2008-2009 CEDAR RIVER HATCHERY ANNUAL REPORT

Cory Cuthbertson

Washington Department of Fish and Wildlife
Olympia, Washington 98501

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Introduction:

Since 1991 the Washington Department of Fish and Wildlife has operated the Cedar River Hatchery near Landsburg, Washington at river mile 22 on the Cedar River. The program was started in response to a decline in naturally spawning sockeye salmon in the Lake Washington watershed. In addition to the goal of stabilizing declining populations the program was designed to allow scientists the opportunity to study sockeye salmon and their life cycle.

History

In response to declining sockeye populations in the Lake Washington basin the WDFW began a supplementation program in the main tributary of Lake Washington, the Cedar River. In 1991, after a few years of minimal success of an egg box program on the Cedar River, the WDFW began operation of the interim hatchery at the Landsburg Dam near Ravensdale, Washington.

For the first two years adult broodstock for the program were captured by gillnet in the lower river at various locations. Due to salmon redd damage, high prespawn mortality, and relative inefficiency of gillnetting for broodstock, construction of a temporary trap and weir at Cavanaugh Ponds Park (RM 6.4) was established. This trap and weir was operated for 15 years but was replaced due to its susceptibility to high water damage, cost and impact of installation and removal requiring heavy equipment, and lack of access to adults who spawned below river mile 6.4. In the fall of 2008 a new, floating resistance-board weir and trap was installed at river mile 1.8 in Renton's Carco Park just upstream of the I-405 bridge over the Cedar River.

The interim hatchery itself is situated on Seattle Public Utilities property at the bottom of the Cedar River Watershed parcel. It was built in stages over 17 years of operation and consists mostly of temporary structures and facilities and is capable of incubating up to 18,700,000 eggs. In the first year of operation 2,079,100 sockeye fry were released from the hatchery, this was the lowest number of fry released during the program's history. The largest number of fry released was achieved in 2000 when 17,209,000 fry were released. The average from 1991 through 2007 is 9,108,600 fry per year.

Program Goals

The primary goals of the Cedar River Hatchery program are to enhance the Lake Washington sockeye population to levels allowing for sport and tribal fishing opportunities; to afford scientists the opportunity to study and learn about sockeye salmon and their life cycle; and to not negatively impact other species in the Cedar River watershed.

Specifically, to collect, hold, and spawn enough adult sockeye broodstock to achieve a green egg take of 18,700,00 eggs and release of 17,000,000 fry after a normal egg to fry loss of 9.1%. Additionally, the hatchery serves to ensure stable sockeye fry production in years when floods impact the survival of natural production in the watershed.

For the 2008-2009 season adults were collected at the new floating resistance-board weir, designed by Cramer Fish Sciences, at a new trap location in Renton, WA (RM 1.8). Adults were then hauled by truck to 1 of 4 16-foot circular holding ponds at the Hatchery site in Landsburg. When the adults were ready to be spawned gametes were collected at the adult pond area, transported to and fertilized in the fertilization room, and then put down in 1 of either the 40 vertical Heath-type or 55 kitoi incubators. When the eggs were in the eyed stage they were shocked, picked, and put back into their incubators to continue incubation until they swam up and were ready to be ponded. At defined times during incubation chilled water was substituted for ambient temperature water to provide distinguishing thermal marks on the otolith bones of all of the hatchery fish. Once the fry swam up and were ready to be ponded they were moved to 1 of either 4 6-foot diameter circular ponds or 4 15-foot by 3-foot rectangular fiberglass raceways. In the 2008-2009 season all of the fry were fed for approximately 14 days and then hauled by truck to be planted at the mouth of the Cedar River (RM 0.1).

Methods and Results:

Adult sockeye counts through the fish ladder at the Ballard Locks conducted by the WDFW and Muckleshoot Indian Tribe biologists indicated that the 2008 run was unexpectedly small. From hatchery releases and Cedar River fry trap data from the 2004-2005 season there should have been a sizeable 2008 adult return if survival from fry to adult was average. But the 2008 returns were the lowest since seasonal counts through the Ballard Locks were initiated in 1972. The total count for the season (6/12/2008-7/31/2008) was only 33,629 (http://wdfw.wa.gov/fish/sockeye/counts.htm), less than 1/10 the number required to have a sport fishing season on Lake Washington.

Trap and Weir Operations:

Due to the low adult returns SPU and the WDFW made the decision to put extra effort into the completion and installation of Cramer Fish Sciences' new floating resistance-board weir in the lower river (RM 1.8) in order to gain access to a higher percentage of the adults entering the Cedar River and to possibly extend broodstock collection later into the season.

The weir structure is made up of 3-foot by 20-foot panels of 1-inch diameter schedule 40 PVC pipe spaced at 1-inch intervals. The panels are held together by stringing individual stringers through overlapping pieces of adjoining panels. The panels are anchored to the river bottom at the upstream edge of the structure by hooking to the substrate cable. The substrate cable runs through eyelets on the substrate rail that is anchored to the river bottom by 38-inch stakes driven into the gravel substrate. The weir panels float up and downstream from the substrate rail lifted by the floatation from the air trapped inside the 1-inch PVC pipes that are capped on both ends and foam in the resistance boards. A 2-foot by 3-foot plywood resistance board is attached at the downstream end of each panel. Additional flotation during higher flows is achieved by setting the resistance boards to act like flaps on the wings of an airplane, using resistance against the fast moving water to lift the panel. At either side of the weir there are vertical bulkheads that block fish from

passing around the end of the submerged portion of the panels. The weir is connected to the riverbank at either end by customizable, rigid aluminum picket sections. These aluminum pickets are propped up against the river current by tripods and are attached to the weir panels by connecting to the bulkheads.

One of the panels was customized with a tunnel that led into the actual trap. Other panels were fitted or retro-fitted with trap doors that could be opened to allow upstream fish passage.

The trap itself is a 6-foot by 10-foot by 6 foot high cage made of aluminum. It consists of individual frame panels that are bolted together, individual pickets that slide into holes drilled in the frame, lids that are bolted to hinges on the top of the walls, and an adjustable vee-trap leading into the cage.

On September 15 WDFW, SPU, and Cramer Fish Sciences crews began the installation of the new weir at the Carco Park, Renton location just upstream from the Interstate Highway 405 overpass. Low flows, good weather, and the expertise of the Cramer Fish Sciences staff made for a quick installation despite some problems with the equipment used for pounding in the substrate rail stakes. Installation of the weir was completed on the afternoon of September 16.

Figure 1, Floating Resistance-Board Weir and Trap with 2 Panels Pulled to Allow Unimpeded Upstream Fish Passage.

In addition to the weir and trap there is an aluminum debris shield that was installed upstream of the trap to deflect large debris floating down the river, protecting the more expensive trap.

Because the trap wasn't completed until September 22 WDFW staff were able to observe fish behavior around and through the weir with the tunnel (eventually leading to the trap) and the adjacent (shallow) trap door completely open. During that week 29 Chinook and many more sockeye were observed swimming upstream through both openings. (Appendix 1)

On September 22 the trap was installed by SPU and WDFW staff and was left open for the night. On September 23 the trap door and the trap itself were closed and set for catching fish during the day and then opened back up for the night. By September 24 WDFW staff observed an accumulation of 20 Chinook in the deep hole below the railroad bridge (RR hole) downstream of the trap and weir (Table 1). The trap door was left open all day in hopes of allowing the Chinook to move upstream since they had been observed using the trap door to move upstream during the week preceding the trap installation. However, there were 30 Chinook in the RR hole by the next morning so the decision was made by SPU and WDFW to open the trap completely, leave the shallow trap door open, open the rigid picket section on the north bank, and disconnect and submerge two weir panels to allow as much opportunity for Chinook passage as possible (Table 1).

By the afternoon of September 28 the number of Chinook in the RR hole and below the weir had decreased to 3 so the decision was made to reconnect the submerged weir panels, close the rigid picket section, close the shallow trap door, and close the trap for fishing during the day (Table 1). The trap door, trap, and rigid picket section were all opened to allow for Chinook passage during the night. On September 29 there were 20 Chinook in the RR hole so two weir panels were removed entirely and the trap door opened (Table 1). By September 30 there were up to 40 Chinook in the RR hole so the north bank rigid picket section was opened and the trap was left open for most of the day (Table 1). The north bank rigid picket section, shallow trap door, trap, and two removed weir sections all remained in the open configuration until October 6 with the exception of closing the trap and shallow trap door for the day on October 2. To address the potential for scour some gravel bags were placed in the area where two weir panels were removed.

Two additional weir panels equipped with a trap doors were completed and installed on October 6 in hopes of allowing Chinook passage on the northern part of the weir where they seemed to be inclined to move upstream. By October 6 the number of Chinook in the RR hole and below the weir had decreased significantly to 4, allowing for more aggressive sockeye fishing (Table 1).

For the remainder of the season Chinook passage through the weir was managed most successfully by opening and closing the north bank rigid picket section. There were only 7 out of 44 days during which the trap and weir were closed entirely, vastly decreasing the ability to catch sockeye. There were also more Chinook in the stretch of river

immediately below the weir including the RR hole than had been observed in previous seasons.

Trapped sockeye were sorted by sex from the trap into 2 aluminum live boxes for holding until they were loaded into rubber carrying boots, carried by hand up the trail to the parking lot, and loaded into the tanker trucks to be hauled to the adult holding ponds at the Cedar River Hatchery. In general, on days when there were more than 50 of one gender of sockeye to be hauled SPU hauled fish in their tanker truck, and on days where there were fewer fish WDFW would haul in their smaller trucks. SPU and WDFW staff worked together to load and haul the adults.

In addition to the 2,001 sockeye trapped and hauled from the weir and trap, 36 females were snagged by hook and line by the WDFW, Muckleshoot Indian Tribe, and volunteers in the lower river and hauled to the hatchery. Lastly, 25 males and 12 females were transported to the hatchery from the SPU fish passage facility at the Landsburg Diversion Dam.

WDFW and SPU staff removed the trap and weir by hand from the river on November 5 in under 4 hours. The substrate rail was left in place in the river.

After extremely high flows during the major storm of January 2009 it was discovered that the substrate rail had been damaged. The rail and substrate pins had been dug up and twisted by the high flows making them potentially dangerous for boaters. SPU and WDFW crews spent two days in January removing the damaged northern portion of the substrate rail. The southern portion of the substrate rail was left in place.

