

**ANNUAL REPORT**

**2005 CEDAR RIVER SOCKEYE ENHANCEMENT PROJECT**

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2005 was a below average year for sockeye in the Lake Washington system, with only 74,000 adult sockeye recorded through the Ballard Locks by the Washington Department of Fish and Wildlife and the Muckleshoot Indian Tribe. Although sockeye are observed in most tributary streams in the Lake Washington system, the majority return to the Cedar River and Bear Creek systems. The Cedar River Sockeye Enhancement Project began in 1991, in an effort to increase the number of sockeye returning to the Cedar River, and to provide biologists a vehicle to study sockeye throughout their life history. The Landsburg Hatchery project is located at river mile 22 in the City of Seattle Cedar River Watershed, and is funded by Seattle Public Utilities. All sockeye fry that have been released from the project have received otolith chillmarks so they can be distinguished from their naturally produced counterparts throughout their life history. Sockeye produced from the hatchery provide biologists an excellent opportunity to study why the sockeye population in Lake Washington is so cyclical. Many different aspects of the sockeye life history are currently being analyzed with ongoing studies of the Lake Washington system.

Releases of unfed fry produced from the Cedar River Sockeye Enhancement Project have varied from a low of 2,079,100 from the first brood year in 1991 to a high of 17,209,000 for the 2000 brood year. Egg to fry survival rates from 86 to 94% have been experienced during the twelve years of hatchery operations at Landsburg. The egg to fry survival rate for the 2005 brood year was 87.7%, resulting in the release of 6,593,000 sockeye fry into the Cedar River. This report summarizes the activities of the 2005 collection and spawning season at the Cedar River Hatchery.

Construction of the Cedar River rack was completed on the afternoon of September 14, 2005. The rack was constructed at river mile 6.5, at a site referred to as Cavanaugh Ponds that is owned by the King County Parks Department. The rack was removed on November 7, 2005. The rack is a structure built on a framework of wood horses anchored with concrete ecology blocks, with a walkway consisting of 2" X 12" boards. Two 10' X 12' fish collection cages are placed in the current seams used by traveling fish. The rack consists of a series of welded 2' x 7' aluminum panels with picket sections spaced 1" apart. These picket sections can be removed during high flow periods so logs and other large debris can pass over the rack. During periods of normal flow small debris is raked and removed from the picket sections so water can flow uninterrupted. It was decided to utilize two 10' x 12' aluminum fish collection cages for the 2005 season because of the anticipated large return of sockeye back to the Cedar River. The collection cages consist of 1" round aluminum bars welded 1" apart. The trap entrances consists of a v-shaped funnel that culminates into a 6" slot. The front section of the cage is equipped with a gate that can be lifted so fish can pass volitionally, and to relieve water pressure during high flow intervals.

Due to concerns about Chinook passage through the weir, in 1999 the Cedar River Sockeye Technical Committee developed a set of fish collection and weir protocols. These protocols have been reviewed annually and were implemented again in 2005 to minimize and avoid delays to Chinook passage. Adult collection began on September 15, 2005, with the last sockeye collected on November 7, 2005. A total of 5,961 sockeye were trapped during this time frame. Out of these, a total of 2,567 females and 2,751 males were hauled to holding ponds at the Landsburg Hatchery. In addition, 643 sockeye, 79 Chinook, 28 Coho, and 16 trout were captured and passed manually upstream of the rack. These numbers do not include fish that passed volitionally through the rack when picket sections were pulled, or when high water prohibited fishing. Overall, The 2005 trapping season was characterized by higher than normal

precipitation, which began in early September just after weir installation. Several modest rain events brought periodic spikes in the river flow, which hampered the ability of weir operators to fish at certain times. On most nights, picket sections were removed, and unrestricted fish passage occurred.

2005 was the third year of fish passage operations at Landsburg Dam. Adult sockeye that were trapped at the facility were utilized for broodstock purposes, and transported downstream if not needed for broodstock. During the course of the season, Seattle Public Utilities staff transported 353 male sockeye and 180 female sockeye to the holding ponds at Landsburg.

Two hauling trucks, each equipped with an oxygen tank and airstones, were used to transport adults from the broodstock collection ponds to the hatchery at Landsburg. The fish in the collection cage were dipnetted in small groups, sorted by hand according to species and sex, and counted before loading onto the truck. All spawning at Landsburg is based on a 1:1 spawning ratio, and fish are hauled to the ponds in accordance to this ratio.

