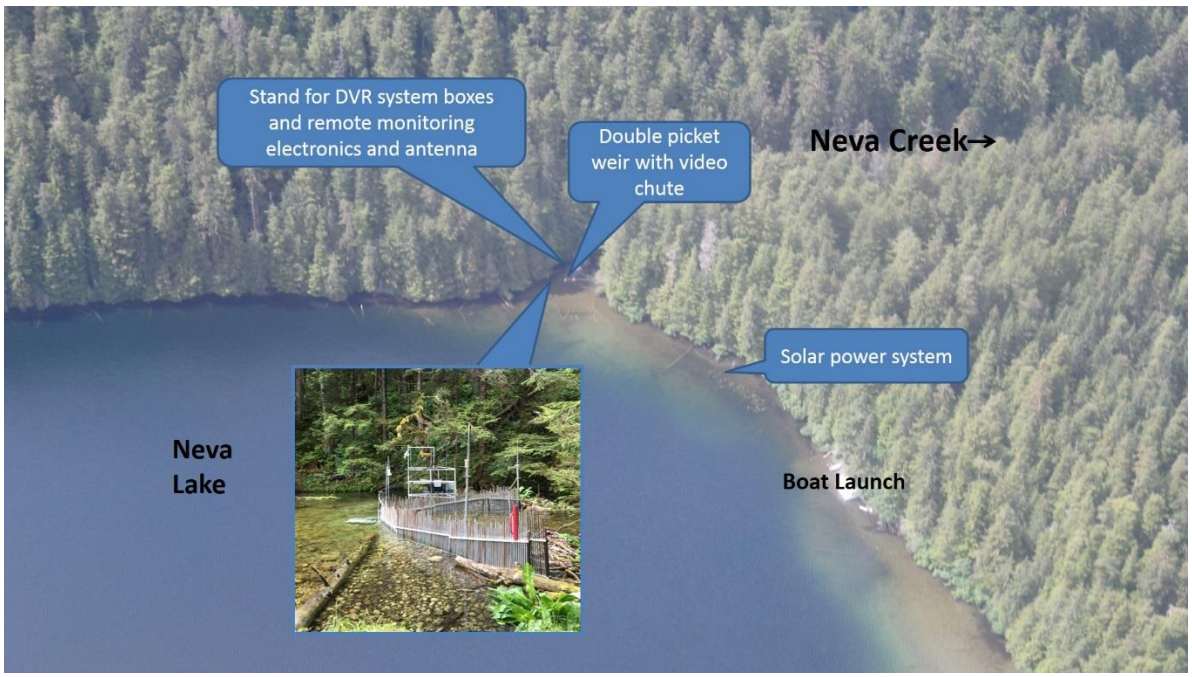


Figure 5. Annotated photo of the outlet (north) end of Neva Lake showing the basic layout of the weirs and solar panels in 2017.

The video fish counting system consisted of three stations: a weir station, a repeater station, and a recording station (Appendix C). The weir station was designed to capture video of fish passing through the weir and transmit it to a repeater station located on a nearby mountain; the repeater then relayed the video to the recording station. At the recording station, a computer with video surveillance software was used to receive, record, and review video from the weir. The Ubiquiti radios used to transmit video and data between the stations were used as transparent wireless bridges, so that they functioned as "long Ethernet cables" connecting the stations to form a local area network (LAN) controlled by a single router. The entire system could be accessed and controlled over the internet using a wireless link from Excursion Inlet to Hoonah.

Weir Station

Fish entering Neva Lake through the double weirs passed through an aluminum video chute equipped with underwater video cameras and lit by LED lights (Figure 6, and Figure 7). The video chute and weir connection was redesigned for 2017 (Figure 8, Figure 9, Appendix A). Both weirs led fish through a common chute entrance (Figure 10, Figure 11). The 70cm long chute had two underwater cameras on each side, two white LED strip lights on the ceiling, and a visor to shade the chute's interior from light reflections. The lights were separately powered through a remotely operated relay that could turn the lights on and off as needed. For most of the season, one of the strip lights was left on continuously, and the second light was automatically turned on between the hours of 6 pm and 8 am. In addition, LED lights were integrated into several of the underwater cameras, and were on continuously. The interior of the aluminum chutes were primed and painted with Pettit, Shipendec, 3333 Newport Green marine paint. A meter stick and chute/camera label (i.e., "Neva 2017 Left" – for left camera) was in the field of view of each camera.

Figure 6. Photo of the double "V" video picket weir setup at the outlet of Neva Lake, 14 June 2017.

Figure 7. Photo of video chute used at Neva Lake weir, 2017.

Figure 8. Shop photo of the upstream side of the “kite” video chute and weir connection, Neva weir, 2017.

Figure 9. Shop photo of the inside of the “kite” video chute with adjustable camera mounts, chute height, and entrance, Neva weir, 2017.

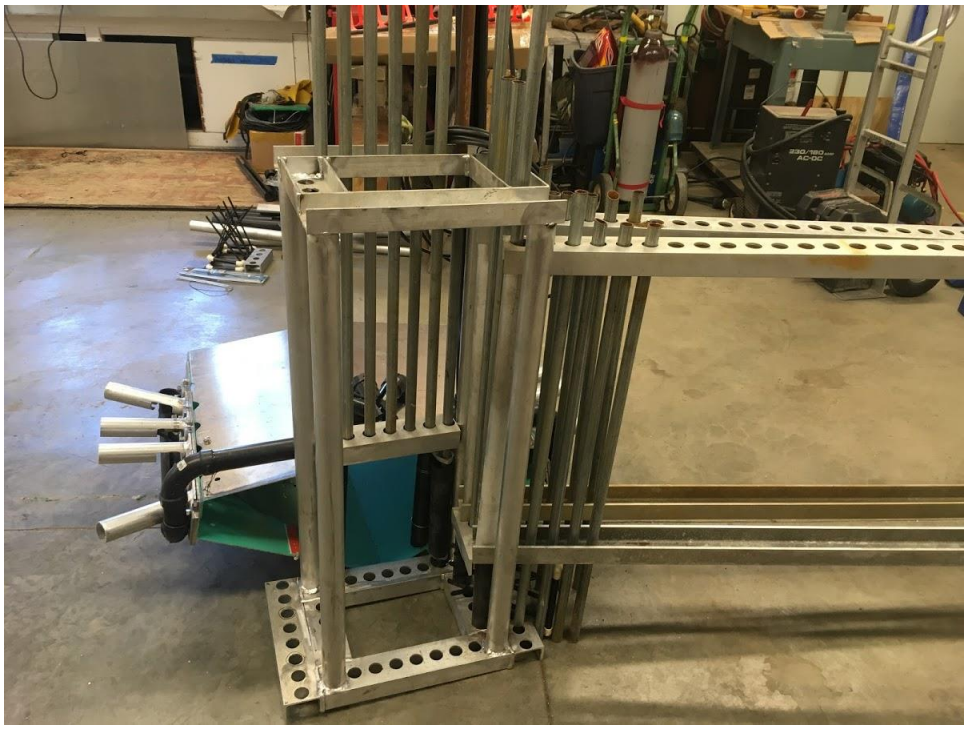


Figure 10. Shop photo of the downstream side of the “kite” video chute and weir connection, Neva weir, 2017.

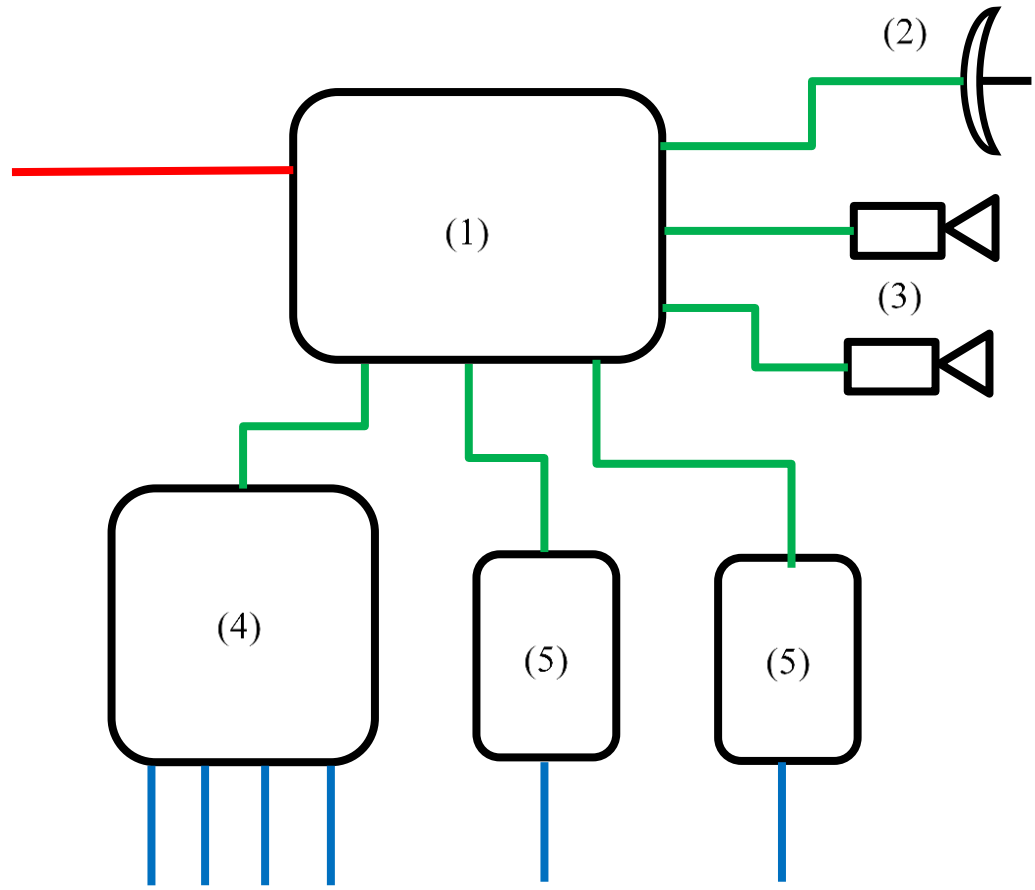
Figure 11. Close-up view of the connection between the pair of weirs, with “crab finger” opening, and the video chute, Neva weir, 2017.

The cameras were on opposite sides of the chute, two on each side and were aimed to view the entire chute, from entrance to exit. The cameras were 8.47mm (1/3in) Sony super HAD color CCD with 420 TVL high resolution and 3.6mm fixed board lenses in 34mm diameter x 60mm long waterproof stainless steel cylinders with Pyrex glass windows.

Waterproof video cables transported the feed from the cameras to two "video boxes," one for each side of the chute (Figure 12). The cables were encased in ABS pipe to prevent damage from chewing by beavers. These plastic battery boxes each contained two individual mini-DVR's which recorded motion-detected, 30-frames-per-second, MPEG4 compressed, .ASF video files, on removable SDHC (secure data high capacity) memory cards (SD cards). The mini-DVR's have user selectable settings for the frame rate, image quality, image size, date/time stamp, and motion detection threshold. The mini-DVR's also have a full suite of video review controls allowing the user to select video recorded at specific dates and times and play the video backward or forward at varying speeds. These video system boxes were the same design that has been used for this project since 2008.

Figure 12. Mini-DVR fish video systems showing the mini-DVR's and monitor in a plastic marine battery box.

After passing through the DVRs, the video signal was carried over RCA video cables to the remote monitoring system box for encoding and transmission through the network. The electronics used to encode and transmit video from the weir site (Figure 13) were contained in a weatherproof metal system box mounted on a structure constructed of surplus weir parts, located next to the weir.



24V DC power from power distribution box

POE power + data

Analog video input

(1) Netonix WS-12-250-DC managed Ethernet switch
(2) Ubiquiti PowerBeam 400 wireless bridge
(3) Amcrest IP3M IP surveillance cameras
(4) Axis M7014 4-channel video encoder
(5) Axis M7001 1-channel video encoders

Figure 13. Schematic of weir station system box used at Neva weir, 2017.

A four-channel Axis video encoder and two single-channel Axis video encoders were used to convert the analog camera feed into a digital format. The four channel encoder was used to encode video from the four underwater cameras in the video chutes, and one of the single-channel encoders was connected to a stand-alone underwater camera viewing the weir entrance. The encoders were connected to a Netonix Ethernet switch, which provided power-over-Ethernet (POE), and served as both a network device and a power source for the system's components. Also mounted on the metal structure was a Ubiquiti PowerBeam 400 wireless bridge, which connected the station to the repeater site on a nearby ridge. Two Amcrest surveillance cameras were mounted nearby to provide aboveground views of the weir site. All of these devices had built-in user interfaces that could be accessed over the internet using a web browser. Using the web-page style interfaces, we could turn devices on and off, view cameras, adjust settings, and collect diagnostic information from anywhere with internet access.

Electric power for the weir station was provided by an array of twelve solar panels located on the lakeshore about 250 feet from the weir site (Figure 14). The 145-watt solar panels were wired to form four separate arrays of three panels each, wired in series. Two junction boxes were used to connect the four arrays, and each junction box contained a Victron BlueSolar charge controller, which charged a bank of two 12V absorbed glass matt (AGM) batteries wired to provide 24V. This configuration created two independent systems, each using six panels to charge two batteries. Power from the battery banks was transmitted to the weir station over a pair of 100-meter long suspended power lines, with a third cable serving as a common ground line.

At the weir site, a power distribution box was used to deliver power from the solar system to the various components of the video system. The two powerlines were connected to a diode battery combiner, and the 24 volt power was stepped down to 12 volts with a voltage converter. A marine wiring bus was used to distribute power to the video boxes, the chute lights, and the remote monitoring system. A Tycon TP-DIN monitor provided the ability to remotely monitor and control the power system through its web interface.

Figure 14. Solar panels, batteries, and charge controllers were supported on weir picket "quadrapods" set on the shore of Neva Lake about 100 meters to the East of the weirs where there is more sun exposure.

Mountaintop Repeater Station

Since the recording station was not within line of sight of the weir station, we had to use an intermediate repeater station to relay data between the two stations. A repeater station was located on a mountain ridge overlooking both the weir site on Neva Lake and the recording station in Excursion Inlet village. The repeater was located at 58.39628°, -135.37795°, at an elevation of 2,778 feet (Figure 15). The repeater is about 2.2 km from the weir site, and about 4.8 km from the recording station.