	Trap Configuration (Hours Set/Fishing)					Fish Activity At the Weir				Fish Observed Below the Weir					
										Sockeye			Chinook		
Date	Trap	Shallow Trap Door	Deep Trap Doors	Deep End Panels	N. Bank Rigid Pickets	Sockeye Hauled	SO PASSED	CK PASSED	CK OBSERVED THROUGH WEIR	AM	Mid	PM	AM	Mid	PM
22-Sep	0	0		24	24					7			3	0	
23-Sep	8	8		24	24										
24-Sep	17	1		24	24	6			6	50	60	85		4	
25-Sep	12	0		8	8	158			3	150	200		35	20	
26-Sep	0	0		0	0	50			1	57	60		30	30	
27-Sep	0	0		0	0				6	100	120		25	30	
28-Sep	7	7		7	7					100	82	90	15	14	3
29-Sep	24	8		8	24	74			1	280	260	260	20	20	20
30-Sep	17	0		0	17	8	27			170	160	160	30	40	40
01-Oct	0	0		0	0				4	250	260	250	30	30	30
02-Oct	16	16		0	0	5			3	180	210	215	20	20	20
03-Oct	0	0		0	0	8			5	150	170	130	30	30	20
04-Oct	0	0		0	0				6	135	130	120	20	20	20
05-Oct	0	0		0	0				5	108	170	180	10	12	10
06-Oct	16	16	0	16	0				6	100	150	140	5	4	
07-Oct	24	24	8	24	0	19	27		0	125	180	135	6	5	5
08-Oct	24	24	24	24	16	38	2		0	150	170	120	1	2	2
09-Oct	24	24	8	24	8	88			1	75	50	50	5	4	5
10-Oct	12	24	12	14	8	40				50	50	50	5	6	6
11-Oct	0	24	0	0	0					50	60	50	6	7	6
12-Oct	10	24	10	10	10					40	40	60	4	4	4
13-Oct	24	24	24	24	8	167			1	137	130	130	1	2	6
14-Oct	24	24	24	24	0	56			3	50	50	25	0	0	2
15-Oct	24	24	24	24	10	61			0	130	125	120	1	2	2
16-Oct	24	24	24	24	12	115		2		115	132	118	2	3	3
17-Oct	12	24	12	24	0	125	47			138	122	127	1	2	2
18-Oct	8	24	0	24	0					80	103	128	0	0	0
19-Oct	24	24	14	24	10					97	85	114	2	0	1
20-Oct	24	24	24	24	16	97	7			30	30	30	0	0	0
21-Oct	24	24	24	24	18	13	49			48	50	5	0	0	0
22-Oct	24	24	24	24	8	13	41			40	50	55	0	0	0
23-Oct	24	24	24	24	24	11	1			40	38	30	0	0	0
24-Oct	24	24	24	24	24	32	71			50	50	80	0	0	0
25-Oct	24	24	24	24	24	60	73			60	50	50	0	0	0
26-Oct	24	24	24	24	24		32			50	50	40	0	0	0
27-Oct	24	24	24	24	24	109	7			112	110	219	0	0	0
28-Oct	24	24	8	24	8	148	6		2	230	222	240	0	1	1
29-Oct	24	24	8	24	8	43	7			177	270		2	2	0
30-Oct	24	24	16	24	12					166	166		0	0	0
31-Oct	24	24	24	24	24	300	10								
01-Nov	24	24	24	24	14	116	5			198	240	200	0	0	0
02-Nov	24	24	24	24	16		7			120	130		0	0	
03-Nov	24	24	24	24	24	37				10	15		0	0	
04-Nov	14	24	24	24	14	4	7			12	14		0	0	0
05-Nov	0	8	8	8	0										
TOTALS:	**725**	**760**	**536**	**767**	**492**	**2,001**	**426**	**2**	**53**						

Table 1, Trap Data

Spawning Operations:
The 2008-2009 spawning season began on September 30 and ended on November 11. There were a few minor adjustments to the spawning procedures outlined below, but overall the spawning operations were orchestrated similarly to past years.

Spawning took place either 1 or 2 times each week for the duration of the spawning season. This is fewer times per week than years past, the rationale for which is outlined in the Discussion portion of this report.

On spawn days all sockeye females were crowded in their ponds, checked for ripeness, and then killed if they were ready to be spawned. Gametes were collected in lidded plastic cups, kept in coolers until all the gametes for the day were collected, and then transported to the fertilization room. Males were also crowded, killed and spawned for 882 of the spawning pairs. The other 48 females' eggs were fertilized by milt collected from live males who were then put in a separate pond and spawned lethally during one of the subsequent spawns.

Strict disinfection procedures and protocols for spawning IHN infected sockeye were adhered to to limit the risk of vertical transmission of the virus from the parents to the offspring. The first and last egg takes were small and the eggs were incubated in vertical, Heath type incubators, while all of the other egg takes were large enough to be incubated in kitoi incubators.

Once the gametes were collected they were brought into the disinfected fertilization room for fertilization. Eggs were fertilized according to a 1:1 matrix whereby each females' eggs are fertilized by one male with a secondary male's milt used as insurance against the first male's milt being compromised or non-viable. This 1:1 matrix is used to ensure a maximum combination of genotypes and to minimize the overrepresentation of males with dominant sperm.

Fertilized eggs are then rinsed thoroughly and water hardened for 1 hour in a 1:100 solution of iodaphor and put into their incubation vessel.

930 females were spawned during the 2008-2009 season giving an adjusted egg take of 2,915,152 with a fecundity of 3,135 eggs per female.

During the 2008-2009 spawning season the plastic cups used for collecting and transporting gametes were disinfected, washed, and reused in order to reduce waste and save money. Immediately after the gametes were poured into the larger 48 ounce bowls used for fertilizing and water hardening the 8 ounce, 16 ounce, and 25 ounce gamete cups were placed in a garbage can filled with iodaphor and water to soak and disinfect for 24 hours. The next day the cups were thoroughly cleaned, rinsed, and dried by hand to ensure that no biological fluid residue, iodaphor, or water remained on the cup before being used again. If a cup was damaged, stained, or scratched it was thrown away. At the request of the WDFW fish health specialist the lids and 48 ounce bowls were not reused

because they present higher vulnerability to contamination and would be much more difficult to thoroughly clean.

In addition to taking eggs, otolith, ovarian fluid, kidney and spleen, and fecundity samples were taken by WDFW hatchery and biological staff. There were 420 otolith, 169 ovarian fluid, and 60 kidney/spleen samples taken in addition to fecundity assessment of 220 females.

Table 2, Spawn Data

Date	Females Spawned	Eggs Taken
30-Sep	12	40,700
06-Oct	45	145,352
13-Oct	84	276,300
16-Oct	57	168,400
20-Oct	123	378,200
22-Oct	66	205,200
27-Oct	130	401,000
29-Oct	51	154,000
03-Nov	144	459,000
07-Nov	93	292,000
12-Nov	63	214,000
17-Nov	45	131,000
20-Nov	17	50,000
Total:	**930**	**2,915,152**

Incubation and Picking Operations:

The first and last spawns, September 30 and November 20, yielded only 12 and 17 ripe females respectively and were incubated in the Heath type incubators. All other spawns yielded enough eggs to warrant incubation in kitoi incubators. Eggs were incubated in Heath-type stacks S-19 and S-20 and kitois A-1 through A-15, excluding A-13. After 1 hour of water hardening in a 1:100 solution of iodaphor eggs are put down in incubators and left alone until they are at the eyed stage. It takes about 45 days for eggs to reach the eyed stage at normal Cedar River Hatchery water temperatures.

Each day during incubation between the second day after fertilization and the eggs hatching eggs are treated with formalin to control fungus growth. This is done by dumping a prescribed amount of formalin into the inflow of each individual incubator and allowing the formalin to flush through the incubator. This method is called the California Flush.

In addition to being treated with formalin every day the eggs and alevins received thermal marks by supplying their incubators with chilled water for prescribed periods of time. To accomplish this ambient spring water is cooled at least 3 degrees Celsius by an array of

chillers before going through an incubator. When an incubator is scheduled to be chilled the ambient temperature spring water supply to that incubator is replaced by the chilled water for the number of hours prescribed by the chilling schedule. When the mark is complete ambient temperature water is returned as the water source for the incubator (Appendix 4)

When the eggs reached the eyed stage they were siphoned out of their incubators and physically shocked (bumped) to help distinguish healthy eggs from dead ones. 24 hours after they were shocked they were picked by a Gensorter egg picker initially and secondarily by hand. Once the eggs were picked they were put back into their incubators layered with substrate (vexar pillows in the Heath-type trays and 1 inch plastic "saddles" in the kitios).

On 3 groups of eggs in kitoi incubators this process was adjusted slightly in order to try a different strategy for incubation for the time between picking and hatching. On those three incubators eyed eggs were suspended on a single layer of vexar above the 1 inch plastic saddles. The mesh on the vexar is small enough to keep eggs from falling through but large enough to allow newly hatched alevins to swim through and into the saddles below. The hope was that the healthy alevins would swim down into the saddles and any dead eggs would be easily lifted out of the kitoi with the vexar when hatching ended. The strategy worked, but on 2 of the 3 kitois there was higher loss, presumably due to suffocation during hatching. Possible reasons and resolutions to this problem are evaluated in the Discussion portion of this report.

During the picking operation eggs were sampled to determine size and weighed to establish accurate populations and rates of loss. The rate of loss for the 2008-2009 season was 4.75%.

Table 3, Egg Loss

				EYED EGGS			EGG	%	ADJUSTED
DATE	Lot	PICK DATE	PICK TUs	NUMBER	LBS	SAMPLE	LOSS	LOSS	EGG TAKE
09/30/08	**S-20**	11/13/2008	704	39,000	11.78	3311	1,700	4.18	40,700
10/06/08	**A-1**	11/18/2008	720	139,000	40.31	3448	6,352	4.37	145,352
10/13/08	**A-2**	11/25/2008	704	270,000	75.06	3597	6,300	2.28	276,300
10/16/08	**A-3**	12/02/2008	752	159,000	44.53	3571	9,400	5.58	168,400
10/20/08	**A-4,5,17**	12/03/2008	704	357,000	101.36	3522	21,200	5.61	378,200
10/22/08	**A-6**	12/05/2008	704	200,000	55.60	3597	5,200	2.53	205,200
10/27/08	**A-7,8,18**	12/11/2008	704	378,000	104.33	3623	23,000	5.74	401,000
10/29/08	**A-9**	12/12/2008	704	150,000	41.40	3623	4,000	2.60	154,000
11/03/08	**A-10,11**	12/17/2008	700	427,000	116.16	3676	32,000	6.97	459,000
11/07/08	**A-12**	12/19/2008	667	282,000	76.13	3704	10,000	3.42	292,000
11/12/08	**A-14**	12/24/2008	673	210,000	56.29	3731	4,000	1.87	214,000
11/17/08	**A-15**	12/30/2008	705	123,000	33.95	3623	8,000	6.11	131,000
11/20/08	**S-19**	01/05/2009	737	49,000	12.94	3788	1,000	2.00	50,000
					0.00			0.00	0
					0.00			0.00	0
					0.00			0.00	0
					0.00			0.00	0
					0.00				
TOTAL				**2,783,000**	**769.84**	**3600**	**132,152**	**4.75**	**2,915,152**

Ponding, Rearing, and Planting Operations:
When fry were ready to be ponded and fed, usually about 123 days after fertilization at normal Cedar River Hatchery water temperatures, they were visually inspected to ensure readiness and then netted out of the kitois or carried in their Heath-type incubator baskets to 1 of either the 4 6-foot circular ponds or 4 3-foot by 15-foot fiberglass raceways.