As in previous years, a very small percentage of females captured in the trap during the early portion of the run are ripe enough to spawn, and require a significant amount of maturation time in the holding ponds until ripe. Early run females, those that enter the trap prior to November, typically take between five and ten days of holding time before they are ripe enough to spawn. Later run females, those that enter the trap after the first of November, typically are much riper upon entering the trap, and require less maturation time, usually one to four days. Males tend to arrive at the trap riper than females, and require significantly less holding time in the ponds.

Adults are held at Landsburg in a series of four thirteen-foot diameter circular ponds that are fed with a combination of gravity fed and pumped pathogen free spring water. Female sockeye were held in separate ponds from the males. Fish were loaded into the ponds until the dissolved oxygen level reached a level between 5 and 6 parts per million.

The eggtake procedure begins by working all fish into one half of the pond with screen mesh crowders. The spawning crew is broken down into two groups of people: fish sorters and fish spawners. After the fish are crowded, two people begin sorting fish. Ripe fish were placed into a net pen for later dispatch and green fish were transferred to the empty side of the pond. After sorting, fish were dispatched in groups of 24, placed on a spawning rack, and covered with a 100 p.p.m. solution of iodophor. After sitting for 10 minutes, fish were wiped free of iodophor and other organics with a paper towel and spawned manually with a Zak knife. Eggs were collected in 16 oz. disposable plastic containers and milt was collected in 8 oz. disposable plastic containers. After collection gametes were placed into separate ice filled coolers for transportation to the fertilization area. After spawning all fish carcasses were returned to the Cedar River at several different locations.

All egg fertilization and disinfection takes place in an area isolated from both the spawning and incubation areas. Before arriving at the fertilization area, it is critical that all equipment such as coolers, raingear, waders and spawning gear be thoroughly disinfected with a 100 p.p.m. Iodophor solution. Ten containers of eggs are placed on the fertilization table, each of which is placed into a new 32 oz. disposable plastic bowl for the process. Milt from a different male is added to each bowl, followed by a teaspoon of pathogen free water. Each bowl has its own spoon to prevent cross contamination. After gently mixing the milt and water into eggs and letting it set for two minutes, milt from a second male is added to serve as a backup. After sitting for five minutes the eggs are flushed in a 100 p.p.m. iodophor solution to remove excess blood,

milt, and other organics. After flushing, the bowls are topped off with fresh iodophor solution, and the eggs are allowed to disinfect and water harden for one hour. This one-hour disinfection period is one of the most important steps taken to insure that no IHNV is transferred into the incubators. After the one-hour water hardening and disinfection process, the eggs were transferred to the respective incubators.

There is currently potential to incubate 18 million eggs at the Landsburg Hatchery. The incubation system consists of 53 Kitoi box incubators and 20 vertical incubators. A Kitoi box incubator is an upwelling style incubator. It is an aluminum box 4' long, 2' wide, and 2' high with two 1.5" intake lines that upwell water through a plate perforated with 3/32" holes staggered 1/2" apart. Water exits the box via a 2" outlet located at the top of the box. Water flows into the box are kept at 10 g.p.m. Each Kitoi box can incubate up to 300,000 eggs, although optimum loading is 240,000. The incubation trailer contains 20 vertical incubators that are each supplied with 4 g.p.m. Each stack can be loaded with up to 112,000 eggs. Each vertical stack and Kitoi box are compartmentalized and have an independent water supply line, to reduce the risk of disease transmission between egg lots.

For egg eyeing, fertilized eggs were poured directly into incubators with no substrate. Eggs were physically shocked at 700 temperature units, and picked using an electric egg picker. After picking and weighing, eggs were placed in their respective incubators along with substrate. Substrate for the vertical incubators was a three layer sheet of 3/4" plastic mesh, which was placed inside the tray. Kitoi substrate consisted of 2" black half-moon shaped plastic saddles. Kitoi boxes were filled with a 5" layer of saddles, then half the eggs were gently dispersed equally over the substrate. Another 5" layer of saddles was carefully added over the eggs, followed by the remaining eggs. After the eggs were put down, they were left alone until hatching. All incubators received daily formalin treatments until hatch-out to reduce the growth of fungus and disease.