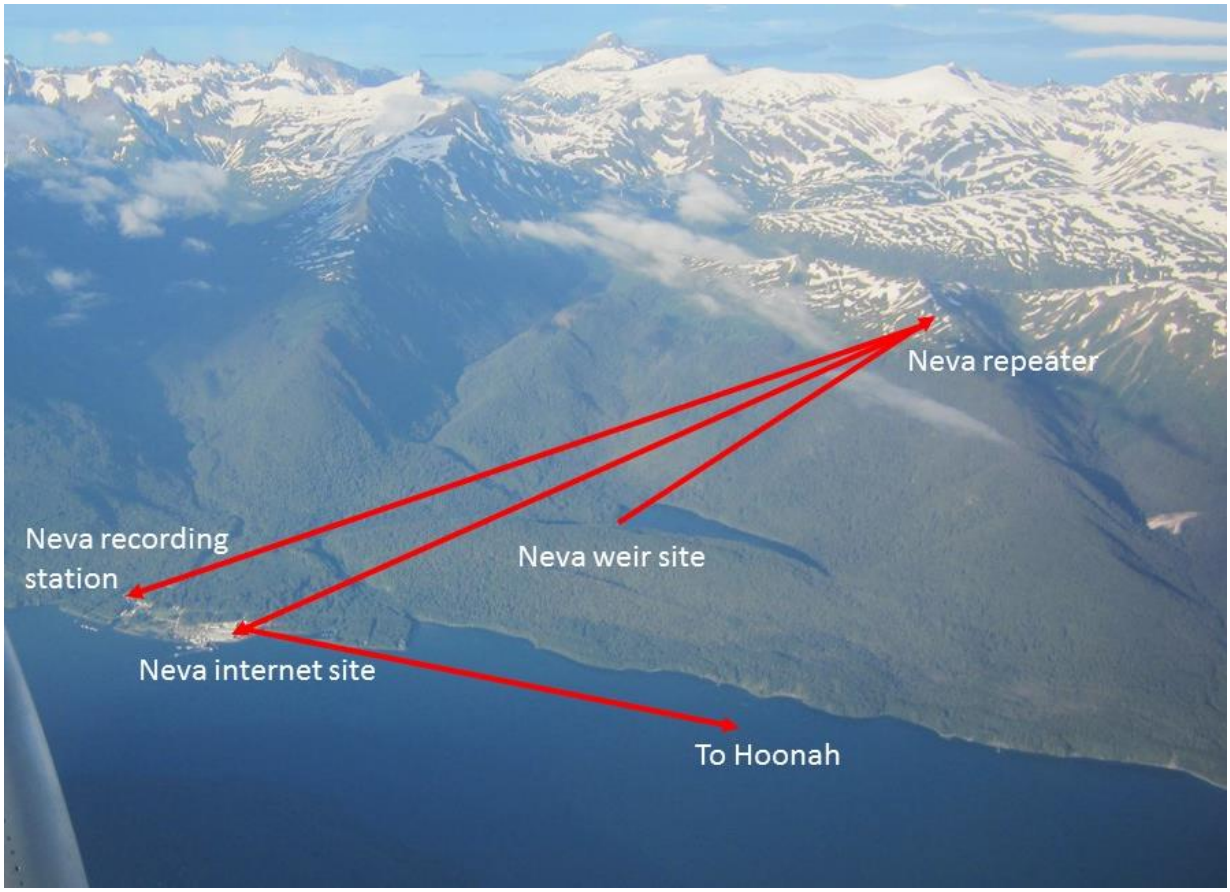
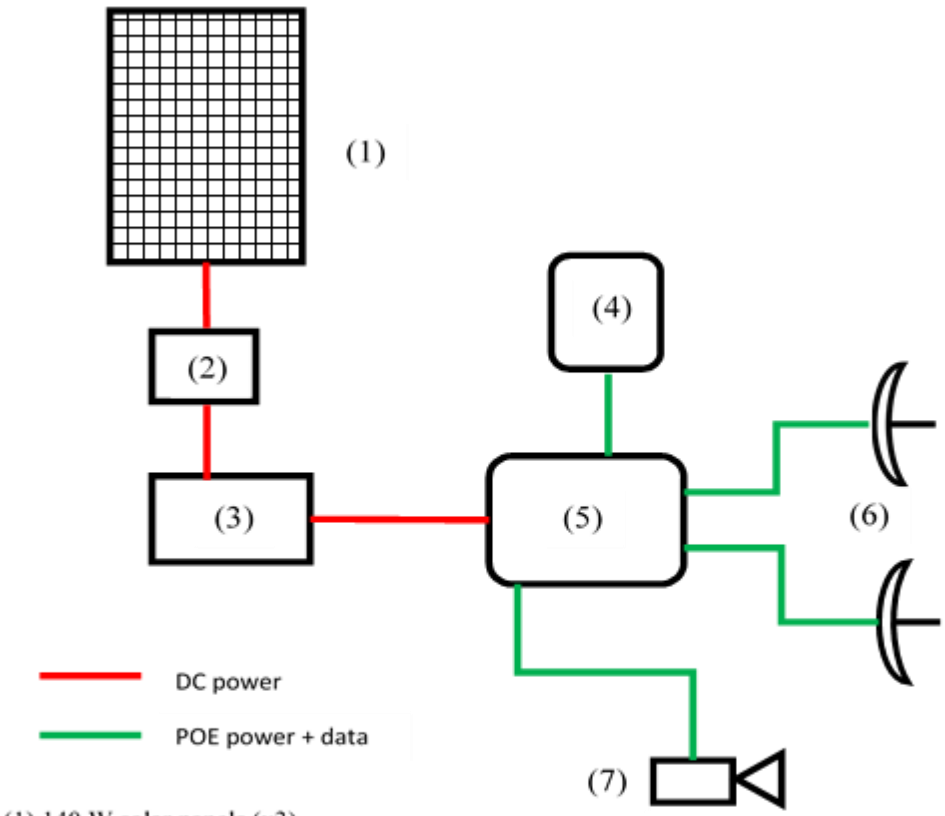


Figure 15. Neva Lake remote monitoring system stations and wireless transmission paths, 2017.

The repeater used a pair of Ubiquiti PowerBeam 400 wireless bridges to relay the signal from the weir site to the recording station, one receiving the signal from the weir and another transmitting to Excursion Inlet village (Figure 16). The radios were connected to a Netonix Ethernet switch, which also provided power with POE. A Tycon TP-DIN monitor was used to monitor and record solar panel input voltage and battery bank voltage. An Amcrest surveillance camera was attached to the repeater structure to provide a live view of the site. Power for the station was supplied by three 145-watt solar panels, regulated by a Morningstar MPPT charge controller charging a bank of six 12 volt 100 amp-hour batteries. The battery bank was connected to the Netonix switch, which distributed power to the various devices with POE.



(1) 140 W solar panels (x3)
(2) Morningstar SunSaver SS-MPPT-15 solar controller
(3) Battery bank (6 x 12V/100 Ah AGM batteries)
(4) Tycon TP-DIN remote monitor
(5) Netonix WS-12-250-DC managed Ethernet switch
(6) Ubiquiti PowerBeam 400-ISO wireless bridges
(7) Amcrest IP3M IP surveillance camera

Figure 16. Schematic of Neva repeater station.

The electronics and battery bank for the repeater were enclosed in a large plastic toolbox which was lined with rigid foam insulation and sealed with a gasketed lid. The electronics box, solar panels, and wireless bridge antennas were all mounted on an aluminum structure which was anchored to the ground with ground line (Figure 17). The structure, electronics box, and solar panels were lifted to the site by helicopter, and installed in the summer of 2016.

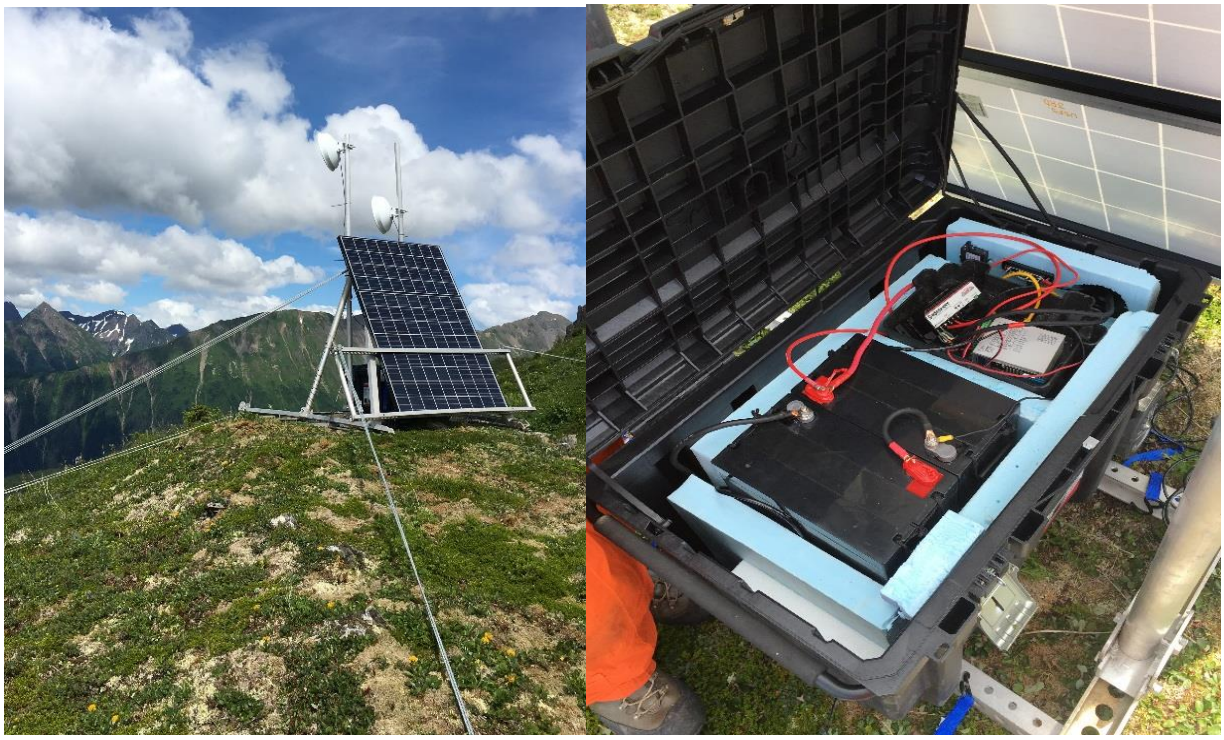


Figure 17. Neva repeater installation (left) and electronics storage box (right), 2016.

Recording Station

The recording station was located in a cabin in Excursion Inlet village, a small community centered on the Ocean Beauty Seafoods processing plant. This station was used to receive and record the video feed relayed from the weir station, and review the video to count fish passing through the weir. A Ubiquiti PowerBeam 400 wireless bridge mounted on the cabin received the signal from the repeater, and the video was recorded on a personal computer. A LinkSys WRT54G router in the cabin was used to control all of the networked devices over the entire LAN (i.e. at all three of the stations).

Video from the weir site was recorded and reviewed using Blue Iris, a software package designed for video surveillance applications. The computer was located in the main living space of the cabin, and constantly displayed live video from all of the cameras at the weir site, including both the underwater and above ground cameras (Figure 18, Figure 19, and Figure 20). Using the software's motion-detection feature, video was recorded to the computer's hard drive whenever the motion detection was triggered. The video from the four cameras in the video chutes were grouped so that video from all four cameras was recorded if motion was detected in any of them. All video was backed up hourly to an external hard drive. In addition, Blue Iris has a "webserver" feature that allows access from the internet to view live video and stored video clips (Figure 21).

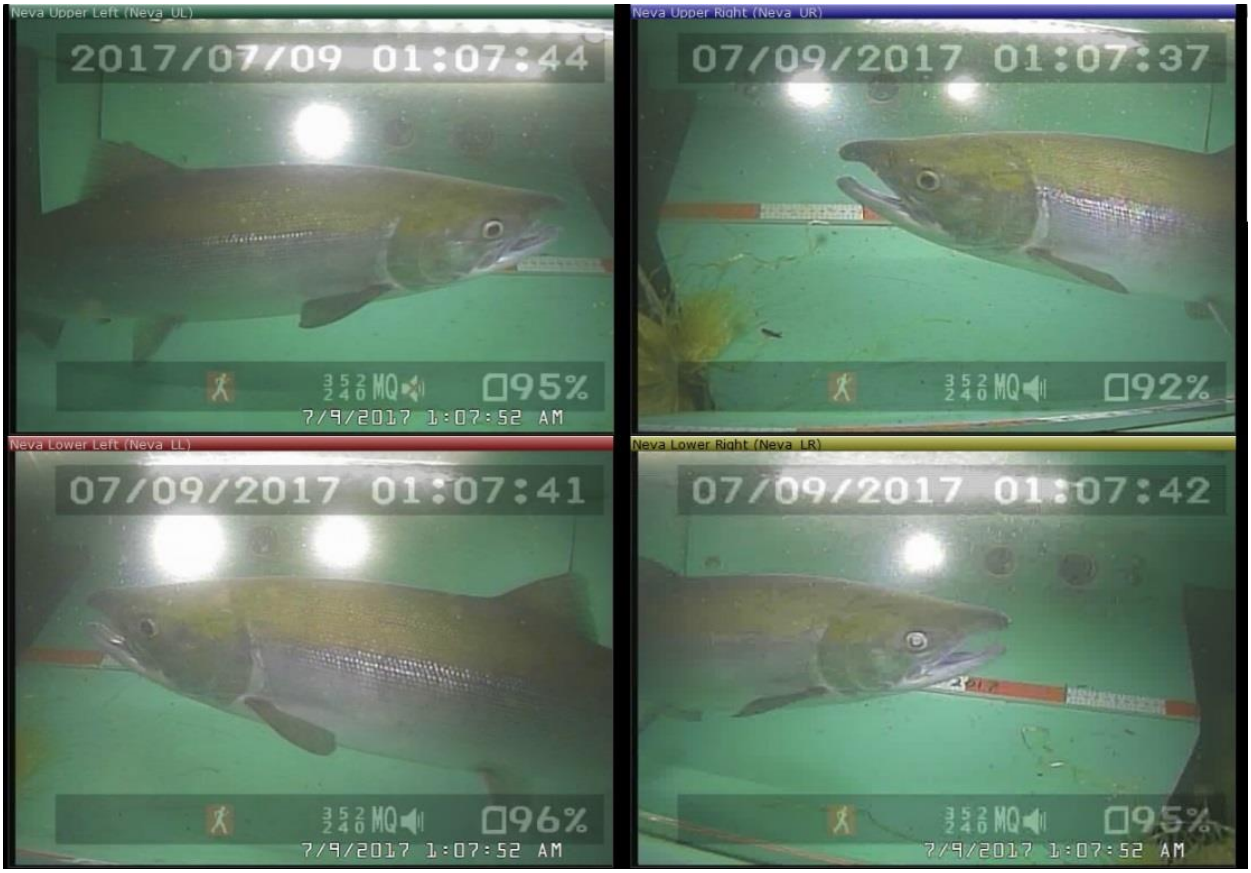


Figure 18. Four-camera video image of a Sockeye Salmon passing through the Neva lake weir, 2017.

Figure 19. Daytime and nighttime (beaver-triggered) video images from one of the site surveillance cameras at the Neva Lake weir, 2017.

Figure 20. Video capture from one of the site surveillance cameras at the Neva Lake weir, 2017.