Ponded fry were fed hourly during the normal workday, 7 days per week, for an average of 14 consecutive days before being planted. Rangen Soft Moist Starter Feed was fed at a rate of between 2-4% body weight per feed day. Further discussion of feed rates and practices can be found in the Discussion portion of this report.

Fish were sampled to determine size when they were ponded and again when they were planted. All fry were hauled and planted by truck at the mouth of the Cedar River (RM .1) in the Cedar Trails Park. Overall survival from the green egg stage to planted fry was 90%.

Table 4, Ponding, Rearing, and Planting Schedule

Incubator	Population	Pond Date	Sample at Ponding (fish/lb)	Plant Date	Sample at Planting (fish/lb)	Food Fed (lbs.)	Days Fed	Conversion
S-20	39,000	30-Jan	2584	17-Feb	1582	11.5	16	1.20
A-1	139,000	6-Feb	2618	23-Feb	1796	27.5	15	1.13
A-2	270,000	9-Feb	2681	25-Feb	1794	38.5	14	0.77
A-3	159,000	17-Feb	2539	4-Mar	1837	32	14	1.34
A-4,A-5	236,000	20-Feb	2597	4-Mar	2101	30.75	11	1.43
A-17	121,000	"	2724	"	2045	21.75	13	1.47
A-6	200,000	23-Feb	2584	9-Mar	2027	34.5	12	1.62
A-7,A-8	264,000	27-Feb	2609	13-Mar	2078	40.5	13	1.57
A-18	114,000	"	2609	"	2138	20.25	13	2.10
A-9	150,000	1-Mar	2561	16-Mar	2132	25.5	13	2.16
A-10	212,000	6-Mar	2593	23-Mar	2072	46.5	15	2.26
A-11	215,000	"	2859	"	2032	47.75	15	1.56
A-12	282,000	10-Mar	2702	25-Mar	2077	48.75	14	1.55
A-14	210,000	15-Mar	2779	1-Apr	1897	43.75	15	1.25
A-15	123,000	19-Mar	2877	2-Apr	2152	20.75	12	1.44
S-19	49,000	22-Mar	2966	2-Apr	2544	9.25	11	3.38
Avg/Total:	**2,783,000**		**2680.13**		**2019.00**	**500**	**14**	**1.64**

Discussion:

Adult Trapping and Weir Management:

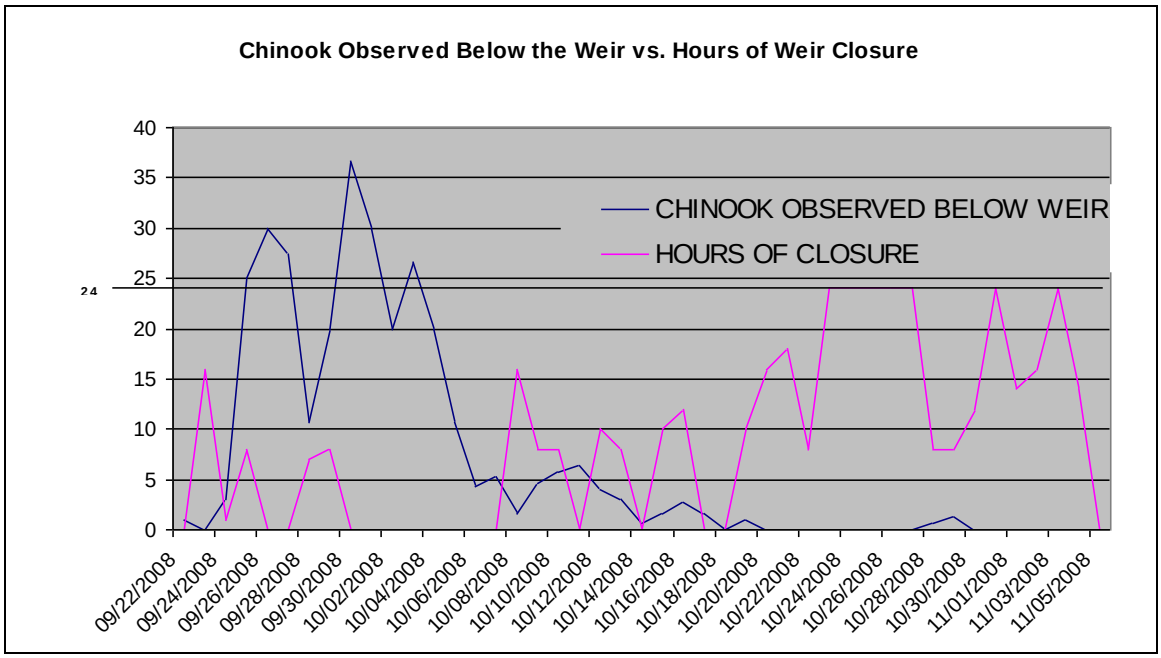


Table 5: "Chinook Observed Below the Weir vs. Hours of Weir Closure" shows that as the number of Chinook observed increased the hours of closure decreased; and as the hours of closure decreased the number of Chinook below the weir decreased. This shows that we responded appropriately to the observations of Chinook and our efforts to allow Chinook passage were successful.

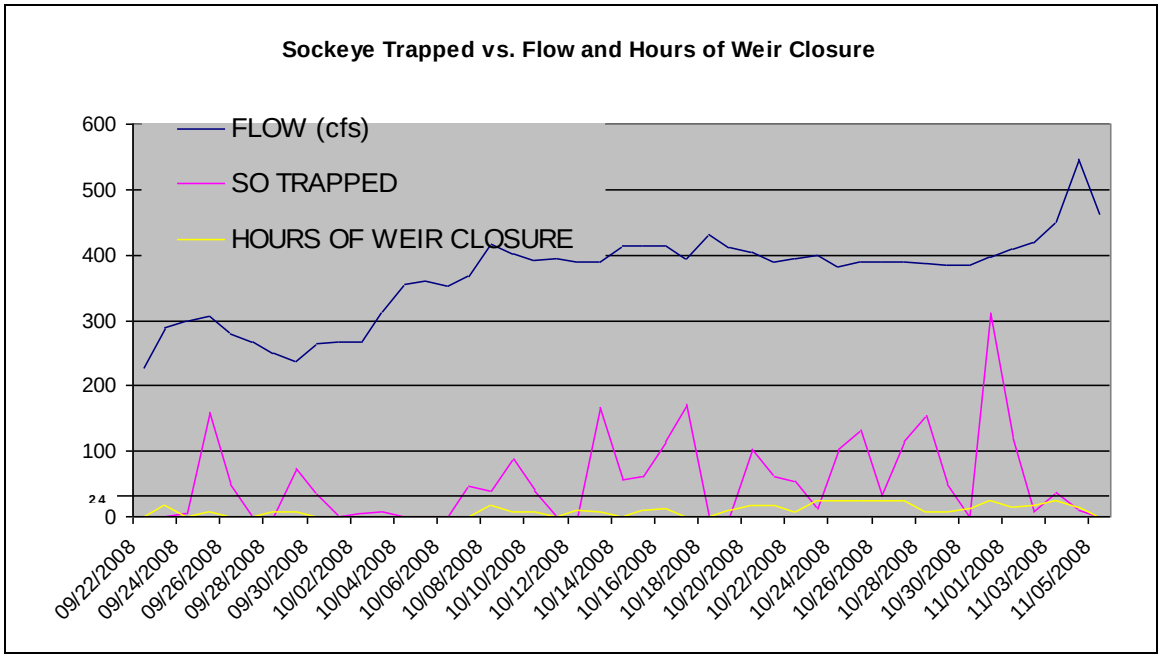


Table 6: "Sockeye Trapped vs. Flow and Hours of Closure" shows that the more significant factor in trapping sockeye is hours of weir closure, not flow. It also shows that when we were able to close the weir during an increase in flow we were able to trap significantly more sockeye than when we closed the weir during lower flow or decreasing flow periods.

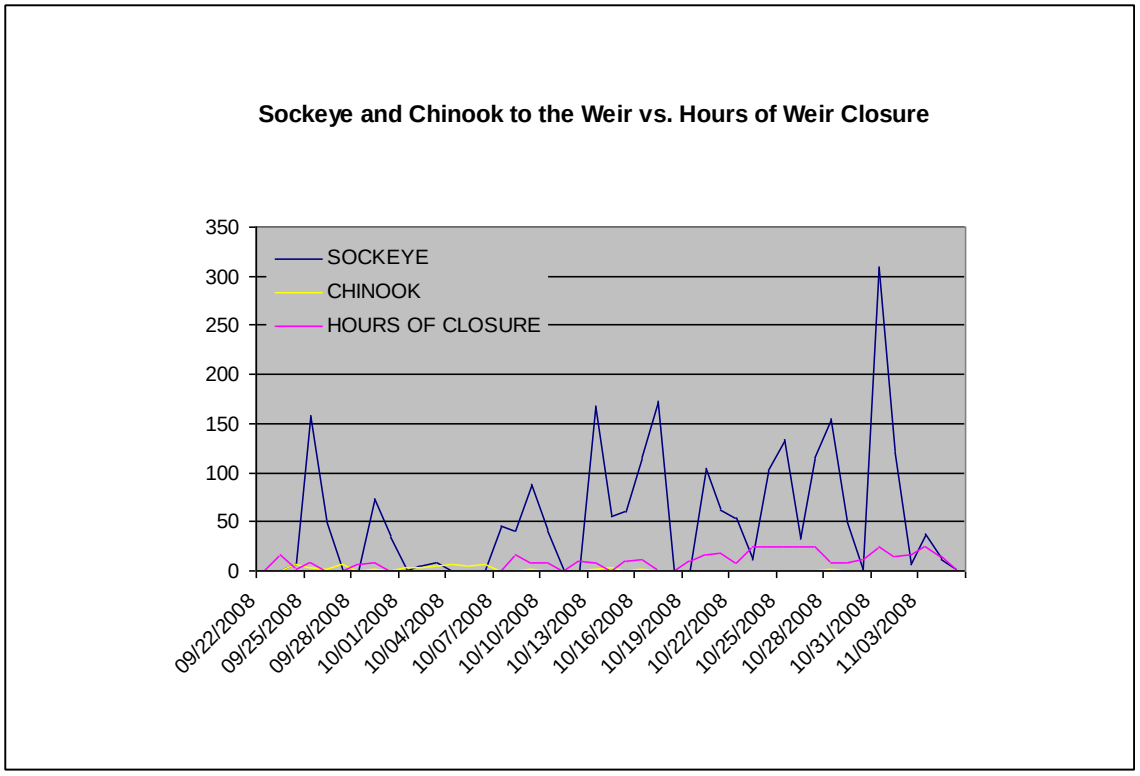


Table 7: "Sockeye Trapped and Chinook Through the Weir or Passed Upstream vs. Hours of Weir Closure" shows that as the hours of weir closure decreases more Chinook swim through the weir and fewer sockeye are trapped.

