ANNUAL REPORT

2003 CEDAR RIVER SOCKEYE ENHANCEMENT PROJECT

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Introduction

The Cedar River Sockeye Enhancement Project began in 1991, with the goals of increasing the number of *Oncorhynchus nerka* returning to the Cedar River and providing biologists with an opportunity to study factors affecting sockeye survival throughout their life history. The Landsburg Hatchery is located at river mile 22 in the City of Seattle Cedar River Watershed. Washington Department of Fish and Wildlife (WDFW) operates the hatchery with funding provided by Seattle Public Utilities. This project is a significant element of the Cedar River Habitat Conservation Plan and Landsburg Mitigation Agreement and is under the oversight of the City of Seattle and three agencies: WDFW, US Fish and Wildlife Service, National Oceanic & Atmospheric Administration (NOAA) Fisheries. The Cedar River Anadromous Fish Committee (AFC) monitors this project and makes recommendations as necessary regarding hatchery operations and program development.

This report fulfills an annual reporting requirement contained in the hatchery operating contract that covers the period of July 1, 1998 – December 31, 2004. It contains information about the adult return, egg collection, incubation survival and release of the brood year (BY) 2003 Cedar River sockeye. All fish released from this program have received otolith chillmarks so they can be distinguished from their naturally produced counterparts throughout their life history. Many different aspects of the sockeye life history are currently being analyzed with ongoing studies of the Lake Washington system. Natural fry production and numbers of hatchery-produced fry migrating past the fry trap in the lower Cedar River are reported in separate WDFW reports. Other reports and information about the sockeye program and its evaluation include the analysis of the operation of the broodstock collection weir on Chinook, Chinook redd survey reports, WDFW and Muckleshoot Indian Tribe (MIT) spawning survey information and others.

2003 Adult Return

2003 proved to be an average year for sockeye in the Lake Washington system. WDFW and MIT estimated 200,000 adult sockeye passed through the Ballard Locks into Lake Washington. Although sockeye are observed in most tributary streams in the Lake Washington system, the majority return to the Cedar River and Bear Creek systems.

Broodstock Collection

Broodstock for the hatchery is collected with a weir that consists of a rack, trap, and collection cages installed at river mile 6.5. The rack is a framework of wood horses anchored with concrete ecology blocks and a walkway consisting of 2"X 12" boards. The rack has a series of welded 2' x 7' aluminum panels with picket sections spaced 1" apart. The 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. The trap entrances consists of a v-shaped funnel that culminates into a 6" slot inside the collection cages. The collection cages are made of 1" round aluminum bars welded 1" apart. The cages are 10' X 12' and are placed on the upstream side of the rack in current seams used by travelling fish. The upstream section of each cage has a gate that can be lifted to pass fish volitionally upriver if needed, and to relieve water pressure during high flow intervals.

Due to concerns about Chinook passage through the weir, the Cedar River Sockeye Technical Committee first developed a set of fish collection and weir protocols in 1999. These protocols have been evaluated and used annually. In 2003, the protocols were modified by the AFC to better minimize and avoid potential delays to Chinook passage or shifts in spawning distribution.

The broodstock collection rack was installed on September 9, 2003 and adult sockeye were trapped between September 10, 2003 and November 17, 2003. The late summer and early fall period of 2003 was marked with very low precipitation and lower than average river flows. However, on October 21, 2003 a large storm dropped almost five inches of rain in one day, causing flows to rapidly increase which resulted in substantial damage to the weir. The weir could not be fully rebuilt after the high flows so a partial weir was used for the remainder of the season. The partial weir was not very effective in capturing additional sockeye broodstock. The partial weir was removed on November 12, 2003.

In 2003, 8,703 sockeye were trapped at the weir although a small portion were captured with gillnets when the weir was not fishing due to high flows. Out of these, 3,393 females and 2,806 males were hauled to holding ponds at the Landsburg Hatchery. In addition, 2,928 sockeye, 71 Chinook, 25 coho, and 40 trout were 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 prevented fishing.

In addition to sockeye from the weir, Seattle Public Utilities provided 461 males and 184 females from the fish passage facilities at the Landsburg Dam. This was the first year of fish passage operations at the Dam. The fish passage facilities contain a sorting facility to separate sockeye from other species and a fish transport truck for hauling sockeye. Sockeye are not passed above the dam due to water quality concerns so some of the adult sockeye were utilized for broodstock and others were transported and released downstream. Sockeye from Landsburg were later evaluated to determine origin and 35.7% of the sockeye used for broodstock were found to be of hatchery origin.