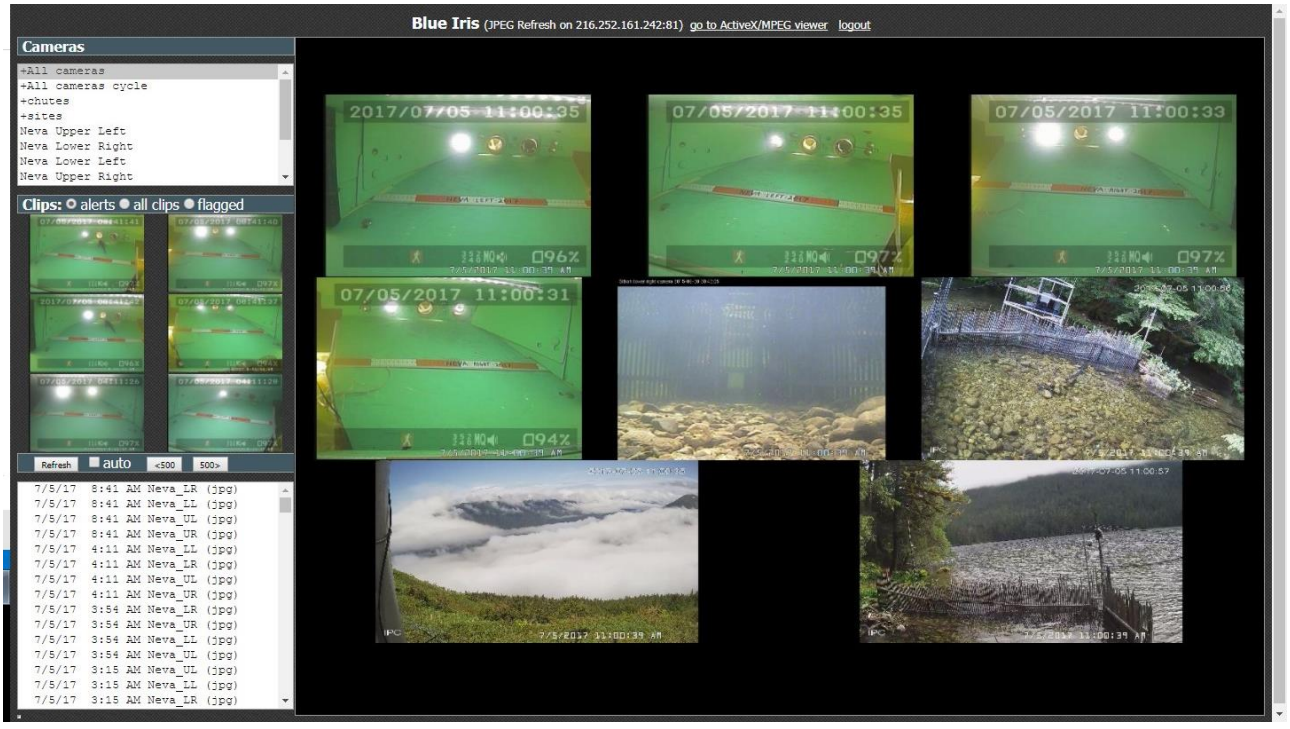


Figure 21. Screen capture of the Blue Iris web-accessible interface, showing views from the underwater and aboveground cameras.

Internet access to the entire system was provided by a wireless link across Icy Strait to Hoonah. Two Ubiquiti AirFiber AF5X radios were used; one mounted on a radio tower on the Ocean Beauty Seafoods office building, and another at a telecommunications tower on Hoonah Mountain 32km away. At the Hoonah Mountain site, the AirFiber radio was connected to the network of a local internet service provider. The mountaintop repeater was used to relay data between the internet-connected AirFiber station, the recording station, and the weir station (Figure 15). With the monitoring system connected to the internet, all of the system's devices could be remotely controlled and configured from anywhere with internet access. The internet connection was also used to maintain communication with the field crew, through email, video chat, and online data file sharing.

Each morning, project personnel would use the Blue Iris software to review the motion-triggered footage from the previous day. Reviewers were instructed to record hourly counts on the daily data sheet in this year's bound data notebook. Video review focused on getting complete and consistent counts of adult and jack Sockeye Salmon into the lake. Other species were usually counted but these counts were not validated and are incomplete. The time period for each hourly count was based on the time stamp from the Blue Iris software, which was derived from an internet time server and synchronized for all cameras. In previous years, project personnel reviewed video and recorded counts from all cameras in the chutes independently, but the synchronized review of video from all four cameras made it possible to make a single hourly count of Sockeye instead.

For the majority of the season, the recording station was located in the Excursion Inlet cabin where project personnel lived and worked. However, the Ocean Beauty Seafoods plant closes at the end of the fishing season in early September, making the cabin no longer available for use. The computer used for recording video was moved to the Hoonah Indian Association office in Hoonah on August 28, where it was configured to connect to the monitoring system network over the internet. For the remainder of the season, the crew recorded and reviewed video in Hoonah rather than Excursion Inlet.

Age, Sex, and Length

The age-sex-length (ASL) sample target for Neva Lake was 180 Sockeye Salmon with 90 to be sampled from main inlet stream spawners and 90 to be sampled from beach spawners. A beach seine was used to capture the fish when they schooled off the mouth of the main inlet stream in August and September and when they moved onto the principal beach spawning areas at the Southeast corner of the lake in September and October.

Adult and jack Sockeye Salmon were measured from the mid-eye to fork-of-tail length in millimeters in an aluminum fish-measuring trough. Sex and length measurements were recorded on mark-sense AWL (age-weight-length) forms supplied by Alaska Department of Fish and Game (ADF&G). Three scales were plucked from the left side of the fish, two rows above the

lateral line on the diagonal from the posterior insertion of the dorsal fin to the anterior insertion of the anal fin (INPFC 1963). The scales were then mounted on numbered gummed "scale cards" so that the scales could be matched with the same fish on the mark-sense form (see ADF&G 2001 for specific sampling procedures).

The scales were aged by personnel at the ADF&G Commercial Fisheries Division Aging Lab in Juneau, Alaska. Ages were reported in European notation where a period separates the number of fresh water and marine annuli (Koo 1962; ADF&G 2010). The total age of the fish is the sum of these two numbers plus one for the winter the egg/alevin was in the redd.

Stream Temperature and Depth

We have used temperature and temperature and pressure data loggers manufactured by the Onset Computer Corporation to measure air temperatures and inlet and outlet stream temperatures and depths at set time intervals each day. We started using temperature data loggers on 27 July 2002 and temperature and pressure data loggers on 13 July 2005. The temperature data loggers (Onset model Optic Stowaway Temp) were placed in 30cm long, 52mm I.D. aluminum pipes positioned just below the stream bottom at the outlet (58˚24.255'N, 135˚24.658'W) and main inlet stream (58˚24.255'N, 135˚24.658'W) of Neva Lake. They were set to record a temperature reading every four hours. We downloaded readings from these temperature data loggers once or twice a year and the last readings were through 21 October 2009.

On 13 July 2005, we deployed two temperature and pressure data loggers (Onset model U20-001-01) - one cabled under a large rock right at the outlet of the lake (58° 24.338'N, 135° 24.635'W) and one cabled up in a tree near the lake outlet at 58° 24.34'N, 135° 24.661'W. On 13 June 2006, we cabled another temperature and pressure data logger in a pipe driven into the bottom of the main inlet stream at 58˚24.255'N, 135˚24.658'W. All three loggers were protected in 30cm long x 38mm ID ABS plastic pipes. The temperature and depth data logger in the main inlet stream was lost in 2008 when the stream channel shifted during high water events. On 1 August 2012 we secured another temperature and pressure data logger to a root wad 100 meters upstream. All loggers were set to record measurements at one hour intervals. 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 Onset Computer Corporation's "HOBOware"™ software. The readings from the logger in the main inlet stream were also calibrated to staff gauge readings taken each time the data logger was checked.

Another pair of Onset air and water temperature loggers was deployed at the outlet in July 2008. The air data logger was placed in a tree about 80 meters downstream of the outlet (58˚24.34'N, 135˚24.661'W) and the water temperature logger was added to the cable holding the temperature and pressure logger under the big rock at the outlet of the lake. Data from these loggers is maintained by the Office of Subsistence Management (ARRI 2013).

RESULTS

Weir counts, Escapement Estimates, and Run Timing

The two independent "V" shaped picket weirs with independently powered underwater motion-detect video camera systems were in place from 13 June through 1200hr on 28 September 2017. Project personnel reviewed the video each day during the season and recorded the hourly passage of each species of fish through the weirs. Separate counts were made for adult and jack Sockeye Salmon.

Fish counting was done using the Blue Iris program on the personal computer and simultaneous replay of video from each of the four chute cameras. The SD card backups were used to maintain continuous video recording while the computer system was being moved to Hoonah in late August.

The raw hourly and daily counts of Sockeye Salmon through the video weirs totaled 3,871 fish, including 3,763 adults and 108 jacks (Table 2). The first Sockeye Salmon was seen at the weir on 21 June and there were still a few Sockeye Salmon passing when the weirs were dismantled in late September. Also counted at the weirs were 709 Coho Salmon, 4,715 Pink Salmon, 66 Chum Salmon, 3,708 Dolly Varden, and 215 Cutthroat Trout.

Due to power system failures, there were several brief gaps in video coverage totaling 21 of the 2,604 hours that the weir was operating. The loss of video was during periods when relatively few Sockeye Salmon were passing. Using the E-M algorithm (McLachlan and Krishnan 1997) to fill in missing data, we estimate that an additional 20 Sockeye Salmon entered the lake during the dates the weir was operated (Table 3) and an additional seven Sockeye Salmon entered the lake after the weir was removed for the season (Table 4). With the fill-in estimation of 27 fish added to the video weir count, the 2017 estimate of Sockeye escapement into Neva Lake was 3,898 fish (Figure 22 and Table 4). The mid-point of the run was on 3 August and 80% of the Sockeye Salmon had entered Neva Lake between 1 July and 9 September (Table 5).

Most of the Sockeye Salmon migrated into the lake during evening hours. Seventy percent migrated between 22hr and 05hr and 60% between 23hr and 04hr.

Table 2. Daily numbers of fish counted at the Neva Creek video weirs, 13 June to 28 September 2017.

Date	Adult Sockeye Salmon	Jack Sockeye Salmon	Total Sockeye Salmon	Coho Salmon	Pink Salmon	Chum Salmon	Dolly Varden	Cutthroat
13-Jun	0	0	0	0	0	0	0	0
14-Jun	0	0	0	0	0	0	0	0
15-Jun	0	0	0	0	0	0	0	0
16-Jun	0	0	0	0	0	0	0	0
17-Jun	0	0	0	0	0	0	0	0
18-Jun	0	0	0	0	0	0	0	0
19-Jun	0	0	0	0	0	0	0	0
20-Jun	0	0	0	0	0	0	0	0
21-Jun	2	0	2	0	0	0	0	0
22-Jun	0	0	0	0	0	0	0	0
23-Jun	0	0	0	0	0	0	0	0
24-Jun	0	0	0	0	0	0	0	2
25-Jun	0	0	0	0	0	0	0	0
26-Jun	0	0	0	0	0	0	0	0
27-Jun	0	0	0	0	0	0	0	0
28-Jun	0	0	0	0	0	0	0	1
29-Jun	13	0	13	0	0	0	0	0
30-Jun	12	0	12	0	0	0	0	0
1-Jul	8	4	12	0	0	0	0	0
2-Jul	0	0	0	0	0	0	0	3
3-Jul	1	0	1	0	0	0	0	0
4-Jul	1	0	1	0	0	0	0	1
5-Jul	0	0	0	0	0	0	0	4
6-Jul	0	0	0	0	0	0	2	0
7-Jul	0	0	0	0	0	0	1	1
8-Jul	11	0	11	0	0	0	0	2
9-Jul	482	0	482	0	0	3	6	0
10-Jul	214	17	231	0	0	0	4	2
11-Jul	87	7	94	0	0	0	1	2
12-Jul	93	8	101	0	0	0	14	2
13-Jul	17	0	17	0	0	0	5	2
14-Jul	18	1	19	0	0	0	16	7
15-Jul	24	1	25	0	0	0	29	0
16-Jul	11	3	14	1	0	0	119	0
17-Jul	62	5	67	0	0	0	102	2
18-Jul	33	8	41	0	0	0	71	1
19-Jul	14	0	14	0	0	0	62	1
20-Jul	115	3	118	0	0	0	268	3
21-Jul	18	0	18	0	0	0	42	2
22-Jul	51	0	51	0	0	0	178	2
23-Jul	24	0	24	0	0	0	48	2
24-Jul	76	3	79	0	0	0	84	1
25-Jul	12	2	14	0	1	3	8	1
26-Jul	27	0	27	0	0	4	38	0
27-Jul	144	4	148	0	0	3	159	4
28-Jul	5	2	7	0	0	1	14	1
29-Jul	0	3	3	0	0	0	6	0
30-Jul	4	5	9	0	0	0	10	0
31-Jul	108	1	109	0	0	4	59	4
1-Aug	4	0	4	0	0	1	4	2
2-Aug	12	0	12	0	0	0	12	1
3-Aug	227	0	227	0	25	0	34	0
4-Aug	73	0	73	0	9	0	40	1
5-Aug	26	0	26	0	2	1	3	0

(continued)

Table 2. (page 2 of 2)

Date	Adult Sockeye Salmon	Jack Sockeye Salmon	Total Sockeye Salmon	Coho Salmon	Pink Salmon	Chum Salmon	Dolly Varden	Cutthroat
6-Aug	51	0	51	0	1	0	1	0
7-Aug	69	0	69	0	0	0	7	0
8-Aug	38	1	39	0	0	0	5	0
9-Aug	55	0	55	0	0	0	2	0
10-Aug	59	0	59	0	2	0	0	1
11-Aug	43	0	43	0	0	0	2	0
12-Aug	31	0	31	0	0	0	2	1
13-Aug	34	0	34	0	1	0	4	3
14-Aug	83	5	88	0	71	0	13	1
15-Aug	8	0	8	0	37	0	2	2
16-Aug	7	0	7	0	28	0	2	0
17-Aug	26	2	28	0	82	0	12	49
18-Aug	9	0	9	0	107	0	14	9
19-Aug	23	0	23	0	40	0	9	1
20-Aug	33	0	33	0	101	2	11	1
21-Aug	31	0	31	0	85	8	9	2
22-Aug	47	0	47	0	309	0	91	12
23-Aug	22	0	22	0	141	0	5	3
24-Aug	18	0	18	1	76	1	2	1
25-Aug	52	0	52	2	108	0	13	1
26-Aug	28	0	28	3	109	0	13	2
27-Aug	9	6	15	6	80	0	22	1
28-Aug	14	0	14	9	112	0	57	1
29-Aug	21	0	21	10	56	0	3	0
30-Aug	31	0	31	28	230	0	56	1
31-Aug	60	0	60	15	265		54	0
1-Sep	63	0	63	49	352	0	26	2
2-Sep	41	0	41	14	126	0	29	5
3-Sep	51	3	54	19	123	3	24	5
4-Sep	99	0	99	0	247	3	68	8
5-Sep	81	0	81	42	186	4	24	6
6-Sep	29	3	32	43	177	0	67	0
7-Sep	16	1	17	42	252	2	85	0
8-Sep	47	3	50	45	183	0	70	1
9-Sep	18	1	19	37	183	1	144	0
10-Sep	39	0	39	39	116	1	46	0
11-Sep	49	0	49	64	102	0	84	1
12-Sep	50	0	50	23	59	0	69	0
13-Sep	37	0	37	13	66	4	64	1
14-Sep	20	0	20	11	56	5	71	0
15-Sep	37	0	37	15	43	0	73	8
16-Sep	38	0	38	26	50	1	83	1
17-Sep	19	0	19	22	69	1	61	0
18-Sep	26	0	26	8	43	0	67	0
19-Sep	18	0	18	21	78	0	76	2
20-Sep	7	1	8	7	53	3	33	10
21-Sep	6	0	6	7	22	5	81	5
22-Sep	3	0	3	7	18	0	70	0
23-Sep	7	0	7	4	6	0	38	3
24-Sep	4	0	4	4	7	2	125	2
25-Sep	5	1	6	5	6	0	90	0
26-Sep	5	4	9	12	4	0	63	2
27-Sep	11	0	11	32	9	0	119	3
28-Sep	6	0	6	23	1	0	8	1
Total[a]	3,763	108	3,871	709	4,715	66	3,708	215

[a]The weirs were operational from 0000hr on June 13 to 1200hr on 28 September.

Table 3. Daily and hourly counts of Sockeye Salmon adults and jacks through the double video weirs at the outlet of Neva Lake, 2017.