Table 1 (Trap Data spreadsheet) also shows that only 2 Chinook were trapped and 53 were observed swimming through the open weir during the season, indicating that Chinook swimming through the open weir is the more significant data. It also indicates that we need to focus on very effective methods of allowing Chinook to swim through the weir or develop more effective methods for trapping and passing Chinook upstream so we can ensure their unimpeded upstream migration.

Spawning and Incubation:

As results and data from (Table 2) show there were fewer spawn days to collect about the same number of eggs compared to the 2007-2008 season. The decision to take eggs on only 1 or 2 days each week led to an increase in efficiency and was made for a number of reasons:

1. To maximize the efficiency of scheduling a smaller crew between both the hatchery and the trap and weir.
2. Because there were fewer adults to handle, WDFW staff was able to check every female on every spawn day, eliminating the risk of "ripe" fish being held in the ponds beyond their successful spawning period. Egg loss, prespawn adult loss, and egg quality all indicated that there were not any adverse effects of spawning on fewer days.

3. Fewer spawn days meant larger egg takes on each spawn day which led to a number of increases in efficiency:
    a. Fewer total incubators used and the more efficient, easier to use kitoi incubators were used proportionally more than Heath type incubators.
    b. Since the amount of formalin used to manage fungus growth on the eggs is based on the number of incubators, not the number of eggs in the incubator, fewer incubators meant less formalin was used.
    c. The chilling schedule was easier to manage with fewer incubators.
    d. WDFW staff needed to set up, break down, and disinfect the egg picker and fertilization room fewer times.
    e. Because there were fewer, more temporally spread out takes of eggs it was easier to manage the limited rearing pond space to allow for all of the groups to receive their full 14 days of feeding, maximizing the probability of survival. In other words, one small group of fry wouldn't need to be planted to vacate a pond needed for the next, small group of fry.

Finally, fewer egg takes meant fewer days of planting which meant less wear on the tanker trucks, less gasoline used, less bottled oxygen used, and easier personnel scheduling.

Table 8, 2003-2009 Egg loss

Season	2003-2004	2004-2005	2005-2006	2006-2007	2007-2008	2008-2009
Total Eggs	11,487,100	16,682,000	7,513,600	13,465,000	2,870,300	2,971,400
Loss	17.26%	8.99%	8.27%	8.37%	6.62%	4.75%

As Table 8 shows the 2008-2009 season had the lowest egg loss in recent years. This is thought to have been the result of several factors:

a. Diligent adherence to spawning protocols including making sure that there isn't any water or fish slime in the cups with the milt and taking the time during spawning to collect enough milt from each male fish.
b. Use of more milt than previous years when fertilizing eggs and more thorough mixing.
c. There were fewer adults to spawn and fewer eggs to fertilize which allowed for more patient attention paid to each fish and group of eggs.
d. Low loss was also due to the avoidance of any major losses during incubation. During almost any other season at least one kitoi has sustained significant, if not total loss due to either ambient or chilled water not being supplied to an incubator during or after a chill event, or water flow being interrupted to an incubator when a neighboring incubator was drained to remove eggs or fry. The complex and antiquated plumbing presents unique flow issues in one of the banks of kitois and if flows are not managed carefully loss of flow to incubators can result. This year new protocols were established to reduce the risk of loss due to interrupted water flow.

The exception to successes in decreasing loss during incubation occurred in 2 of the 3 kitois in which eyed eggs were placed on a layer of vexar suspended above the saddles as described in the Methods and Results portion of this report.

In these kitois eyed eggs were not layered at lower densities in the saddles, they were placed in a single, high-density stratum until they hatched and swam down through the other eggs and vexar into the saddles below. After observations, analyses by a pathologist of mortalities, and dialog with other hatchery managers who use this strategy it seems most probable that the loss was due to suffocation as the newly hatched fry were trying to swim down through the mass of eggs to get to the substrate saddles. Eric Prestegard, who uses this strategy more successfully, advised using a wire hook of some sort to shake or bounce the vexar and eggs a couple of times a day during hatch to allow newly hatched fry to swim down through the eggs and vexar to the substrate below. Resulting losses were estimated to be about 1% per incubator.

Flooding and Electrical Problems:
Beyond the normal challenges, and some of the new ones associated with learning how to effectively operate the new trap and weir, there were 2 noteworthy challenges of the 2008-2009 season. In January there was a significant flood event and, concurrently, there were some problems with the electrical system that provides power to the pumps at the upper (main) pump station.

During the first week of January a combination of winter storms and rising temperatures created extremely high flows in the Cedar River as well as other rivers in the area. WDFW and SPU staff worked together to place sandbags in strategic places around the hatchery grounds to limit the possibility of erosion or contamination from potentially IHN infected river water. River water did not breach the sandbag walls, erosion at the hatchery was minimal, and pathology reports from the season indicated that there were no cases of IHN as a result of contamination from floodwater or any other causes.

There was some erosion just below the diversion dam next to the parking area and along the pipeline trail that follows the main water line between the hatchery and the lower pump array and adult pond area. The erosion along the pipeline trail potentially puts that main water line at risk of being undercut and compromised. That erosion also makes walking the pipeline trail more dangerous.

While sandbags appeared to keep river water out of the Spring Pond, incubation area, and any of the other hatchery water sources, there was some concern that contamination had occurred and that if the water had gone any higher it would have compromised the Spring Pond and the lower hatchery pump array near the adult ponds. Because the flood happened late in the season on a year when there were not many IHN carrying adults in the Cedar River there was likely a low level, if any, virus in the river water at that time. Despite the relatively low risk of contamination it was still reassuring that pathology reports indicated no cases of IHN this season.

A power outage in December began a series of electrical problems that resulted in over a month of unpredictable power failures. Electricians visited the hatchery several times before correctly identifying and fixing the source of the problem, a short in the wire supplying power to the upper pumps. During the time between the initial power outage and the short being fixed the upper pumps were used until their increasingly regular failure, requiring resetting a feeder breaker. This motivated the switch to the lower pumps as the primary water source. Once the problem had been fixed the upper pumps were again used as the primary water source for the hatchery.

Temporary hatchery staff on standby did an exemplary job of ensuring uninterrupted water flow to the eggs and fry during the intermittent power outages. They followed pump failure and power outage procedures under challenging weather conditions for each and every problem that came up no matter what time of day or night. That no eggs or fry were lost during the series of problems is a testament to their effort and dedication.

Feeding:

Because of the success with Rangen's soft moist starter diet in the 2007-2008 season the same feed was used for the 2008-2009 season. That feed seems to perform well for sockeye at the Cedar River Hatchery for a number of reasons. Most significantly, perhaps, is that it falls very slowly through the water column giving the less aggressive fry a prolonged opportunity to feed. The rate of conversion of food to growth (Table 4, "Ponding, Rearing, and Planting Schedule") is not as impressive as some of the other starter feeds, but more of the faster sinking feed goes to the bottom of the pond and is wasted which requires feeding more. Additionally, rates of conversion are difficult to compare during the first couple of weeks of feeding because of the presence of slightly variable amounts of yolk on some of the fish. Much more importantly, the fish eat Rangen's feed more aggressively and grow uniformly at a favorable rate.

In addition to the performance of Rangen's feed, some changes to water inflow for the rearing ponds decreased the amount of feed being wasted. Previously inflows were situated such that the top of the water column moved quickly from the inflow to the drain, taking with it a significant amount of uneaten food. Inflows were extended to the bottom of the pond and elbows were added to the inflows to direct the flow in a more advantageous course through the ponds. The result was the use of far less food to achieve the same amount of growth.

Once a newly ponded group of fish was eating well the rate of feed was maintained at approximately 3-4% body weight each feed day for about of 14 days. Hatchery personnel were instructed and shown how to watch the fish's feeding behavior carefully, make sure feed wasn't going to the bottom of the pond, and adjust feed rates according to those factors in addition to the rate of feed. This feeding to satiation ensured that all of the fish in each pond were getting enough feed to achieve their maximum growth.

Conclusions:

Broodstock Collection:

It was encouraging that about the same number of eggs were collected during the 2008-2009 season as were collected during the 2007-2008 season even though the number of adult sockeye passing into the Lake Washington Basin through the Ballard Locks was roughly half of what it was during the 2007-2008 season. The new weir and adult trapping location certainly led to this increase in trapping efficiency. That we collected as many adults while the new weir was only closed and fishing aggressively for 7 of 45 potential days of fishing seems to indicate that if we can close the weir and fish more regularly we will be able to collect many more adults at this new location with the new weir. Of course, this also indicates that a more effective strategy for allowing upstream migration of other species is vital. The apparent potential to collect sockeye broodstock much more effectively if the weir can be closed for fishing more of the time without impeding Chinook and coho migration is exciting.

Conversely, that as many Chinook seemed to be held up immediately below the new weir is unsettling. The goal of allowing upstream migration of other species is a central goal of the sockeye program and is vital to the overall health of the Cedar River.