Adult holding and spawning

Sockeye in collection cages are dipnetted in small groups sorted by sex, counted, and loading into fish hauling trucks. The hauling trucks are equipped with oxygen tanks and airstones and are used to transport adults from the weir to the hatchery holding ponds at Landsburg. 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, only a very small percentage of females captured in the trap during the early portion of the run are ripe enough to spawn and most require a significant amount of maturation time in the holding ponds before they are ripe. Early run females 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 that enter the trap after November 1st 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 pathogen free spring water. Three of the ponds are gravity fed and one pond is fed

using a diesel generator powered pump. Female sockeye are held in separate ponds from the males. Loading densities for the ponds are determined by loading fish into the ponds until the dissolved oxygen level drops to between 5 and 6 parts per million (ppm).

The eggtake begins by separating the staff into two crews: fish sorters and fish spawners. The sorters work fish into one half of the pond with screen mesh crowders. Ripe fish are sorted into a net pen for later dispatch and green fish are transferred to the empty side of the pond. After sorting, fish are dispatched in groups of 24, placed on a spawning rack, and covered with a 100 ppm iodophor solution. After sitting for 10 minutes, the spawning crew wipes fish free of iodophor and other organics with a paper towel and the fish are spawned manually with a Zak knife. Eggs are collected in 16 oz. disposable plastic containers and milt is collected in 8 oz. disposable plastic containers. After collection, gametes (eggs and milt) are placed in separate ice-filled coolers for transportation to the fertilization area.

In 2003, the first eggtake occurred on September 22nd and eggtakes continued until December 2, 2003. A total of 3,261 females were spawned with 2,366 males. With the loss of the weir on October 21 less male sockeye were captured and the hatchery was unable to meet the 1:1 spawning ratio. After spawning all fish carcasses were returned to the Cedar River at several different locations.

Fertilization

All egg fertilization and disinfection take place in an area isolated from both the spawning and incubation areas. All equipment such as coolers, raingear, waders and spawning gear are thoroughly disinfected with a 100 ppm iodophor solution before arriving at the fertilization area. Ten containers of eggs are placed on the fertilization table, each of which are 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 in case the first male was infertile. After sitting for five minutes the eggs are flushed in a 100 ppm 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 infectious hematopoietic necrosis virus (IHNV) is transferred to the incubators. After the one-hour water hardening and disinfection process, the eggs are transferred to the respective incubators.

Incubation

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" diameter 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 normally 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. In particular, infectious hematopoietic necrosis (IHN) continues to be a threat to hatchery operations, especially now that fish passage improvements in the Cedar River allow sockeye to spawn near the hatchery.
For egg eyeing, fertilized eggs are 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 are placed in their respective incubators along with substrate. Substrate for the vertical incubators is a three layer sheet of 3/4" plastic mesh, which is placed inside the tray. Kitoi substrate consists of 2" black half-moon shaped plastic saddles. Kitoi boxes are filled with a 5" layer of saddles, and then half the eggs are gently dispersed equally over the substrate. Another 5" layer of saddles is carefully added over the eggs, followed by the remaining eggs. After the eggs are put down, they are left alone until hatching. All incubators received daily formalin treatments until hatchout to reduce the growth of fungus and disease

Because of the consistent spring water temperatures at the 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 are brushed frequently to prevent clogging caused by eggs shells. The Kitoi incubators are also gently stirred and plunged to bring up eggshells and organics from the bottom of the incubator. Fish are ponded for release at an average of 1700 temperature units. A temperature unit is the average water temperature for the day minus 32 (degrees Fahrenheit). Trays from the vertical stacks are transferred manually to the acclimation ponds, where they were gently poured over a screen basket to capture egg and fry loss. Kitoi substrate was removed manually with an aluminum scoop. The remaining fry are flushed into a screen bucket and poured manually over a screen collection basket into the release ponds.

In 2003, the 3,261 spawned females produced 11,128,100 eggs, which resulted in an average fecundity of 3,412 eggs per female. After shocking, 1,668,100 non-viable eggs were picked off as loss, producing a green to eyed egg survival of 94.0%. Egg incubation started on September 18, 2003 and ended on April 3, 2004 with the last fry release. Egg to fry survival was through incubation was 88%. The egg to fry survival was greater than expected do to the loss of a full Kitoi. No IHN virus was detected in incubators during the 2003 season, and adults tested showed unusually low levels of the virus during the early and middle components of the eggtake

Fry Release

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 have ranged from 86% to 94% during the last twelve years of hatchery operations at Landsburg.