	Hour[a]																								
Date	00-01	01-02	02-03	03-04	04-05	05-06	06-07	07-08	08-09	09-10	10-11	11-12	12-13	13-14	14-15	15-16	16-17	17-18	18-19	19-20	20-21	21-22	22-23	23-24	Total
13-Jun	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
14-Jun	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
15-Jun	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
16-Jun	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
17-Jun	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
18-Jun	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
19-Jun	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
20-Jun	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
21-Jun	0	2	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	2
22-Jun	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
23-Jun	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
24-Jun	0	0	0	0	0	0	0	0	0	0	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	0	0	0	0	0	0	0	0	0	0	0
26-Jun	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
27-Jun	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
28-Jun	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
29-Jun	0	0	3	10	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	13
30-Jun	4	3	2	2	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	12
1-Jul	4	2	0	0	0	0	0	0	0	0	0	0	0	0	4	2	0	0	0	0	0	0	0	0	12
2-Jul	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
3-Jul	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1
4-Jul	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1
5-Jul	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
6-Jul	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
7-Jul	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
8-Jul	0	0	0	1	2	0	3	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	4	0	11
9-Jul	78	88	101	132	72	2	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	8	1	482
10-Jul	88	28	45	59	1	0	1	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	8	231
11-Jul	30	15	25	10	2	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	12	94
12-Jul	48	1	23	25	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	3	101
13-Jul	7	2	3	4	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	17
14-Jul	10	4	3	0	2	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	19
15-Jul	6	3	7	8	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	25
16-Jul	0	0	8	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	1	4	14
17-Jul	18	35	5	7	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	2	67
18-Jul	5	5	21	4	4	1	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	41

(continued)

Table 3. (page 2 of 3)

Date	Hour[a]																							Total
	00-01	01-02	02-03	03-04	04-05	05-06	06-07	07-08	08-09	09-10	10-11	11-12	12-13	13-14	14-15	15-16	16-17	17-18	18-19	19-20	20-21	21-22	22-23	23-24	
19-Jul	9	1	3	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	14
20-Jul	12	28	29	14	20	9	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	1	4	0	118
21-Jul	1	10	6	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	18
22-Jul	4	10	5	4	3	3	4	1	0	0	0	0	0	0	0	0	0	0	0	0	3	7	7	0	51
23-Jul	2	3	0	0	0	0	0	1	0	0	0	0	0	0	0	0	2	2	0	0	0	0	2	12	24
24-Jul	0	30	24	5	2	1	2	0	4	0	0	0	0	0	0	0	0	2	2	2	0	0	0	5	79
25-Jul	0	8	4	2	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	14
26-Jul	0	0	0	7	12	4	0	0	0	0	0	0	0	0	0	0	0	0	1	1	1	0	0	1	27
27-Jul	7	1	1	1	2	0	0	0	0	0	0	0	0	0	0	0	4	21	25	18	44	21	3	0	148
28-Jul	3	0	1	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	2	7
29-Jul	1	1	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	3
30-Jul	0	1	2	3	0	0	0	0	0	0	0	0	0	0	0	0	0	1	2	0	0	0	0	0	9
31-Jul	3	1	10	12	3	0	0	1	0	0	0	0	0	0	0	0	0	0	0	17	25	20	17	0	109
1-Aug	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	2	0	1	0	4
2-Aug	0	0	4	1	0	0	0	0	0	0	0	0	0	0	0	0	1	0	2	1	1	1	1	0	12
3-Aug	4	5	14	51	10	0	0	0	0	0	0	0	0	2	3	15	43	24	47	6	1	0	0	2	227
4-Aug	5	26	22	2	0	3	0	0	0	0	0	0	0	0	3	6	0	0	6	0	0	0	0	0	73
5-Aug	2	0	0	3	2	0	0	0	0	0	0	0	0	0	0	0	0	0	0	2	5	0	1	11	26
6-Aug	8	3	5	0	3.7	1.9	0.9	0.6	0.7	0.3	0.5	0.5	0.5	0.5	0.7	0	0	0	0	13	7	2	12	1	62
7-Aug	5	2	13	0	0	4	0	0	0	0	0	0	0	0	0	0	1	3	2	0	1	2	3	33	69
8-Aug	14	3	3	3	7	5	2	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	1	39
9-Aug	1	1	6	5	5	1	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	5	30	55
10-Aug	17	9	10	7	6	7	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	1	0	1	59
11-Aug	11	13	4	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	14	43
12-Aug	11	4	0	3	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	2	1	1	2	6	31
13-Aug	1	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	4	4	7	17	34
14-Aug	10	9	9	7	10	12	5	5	3	5	1	3	1	0	1	0	0	0	0	3	0	0	2	2	88
15-Aug	1	0	2	0	0	0	1	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	3	8
16-Aug	0	0	0	2	1	4	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	7
17-Aug	0	3	2	0	0	0	0	0	0	0	0	0	0	0	0	0	4	0	13	3	0	2	0	1	28
18-Aug	0	0	4	1	1	0	0	0	0	0	0	0	0	0	0	0	0	1	1	0	1	0	0	0	9
19-Aug	1	2	1	3	1	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	1	13	23
20-Aug	8	5	8	1	1	2	0	0	1	0	1	1	0	0	1	0	0	0	0	0	0	0	1	3	33
21-Aug	5	12	7	0	2.1	1.1	0.5	0.3	1	0	0	0	0	1	1	1	2	0	0	1	0	0	0	0	35
22-Aug	1	9	4	4	2	0	0	0	1	0	1	1	0	0	2	5	13	1	2	0	0	0	0	1	47
23-Aug	2	9	3	3	1	0.7	0.4	0.2	0.3	0.1	0.2	0	0	1	0	0	2	0	0	1	0	0	0	0	24
24-Aug	1	2	4	0	0	1	0	0	1	0	0	0	0	0	0	0	0	3	2	0	0	0	3	1	18

(continued)

Table 3. (page 3 of 3)

	Hour[a]																								
Date	00-01	01-02	02-03	03-04	04-05	05-06	06-07	07-08	08-09	09-10	10-11	11-12	12-13	13-14	14-15	15-16	16-17	17-18	18-19	19-20	20-21	21-22	22-23	23-24	Total
25-Aug	6	12	6	5	4	3	0	0	0	0	1	0	0	0	2	2	4	1	3	2	0	0	1	0	52
26-Aug	3	3	8	0	3	3	1	0	1	0	0	0	0	0	0	0	0	4	1	1	0	0	0	0	28
27-Aug	2	2	3	0	1	1	0	0	0	0	0	0	0	0	0	0	0	0	1	2	0	1	1	1	15
28-Aug	0	1	1	2	0	3	0	0	1	0	0	1	0	0	0	0	0	0	0	0	0	0	1	4	14
29-Aug	3	2	2	3	1	1	1	2	0	0	0	0	0	0	0	0	2	3	0	0	0	0	1	0	21
30-Aug	0	0	0	1	1	1	1	0	1	0	0	0	2	5	4	7	2	2	1	2	1	0	0	0	31
31-Aug	6	9	3	0	2	1	1	0	2	2	5	5	3	2	9	3	0	1	3	1	0	0	1	1	60
1-Sep	6	10	7	6	1	1	1	2	0	1	3	2	2	4	1	4	0	2	0	0	1	0	3	6	63
2-Sep	4	4	0	2	4	1	1	0	1	0	0	2	0	0	1	2	1	0	2	12	1	0	1	2	41
3-Sep	2	7	5	3	4	2	3	2	0	0	1	2	7	2	2	1	3	2	2	0	1	0	0	3	54
4-Sep	1	4	5	2	5	5	8	6	2	2	3	6	5	4	2	10	0	5	9	6	2	6	0	1	99
5-Sep	1	2	0	5	2	5	4	5	9	1	5	1	1	1	0	1	0	5	11	6	2	7	3	4	81
6-Sep	7	5	3	1	0	3	0	2	0	1	1	1	0	2	1	0	0	1	0	0	1	2	1	0	32
7-Sep	0	0	2	1	0	1	0	0	0	0	1	2	0	0	0	0	0	1	1	0	0	0	1	7	17
8-Sep	9	2	2	2	2	1	1	0	3	1	1	3	7	5	0	6	1	1	1	0	2	0	0	0	50
9-Sep	0	2	0	0	0	0	0	0	0	0	1	2	0	1	0	0	0	0	0	0	1	5	1	6	19
10-Sep	9	5	2	4	3	1	0	1	1	1	0	0	0	0	1	0	0	0	0	0	1	3	3	4	39
11-Sep	3	1	1	1	1	3	0	0	0	0	0	0	0	0	0	0	1	2	0	0	2	3	19	12	49
12-Sep	4	4	3	8	3	3	1	0	1	2	1	0	1	0	0	0	0	0	1	5	1	3	4	5	50
13-Sep	7	4	2	3	2	5	3	1	2	0	1	0	0	0	0	0	1	1	0	0	0	1	0	4	37
14-Sep	5	0	0	0	0	0	0	1	2	0	0	0	0	0	0	0	0	0	0	0	0	0	1	11	20
15-Sep	6	6	7	1	3	2	0	0	1	1	0	0	0	0	0	0	0	0	1	0	1	1	2	5	37
16-Sep	2	1	2	3	2	2	7	0	1	0	0	0	1	0	0	0	0	0	0	0	1	1	8	7	38
17-Sep	5	2	1	3	3	0	0	0	0	0	0	0	1	0	1	0	0	0	0	1	2	0	0	0	19
18-Sep	2	0	3	3	1	1	2	0	1	0	0	0	0	0	1	0	0	1	2	0	3	2	1	3	26
19-Sep	4	3	2	1	1	3	0	1	0	0	0	0	0	0	0	0	0	0	0	1	2	0	0	0	18
20-Sep	1	0	1	0	0	2	0	1	1	0	1	0	0	0	0	0	0	0	0	0	0	0	0	1	8
21-Sep	1	3	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	6
22-Sep	0	0	1	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	3
23-Sep	1	0	1	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	1	2	1	0	7
24-Sep	0	0	1	0	0	1	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	1	0	4
25-Sep	1	0	1	3	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	6
26-Sep	1	1	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	6	9
27-Sep	1	2	1	2	0	2	0	0	2	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	11
28-Sep	0	0	2	1	1	0	2	0	0	0	0	0	0.1	0.1	0.1	0.2	0.2	0.2	0.3	0.2	0.3	0.2	0.3	0.6	9
Total	551	498	534	475	231	122	58	35	46	19	29	35	33	32	42	66	87	91	146	109	122	102	143	285	3,891

[a]Shaded cells with values to one decimal place were filled-in using the EM algorithm. They total 19.6 fish.

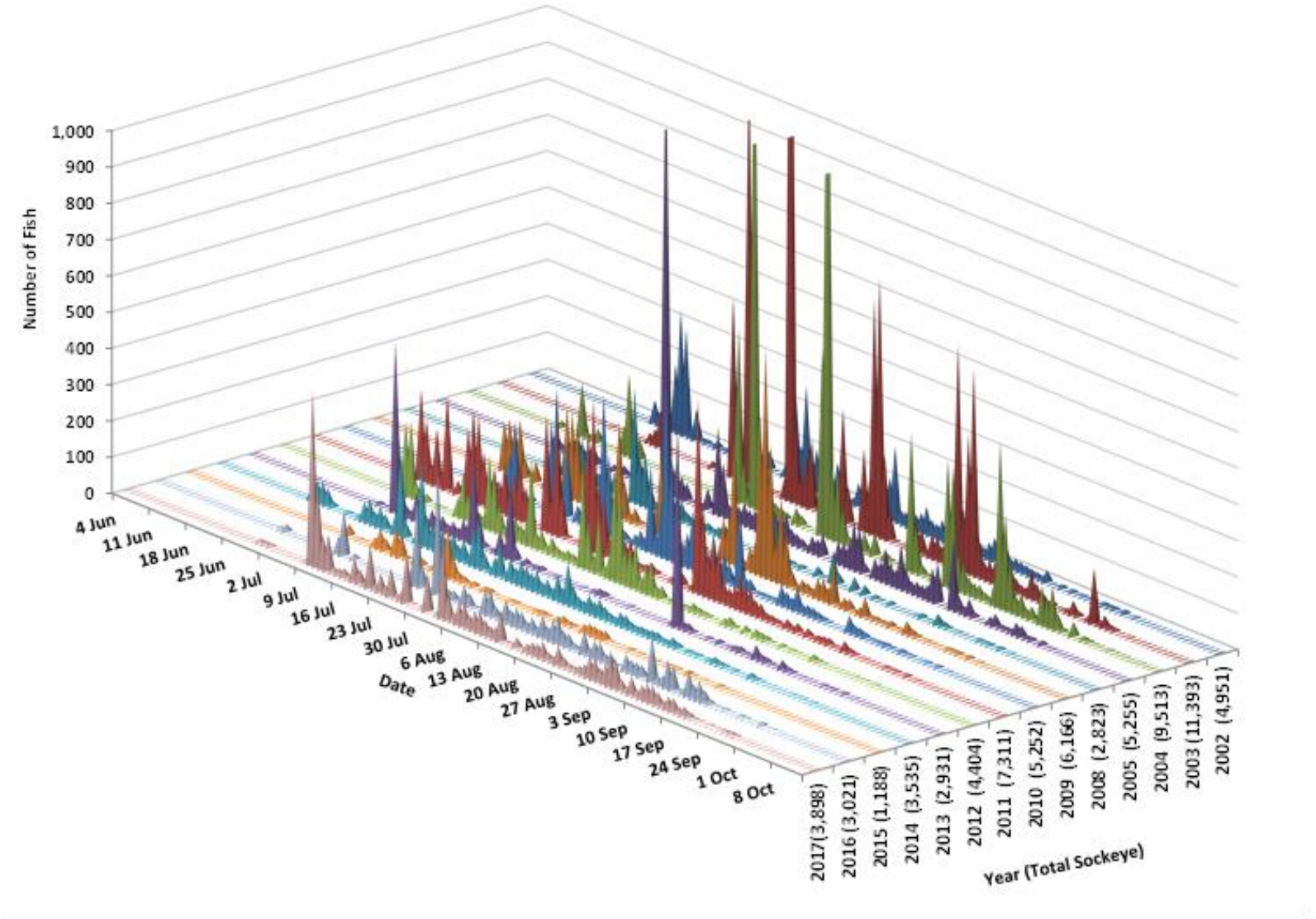


Figure 22. Estimated daily escapement of Sockeye Salmon into Neva Lake, 4 June to 13 October 2002 to 2005 and 2008 to 2017.

Table 4. Estimated daily escapement of adult and jack Sockeye Salmon into Neva Lake, from 4 June to 13 October 2002 to 2005 and 2008 to 2017.