In the 2009-2010 season careful design and implementation of new weir and trap equipment, configuration, and strategies could have a significant impact in the ability to collect many more sockeye and allow for much better upstream migration of other species. A number of different ideas have been proposed to increase trapping efficiency including:

1. Building and implementing a trap door in the north bank rigid picket section that can be opened and closed from the top of the rock wall on the north bank. With this trap door in place staff could open and close the weir much more quickly, without spooking any fish by wading across the river, and without a partner for safety. This new trap door would allow much more surgical upstream passage of Chinook and will increase trapping efficiency.
2. Instead of a narrow tunnel leading into the trap a much wider opening will be afforded by building and installing bulkheads identical to the ones at the north and south ends of the weir. This will allow fish entry into the trap without them having to swim under the weir and through a narrow tunnel. It might also allow more flow through that part of the structure which could attract more fish to that area.
3. The underside of the weir will be painted to eliminate the possibility that fish are being spooked by the unnatural color of the weir.
4. The wing walls, which are installed upstream of the trap for protection against large debris, will not be installed until flows increase and large debris starts moving down the river. Hopefully this will allow for more flow to pass through the trap during lower flows, attracting more fish to the trap. Additionally, during lower flows the wing walls might be set to funnel more flow into the trap to achieve that same goal.

Hatchery Water Supply Sources:
During the series of electrical problems and flood events it became clear that it is essential to have reliable back-up water supply sources for the hatchery. There were

several instances when the primary water source was unreliable to the point of compromising the safety of developing eggs and fry. Steps can be taken to address the electrical problems and vulnerability to floods to increase the reliability of the existing water sources, but there are undoubtedly many more vulnerabilities that cannot be anticipated that would warrant the use of a back up source of water. In response to the different problems that came up during the 2008-2009 season all 3 water sources (upper spring array #1, lower spring array #3, and the spring pond) were used and were essential to the survival of the eggs and fry.

Additionally, spring array #3 does not provide enough water to supply water to all of the incubators at the current interim hatchery, much less all of the incubators in the proposed new permanent hatchery. During the concurrent flood and electrical problems when spring array #3 was used as a primary water source it would not have supplied enough water if we had a big year and had eggs in all of the incubators without supplementation from the spring pond. Improvements can be made to collect more water at spring array #3 but it would probably still not be enough on its own if something interrupted the water supply from spring array #1.

Egg Loss Improvements and Value:
On a year when significant floods apparently scoured out and destroyed the majority of the natural sockeye production in the Cedar River it was increasingly important to have successful hatchery supplementation. The 2009 Cedar River fry trap data will likely show that the contribution of hatchery fry to the Lake Washington Basin will be very significant. The floods this year illuminated the value of the hatchery program to serve as protection against more severe losses to the overall sockeye population.

Lastly, unexpectedly low adult returns, significant loss due to floods, increases in egg to fry survival in the hatchery, and other improvements in hatchery efficiency all point to the importance of continuing to improve our ability to successfully achieve the goals of this program.

Appendices: Appendix 1, 2008 Adult Trap and Weir Activities Log

2008 Trap Log

Mon (15 Sept)
Begin to install weir -substrate rail

Tues (16 Sept)
Weir completed, weir trap door and trap tunnel open.

Thursday (18 Sept)
10am-11am 4 Chinook swim through trap tunnel. 20-25 sockeye in 50 yd stretch above the weir.

Friday (19 Sept)
Observed 16 sockeye and 0 Chinook above the weir; 6 sockeye and 0 Chinook below the weir.
*Total fish hauled = 4

Saturday (20 Sept)
Cloudy w/ some rain. 7:00 am: 5 sockeye below the weir, 31 above the weir, 0 Chinook
10:00am: 4 Chinook move up the tailout to the weir, seem to check the flow through the trap tunnel and in the deep end (right bank) of the weir. 2 Chinook observed moving through the trap tunnel, not sure if the other 2 swam through unnoticed or went downstream but they're not below the weir anymore. Walked to the RR bridge hole and observed about 20 Chinook and 15 sockeye in that hole.
11:00am: Checked weir; sat on the wall above the far side of the weir for 1 hour: saw 7 Chinook move up though the tailout. They seem to check out the 2 flows by the wall and below the trap tunnel, they go from the deep end to the trap tunnel and then swim up through the trap tunnel. Only 1 of the 7 swam up the deep end under the weir panels and then moved to the trap door and swam through the trap door. All others went through the trap tunnel. It took each fish about 5-10 minutes to figure out where to get through.
1:00pm: 4 more Chinook moved up the tailout and through the trap tunnel.
3:00pm: 2 more Chinook moved up the tailout and through the trap tunnel.

Sunday (21 Sept)
7:25am: 15 Chinook 7 sockeye below the weir. 8 Chinook observed moving through the weir, still 7 below.
8:45am: Still 4 Chinook below the weir. Observed 1 Chinook and 2 sockeye pass through the wier. Poor visibility but can see at least 12 Chinook in the pool below the RR bridge (RR hole).
10:30am: 9 sockeye and 3 Chinook below the weir. No sockeye or Chinook movement.
2:15pm: Still no movement.

Monday (Sept 22)
8:00am: Flow=228 CFS. 30 sockeye above the weir, 7 below; 1 Chinook above the weir, 3 below.
9:30am: 4 Chinook jacks in the stretch above the weir, 0 Chinook below.
4:00pm: Trap installed, not fishing, pickets out of upstream end of trap.

Tues (23 Sept)
Flow= 288 CFS Started fishing in the morning, by 4 p.m. had caught 8 sockeye, no Chinook. Opened weir trap door, opened up trap.

Wed (24 Sept)
7:00am: Flow= 299 CFS Cage set and trap door shut. Fishing.
7:30am: 4 Chinook and 15-20 sockeye observed below the weir, opened the trap door to allow passage.
8:00am: observed 20 Chinook and 150 sockeye in the RR hole. 1 Chinook swims up through the trap door.
8:15am: 4 Chinook and 6 sockeye swim through the trap door.
10:00am: 1 Chinook swims through the trap door.
10:50am: 1 sockeye " " " "
11:50am: 2 sockeye " " " "
12:20pm: 4 sockeye " " " "
3:30pm: haul 1 female, 5 male sockeye. Observed 85 sockeye below weir, 0 Chinook.
*Total fish hauled =15

Thu (25 Sept)

8:00am: Flow= 306 CFS. 208 sockeye in trap, no Chinook. 35 Chinook in the RR hole, opened weir trap door, fixed weir on north shore removed, two weir panels disconnected from adjacent panels and sunk, trap opened.
10:00am: 15 sockeye and 3 Chinook observed moving up the tailout.
10:30am: hauled 65 male and 65 female sockeye.
12:30pm: observed 200+ sockeye and 20 Chinook in the RR hole.
2:00pm: haul 28 female sockeye
*total fish hauled =158

Fri (26 Sept)
8:00am: Flow= 278 CFS. Not fishing, increased opening on vee entrance from 6.25 to 9.25 inches, removed individual pickets on the upstream end of the trap cage and every other individual picket on the upstream wing walls to increase the flow through the cage.
1:15pm: 1 Chinook observed swimming over the submerged panels.
*total fish hauled =50

Sat (27 Sept)
7:20am: Flow= 268 CFS. Paul F. observes 4 Chinook swim up the deep end and through the weir.
7:45am: 2 more Chinook swim through the weir.
8:15am: observed 15 Chinook and 100+ sockeye in the RR hole.
10:00am: no fish moving between RR hole and weir.
12:00pm: still no fish moving.
2:00pm: 2 sockeye move upstream through the weir.

Sun (28 Sept)
7:00am: 5 sockeye, 0 Chinook swim through the weir.
7:30am: poor visibility but still able to observe 60 sockeye and 14 Chinook in the RR hole.
8:00am: 7 sockeye, 0 Chinook swim through the weir.
10:00am: 2 sockeye, 0 Chinook swim through the weir.
11:15am: observe 1 Chinook in the hole near the swimming beach about 40 yds. above the weir.
11:30am: observe 7 Chinook and 15 sockeye in the RR hole.
2:00pm: no fish moving, observe 70 sockeye and 5 Chinook in RR hole. Gary S. arrives and helps set the trap/close the weir:
5:00pm: fixed panel on north shore put back in place, new transition tunnel installed, sunk panels (2) raised and reconnected.
7:00pm: weir trap door closed, vee entrance adjusted to 8 3/8 inches.

Mon (29 Sept)
8:00am: Flow= 268. 5 Chinook observed holding below weir, 74 sockeye in trap (14 female, 54 male), no Chinook, one weir panel disconnected and sunk, weir trap door opened, trap remained in trapping mode.
9:00am: observed 200 sockeye and 20 Chinook in RR hole.
11:30am: 1 Chinook observed swimming through the submerged weir panel.
1:30pm: 1 sockeye swims through the submerged weir panel.
3:00pm: 3 sockeye swim through the submerged weir panel.
*total fish hauled =74

Tue (30 Sept)
8:00am: Flow= 265. no Chinook in vicinity below weir in morning, about 20 sockeye in trap (females transported, males released).
11:30am: 1 coho swims through the weir over the submerged panel, 3 sockeye swim through the trap door.
12:00pm: observed 160 sockeye and 40 Chinook in RR hole.
4:00pm: received report regarding Chinook between weir and Library

5:00pm: Gary and Paul removed fixed weir at north shore, and completely removed two picket panels, removed half of pickets on upstream end of trap, removed door panels in trap, removed fingers on vee entrance, weir trap door remains open.
*total fish hauled =8

Wed (1 Oct)
8:00am: Flow= 268 CFS. Observed 250 sockeye, 30 Chinook in the RR hole.
11:00am: observed 2 Chinook swim through open sections of the weir.

Thurs (2 Oct)
7:30am: Flow= 268 CFS. Watched 2 Chinook swim through weir where panels are pulled. Both fish moved through quickly without delay.
8:30am: Set trap for fishing, closed shallow side trap door. 2 Panels still pulled, rigid pickets still pulled on North end.
11:30am: 1 Chinook swims through weir at pulled panels, 35 sockeye, too. Light rain. Observed 20 Chinook and 150 sockeye in RR hole.
12:30pm: Rain stops, no fish moving through weir.
3:00pm: Cleaned weir, 7 sockeye in the trap.
*total fish hauled =5

Fri (3 Oct)
8:00am: Flow= 313 CFS. Watched 4 Chinook swim through weir at pulled panels. 14 sockeye in the trap.
9:00am: No fish movement. Gary floated through the RR hole and didn't see much but we were able to observe 30 Chinook from the bank when he spooked them as he floated into the hole. 120 sockeye in RR hole.
11:00am: Watch 9 sockeye swim through the weir at pulled panels. Bruce Bachen stops by.
12:30pm: Watch 1 Chinook swim through the weir at pulled panels. Load/haul 8 female sockeye, put 8 males upstream. Pulled pickets out of the trap, not fishing.
3:00pm: Cleaned weir, set some gravel bags along substrate rail/around trap.
*total fish hauled =8

Sat (4 Oct)
8:00am: Flow= 354 CFS. Observed 6 Chinook and 25 sockeye swim up through weir at pulled panels.
10:00am: Cleaned weir. Watched 5 sockeye swim through weir at pulled panels. Lots of leaves coming down the river, doesn't take much to lay the weir panels down.
12:30pm: Watched 25 sockeye swim through the weir at pulled panels. Paul stopped by.
1:30pm: Paul got temporary generator hooked up to the trailer. Cleaned weir.
3:00pm: Did counts/observations. Watched 5 sockeye swim through the weir.
4:00pm: Security shows up to relieve Richard ½ hour late.