The optimal release time for a given eggtake is based on temperature units, KD value and visual observation (swim up). The KD value is calculated by taking the cube root of the average weight of 100 fry, multiplying by 10 and dividing by the average length. The average KD value for fry naturally produced fry in the river is 1.82 (WDFW) and 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 is determined ready for release, they are ponded into four 6' diameter acclimation ponds filled with spring water.

Acclimation time is a minimum of nine hours at the beginning of the release season and is increased up to twelve hours at the end of the season. Acclimation allows fry to adjust from incubators to an open water environment. All fry releases occur one hour after official sunset because fry trap counts have shown that sockeye fry outmigrate almost exclusively at night.

All sockeye eggs and fry are marked at Landsburg hatchery using a process called otolith chillmarking. The otolith, or Aearbone@ 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 are 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 gives biologists the ability to differentiate between naturally produced fish and hatchery fish.

The final egg to fry survival rate for the 2003 brood year was 86.3%, resulting in the release of 9,916,000 sockeye fry into the Cedar River. Of the 9,916,000 fry released; 7,199,000 or 72.6%, were released below the fry trap at RM 0.1; and 2,717,000, or 27.4%, were released directly from the Landsburg Hatchery at RM 22.

The spring of 2004 was the third and final year of an experimental rearing study for sockeye fry. A series of four 3'X3'X16' fiberglass rearing raceways were utilized at the adult holding pond site for short term sockeye rearing. Four groups of fry were reared for periods of between 10 and 18 days to determine the effects of feeding on fry to adult survival. All fed groups received unique otolith banding patterns and were released with a control group of unfed fry. All reared fish were released at RM 0.1, just upriver from Lake Washington.

Appendix

Lake Washington Sockeye

2004 Landsburg Ladder Broodstock

Results of Otolith Examination (provided by WDFW Otolith Lab)

Item #	Vial number	Date of otolith removal	Sex	Total Length (mm)	Mark Status	Brood Year	Release	Otolith Age
1	H1	10/20/2003	F	640	1	1998	M2	5
2	H2	10/23/2003	M	690	1	1998	M3	5
3	H3	10/23/2003	M	650	1	1998	M1	5
4	H4	10/23/2003	M	580	1	1999	E3	4
5	H5	10/23/2003	M	710	1	1998	L3	5
6	H6	10/23/2003	M	670	1	1998	M3	4
7	H7	10/23/2003	M	700	0			4
8	H8	10/23/2003	M	660	1	1999	E3	4
9	H9	10/23/2003	M	520	1	2000	E1	4
10	H10	10/23/2003	M	620	0			4
11	H11	10/23/2003	M	600	1	1999	M2	4
12	H12	10/23/2003	M	640	1	1999	E2	4
13	H13	10/23/2003	F	580	0			5
14	H14	10/23/2003	F	550	999			
15	H15	10/23/2003	F	600	0			5
16	H16	10/23/2003	F	560	0			4
17	H17	10/23/2003	F	620	0			4
18	H18	10/24/2003	M	610	1	1999	M2	4
19	H19	10/24/2003	M	660	1	1998	M3	5
20	H20	10/24/2003	M	630	1	1998	M1	5
21	H21	10/26/2003	M	600	1	1999	M2	4
22	H22	10/26/2003	M	700	1	1998	M3	5
23	H23	10/26/2003	M	610	0			5
24	H24	10/26/2003	M	700	1	1998	L2	VAT
25	H25	10/26/2003	M	570	1	1998	M3	5
26	H26	10/26/2003	M	690	0			5
27	H27	10/26/2003	M	700	1	1998	L1	4
28	H28	10/26/2003	F	600	1	1998	L2	5
29	H29	10/26/2003	F	550	1	1998	L2	5
30	H30	10/26/2003	F	660	1	1998	L1	5
31	H31	10/26/2003	F	580	0			4
32	H32	10/26/2003	F	630	1	1998	L1	4
33	H33	10/26/2003	F	600	0			4
34	H34	10/26/2003	F	650	0			5
35	H35	10/26/2003	F	630	1	1998	L1	5
36	H36	10/26/2003	F	630	0			5
37	H37	10/26/2003	F	540	1	1998	M3	4
38	H38	10/26/2003	F	620	1	1998	E2	5
39	H39	10/26/2003	F	620	1	1998	M3	5
40	H40	10/26/2003	F	600	1	1998	M1	5