Date	2002	2003	2004	2005	2008	2009	2010	2011	2012	2013	2014	2015	2016	2017
4 Jun	0	0	0	0	0	0	0	0	0	0	0	0	0	0
5 Jun	0	0	0	0	0	0	0	0	0	0	0	0	0	0
6 Jun	0	0	0	0	0	0	0	0	0	0	0	0	0	0
7 Jun	0	0	0	0	0	0	0	0	0	0	0	0	0	0
8 Jun	0	0	0	0	0	0	0	0	0	0	0	0	0	0
9 Jun	0	0	0	0	0	0	0	0	0	0	0	0	0	0
10 Jun	1	0	0	0	0	0	0	0	0	0	0	0	0	0
11 Jun	0	0	0	0	0	0	0	0	0	0	0	0	0	0
12 Jun	0	0	0	0	0	0	0	0	0	0	0	0	0	0
13 Jun	0	0	0	0	0	0	0	0	0	1	0	0	0	0
14 Jun	0	0	0	0	0	0	0	0	0	0	0	0	0	0
15 Jun	0	0	0	0	0	0	0	0	0	0	0	0	0	0
16 Jun	0	0	0	0.0	0	0	0	0.0	0.0	5	0.5	0.0	0	0
17 Jun	1	0	0	0.2	0	0	0	1.1	0.6	0	0	0.0	0	0
18 Jun	2	0	0	0.5	0	0	0	2.2	1.2	0	0	0.0	0	0
19 Jun	0	0	0	0.0	0	0	0	0.0	0.0	0	0	0.0	0	0
20 Jun	1	0	0	0	0	0	0	0.6	0	0	0	0	0	0
21 Jun	0	0	22	0	0	0	0	14.0	1	0	40	0	0	2
22 Jun	1	1	0	0	0	0	0	0	1	0	60	0	0	0
23 Jun	1	5	0	0	0	0	0	3	0	0	62	0	0	0
24 Jun	0	0	0	0	0	0	0	248	0	0	49	0	0	0
25 Jun	0	6	149	0	0	0	0	170	1	0	19	0	1	0
26 Jun	1	2	17	49	0	0	0	54	35	0	2	0	5	0
27 Jun	62	0	22	18	0	0	0	156	201	5	4	0	12	0
28 Jun	35	0	40	27	0	133	1	43	208	13	10	0	22	0
29 Jun	0	6	1	44	4	147	8	261	46	6	5	0	0	13
30 Jun	31	2	4	66	0	142	14	11	26	2	10	0	0	12
1 Jul	188	0	4	34	0	156	14	36	25	468	52	0	0	12
2 Jul	340	26	0	31	15	55	19	4	2	119	68	0	0	0
3 Jul	295	43	77	60	11	0	0	195	6	31	39	0	15	1
4 Jul	28	99	225	23	137	58	2	253	6	22	58	34	5	1
5 Jul	84	32	89	0	78	0	110	239	2	77	42	0	0	0
6 Jul	12	6	63	0	151	22	205	146	2	29	9	7	0	0
7 Jul	14	3	2	18	111	29	2	35	49	8	57	5	0	0
8 Jul	8	0	0	0	97	16	0	112	125	46	239	1	48	11
9 Jul	21	0	0	27	55	0	21	85	70	24	43	26	126	482
10 Jul	8	0	0	9	38	244	0	140	3	42	4	58	0	231
11 Jul	11	0	0	2	10	235	0	55	34	27	21	36	18	94
12 Jul	11	0	0	65	20	213	0	128	33	38	233	8	2	101
13 Jul	4	0	0	4	48	101	250	162	203	28	87	77	0	17
14 Jul	37	19	0	2	17	137	344	98	157	56	66	72	0	19
15 Jul	40	3	0	2	0	30	35	27	78	60	59	12	0	25
16 Jul	21	0	0	0	0	22	209	1	21	249	61	2	0	14
17 Jul	10	0	0	1185	313	4	5	2	99	90	60	56	1	67
18 Jul	43	496	0	105	131	0	44	319	63	19	72	21	0	41
19 Jul	52	361	1	88	146	53	30	94	47	6	40	4	2	14
20 Jul	5	45	0	61	66	265	4	336	51	12	61	14	2	118
21 Jul	2	1135	0	49	22	109	24	127	239	68	26	11	1	18
22 Jul	31	92	2	7	40	22	45	11	43	33	107	20	47	51
23 Jul	4	7	0	0	42	41	380	3	54	229	130	144	238	24
24 Jul	239	0	3	10	75	14	222	7	19	43	47	63	66	79
25 Jul	103	1	474	57	8	6	119	24	47	5	12	26	4	14
26 Jul	273	6	111	0	51	0	53	340	25	20	47	20	8	27
27 Jul	94	4	24	239	28	61	26	412	19	8	90	10	342	148
28 Jul	110	67	1402	146	16	213	10	196	29	12	17	17	11	7
29 Jul	39	1914	256	38	15	23	29	158	24	16	64	0	26	3
30 Jul	23	231	199	57	20	77	45	51	18	1	43	15	28	9
31 Jul	49	76	60	41	23	0	35	32	264	5	68	16	11	109
1 Aug	96	142	34	59	14	1	236	61	131	7	58	5	54	4
2 Aug	25	192	29	47	23	0	51	59	40	2	46	0	39	12
3 Aug	8	9	21	50	41	0	146	68	159	1	57	3	10	227
4 Aug	17	11	5	94	17	6	488	19	26	0	32	8	1	73
5 Aug	64	367	44	5	4	18	280	13	64	0	45	9	62	26
6 Aug	7	125	29	97	0	5	107	18	310	6	26	4	76	62
7 Aug	23	79	7	70	0	0	61	29	292	0	70	5	32	69
8 Aug	361	311	0	84	0	0	92	16	103	10	39	6	14	39
9 Aug	206	103	1	78	0	116	158	2	106	18	113	10	62	55
10 Aug	146	7	522	41	0	125	85	2	131	17	58	14	40	59
11 Aug	116	4	1633	33	0	345	17	10	38	5	32	9	51	43
12 Aug	206	224	197	25	216	55	42	76	78	2	27	2	46	31
13 Aug	37	143	198	13	125	7	118	34	91	1	48	13	25	34
14 Aug	35	653	95	43	125	63	28	7	31	1	36	22	42	88

(continued)

Table 4. (page 2 of 2)

Date	2002	2003	2004	2005	2008	2009	2010	2011	2012	2013	2014	2015	2016	2017
15 Aug	80	716	26	42	16	81	78	19	36	7	49	13	23	8
16 Aug	41	233	24	61	13	437	53	532	7	3	34	11	59	7
17 Aug	52	84	41	0	7	630	15	251	10	0	23	4	35	28
18 Aug	74	8	53	0	14	372	231	130	16	1	18	23	58	9
19 Aug	45	3	16	57	0	106	36	169	9	2	36	30	76	23
20 Aug	40	6	64	65	0	239	35	152	10	2	35	28	43	33
21 Aug	56	48	4	65	27	144	8	59	24	3	22	26	39	35
22 Aug	79	83	25	133	7	46	10	47	18	3	17	28	18	47
23 Aug	47	67	11	124	0	13	10	59	13	13	20	6	9	24
24 Aug	29	17	5	29	87	32	10	92	10	555	19	3	63	18
25 Aug	40	64	2	0	33	28	10	76	4	24	22	2	23	52
26 Aug	27	67	2	52	0	20	53	71	2	23	23	4	49	28
27 Aug	35	45	379	50	0	53	41	44	17	11	13	9	50	15
28 Aug	40	50	133	93	38	58	31	39	27	2	14	4	25	14
29 Aug	27	15	30	61	0	40	66	20	11	2	26	7	30	21
30 Aug	46.5	621	10	47	28	116	24	19	2	9	18	1	9	31
31 Aug	66	173	9	120	0	12	28	15	21	4	3	2	5	60
1 Sep	26	385	2	56	13	29	26	9	6	14	10	5	46	63
2 Sep	80	567	0	31	7	32	20	25	22	4	8	2	37	41
3 Sep	27	109	348	36	0	8	14	14	20	7	9	6	36	54
4 Sep	31	49	334	33	14	20	7	26	17	14	4	6	35	99
5 Sep	27.8	57	104	39	0	54	0	8	7	18	9	7	8	81
6 Sep	24.6	55	81	91	0	11	0	23	2	8	19	3	123	32
7 Sep	21.4	49	49	111	0	13.5	0	9	13	8	13	13	22	17
8 Sep	18.2	69	37	0	0	10.2	45	16	5.2	38	10	6	28	50
9 Sep	15	76	38	0	6.6	9.8	25	19	8	19	5	2.9	78	19
10 Sep	35	38	23	197	15.0	18.5	24	21	5	17	8	5.2	70	39
11 Sep	5	25	14	46	4.6	6.4	17	8	3.3	8	3.1	1.8	11	49
12 Sep	5	24	72	22	6.3	7.6	7	7	3.9	5.7	3.6	2.1	16	50
13 Sep	13	75	456	47	30.2	34.9	8	29.4	17.8	26.3	16.6	9.8	71	37
14 Sep	3	48	262	17	16.9	19.8	10	16.7	10.1	14.9	9.4	5.6	40	20
15 Sep	12	31	143	0	9.5	11.6	13	9.8	5.9	8.7	5.5	3.3	55	37
16 Sep	5.3	11	51	0	3.8	4.4	8	3.7	2.2	3.3	2.1	1.2	37	38
17 Sep	7.8	16	61	21	6.0	6.5	5	5.4	3.3	4.9	3.1	1.8	17	19
18 Sep	6.0	4	27	35	4.0	5.0	13	4.2	2.5	3.7	2.4	1.4	6	26
19 Sep	4.8	7	37	12	3.4	4.0	8	3.4	2.0	3.0	1.9	1.1	6	18
20 Sep	3.3	13	12	12	2.3	2.8	7	2.3	1.4	2.1	1.3	0.8	9	8
21 Sep	12.1	39	107	13	9.7	10.1	2	8.5	5.2	7.6	4.8	2.9	3	6
22 Sep	10.0	17	77	34	7.8	8.3	5	7.0	4.3	6.3	4.0	2.4	2	3
23 Sep	11.7	2	114	32	9.0	9.8	7.9	8.2	5.0	7.4	4.7	2.8	9	7
24 Sep	6.0	17	47	12	4.6	5.0	4.0	4.2	2.6	3.8	2.4	1.4	7	4
25 Sep	14.2	152	14	13	10.9	11.8	9.5	9.9	6.0	8.9	5.6	3.3	2	6
26 Sep	2.1	16	6	4.5	1.7	1.8	1.4	1.5	0.9	1.3	0.8	0.5	5	9
27 Sep	7.2	34	41	15.3	5.7	6.0	4.8	5.0	3.0	4.5	2.9	1.7	2	11
28 Sep	1.8	16	3	3.9	1.4	1.5	1.2	1.3	0.8	1.1	0.7	0.4	3.3	9
29 Sep	2.5	12	14	5.3	2.0	2.1	1.7	1.7	1.1	1.6	1.0	0.6	4.6	0.0
30 Sep	1.2	3	10	2.7	1.0	1.0	0.8	0.9	0.5	0.8	0.5	0.3	2.3	1.4
1 Oct	0.7	2	5	1.4	0.5	0.6	0.4	0.5	0.3	0.4	0.3	0.2	1.2	0.8
2 Oct	0.9	5	4	1.8	0.7	0.7	0.6	0.6	0.4	0.5	0.3	0.2	1.6	1.0
3 Oct	0.0	0	0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
4 Oct	0.9	2	7	1.8	0.7	0.7	0.6	0.6	0.4	0.5	0.3	0.2	1.6	1.0
5 Oct	0.7	3	4	1.4	0.5	0.6	0.4	0.5	0.3	0.4	0.3	0.2	1.2	0.8
6 Oct	0.3	0	3	0.6	0.2	0.2	0.2	0.2	0.1	0.2	0.1	0.1	0.5	0.3
7 Oct	0.4	0	4	0.8	0.3	0.3	0.3	0.3	0.2	0.2	0.2	0.1	0.7	0.4
8 Oct	0.2	2	0	0.4	0.2	0.2	0.1	0.1	0.1	0.1	0.1	0.0	0.4	0.2
9 Oct	0.0	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 Oct	0.7	3.1	4	1.5	0.3	0.6	0.5	0.5	0.3	0.4	0.3	0.2	1.2	0.8
11 Oct	0.0	0.0	0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
12 Oct	0.2	0.8	1	0.4	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.0	0.3	0.2
13 Oct	0.2	0.8	1	0.4	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.0	0.3	0.2
Total	**4,951**	**11,393**	**9,513**	**5,255**	**2,823**	**6,166**	**5,252**	**7,311**	**4,404**	**2,931**	**3,535**	**1,188**	**3,009**	**3,898**
Weir Count	4,471	11,388	9,513	5,212	2,657	5,950	5,217	7,182	4,313	2,812	3,460	1,134	2,990	3,891
Difference	532	5	0	43	166	216	35	130	91	119	75	54	19	7

Shaded cells with whole numbers entries are the estimated best guess and shaded cells with values to one decimal place are interpolated (see below).
Missing values prior to 16 June were assumed to be zero.
Missing values between 16 and 21 June were filled-in using the EM algorithm applied to counts in June.
Missing values after 6 September were filled-in using the EM algorithm applied to counts in September and October.

Notes for 2002:

The 4,951 total is the Darroch estimates of 3,738 adults and 1,213 jacks (Van Alen 2004). Missing values on 30 August and 5 to 8 September were linerally interpolated and the remaining 295 fish were listed on 3 July when fish had passed through pulled pickets on the weir.

Notes for 2003:

The 11,393 total is the Darroch estimates with adults and jacks combined and three release and two recovery strata (Van Alen 2005). The 287 fish difference between the weir count that the Darroch estimate were added to the 98 fish actually counted on 1 September since many fish were known to have passed uncounted through pulled pickets on this date. These fish were apportioned between adults and jacks in the same proportion as the 98 fish counted.

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=53, CV=32%). We used the estimated daily proportions from an 2002 to 2005 EM fill-in to estimate the daily counts after 8 September (Van Alen 2009).

Table 5. Estimated cumulative daily proportion of adult and jack Sockeye Salmon escapement into Neva Lake, from 4 June to 12 October 2002 to 2005 and 2008 to 2017.