Sun (5 Oct)
7:00am: Flow= 360 CFS. Watch 1 Chinook and 10 sockeye swim through weir at pulled panels.
8:00am: Watch 4 Chinook and 14 sockeye siwm through weir at pulled panels.
11:00am: Watch 4 sockeye swim through weir at pulled panels. Observed 170 sockeye and 12 Chinook at RR bridge.
1:00pm: Watch 12 sockeye swim through weir at pulled panels. Holly (Muckleshoot) stopped by and asked about fish moving through the weir. I told her it seems like the fish swim through without being held up at all. Observed 12 Chinook at RR hole.

Mon (6 Oct)
8:00am: Flow= 352 CFS. Watch 5 Chinook and 7 sockeye swim through weir at pulled panels. Gary, John, Jeff, and SPU crew put panels with trap doors back in the deep end.
11:30am: Trap set, panels in place but trap doors open on deep panels, rigid picket at the wall is still out.
1:00pm: 6 sockeye and 2 Chinook move through the weir at pulled rigid picket. Brodie stopped by. Observed 5 Chinook at RR hole.

Tue (7 Oct)
7:00am: Flow= 368 CFS. Watch 30 sockeye swim through weir at pulled rigid picket.
8:00am: Observed 4 Chinook in RR hole.
8:30am: Load/haul 19 female sockeye and put 27 male sockeye upstream. Rake weir.
10:30am: Watch 14 sockeye swim through new trap doors, no Chinook movement.
11:30am: Observed 180 sockeye and 5 Chinook in RR hole. 7 sockeye in the trap.
2:30pm: Cleaned weir. 15 sockeye in the trap.
3:00pm: Closed 2 deep end trap doors. Chad floated through the RR hole and saw 5 Chinook. Steve Foley stopped by.
*total fish hauled =19
Wed (8 Oct)
7:00am: Flow= 416 CFS. Observed 1 Chinook and 150 sockeye in the RR hole.
8:00am: Load/haul 21 female and 17 male sockeye.
10:00am: Set rigid picket section on the north end of the weir per Paul, Cory, Brodie, and Gary's request. Cleaned weir.
1:00pm: Observed 2 Chinook and 170 sockeye in the RR hole.
3:00pm: Cleaned weir.
4:00pm: Observed 2 Chinook and 120 sockeye in RR hole.
*total fish hauled =38

Thurs (9 Oct)
07:00am 402 CFS. 3 Chinook observed below weir. Doors opened for passage
08:00am Cleaned weir
09:00am SPU Hauled fish
14:00pm Cleaned weir. No Chinook or Sockeye observed.
*total fish hauled =105

Friday (10 Oct)
07:00am 5 Sockeye passed through weir door.
08:00am Cleaned weir One Chinook dead on weir. 12 female and 23 male sockeye captured. Weir cleaned
10:00am 5 Chinook holding in RR hole. 11 Sockeye passed through the trap doors.
13:30pm 18 female and32 male Sockeye captured
14:00pm Pulled eight pickets from trap for Chinook passage
*total fish hauled =50

Saturday (11 Oct)
07:00am 4 Chinook and 50 Sockeye observed in RR hole. 40-50 sockeye below bridge and no Chinook observed
09:00am 10 Sockeye swam through side channel.
10:00am 3 Sockeye below bridge swimming through. No Chinook observed.
12:00pm 5 Chinook and 50 Sockeye in RR hole.
14:00pm 7 Sockeye below bridge
15:00pm 9 Sockeye and no Chinook observed below bridge

Sunday (12 Oct)
07:00am 1 Chinook observed in side channel. 2 Sockeye below bridge.
08:00am 40 Sockeye and 3 Chinook in RR hole
10:00am No Chinook below bridge and 8 Sockeye observed.
11:30am Cleaned weir
13:45pm closed side pickets and trap to begin captures
14:00pm Sockeye moving upstream

Mon (13 Oct)

8:30am: Flow= 390 CFS. Load/haul 166 sockeye.
9:30am: Observed 1 Chinook, 100 sockeye in RR hole.
12:30pm: Observed 2 Chinook, 130 sockeye in RR hole.
2:30pm: Rigid picket to remain pulled for the night. Observed 6 Chinook, 130 sockeye in RR hole.
3:00pm: Estimate 50 sockeye in trap.
*total fish hauled =167

Tue (14 Oct) 8:00am: Flow= 453 CFS. Watch 2 Chinook swim through weir at pulled picket section. Transferred 20 female, 41 male sockeye into live boxes.
9:00am: Steve Foley stopped by and marked a Chinook redd below the weir.
10:15am: Load/haul 20 females and 41 males.
12:45pm: big log washes over the weir without any trouble. Looks like about 20 sockeye in the trap.
2:30pm: Observed 2 coho and 1 Chinook in the tailout below the footbridge.
*total fish hauled =56

Wed (15 Oct)
8:00am: Flow= 414 CFS. Very little fish movement. Transfer 25 female and 36 male sockeye into live boxes.
9:30am: Observe 1 Chinook, 130 sockeye in RR hole.
1:30pm: Install rigid picket section.
2:00pm: Load/haul 25 female and 36 male sockeye.
*total fish hauled =72

Thu (16 Oct)
8:30am: Flow= 415 CFS. Transfer 39 female and 76 male sockeye into live boxes. 2 Chinook trapped and passed upstream. 1 of them goes upstream, the other one went downstream and over the weir. Removed rigid picket section.
9:00am: Load/haul 39 female and 76 male sockeye.
10:00am: Observed 2 Chinook and 115 sockeye in the RR hole.
11:00am: Floaters come by and see 4 Chinook in RR hole.
12:30pm: Observed 2 Chinook and 132 sockeye in RR hole.
2:00pm: Steve Foley and other folks from the AFC meeting stop by and look at the weir. Install rigid picket section.
4:00pm: Pulled rigid picket due to Chinook observed below the weir.
*total fish hauled =115

Fri (17 Oct)
8:00am: Flow= 394 CFS. Transfer 24 female, 45 male sockeye to live boxes. Install rigid picket.
9:00am: Load/haul 24 female, 45 male sockeye. Brodie, Cory, Alika, Marianne go snagging with Mike Leslie.
10:00am: Observed 1 Chinook and 138 sockeye in RR hole.
11:00am: Observed 1 coho in the hole above the weir. Seems like there are more coho around.
12:00am: Snaggers get back with 36 females. Load/haul 22 female sockeye from trap, pass 37 male sockeye upstream.
1:00pm: opened deep trap doors, pulled rigid picket section.
*total fish hauled =127

Sat (18 Oct)
7:00am: Relieved guard, found out that our schedule has changed and didn't have to be here until 8am. Observed 0 Chinoook above or below the weir.
10:00am: Replaced trap pickets (set for fishing with rigid picket pulled and trap doors open).
12:30pm: Lower resistance boards where water and fish are flowing over the sunk panels.

Sun (19 Oct)
8:00am: Observed 0 Chinook above or below the weir.
8:30am: Transfer 6 female sockeye into live box, passed 23 male sockeye upstream.
9:30am: Observed 2 Chinook and 97 sockeye in RR hole.
10:00am: Closed 2 trap doors.
2:30pm: Replaced rigid picket section.
3:00pm: Observed 1 Chinook, 114 sockeye in RR hole.

Mon (20 Oct)
8:00am: Transfer 34 female and 65 male sockeye into live boxes, pass 8 male sockeye upstream.
9:00am: Load/haul 34 female and 64 male sockeye.
11:00am: Observed 0 Chinook and 33 sockeye in RR hole.
1:00pm: Observed 30 sockeye and 0 Chinook in RR hole.
3:00pm: Seems like there are a lot of sockeye moving upstream today.
4:00pm: Closed rigid picket section.
*total fish hauled =98

Tues (21 Oct)
8:00am: Flow 390 CFS. Weir full of leaves. Entrance of trap clogged with leaves. Four Sockeye in trap. Three males released, one female placed in holding cage. 3 Sockeye observed crossing the line. Crew cleaned the weir and trap.
9:30am 48 sockeye and one Chinook observed in railroad hole. 2 Sockeye crossing line.
11:30am Three Sockeye observed crossing the line.
12:00pm 5 Sockeye observed crossing the line.
13:00pm Fish in trap sorted to cages. 46 males upstream and 13 Females held.
14:00pm 5 Sockeye observed swimming.
15:30pm No Sockeye crossing the line. 80 Sockeye in railroad hole
*total fish hauled =13

Wed (22 Oct)
8:30am Flow 394 CFS. 26 Females sorted to trap and 41 males released upstream. Fish hauled. Pickets pulled on left side and left weir open.
9:30am 45 Sockeye observed in railroad hole. No fish crossing the line. Few fish swimming including a few Coho.
10:00 few Coho passing upstream on left side.
11:00am No fish crossing the line. 55 holding in the rail road hole.
12:00pm No fish crossing the line. Raked the weir
16:00pm 50-60 fish holding in railroad hole. Left pickets open for Chinook and Coho passage.
*total fish hauled =13

Thurs (23 Oct)
8:00am Flow 398 CFS: 2 Sockeye crossing the line. No Chinook holding bellow the weir.
9:00am 4 Sockeye captured and placed in holding cage. 7 male Sockeye released. 1 female hatchery Coho released upstream. Weir cleaned. Closed left side.
11:00am; 6 Sockeye below line.
12:00pm, 10 Sockeye below line
13:00pm No Chinook or Coho visible above line. RR hole holding approximately 42 Sockeye and three or four Coho.
*total fish hauled =11

Friday (24 Oct)
8:00am 381 CFS. Weir cleaned. One female and male placed in holding cage.
10:00am; 23 males, 9 females captured and separated. 1 female hatchery Chinook spawned on weir and released down stream (caught on weir).
12:30pm 14 females captured and 36 male Sockeye released upstream.