The first egg-take for the 2005 brood occurred on September 22, and egg-take continued until December 9, 2005. A total of 2,451 females were spawned with 2,344 males. The 2,451 females produced a total of 7,513,600 eggs, which resulted in a fecundity of 3,065, the lowest fecundity ever observed in the broodstock collected in the Cedar River. After shocking, 573,800 non-viable eggs were picked off as loss, producing a green to eyed egg survival of 92.4%.

Despite rigorous disinfection protocols, 2005 proved to be the second year that IHNV was found in incubators at the Landsburg Hatchery. A total of 1 incubator was confirmed to contain the virus. This incubator was destroyed, resulting in the loss of 63,000 fry. The source of contamination was not confirmed, however 2002 was the first year of adult passage above the aqueduct crossing, and subsequently up to several thousand sockeye are observed spawning within close proximity to the hatchery annually. No IHNV was detected in incubators during the 2004 season, however, adults tested showed very low levels of the virus during the early and middle components of the eggtake. Average levels of IHNV were detected in adult sockeye during the 2005 brood year.

Because of the consistent spring water temperatures at Landsburg hatchery, egg and alevin development occurs consistently and predictably. Sockeye typically hatch-out at 1060 temperature units. At this time, the vertical tray screens and Kitoi outlet screens were brushed frequently to prevent clogging caused by eggs shells. The Kitoi incubators were also gently stirred and plunged to bring up eggshells and organics from the bottom of the incubator. Fish were ponded for release at an average of 1700 temperature units. Trays from the vertical stacks

were transferred manually to the acclimation ponds, where they were gently poured over a screen basket to capture egg and fry loss. Kitoi boxes are ponded by first flushing fry out of the outlet port into a screen bucket, then manually transferred into the acclimation ponds. After the majority of the fry are flushed from the Kitoi box, the substrate was removed manually with an aluminum scoop. The remaining fry are manually siphoned into a screen bucket and poured into the ponds.

The optimal ponding time for a given eggtake was based on temperature units, KD value and visual observation. The KD value is a length to weight equation that is used to gauge fry development and yolk absorption. Historical KD factors from naturally produced fry captured at the fry trap are used as a baseline for hatchery produced fry. When a group of fish was determined ready for release, they were ponded into four 6' diameter acclimation ponds filled with spring water. Acclimation time was a minimum of nine hours at the beginning of the release season, and increased up to twelve hours at the end of the season. All fry releases occurred at one hour after official sunset, because fry trap counts have shown that sockeye fry outmigrate almost exclusively at night. Fry were released at three different locations on the Cedar River: just above the river mouth at river mile .1, at the railroad trestle at river mile 13.5, and at the Landsburg Hatchery at river mile 22.

All sockeye eggs and fry are marked at Landsburg hatchery using a process called otolith chillmarking. The otolith, or "earbone" of the fish, is marked with a series of increments by exposing eggs and fry to scheduled bouts of water chilled to eight degrees Fahrenheit colder than ambient spring water for a period of twelve hours. By scheduling a series of these cold water events, a unique mark can be placed on all fish within a given incubation vessel. Because each incubation vessel receives a unique mark, all fish from a given vessel were released at the same time and location. The purpose for this is to determine differences in survival between fish released in different locations, under varying flow regimes, and at different times of the year. Because otolith marking is permanent, the process allows tracking of fish throughout their entire life history, and also gives biologists the ability to differentiate between naturally produced fish and hatchery fish.

Egg incubation started on September 22, 2005 and ended on April 12, 2006 with the last fry release. Overall egg to fry survival was 87.7%. Of the 6,593,000 fry released; 2,026,000 or 30.7%, were released below the fry trap at river mile .1; 2,464,000, or 37.4%, were released directly from the Landsburg Hatchery at river mile 22; and 2,103,000, or 31.9% were released from river mile 13.5.