Date	2002	2003	2004	2005	2008	2009	2010	2011	2012	2013	2014	2015	2016	2017	Average
4 Jun	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
5 Jun	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
6 Jun	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
7 Jun	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
8 Jun	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
9 Jun	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
10 Jun	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
11 Jun	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
12 Jun	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
13 Jun	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
14 Jun	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
15 Jun	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
16 Jun	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.002	0.000	0.000	0.000	0.000	0.000
17 Jun	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.002	0.000	0.000	0.000	0.000	0.000
18 Jun	0.001	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.002	0.000	0.000	0.000	0.000	0.000
19 Jun	0.001	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.002	0.000	0.000	0.000	0.000	0.000
20 Jun	0.001	0.000	0.000	0.000	0.000	0.000	0.000	0.001	0.000	0.002	0.000	0.000	0.000	0.000	0.000
21 Jun	0.001	0.000	0.002	0.000	0.000	0.000	0.000	0.002	0.001	0.002	0.011	0.000	0.000	0.001	0.001
22 Jun	0.001	0.000	0.002	0.000	0.000	0.000	0.000	0.002	0.001	0.002	0.028	0.000	0.000	0.001	0.003
23 Jun	0.001	0.001	0.002	0.000	0.000	0.000	0.000	0.003	0.001	0.002	0.046	0.000	0.000	0.001	0.004
24 Jun	0.001	0.001	0.002	0.000	0.000	0.000	0.000	0.037	0.001	0.002	0.060	0.000	0.000	0.001	0.007
25 Jun	0.001	0.001	0.018	0.000	0.000	0.000	0.000	0.060	0.001	0.002	0.065	0.000	0.000	0.001	0.011
26 Jun	0.002	0.001	0.020	0.009	0.000	0.000	0.000	0.067	0.009	0.002	0.066	0.000	0.002	0.001	0.013
27 Jun	0.014	0.001	0.022	0.013	0.000	0.000	0.000	0.089	0.055	0.004	0.067	0.000	0.006	0.001	0.019
28 Jun	0.021	0.001	0.026	0.018	0.000	0.022	0.000	0.095	0.102	0.008	0.070	0.000	0.013	0.001	0.027
29 Jun	0.021	0.002	0.026	0.026	0.001	0.045	0.002	0.130	0.112	0.010	0.071	0.000	0.013	0.004	0.033
30 Jun	0.027	0.002	0.027	0.039	0.001	0.068	0.004	0.132	0.118	0.011	0.074	0.000	0.013	0.007	0.037
1 Jul	0.065	0.002	0.027	0.045	0.001	0.094	0.007	0.137	0.124	0.171	0.089	0.000	0.013	0.010	0.056
2 Jul	0.134	0.004	0.027	0.051	0.007	0.103	0.011	0.137	0.124	0.211	0.108	0.000	0.013	0.010	0.067
3 Jul	0.194	0.008	0.035	0.063	0.011	0.103	0.011	0.164	0.126	0.222	0.119	0.000	0.018	0.010	0.077
4 Jul	0.199	0.017	0.059	0.067	0.059	0.112	0.011	0.199	0.127	0.229	0.135	0.029	0.020	0.011	0.091
5 Jul	0.216	0.019	0.068	0.067	0.087	0.112	0.032	0.231	0.128	0.256	0.147	0.029	0.020	0.011	0.102
6 Jul	0.219	0.020	0.075	0.067	0.140	0.116	0.071	0.251	0.128	0.265	0.150	0.034	0.020	0.011	0.112
7 Jul	0.222	0.020	0.075	0.071	0.180	0.120	0.071	0.256	0.139	0.268	0.166	0.039	0.020	0.011	0.118
8 Jul	0.223	0.020	0.075	0.071	0.214	0.123	0.071	0.271	0.168	0.284	0.234	0.040	0.036	0.013	0.132
9 Jul	0.227	0.020	0.075	0.076	0.233	0.123	0.075	0.283	0.183	0.292	0.246	0.061	0.078	0.137	0.151
10 Jul	0.229	0.020	0.075	0.077	0.247	0.162	0.075	0.302	0.184	0.306	0.247	0.110	0.078	0.196	0.165
11 Jul	0.231	0.020	0.075	0.078	0.250	0.201	0.075	0.310	0.192	0.316	0.253	0.141	0.084	0.220	0.175
12 Jul	0.233	0.020	0.075	0.090	0.258	0.235	0.075	0.327	0.199	0.329	0.319	0.147	0.084	0.246	0.188
13 Jul	0.234	0.020	0.075	0.091	0.275	0.252	0.123	0.349	0.245	0.338	0.343	0.212	0.084	0.251	0.207
14 Jul	0.242	0.022	0.075	0.091	0.281	0.274	0.189	0.363	0.281	0.357	0.362	0.273	0.084	0.256	0.225
15 Jul	0.250	0.022	0.075	0.092	0.281	0.279	0.195	0.366	0.299	0.378	0.379	0.283	0.084	0.262	0.232
16 Jul	0.254	0.022	0.075	0.092	0.281	0.282	0.235	0.367	0.304	0.463	0.396	0.284	0.084	0.266	0.243
17 Jul	0.256	0.022	0.075	0.317	0.391	0.283	0.236	0.367	0.326	0.493	0.413	0.332	0.085	0.283	0.277
18 Jul	0.265	0.066	0.075	0.337	0.438	0.283	0.244	0.410	0.340	0.500	0.433	0.349	0.085	0.293	0.294
19 Jul	0.275	0.097	0.075	0.354	0.490	0.291	0.250	0.423	0.351	0.502	0.444	0.353	0.085	0.297	0.306
20 Jul	0.276	0.101	0.075	0.366	0.513	0.334	0.251	0.469	0.363	0.506	0.462	0.364	0.086	0.327	0.321
21 Jul	0.277	0.201	0.075	0.375	0.521	0.352	0.255	0.487	0.417	0.529	0.469	0.374	0.086	0.332	0.339
22 Jul	0.283	0.209	0.075	0.376	0.535	0.356	0.264	0.488	0.427	0.540	0.499	0.390	0.102	0.345	0.349
23 Jul	0.284	0.210	0.075	0.376	0.550	0.362	0.336	0.489	0.439	0.619	0.536	0.512	0.181	0.351	0.380
24 Jul	0.332	0.210	0.076	0.378	0.576	0.365	0.379	0.489	0.443	0.633	0.549	0.565	0.203	0.371	0.398
25 Jul	0.353	0.210	0.126	0.389	0.579	0.366	0.401	0.493	0.454	0.635	0.553	0.586	0.204	0.375	0.409
26 Jul	0.408	0.210	0.137	0.389	0.597	0.366	0.411	0.539	0.460	0.642	0.566	0.603	0.207	0.382	0.423
27 Jul	0.427	0.211	0.140	0.434	0.607	0.375	0.416	0.596	0.464	0.644	0.591	0.612	0.321	0.420	0.447
28 Jul	0.449	0.217	0.287	0.462	0.613	0.410	0.418	0.622	0.470	0.649	0.596	0.626	0.324	0.422	0.469
29 Jul	0.457	0.385	0.314	0.469	0.618	0.414	0.424	0.644	0.476	0.654	0.614	0.626	0.333	0.422	0.489
30 Jul	0.462	0.405	0.335	0.480	0.625	0.426	0.432	0.651	0.480	0.654	0.627	0.639	0.342	0.425	0.499
31 Jul	0.472	0.411	0.341	0.488	0.633	0.426	0.439	0.655	0.540	0.656	0.646	0.652	0.346	0.453	0.511
1 Aug	0.491	0.424	0.345	0.499	0.638	0.426	0.484	0.664	0.570	0.658	0.662	0.656	0.364	0.454	0.524
2 Aug	0.496	0.441	0.348	0.508	0.646	0.426	0.494	0.672	0.579	0.659	0.675	0.656	0.377	0.457	0.531
3 Aug	0.498	0.442	0.350	0.518	0.661	0.426	0.521	0.681	0.615	0.660	0.691	0.659	0.380	0.515	0.544
4 Aug	0.501	0.443	0.351	0.536	0.667	0.427	0.614	0.684	0.621	0.660	0.700	0.666	0.380	0.534	0.556
5 Aug	0.514	0.475	0.355	0.537	0.668	0.430	0.668	0.685	0.635	0.660	0.713	0.673	0.401	0.540	0.568
6 Aug	0.515	0.486	0.358	0.555	0.668	0.431	0.688	0.688	0.706	0.662	0.720	0.677	0.426	0.556	0.581

(continued)

Table 5. (page 2 of 2)

Date	2002	2003	2004	2005	2008	2009	2010	2011	2012	2013	2014	2015	2016	2017	Average
7 Aug	0.520	0.493	0.359	0.568	0.668	0.431	0.700	0.692	0.772	0.662	0.740	0.681	0.437	0.574	0.593
8 Aug	0.593	0.520	0.359	0.584	0.668	0.431	0.717	0.694	0.795	0.665	0.751	0.686	0.442	0.584	0.606
9 Aug	0.635	0.529	0.359	0.599	0.668	0.450	0.747	0.694	0.819	0.671	0.783	0.694	0.462	0.598	0.622
10 Aug	0.664	0.530	0.414	0.607	0.668	0.470	0.763	0.695	0.849	0.677	0.800	0.706	0.476	0.613	0.638
11 Aug	0.687	0.530	0.586	0.613	0.668	0.526	0.767	0.696	0.858	0.679	0.809	0.714	0.492	0.624	0.661
12 Aug	0.729	0.550	0.606	0.618	0.745	0.535	0.775	0.706	0.876	0.679	0.816	0.715	0.508	0.632	0.678
13 Aug	0.737	0.562	0.627	0.620	0.789	0.536	0.797	0.711	0.896	0.680	0.830	0.726	0.516	0.641	0.691
14 Aug	0.744	0.620	0.637	0.629	0.834	0.546	0.802	0.712	0.903	0.680	0.840	0.745	0.530	0.663	0.706
15 Aug	0.760	0.682	0.640	0.637	0.839	0.559	0.817	0.715	0.911	0.682	0.854	0.756	0.538	0.665	0.718
16 Aug	0.768	0.703	0.642	0.648	0.844	0.630	0.827	0.787	0.913	0.683	0.864	0.765	0.557	0.667	0.736
17 Aug	0.779	0.710	0.647	0.648	0.846	0.733	0.830	0.822	0.915	0.683	0.870	0.768	0.569	0.674	0.750
18 Aug	0.793	0.711	0.652	0.648	0.851	0.793	0.874	0.839	0.919	0.684	0.875	0.788	0.588	0.677	0.764
19 Aug	0.803	0.711	0.654	0.659	0.851	0.810	0.881	0.863	0.921	0.684	0.885	0.813	0.613	0.683	0.774
20 Aug	0.811	0.712	0.661	0.671	0.851	0.849	0.888	0.883	0.923	0.685	0.895	0.836	0.628	0.691	0.785
21 Aug	0.822	0.716	0.661	0.684	0.861	0.872	0.889	0.891	0.929	0.686	0.901	0.858	0.641	0.700	0.794
22 Aug	0.838	0.723	0.664	0.709	0.863	0.880	0.891	0.898	0.933	0.687	0.906	0.882	0.647	0.712	0.802
23 Aug	0.847	0.729	0.665	0.733	0.863	0.882	0.893	0.906	0.936	0.692	0.912	0.887	0.650	0.718	0.808
24 Aug	0.853	0.731	0.666	0.738	0.894	0.887	0.895	0.919	0.938	0.881	0.917	0.889	0.671	0.723	0.829
25 Aug	0.861	0.736	0.666	0.738	0.906	0.891	0.897	0.929	0.939	0.889	0.924	0.891	0.678	0.736	0.834
26 Aug	0.867	0.742	0.666	0.748	0.906	0.895	0.907	0.939	0.939	0.897	0.930	0.894	0.695	0.743	0.841
27 Aug	0.874	0.746	0.706	0.758	0.906	0.903	0.915	0.945	0.943	0.901	0.934	0.902	0.711	0.747	0.849
28 Aug	0.882	0.750	0.720	0.775	0.919	0.913	0.921	0.950	0.949	0.901	0.938	0.905	0.719	0.751	0.857
29 Aug	0.887	0.752	0.723	0.787	0.919	0.919	0.933	0.953	0.952	0.902	0.945	0.911	0.729	0.756	0.862
30 Aug	0.897	0.806	0.724	0.796	0.929	0.938	0.938	0.955	0.952	0.905	0.950	0.912	0.732	0.764	0.871
31 Aug	0.910	0.821	0.725	0.819	0.929	0.940	0.943	0.957	0.957	0.907	0.951	0.914	0.734	0.780	0.878
1 Sep	0.915	0.855	0.725	0.829	0.934	0.945	0.948	0.959	0.958	0.911	0.954	0.918	0.749	0.796	0.885
2 Sep	0.932	0.905	0.725	0.835	0.936	0.950	0.952	0.962	0.963	0.913	0.956	0.920	0.762	0.806	0.894
3 Sep	0.937	0.915	0.762	0.842	0.936	0.951	0.955	0.964	0.968	0.915	0.959	0.925	0.774	0.820	0.902
4 Sep	0.943	0.919	0.797	0.848	0.941	0.954	0.956	0.968	0.972	0.920	0.960	0.930	0.785	0.846	0.910
5 Sep	0.949	0.924	0.808	0.856	0.941	0.963	0.956	0.969	0.973	0.926	0.962	0.936	0.788	0.866	0.915
6 Sep	0.954	0.929	0.816	0.873	0.941	0.965	0.956	0.972	0.974	0.929	0.968	0.938	0.829	0.875	0.923
7 Sep	0.958	0.933	0.821	0.894	0.941	0.967	0.956	0.973	0.977	0.931	0.971	0.949	0.836	0.879	0.928
8 Sep	0.962	0.939	0.825	0.894	0.941	0.969	0.964	0.975	0.978	0.944	0.974	0.954	0.845	0.892	0.933
9 Sep	0.965	0.946	0.829	0.894	0.944	0.970	0.969	0.978	0.980	0.951	0.976	0.957	0.871	0.897	0.938
10 Sep	0.972	0.949	0.832	0.932	0.949	0.973	0.974	0.981	0.981	0.957	0.978	0.961	0.895	0.907	0.946
11 Sep	0.973	0.951	0.833	0.941	0.950	0.974	0.977	0.982	0.982	0.959	0.979	0.963	0.898	0.919	0.949
12 Sep	0.974	0.953	0.841	0.945	0.953	0.976	0.978	0.983	0.983	0.961	0.980	0.964	0.904	0.932	0.952
13 Sep	0.977	0.960	0.889	0.954	0.963	0.981	0.980	0.987	0.987	0.970	0.984	0.973	0.927	0.942	0.962
14 Sep	0.977	0.964	0.916	0.957	0.969	0.984	0.982	0.989	0.989	0.975	0.987	0.977	0.940	0.947	0.968
15 Sep	0.980	0.967	0.931	0.957	0.973	0.986	0.984	0.990	0.990	0.978	0.989	0.980	0.959	0.956	0.973
16 Sep	0.981	0.968	0.937	0.957	0.974	0.987	0.986	0.991	0.991	0.980	0.989	0.981	0.971	0.966	0.976
17 Sep	0.982	0.969	0.943	0.961	0.976	0.988	0.987	0.992	0.992	0.981	0.990	0.983	0.977	0.971	0.978
18 Sep	0.983	0.970	0.946	0.968	0.978	0.989	0.989	0.992	0.992	0.982	0.991	0.984	0.979	0.977	0.980
19 Sep	0.984	0.970	0.950	0.970	0.979	0.990	0.991	0.993	0.993	0.983	0.991	0.985	0.981	0.982	0.981
20 Sep	0.985	0.971	0.951	0.972	0.980	0.990	0.992	0.993	0.993	0.984	0.992	0.985	0.984	0.984	0.983
21 Sep	0.988	0.975	0.962	0.975	0.983	0.992	0.992	0.994	0.994	0.987	0.993	0.988	0.985	0.986	0.985
22 Sep	0.990	0.976	0.970	0.981	0.986	0.993	0.993	0.995	0.995	0.989	0.994	0.990	0.985	0.986	0.987
23 Sep	0.992	0.976	0.982	0.987	0.989	0.995	0.995	0.996	0.996	0.991	0.996	0.992	0.988	0.988	0.990
24 Sep	0.993	0.978	0.987	0.989	0.991	0.995	0.996	0.997	0.997	0.993	0.996	0.993	0.991	0.989	0.992
25 Sep	0.996	0.991	0.989	0.992	0.995	0.997	0.997	0.998	0.998	0.996	0.998	0.996	0.991	0.991	0.995
26 Sep	0.996	0.993	0.989	0.993	0.995	0.998	0.998	0.998	0.998	0.996	0.998	0.997	0.993	0.993	0.995
27 Sep	0.998	0.996	0.994	0.996	0.997	0.999	0.999	0.999	0.999	0.998	0.999	0.998	0.994	0.996	0.997
28 Sep	0.998	0.997	0.994	0.996	0.998	0.999	0.999	0.999	0.999	0.998	0.999	0.998	0.995	0.998	0.998
29 Sep	0.999	0.998	0.995	0.997	0.998	0.999	0.999	0.999	0.999	0.999	0.999	0.999	0.996	0.998	0.998
30 Sep	0.999	0.998	0.997	0.998	0.999	0.999	0.999	1.000	1.000	0.999	0.999	0.999	0.997	0.999	0.999
1 Oct	0.999	0.999	0.997	0.998	0.999	0.999	0.999	1.000	1.000	0.999	1.000	0.999	0.997	0.999	0.999
2 Oct	0.999	0.999	0.997	0.999	0.999	1.000	1.000	1.000	1.000	0.999	1.000	0.999	0.998	0.999	0.999
3 Oct	0.999	0.999	0.997	0.999	0.999	1.000	1.000	1.000	1.000	0.999	1.000	0.999	0.998	0.999	0.999
4 Oct	0.999	0.999	0.998	0.999	0.999	1.000	1.000	1.000	1.000	0.999	1.000	0.999	0.998	0.999	0.999
5 Oct	1.000	0.999	0.999	0.999	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	0.999	0.999	0.999
6 Oct	1.000	0.999	0.999	0.999	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	0.999	1.000	1.000
7 Oct	1.000	0.999	0.999	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	0.999	1.000	1.000
8 Oct	1.000	1.000	0.999	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	0.999	1.000	1.000
9 Oct	1.000	1.000	0.999	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	0.999	1.000	1.000
10 Oct	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000
11 Oct	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000
12 Oct	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000
13 Oct	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	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 2017, 110 Sockeye Salmon were sampled for age (three scales/fish), sex, and length (mid-eye-to-fork) data. Project personnel captured 83 beach seining off the mouth of the main inlet stream on 23 and 24 August and 27 seining beach spawners at the southeast end of the lake on 28 September. Both freshwater and marine ages could be determined from only 2 of the 110 fish sampled due to scales that were regenerated, resorbed, mounted upside down, or obscured. Freshwater ages were readable from 20 females and 21 males and all were freshwater-age-1. except for one age-2. female.