13:00pm 11 Sockeye pass the line
14:00pm 9 Sockeye pass the line, 80 at RR hole
15:00pm 8 females captured, 36 males released upstream.
*total fish hauled =33

Saturday (25 Oct)
7:00am 390 CFS. Security observed 2 unknown salmon swim over the weir.
8:00am 50-60 Sockeye holding in RR hole. 2 Sockeye passed the line
10:00am 1 female wild Coho released, 19 female Sockeye captured and 40 males released upstream. One Chinook Jack found dead on weir.
13:00pm 33 male Sockeye passed upstream. One female escaped out of workers hand. SPU hauled 60 females to hatchery
14:00pm Weir cleaned, no Chinook or Coho observed or in trap. All day 9 Sockeye observed passing the line.
*total fish hauled =60

Sunday (26 Oct)
8:00am weir is 10-12 inches below water. Fish are swimming over the weir. Unlocked fish trap and holding cage. 2 female Sockeye captured and 8 males released. 2 wild male Coho released. Weir was cleaned.
12:00pm 4 Sockeye passing the line. 18 male Sockeye passed upstream, 5 females captured. One wild male Coho released.
15:00pm 6 male Sockeye passed upstream.

Monday (27 Oct)
8:00am 390 CFS. No Coho or Chinook observed or in trap. 53 females Sockeye to include 7 from the day before and 56 males captured and hauled by SPU.
9:00am weir cleaned. Observed 20 new fish in trap.
11:30am No Chinook or Coho observed, 200 holding at RR hole.
11:30am one dead Jack found on picket Sockeye are moving
14:00pm 32 females and 66 male Sockeyes captured. 5 old Sockeye males and 1 wild male Coho released.
*total fish hauled =109

Tuesday ((28 Oct)
8:00am 2 Chinook below weir, side picket and 2 hatches opened for passage.
8:30am 38 female and 54 male Sockeye captured. Five old males released. No Coho or Chinook in trap.
9:00am SPU hauled 70 females and 103 male Sockeye to hatchery
9:30am weir cleaned.
10:30am 2 Chinook passed through the hatches. There was another Chinook earlier not sure where he went?
11:00am One Coho and about 200 Sockeye in RR hole.
13:00pm Saw 1 Chinook and 5 Coho in RR hole.
14:00pm Weir was cleaned. Fish protection device installed.
15:00pm 10 Sockeye in trap. About 240 Sockeye in RR hole.
*total fish hauled =173

Wednesday (29 Oct)
8:00am 390 CFS. No Chinook below weir. Side pickets and hatches closed.
8:30am Still no Chinook or Coho visible. Weir cleaned. 1 Dead spawned male Chinook on weir.
10:00am 117 Sockeye in RR hole and 2 Chinook. 6 Coho downstream of bridge.
12:00pm 16 female and 20 male Sockeye captured. 7 males released. No Coho or Chinook in trap.
12:45pm 200 Sockeye, 2 Coho, 2Chinook in RR hole. About 70 Sockeye above and below weir.
13:00pm 16 female and 20 male Sockeye transported to hatchery
13:30pm pulled and fixed side pickets and hatches were opened
14:00pm cleaned weir
16:00pm 245 Sockeye, 2 Coho and 2 Chinook in RR hole
*total fish hauled =36

Thursday (30 Oct)
8:00am No Chinook or Coho Present
8:30am Side pickets pulled and repaired.
11:30am Side pickets replaced and enforced with sand bags.
12:00pm 166 Sockeye, 1 Coho and 1 Chinook in RR hole. RR hole Sockeye population decreasing.
12:30pm Weir cleaned. 7 females and 9 male Sockeye captured. 7 males released
14:30pm 166 Sockeye 1 Chinook and 4 Coho in RR hole.
15:00pm 8 female and 20 male sockeye captured. 14 more Sockeye moved into trap.

Friday (31 Oct)
8:00am 22 females and 23 male Sockeye Captured. 3 males Sockeye, 1 male hatchery Coho released.
9:30am SPU transported 37 Female and 52 males to hatchery.
10:30am No Chinook observed below bridge. Good number of sockeye moving from RR hole.
12:00pm Cleaned weir
13:00pm 66 Female and 55 male Sockeye captured. No Chinook or Coho trapped. 20 Sockeye in trap. They're moving from RR hole!!
14:00pm SPU transported 99 Females and 112 male Sockeye to the hatchery. 3 males released.
15:30pm Weir cleaned.
*total fish hauled =301

Saturday (Nov 1)
8:00am Recount captures, 16 female and 22 male Sockeye.
9:00am 35 female and 66 male Sockeye total captured. 5 male Sockeye and 1 wild Coho released. Cleaned weir Bad leaf day.
10:00am 200 Sockeye and 2 Chinook in RR hole
11:00am Cleaned Weir again
12:00pm 15 Sockeye in trap
12:30pm SPU showed up and transported 41 females and 75 males.
13:00pm cleaned weir
14:00pm Pickets pulled for Chinook passage but none observed.
15:30pm Weir cleaned. Fish moving below weir.
*total fish hauled =116

Sunday (Nov 2)
8:00am 410 CFS. 8 Sockeye in trap. Weir loaded with leafs. No Chinook observed. Cleaned weir and reinstalled pickets.
10:00am No fish movement below bridge. 120 Sockeye in RR hole.
11:00am 18 Sockeye in trap.
11:30am Cleaned Weir
12:30pm Cleaned weir
14:30pm 13 females and 22 male Sockeye captured. 1 female hatchery Coho and 7 male Sockeye released.
15:00pm 450 CFS. Cleaned weir

Monday (Nov 3)
8:15am Cleaned weir
11:30 No salmon across line. Only 15 salmon in RR hole. Poor visibility
13:00pm SPU hauled 15 female and 22 males to hatchery
14:30pm Cleaned weir
*total fish hauled =37

Tuesday (Nov 4)
8:00am 546 CFS. 2 Sockeye observed under line
11:00am Weir cleaned
11:30am entrance of trap below river bed and fish were unable to enter trap
12:30pm 2 Sockeye passed observation line.

14:00pm 8 Sockeye in trap released by removal of pickets.
*total fish hauled =15

Wednesday (Nov 5)
9:00am Removal of weir. 6 SPU and 5 DFW crew members. Dry suits were required to release panels from rocks stuck on the cable hooks. Most aluminum parts and expensive materials were transported to Landsburg.
Removal, first the holding cages were removed followed by the trap and then the panels. Took about four hours.
SPU members owe us Pizza for falling in the river several times.

Appendix 2, Power Failure Log

12-12-08
There was a power outage at the Landsburg treatment building and hatchery. A tree fell across PSE lines near the fish passage office trailer. The STANDBY ENGINE-GENERATOR did start. PSE fixed the problem on 12-12-08.

12-12-08
Pump #1 at pump station #1 did not work after outage.

12-12-08 – 12-16-08
Pump #2 at pump station #1 (upper spring) still worked and was used until Bob Kreiger fixed the control sensor on 12-17-08. The spring pond pump at the hatchery was used as the primary back-up water supply with pump station #3 (lower springs) as a secondary back-up. The hatchery has been running gravity fed water through the pipes and valves near the broodstock ponds to prevent damage from freezing. This prevented them from using pump station #3 as the primary back-up because the same gravity cisterns supply water to the adult broodstock ponds and the pump station #3 vault.

12-17-08
Bob Kreiger reported a control sensor on a pump at pump station #1 blew, probable associated with power outage. He fixed it. Once he fixed pump #1 at pump station #1 it was used as the primary water source with pump #2 at pump station #1 as the primary back-up, the spring pond pump as the secondary back-up, and pump station #3 as the tertiary back-up.

12-22-08 – 12-26-08
SERVICE breaker (200A) at the PSE meter pole (on the north side of the river) for the hatchery tripped 2-3 times during this week. Each time the breaker tripped the generator came on as designed and water from pump station #1 was not interrupted.

12-30-08
Bob Kreiger and Steve Conly checked the whole system in several different places for shorts or other potential causes and determined that everything on the hatchery side of the SERVICE breaker (200A) at the PSE meter pole was in good shape. "Balanced and stable" was their term. The only thing they could figure out was that the adjustment on the SERVICE breaker was set all the way down (most sensitive) which would cause it to trip more easily. They adjusted it so it would take more of an event to trip.

1-1-09
The FEEDER breaker (100A) for pump station #1 at the Dam Switchboard tripped around 6:00 AM, this was the first time this has ever happened since the system was completed last summer. The label on the breaker is Spring Well 1. The STANDBY ENGINE-GENERATOR did not start because power was available to the rest of the hatchery. Alarms sounded at the hatchery because the tower water was low. Hatchery staff tried to start pump #2 at pump station #1 (primary back-up) with the remote start panel but it wouldn't start because the feeder breaker had tripped cutting all power to pump station #1. The spring pond

pump (secondary back-up) was started. When staff discovered that the FEEDER breaker (100A) for pump station #1 at the Dam Switchboard had tripped it was reset however it tripped again almost immediately. The water level in Head box A was low but never empty. Flow was not disrupted to the incubators.

The hatchery was using pump one at pump station #1. Circuit breakers at pump station #1 did not trip. The hatchery staff switched off the individual pump breakers (40A) for each motor at each starter at pump station #1, reset the FEEDER breaker (100A) for pump station #1 at the Dam Switchboard, and turned on the individual pump breaker (40A) for pump two at pump station #1. After starting pump two they turned off the back up spring water pond pump.

The Feeder breaker tripped again using pump two at 12:00 PM. The hatchery switched off the individual pump breaker (40A) for pump 2, reset the FEEDER breaker (100 A), and started pump one.

1-2-09
The FEEDER breaker (100A) for pump station #1 at the Dam Switchboard tripped at 6:00 AM. The hatchery reset breakers again and restarted pump one and continue to have the spring water pond pump set up as the primary back up water supply to the hatchery. The pump breaker for pump two is set to the off position.

1-3-08
The FEEDER breaker for pump station #1 at the Dam Switchboard tripped at 5:00 PM. The hatchery staff reset breakers again and restarted pump #1 and continue to have the spring water pond pump set up as the primary back up water supply to the hatchery. The pump breaker for pump #2 at pump station #1 is still set in the off position.

1-3-08 – 1-8-08

No electrical problems. Still using pump station #1.

1-8-08

The FEEDER breaker for pump station #1 tripped and was reset during the night.

1-9-08

Brodie and Cory decide that pump station #1 is too unreliable and pump station #3 should be used as the primary water source until the problem with pump station #1 is resolved. Pump station #1 is the primary back-up, the spring pond is the secondary back-up. Spring well #3 provides just enough water for the current needs of the hatchery with very little overflow from the spring well, main tower, and A Box. There is also a small amount (~20-30 gpm) of pumped water going to the adult ponds to keep the ponds and valves from sustaining damage.