Brood Year	Adults Collected for Hatchery				Hatchery Egg Take	Number of Hatchery Fish Released
	Males		Females			
	Taken	Spawned	Taken	Spawned		
1991	787	787	787	787	2,326,900	2,079,100
1992	937	937	1,123	937	3,251,448	3,067,404
1993	2,828	2,828	2,874	2,828	8,750,466	8,253,059
1994	2,254	2,201	2,494	2,411	7,656,794	7,182,522
1995	1,604	1,550	1,849	1,773	6,145,259	5,592,000
1996	4,634	4,441	4,956	4,752	15,674,000	14,204,000
1997	3,004	3,004	3,710	3,374	11,106,000	9,799,300
1998	2,625	2,625	3,393	3,296	10,466,500	9,636,000
1999	913	900	1,002	967	3,472,200	3,244,000
2000	5,035	4,921	5,785	5,376	18,554,000	17,209,000
2001	3,476	2,972	4,073	3,796	13,547,000	12,532,000
2002	5,413	5,142	5,810	5,330	18,095,000	15,957,000
2003	2,806	2,366	3,393	3,261	11,128,100	9,916,000
2004	5,324	4,458	5,370	5,092	16,682,000	15,255,000
2005	2,751	2,344	2,567	2,451	7,513,000	6,593,000
<b>Total</b>	<b>44,391</b>	<b>41,476</b>	<b>49,186</b>	<b>46,431</b>	<b>154,368,667</b>	<b>140,519,385</b>

**2005 CEDAR RIVER SOCKEYE EGGTAKE DATA**

EGGTAKE DATE	NUMBER OF FEMALES SPAWNED	ESTIMATED EGGTAKE	CUMULATIVE EGGTAKE	ACTUAL LIVE EGGS	ACTUAL DEAD EGGS	ACTUAL EGGTAKE
09/22/2005	58	185,000	185,000	167,000	13,000	180,000
09/28/2005	80	256,000	441,000	220,000	23,000	243,000
10/03/2005	129	412,000	853,000	380,000	23,000	403,000
10/05/2005	112	358,000	1,211,000	294,000	45,000	339,000
10/10/2005	163	521,000	1,732,000	425,000	54,000	479,000
10/12/2005	146	467,000	2,199,000	398,000	60,000	458,000
10/17/2005	238	761,000	2,960,000	695,000	58,000	753,000
10/19/2005	207	662,000	3,622,000	557,000	41,000	598,000
10/20/2005	226	723,000	4,345,000	681,000	62,000	743,000
10/24/2005	180	578,000	4,921,000	492,000	53,000	545,000
10/26/2005	186	595,000	5,516,000	532,000	26,000	558,000
10/31/2005	237	758,000	6,274,000	702,000	43,000	745,000
11/02/2005	161	515,000	6,789,000	448,000	33,000	481,000
11/07/2005	191	611,000	7,400,000	546,000	29,000	575,000
11/14/2005	67	214,000	7,614,000	207,000	4,000	211,000
11/22/2005	33	105,000	7,719,000	93,000	3,000	96,000
11/28/2005	22	70,000	7,789,000	63,000	3,000	66,000
12/05/2005	12	38,000	7,827,000	31,000	600	31,600
12/09/2005	3	9,000	7,836,000	8,800	200	9,000
<b>TOTAL</b>	<b>2451</b>			<b>6,939,800</b>	<b>573,800</b>	<b>7,513,600</b>

## 2005 Brood Cedar River Sockeye Fry Releases

Incubation Vessel	Release Date	Release Location (River Mile)	Number Released
S1, S2	02/06/2006	22	165,000
A1	02/14/2006	22	219,000
A2, S3	01/28/2006	22	347,000
A3, S4	02/01/2006	22	289,000
A8, A9, A10	02/22/2006	22	692,000
A4, A5, A6, A7	02/23/2006	13.5	819,000
A16, A17	02/27/2006	13.5	491,000
A18, A19, S-3	02/28/2006	22	542,000
A11, A12	03/02/2006	13.5	555,000
A15	03/05/2006	22	210,000
A13, A14	03/06/2006	13.5	238,000
A25, A26	03/13/2006	0.1	544,000
A20, A21, A22	03/16/2006	0.1	700,000
A23, A24	03/21/2006	0.1	446,000
A27	03/29/2006	0.1	206,000
S18, S19, S20	04/12/2006	0.1	130,000

TOTAL RELEASED 6,593,000

Total RM 22 Releases 2,464,000  
Total RM 13.5 Releases 2,103,000  
Total RM .1 Releases 2,026,000