Comparing the age compositions of the Neva Lake Sockeye escapements from 2002 to 2016 shows that freshwater-age-1 fish have typically dominated the runs, with age-1.2 and 1.3 being the most abundant (Table 6). Nevertheless, freshwater-age-2 fish were 30% , 32%, 73%, and 20% of the Sockeye Salmon aged in 2006, 2010, 2012, and 2014, respectively.

Table 6. Age composition of the Sockeye Salmon escapement into Neva Lake, 2002 through 2016.

		Age								
Year	Sample Size	1.1	1.2	1.3	2.1	2.2	2.3	3.1	3.2	Total
2002	606	22%	45%	28%		4%				99%
2003	1054	20%	71%	5%	2%	2%	1%			101%
2004	480	10%	70%	16%		4%				100%
2005	444	3%	43%	40%	2%	11%	2%			101%
2006	205		19%	51%		28%	2%			100%
2007	115	15%	61%	16%	6%		3%			101%
2008	360	6%	58%	25%	3%	7%	1%			100%
2009	290	9%	33%	49%	2%	6%	1%			100%
2010	87	9%	35%	24%	5%	26%	1%			100%
2011	90		33%	52%	2%	6%	7%			100%
2012	91	1%	7%	19%		16%	2%		55%	100%
2013	147	1%	90%	2%		3%		2%	2%	100%
2014	92	4%	22%	53%		10%	1%		10%	100%
2015	59		90%			2%	5%		3%	100%
2016	20	40%	5%	50%		5%				100%

Stream Temperature and Depth

We have no new data to report from the temperature and temperature and pressure (depth) data loggers in Neva Lake's inlet and outlet streams since 28 September 2016. On 28 September 2017, the files on the three temperature and pressure data loggers were downloaded onto a data shuttle but an unrecoverable error occurred when trying to upload and process the files. We will relaunch the shuttle and attempt to download the loggers at the start of the 2018 season. On 28 September 2017 we also switched out the stream and air temperature data loggers at the outlet and sent them to the Aquatic Restoration and Research Institute (ARRI 2013). The temperature data from these loggers is not available for this report but will be available for future reports.

In Neva Creek (the outlet stream) the average water temperatures often exceeds 17ºC in July and August (Table 7 and Figure 23).

Table 7. Average monthly temperature (ºC) of Neva Creek, August 2002 to September 2016.

	Month												
Year	01	02	03	04	05	06	07	08	09	10	11	12	Ave.
2002								14.7	12.2	9.0	6.4	4.0	
2003	2.6	2.5	2.8	6.3	12.0	15.0	17.4	16.4	13.0	9.2	4.6	2.3	8.7
2004	1.7	2.1	3.1	5.8	12.8	16.3	18.3	17.8	13.5	8.9	4.8	3.2	9.0
2005	1.2	1.1	3.3	6.4	13.5	16.3	17.2	17.7	14.1	8.6	5.0	3.0	9.0
2006	2.3	1.6	1.6	4.3	9.3	14.9	16.2	14.7	11.8	8.4	2.4	1.3	7.4
2007	1.2	1.0	0.6	2.3	8.9	13.0	15.4	16.2	13.4	8.3	4.9	1.2	7.2
2008	0.8	0.3	1.5	3.0	8.7	12.3	13.3	13.9	11.7	7.6	4.5	2.2	6.7
2009	1.2	0.9	0.1	1.9	9.5	14.7	17.1	15.8	12.6	8.3	4.4	1.9	7.4
2010	1.4	2.3	3.2	6.0	11.9	14.8	14.5	16.3	13.4	8.5	4.8	1.5	8.2
2011	1.2	1.2	0.7	3.7	10.5	14.5	16.3	14.9	11.3	8.1	3.6	2.0	7.3
2012	1.0	1.2	1.6	4.9	8.9	12.4	13.9	15.2	11.6	7.5	3.1	1.4	6.9
2013	1.4	1.7	1.9	3.7	9.0	15.3	17.3	18.5	15.0	9.7	4.3	1.2	8.3
2014	2.0	1.2	1.0	4.1	12.0	14.0	16.6	15.8	12.8	8.6	5.2	2.6	8.0
2015	2.3	2.3	3.6	6.0	13.6	16.3	17.6	16.7	12.1	8.7	5.6	2.9	9.0
2016	2.3	3.5	4.5	8.1	12.0	15.9	18.2	17.2					
Ave.	1.6	1.6	2.1	4.8	10.9	14.7	16.4	16.1	12.7	8.5	4.5	2.2	7.9

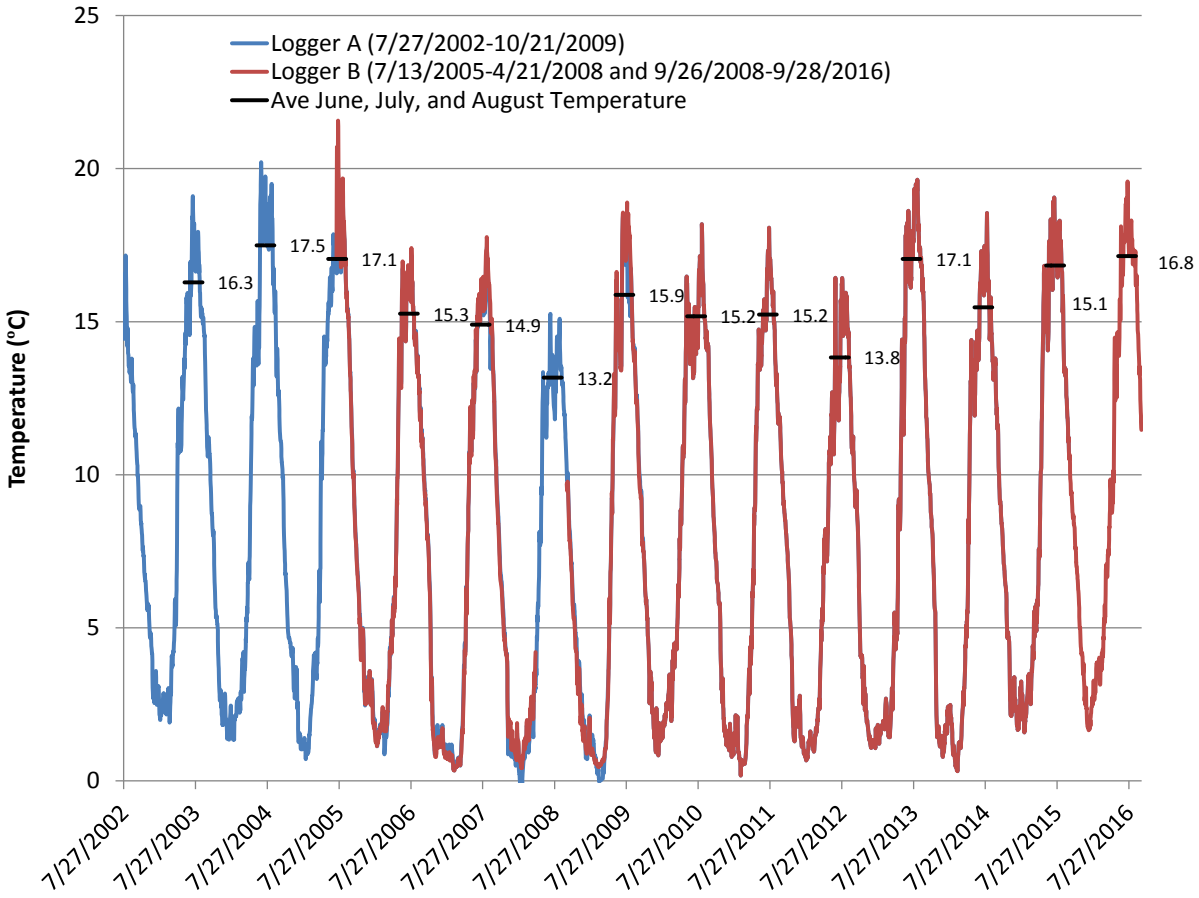


Figure 23. Average daily temperatures (˚C) and average June through August temperatures at the outlet of Neva Lake, 27 July 2002 to 28 September 2016.

Barometric-corrected depth readings are now available from the outlet of Neva Lake from 13 July 2005 to 28 September 2016 with exception of the period from April through September 2008 (Table 8 and Figure 24). Water levels tend to be the lowest in late-winter and mid-late summer. The lower water levels from late-July to late-August corresponded with the highest water temperatures.

Table 8. Average monthly depth (meters) of Neva Creek, July 2006 to March 2008 and July 2008 to September 2016.

	Month												
Year	01	02	03	04	05	06	07	08	09	10	11	12	Ave.
2005								0.412	0.484	0.492	0.500	0.433	
2006	0.319	0.284	0.232	0.259	0.361	0.400	0.302	0.349	0.420	0.396	0.246	0.272	0.320
2007	0.273	0.222	0.182	0.247	0.360	0.504	0.443	0.269	0.349	0.420	0.318	0.244	0.319
2008	0.249	0.223	0.237							0.520	0.400	0.312	
2009	0.306	0.270	0.186	0.211	0.338	0.447	0.251	0.273	0.397	0.369	0.328	0.271	0.304
2010	0.297	0.241	0.230	0.232	0.304	0.347	0.341	0.282	0.269	0.350	0.370	0.235	0.291
2011	0.217	0.265	0.189	0.176	0.325	0.353	0.247	0.334	0.395	0.395	0.369	0.395	0.305
2012	0.288	0.287	0.228	0.260	0.382	0.498	0.415	0.306	0.411	0.369	0.294	0.236	0.331
2013	0.305	0.327	0.222	0.213	0.466	0.457	0.273	0.173	0.267	0.370	0.335	0.317	0.310
2014	0.451	0.284	0.213	0.202	0.327	0.348	0.337	0.383	0.347	0.386	0.273	0.253	0.317
2015	0.361	0.308	0.280	0.315	0.400	0.375	0.254	0.337	0.392	0.442	0.392	0.339	0.349
2016	0.331	0.321	0.295	0.371	0.483	0.408	0.273	0.316					
Ave.	0.309	0.276	0.227	0.249	0.375	0.414	0.313	0.312	0.373	0.410	0.348	0.301	0.316

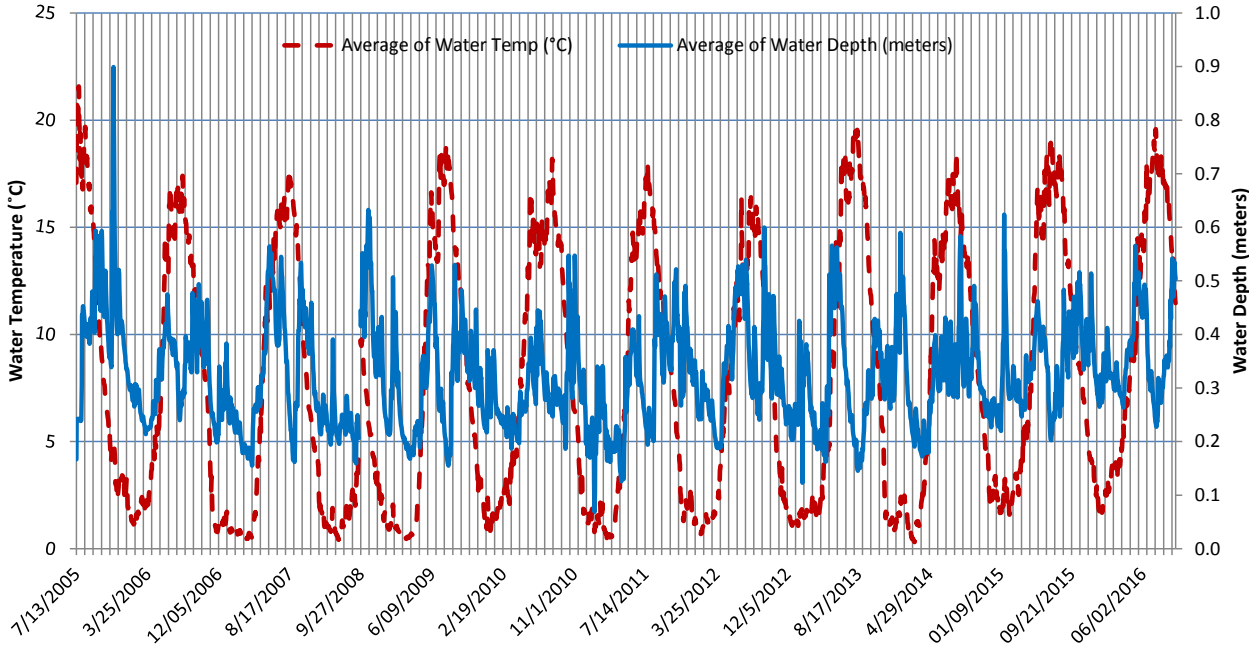


Figure 24. Water temperature and depth at the outlet of Neva Lake from 13 July 2005 to 28 September 2016.

In Neva Lake's main inlet stream, temperature and depth readings available from 2006 to 2016 (Table 9 and Table 10) show August 2013 had the highest average temperature and lowest average depth.

Table 9. Average monthly temperature (ºC) of Neva Lake's main inlet stream, July 2006 to March 2008 and September 2012 to September 2016.

	Month												
Year	01	02	03	04	05	06	07	08	09	10	11	12	Ave.
2006							7.8	7.4	6.9	5.4	0.6	1.7	
2007	1.4	1.0	0.7	2.1	4.4	6.0	7.4	8.8	7.5	5.1	3.3	1.0	4.1
2008	0.8	0.8	1.4										
2009													
2010													
2011													
2012									6.8	4.0	1.8	0.5	
2013	1.4	2.0	0.8	1.7	4.2	6.8	8.7	10.4	8.2	6.0	2.4	1.2	4.5
2014	2.7	0.6	0.7	2.9	5.5	6.5	8.1	8.3	7.5	5.6	3.3	2.4	4.5
2015	2.4	1.8	2.6	4.0	6.3	8.1	9.1	8.6	6.9	6.0	3.6	2.3	5.1
2016	2.8	3.1	3.7	5.0	6.1	7.8	9.7	9.2					
Ave.	1.9	1.6	1.7	3.1	5.3	7.0	8.5	8.8	7.3	5.4	2.5	1.5	4.5

Table 10. Average monthly depth (meters) of Neva Lake's main inlet stream (data logger readings are calibrated to the upper staff gauge), July 2006 to March 2008 and September 2012 to September 2016.