1-10-08 – 1-12-08

The FEEDER breaker for pump station #1 tripped 2 times over the weekend with the pump switches set in the hand position and the pumps not running.

Concern:
Right now the hatchery has questionable pumping capabilities from the upper pump station due to the repeated tripping of the FEEDER breaker. The spring pond pump is the primary back up with pump station #3 as the secondary back-up. To provide water from pump assemble 3 to the hatchery (in the event of more failures), staff need to open and close a number of valves, start the pump (all from the broodstock area) and then charge the line to the hatchery. There is some uncertainty as to the valve setting at pump assemble 3. It needs to be adjusted so the pump chamber is not drawn down too far. Starting pump assemble 3 may take 5-10 minutes.

FYI:
The hatchery will be ponding fry soon (end of January). This may affect the availability of water from pump assemble 3 because the same gravity cisterns supply water to pump assembly #3 vault and the fiberglass rearing ponds.

Description of breakers, pumps, etc..

1. SERVICE breaker (200A) at the PSE meter pole (on the north side of the river).
2. PSE SERVICE MAIN breaker (200A) at the Dam Switchboard (on the south side of the river).
3. STANDBY ENGINE-GENERATOR SERVICE MAIN breaker(200A) at the Dam Switchboard (on the south side of the river).
4. FEEDER breaker (100A) for pump station #1 at the Dam Switchboard.
5. MAIN breaker (100A) at each pump station.
6. Individual pump breakers (40A) for each motor at each starter.
7. Pump assemble 1 is above the dam.
8. Pump assemble 3 is near adult ponds.
9. Spring pond pump is at the hatchery.

Appendix 3, Trap and Weir Protocols

Operational Guidelines for the Cedar River Weir and Fish Trap at I-405
2008 Field Season

These guidelines are based on the framework that was established for the 1999 field season in response to concerns regarding weir impacts to Chinook salmon. The guidelines are based on nine years of successful implementation during the 1999-2007 brood collection years. It is recognized that the Cedar River Anadromous Fish Committee and the Sockeye Hatchery Adaptive Management Work Group will have the opportunity to recommend changes to these guidelines if conditions change during the season. Such adaptive management will be documented and communicated through the committee chair. Since the implementation of this protocol and the adaptive management approach, the operation of the weir has been successful in avoiding impacts to Chinook salmon. Careful monitoring of fish behavior at the new location, with the new weir will be necessary to be responsive to changing conditions and fish behavior. The number of Chinook salmon passing the weir and entering the trap in relation to the number of sockeye salmon entering the trap will dictate how the trap and weir will be operated.

GOALS:
The weir and fish trap in the Cedar River are maintained and operated to collect sockeye broodstock. However, an additional goal of equal importance is to minimize the risks of adverse effects to upstream migrating adult Chinook salmon. These protocols are intended to satisfy both goals.

Due to ESA issues involving Chinook salmon in the Cedar River, the weir will be operated to avoid adverse impacts to adult Chinook salmon. There are two major impacts that we will seek to avoid: 1) having Chinook spawn within 25 meters above or below the weir such that the eventual removal of the weir could impact those redds, and 2) significantly delaying (defined as more than 24 hours) the upstream migration of Chinook. It is recognized that operating the weir to avoid impacts to Chinook compromises our ability to meet the objective of collecting sockeye broodstock.

Hatchery personnel and biological staff will communicate and work together to monitor Chinook activity in the area adjacent to the weir.

- Because this weir design and location are new this year, monitoring and documenting Chinook responses to this new situation is very important.
- An open weir is defined as the condition that exists when fish have unrestricted access through one or more openings in the weir or trap.

- There will be no restrictions on fishing (closed weir) if there are no Chinook observed downstream of the weir for a 24-hour period, outside of the peak Chinook spawning period, however during the typical peak Chinook spawning period (typically September 25 through October 10) as determined by redd surveys and live counts, the weir will be opened for a 12-hour period following three consecutive days of fishing regardless of Chinook being observed.
- If Chinook are observed holding in the area immediately downstream of the weir, and there is a need to collect sockeye adults, then the weir will be opened to allow Chinook to move upstream. The duration of the opening will be in response to the observed behavior of the Chinook, with the goal of keeping any potential delay of Chinook to less than 24 hours. This may be accomplished by opening the weir at night.
- If field biologists or field technicians see more than 10 Chinook holding between the weir and the Renton Library below the weir, they will discuss the situation with the hatchery staff and jointly determine a course of action (i.e., opening the weir).
- The weir is to be fished only when sockeye adults need to be collected.
- If there are more Chinook in the trap than sockeye trap pickets will be pulled.
- Chinook that enter the trap will be passed upstream as quickly as possible.
- If the number of Chinook in the trap exceeds what can be removed in 30 minutes, trap pickets will be pulled to pass Chinook.

If a Chinook female unavoidably constructs a redd in close proximity to the weir, then the redd is to be immediately marked and a discussion will take place. This discussion will include, but is not limited to, the following types of actions: early weir removal, staged weir removal, and modification of weir operations. Discussion will include at least these people or their designee: Rand Little (SPU), Gary Sprague (SPU), Paul Faulds (SPU), Brodie Antipa (WDFW), Larry Fisher (WDFW), Steve Foley (WDFW) Annette Hoffmann(WDFW), Eric Warner (MIT), and Tom Sibley (NMFS).

PROPOSED SCHEDULE FOR BROODSTOCK COLLECTION.

The following target numbers to be collected are based upon a large run size, assuming an average fecundity of 3,200, and a 1:1 male to female spawning ratio. The prediction for sockeye returns entering Lake Washington is low for 2008. It may not be possible to achieve the eggtake goal of 18.4 million sockeye eggs.

Weekly targets for gamete collection are based upon the average run timing curve, which is identical to the one provided in exhibit A of the Cedar River MOA. It is agreed that between- week adjustments to accommodate actual returns will be appropriate.

Week beginning	Percentage of eggs	Cumulative Number of Eggs	Cumulative Number of Adults	Weekly Adult Goal
Sept. 15	4.9%	901,600	564	564
Sept. 22	12.0%	2,208,000	1,380	817
Sept. 29	21.7%	3,992,800	2,496	1,116
Oct. 6	33.3%	6,127,200	3,830	1,334
Oct. 13	45.2%	8,316,800	5,198	1,369
Oct. 20	56.3%	10,359,200	6,475	1,277
27-Oct	66.4%	12,217,600	7,636	1,162
Nov. 3	75.4%	13,873,600	8,671	1,035
Nov. 10	83.4%	15,345,600	9,591	920

Nov. 17	90.0%	16,560,000	10,350	759
Nov. 24	95.5%	17,572,000	10,983	633
Dec. 1	100.0%	18,400,000	11,500	518

MONITORING

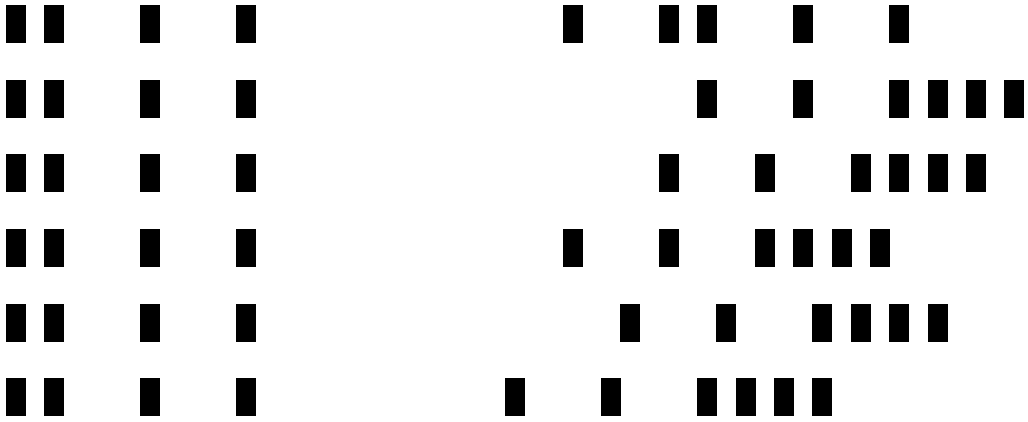
The following monitoring activities associated with the weir are to be conducted by hatchery personnel:

- Observe and enumerate Chinook and sockeye 25 m up and downstream of the weir (when possible) three times daily; it is recognized that at times of high flow or turbidity, accurate observation and enumeration may be compromised. The observation times are as follows: once between 7 AM and 9 AM, once between 11 AM and 1 PM, and once between 3 PM and 5 PM. For sockeye, total estimated numbers are to be recorded.
- Record the number and sex of Chinook that are collected in the fish trap and passed upstream; notice and record any tags or marks observed on the fish. Provide data to the co managers.
- Record the number and sex (where possible) of all other species passed upstream. All Atlantic salmon will be killed and sampled by WDFW staff.
- Count and flag any Chinook redd within 25 m of the weir.
- Chinook carcasses that float onto the weir will be retrieved (placed on the bank) as workload allows. Carcass sampling will be coordinated with Steve Foley.

Appendix 4, Summary of Thermal Mark Patterns

Cedar River Hatchery
Cedar River Sockeye Brood Year 2008
Summary of Thermal Mark Patterns

Eggtake Date	Incubation Vessel	Amount	Pattern Code	Pre-hatch	Post-hatch	Schematic
09/30/2008	S20	38,400	E4f	nww	wwwn	
10/06/2008	A1	144,000	E4f	nww	wwwn	
10/13/2008	A2	268,000	E4f	nww	wwwn	
10/16/2008	A3	182,000	E4f	nww	wwwn	
10/20/2008	A4	150,000	E4f	nww	wwwn	
10/20/2008	A5	121,000	E4f	nww	wwwn	
10/20/2008	A17	121,000	E4f	nww	wwwn	
10/22/2008	A6	211,000	M4f	nww	wnww	
10/27/2008	A7	157,000	M4f	nww	wnww	
10/27/2008	A8	133,000	M4f	nww	wnww	
10/27/2008	A18	133,000	M4f	nww	wnww	
10/29/2008	A9	163,000	M4f	nww	wnww	

11/03/2008	A10	230,000	M4f	nww	wnww	
11/03/2008	A11	230,000	L4f	nww	wwnnn	
11/07/2008	A12	297,000	L4f	nww	wwnnn	
11/12/2008	A14	201,000	L4f	nww	wwnnn	
11/17/2008	A15	144,000	L4f	nww	wwnnn	
11/20/2008	S19	54,000	L4f	nww	wwnnn	

Pattern Code Legend
E = early spawn
M = middle spawn
L = late spawn
4 = released below fry trap
f = fed fry