	Month												
Year	01	02	03	04	05	06	07	08	09	10	11	12	Ave.
2006							0.19	0.20	0.21	0.21	0.18	0.12	
2007	0.14	0.11	0.09	0.13	0.19	0.23	0.17	0.10	0.16	0.17	0.13	0.11	0.14
2008	0.11	0.09	0.09	0.08									
2009													
2010													
2011													
2012								0.10	0.15	0.10	0.07	0.06	
2013	0.08	0.09	0.05	0.05	0.18	0.15	0.06	0.04	0.14	0.17	0.15	0.14	0.11
2014	0.19	0.15	0.10	0.09	0.16	0.16	0.14	0.18	0.18	0.20	0.15	0.15	0.15
2015	0.21	0.18	0.15	0.16	0.17	0.15	0.16	0.21	0.23	0.24	0.19	0.14	0.18
2016	0.14	0.14	0.12	0.17	0.21	0.16	0.13	0.18	0.25				
Ave.	0.14	0.13	0.10	0.11	0.18	0.17	0.14	0.14	0.19	0.18	0.15	0.12	0.15

DISCUSSION

In 2017, we estimate that 3,898 Sockeye Salmon escaped into Neva Lake. This was the cumulative maximum daily count of 3,871 fish through the video chutes plus 27 fish that were estimated to have entered the lake when the video system was not operating and after the weir

was pulled for the season (Table 3). This is an improvement from the previous year, but continues a trend of relatively low escapements over recent years (Table 11).

Table 11. Annual estimates of the escapement of Sockeye Salmon into Neva Lake, 2002 to 2017.

Year	Total	Escapement Estimate Method
2002	4,951	picket weir to spawning area mark-recapture
2003	11,393	picket weir to spawning area mark-recapture
2004	9,513	picket weir to spawning area mark-recapture
2005	5,255	picket weir to spawning area mark-recapture
2006	5,931	picket weir to spawning area mark-recapture
2007	5,993	picket weir to spawning area mark-recapture
2008	2,823	picket weir to video and spawning area mark-recapture
2009	6,166	picket weir to video weir mark-recapture
2010	5,252	redundant video weirs
2011	7,311	redundant video weirs
2012	4,404	redundant video weirs
2013	2,931	redundant video weirs
2014	3,535	redundant video weirs
2015	1,188	redundant video weirs
2016	3,009	redundant video weirs w/syncronized cameras
2017	3,898	redundant video weirs w/syncronized cameras

In 2017, the video counts appear to be reliable estimates of the daily escapement of Sockeye Salmon into the lake. With the ability to view synchronized video from all chute cameras at the same time using the Blue Iris program on the computer, project personnel were able to reliably track and count each Sockeye Salmon that swam through the chute and into the lake. However, it was difficult to distinguish between adult and jack Sockeye Salmon in the video review and jacks were often counted as adults.

The counts of Pink Salmon and Dolly Varden, should be regarded as a rough indicator of abundance, rather than absolute counts. Some individuals of these two species were seen to pass back and forth through the weir many times, confounding attempts to reliably count each fish only once. The authors re-reviewed several days of video after the season and found the counts of Sockeye Salmon were consistent with the counts made inseason. The E-M fill-in of 27 fish appears to be a reasonable estimate of the number that entered the lake without being directly counted by project personnel.

This year was the first year that a single video chute was used, rather than a pair of separate chutes. The new weir connection and chute design worked well. Migrating salmon usually swam freely through the middle of the chute and just within the field-of-view of all four cameras. With the color cameras and lighted video chutes the night footage is as good as or better than the day footage (Figure 18).The use of aluminum and plastic pipes to shield camera and power cables from being chewed by beavers worked well, as no cables were damaged this season.

Unlike the traditional picket weirs, where fish are physically passed or visually counted at the schedule of project personnel, the video technology used by this project allowed the fish to migrate into the lake whenever they choose and with less exposure to predators. From 2002 to 2009, there were often bears fishing behind the weir or trying to get into the trap. In the past seven seasons, without the weir holding fish back, project personnel have only observed bears transiting the area and none actively feeding at the weir site.

Using a beach seine in the lake to capture Sockeye Salmon for biological samples worked better than trapping them at the weir. Sockeye Salmon were easy to capture in and off the main inlet stream in August and on the beach spawning areas after mid-September. We accept that scale samples are to estimate freshwater ages and not total ages given the high proportion of un-readable scales sampled from these mature, spawning imminent, Sockeye Salmon.

Retaining a complete video record of all fish that passed through the video chutes each year allows the counts to be double checked and the video to be reviewed for other purposes. When project personnel observe anything unusual they note the time and a description of the observation on the daily data sheet which is provided in a bound data notebook. Perhaps others would want to review the video specifically to count or look at the size and behavior of Dolly Varden Char, Cutthroat Trout, Stickleback, or other species (including river otter or beaver). We can use the video system to monitor for any Atlantic salmon or other invasive species entering the lake.

CONCLUSIONS

1. The Sockeye Salmon run into Neva Lake is an important subsistence resource for rural residents from Hoonah, Excursion Inlet, and Gustavus and non-rural residents from Juneau. There has been an increase in subsistence fishing effort and subsistence harvests of Sockeye and Coho Salmon at Neva in recent years.

2. This project was the result of the cooperative effort between the Alaska Department of Fish and Game, the Hoonah Indian Association, and the U.S. Forest Service to estimate the escapement and age composition of Sockeye Salmon into Neva Lake. This is the final report for the Fisheries Resource Monitoring Program study 14-612 for years 2014 to 2017 and summarizes escapement and age composition results back to the project's inception in 2002.

3. We estimate that 3,898 Sockeye Salmon escaped into Neva Lake in 2017. For comparison, the escapement estimates were 4,951; 11,393; 9,513; 5,255; 5,931; 5,993; 2,823; 6,166; 5,252; 7,311, 4,404, 2,931, 3,535, 1,188, and 3,009 fish from 2002 to 2016, respectively.

4. In 2017, the midpoint of the run was on 3 August and 80% of the run had entered into Neva Lake between 30 June and 10 September. On average, from 2002 through 2016, the midpoint is on 30 July and 80% of the Sockeye Salmon have migrated into Neva Lake between 4 July and 2 September.

5. There are two main runs of Sockeye Salmon into Neva Lake – an earlier run of fish that spawn in the main inlet stream and a later run of fish that spawn in beach spawning areas.

6. Freshwater-age-1 fish usually dominate the Sockeye escapement but in 2006, 2010, 2010, and 2014, freshwater-age-2 and 3 fish comprised 30%, 32%, 73%, and 20% of the samples. In 2017, only 1 of the 41 fish sampled with readable freshwater ages was freshwater-age-2.

7. This weir project has successfully transitioned from a traditional picket weir project that requires project personnel to pass each fish, and conduct a weir-to-above weir mark-recapture study to validate the accuracy of the weir counts, to a redundant video weir project which allows fish to pass whenever they want and project personnel to get validated counts hour-by-hour. In 2016 and 2017, project personnel were able to remotely monitor the project site and simultaneously view video from the four chute cameras when counting fish into the lake.

RECOMMENDATIONS

We recommend the continued monitoring and assessment of the Neva Lake Sockeye Salmon stock using this remotely monitored, double-redundant, 24/7 swim through video weir system. This system has proven to be a reliable way of counting fish as they migrate freely into Neva Lake. Analog cameras and recorders should probably be replaced with digital POE (Power-Over-Ethernet) cameras and recorders to simplify wiring and improve system performance. Motion-triggered video from the chute cameras should continue to be saved on recorders both on- and off-site for redundancy.

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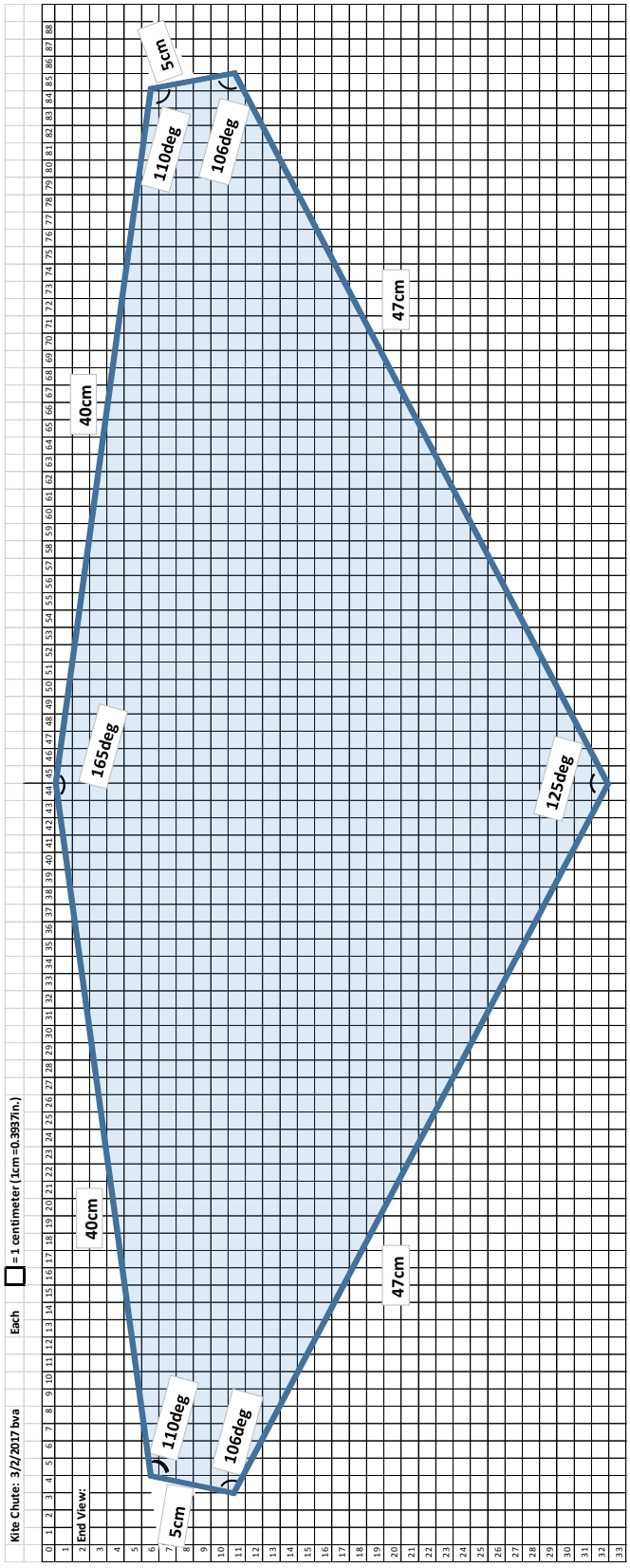
APPENDICES

Appendix A. End view of the 70cm long “kite” chute used at Neva Lake video weir, 2017.



Appendix B. Parts list for the mini-DVR-based fish video system used at Neva Lake, 2011-2017.

Component	Description	Cost Each (plus shipping)
Mini-DVR (digital video recorder). A mini-DVR is needed for each camera and for each video review station. YOKO Technology Corporation, "SecuMate Pro Portable Security Recorder", (Model RYK-9122 has MPEG4 video compression and Model RYK-9114 has H.264 video compression). We recommend using the MPEG4 model.	Portable, pocket size, solid state, one channel DVR for compressed motion detect recording and full-featured playback of video files in non-proprietary format. Video files are stored on SD or SDHC memory cards with capacity up to 32GB. Available from multiple vendors on the Web.	$125 to $190
SD or SDHC Memory Card(s). One or more pairs of SD cards are needed for each camera/mini-DVR unit.	Class 2, 4, or 6 SD (secure digital) or SDHC (secure digital high capacity) memory cards. Available from multiple vendors on the Web or local stores.	8Gb - <$12ea
Underwater Camera(s). There can be two cameras in each video chute - a left camera and a right camera.	Model YCC-350LWW-6S from Jet Security USA, Inc. (www.jetsecurityusa.com). 1/3" Sony Super HAD CCD color camera with 3.6mm lens in underwater housing with independently powered bright white LED lights built into the housing. Put heat shrink tubing over both the camera body and cable connection (i.e., 1.3 in 6:1 Dual Wall Heat Shrink from www.cableorganizer.com).	$240 (camera w/LEDs), $60 (10M cable), $170 (50M cable)
Monitor(s). Monitors are needed to check video quality and DVR settings in the field and to review video footage back in the camp or office. If both DVR's are in the same system (battery) box then the operator can use one, two-channel, monitor to view both DVR's.	Portable, 12V dc powered, 7" diagonal, TFT LCD, 2 channel, color monitor with auto on/off. Available from multiple vendors on the Web.	$100
LED light bar(s). One to four light bars are used to illuminate the inside of the video chute.	SeaMaster Lights (www.SeaMasterLights.com), 12V dc, 0.20 watt, 25cm light bar with 15 white LED's in a IP68 rated waterproof housing. Purchased from local or online marine supply vendor	$34
Dusk-to-Dawn Sensor. Photoelectric switch for turning the lights on at dusk and off at dawn.	Flexcharge (www.flexcharge.com), Night Watchman 10A Dusk to Dawn Controller. Multiple vendors on Web.	$30
Solar Panel.	Kyocera KD-135SX-UPU 135W panel (7.63 Amps @ 17.7Vmp) with standard junction box. Available from multiple vendors on the Web.	$431
Charge controller.	Morningstar ProStar-30M (12V dc 30 amp w/ meter). Multiple vendors on the Web.	$164
Battery. 12V DC AGM 80-115Ah w/ bolt terminals	Purchased from local vendor.	$241
Converters. 12V-12V dc converter for powering CCD camera, LED lights, and monitors and 12V-5V dc converter for powering mini-DVRs.	DC/DC converters should be IP67+ rated and have continuous short circuit protection (www.dogcamsport.co.uk sells 12V and 5V wiring kits with the converters encapsulated in rubber).	$34 (per kit)
Enclosure. Weatherproof housing for battery, charge controller, DC/DC voltage converters, two mini-DVRs, two channel monitor, and associated wiring.	Group 27 or 31 size plastic battery box (from local marine and auto parts stores) with custom hinged lid(s).	$17
2.1MM plugs, male, 18 AWG	Available from multiple vendors on the Web.	$3
Video Chute. Aluminum w/ visor.	Custom welded from 1/8" sheet aluminum (Appendix B). Primed and painted (Pettit Marine Paint, Shipendec, 3333 Newport Green) inside. Mounts/holes for one to four 25cm LED light strips on top and paired cameras, meter sticks, location plates, sun visor on upstream end, and attachment for picket or net weir on downstream end.	$300 for materials

Appendix C. Parts list for the remote monitoring system used at Neva Lake, 2017.

Component	Description	Approx. cost each (plus shipping)
Weir station		
Wireless bridge	Ubiquiti Networks PowerBeam M5 400	$100
Managed network switch	Netonix WS-12-250-DC	$380
Video encoder (4 channel)	Axis M7014	$260
Video encoder (1 channel)	Axis M7001	$210
Solar charge controller	Victron BlueSolar MPPT 100/30	$200
IP video cameras (2)	Amcrest IP3M-954EW	$110
Solar panels (12)	Kyocera KD-145SX-UPU, 145 watt	$431
Batteries (4)	12 volt, 80 amp-hour absorbed glass mat (AGM)	$240
Repeater station		
Wireless bridges (2)	Ubiquiti Networks PowerBeam M5 400 ISO	$120
Managed network switch	Netonix WS-12-250-DC	$380
Remote system monitor	Tycon Power Systems TP-DIN-Monitor-WEB	$125
Solar charge controller	Morningstar SunSaver SS-MPPT-15L	$210
IP video camera	Amcrest IP3M-954EW	$110
Batteries (6)	12 volt, 115 amp-hour absorbed glass mat (AGM)	$240
Solar panels (3)	Kyocera KD-145SX-UPU, 145 watt	$431
Recording station		
Wireless bridge (to repeater)	Ubiquiti Networks PowerBeam M5 400	$100
Router	Linksys WRT-54G wireless broadband router	$40
Computer workstation	Hewlett-Packard EliteDesk 800	$500
Surveillance software	Perspective Software Blue Iris v. 4.3.9.7	$60

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