41	H41	10/26/2003	F	630	1	1998	M3	4
42	H42	10/26/2003	F	620	1	1998	M1	5
43	H43	10/26/2003	F	560	0			4
44	H44	10/26/2003	F	610	1	1998	L2	5
45	H45	10/26/2003	F	680	1	1998	M3	4
46	H46	10/26/2003	F	640	1	1998	M2	5
47	H47	10/26/2003	F	580	0			4
48	H48	10/26/2003	F	640	1	1998	M3	5
49	H49	10/26/2003	F	620	0			4
50	H50	10/26/2003	F	640	1	1998	L1	5
51	H51	10/29/2003	M	720	1	1998	E2	5
52	H52	10/29/2003	M	790	1	1998	L2	5
53	H53	10/29/2003	M	575	0			4
54	H54	10/29/2003	M	635	0			4
55	H55	10/29/2003	M	730	1	1998	M2	4
56	H56	10/29/2003	M	670	1	1998	M1	VAT
57	H57	10/29/2003	M	735	0			4
58	H58	10/29/2003	M	685	0			4
59	H59	10/30/2003	M	650	1	1998	L1	5
60	H60	10/30/2003	M	640	0			4
61	H61	10/30/2003	M	660	0			4
62	H62	10/30/2003	M	710	0			4
63	H63	10/30/2003	M	640	0			4
64	H64	10/30/2003	M	620	1	1998	L1	4
65	H65	10/30/2003	M	670	1	1998	L1	5
66	H66	10/30/2003	M	700	0			5
67	H67	10/30/2003	M	680	0			5
68	H68	10/30/2003	M	660	0			4
69	H69	10/30/2003	M	590	0			4
70	H70	10/30/2003	M	580	1	1998	M1	4
71	H71	10/30/2003	M	700	1	1998	L2	4
72	H72	10/30/2003	M	710	1	1998	E2	4
73	H73	10/30/2003	M	620	0			4
74	H74	10/30/2003	M	710	0			4
75	H75	10/30/2003	M	721	0			4
76	H76	10/30/2003	M	640	0			4
77	H77	10/30/2003	M	570	1	1999	E3	4
78	H78	10/30/2003	M	630	0			4
79	H79	10/30/2003	M	641	1	1998	M1	5
80	H80	10/30/2003	M	600	0			4
81	H81	10/30/2003	M	611	1	1998	L3	4
82	H82	10/30/2003	M	620	1	1998	M2	4
83	H83	10/30/2003	M	671	0			5
84	H84	10/30/2003	M	700	0			5
85	H85	10/30/2003	M	610	0			4
86	H86	10/30/2003	M	651	0			5
87	H87	10/30/2003	M	660	1	1998	M3	4
88	H88	10/30/2003	M	700	1	1998	M3	5
89	H89	10/30/2003	M	640	0			4

90	H90	10/26/2003	N/A	550	0			4
91	H91	12/2/2003	M	600	0			4
92	N/A	10/30/2003	M	610	0			
93	H92	10/30/2003	M	680	1	1998	M3	5
94	H93	10/30/2003	M	710	0			4
95	H94	10/30/2003	M	611	0			4
96	H95	10/30/2003	M	650	0			4
97	H96	11/3/2003	M	720	1	1998	L2	5
98	H97	11/3/2003	M	720	0			5
99	H98	11/3/2003	M	670	0			5
100	H99	12/2/2003	M	620	0			4
101	N/A	10/30/2003	M	690	999			
102	H100	11/3/2003	F	550	0			4
103	H101	10/26/2003	F	N/A	0			4
104	H102	11/3/2003	F	675	0			5
105	H103	11/3/2003	F	605	0			4
106	H104	11/3/2003	M	635	0			4
107	H105	11/3/2003	M	650	0			4
108	H106	11/3/2003	F	535	0			4
109	H107	11/3/2003	M	705	1	1998	L1	5
110	H108	11/3/2003	M	590	0			4
111	H109	11/3/2003	M	690	1	1998	L1	5
112	H110	11/3/2003	F	640	1	1998	E2	5
113	H111	11/3/2003	F	600	0			4
114	H112	11/3/2003	M	575	0			4
115	H113	11/3/2003	M	630	0			5
116	H114	11/3/2003	F	510	0			4
117	H115	11/3/2003	M	470	1	2000	L1	4
118	H116	11/3/2003	F	590	1	1998	L1	5
119	H117	11/3/2003	F	640	0			4
120	H118	11/3/2003	M	611	1	1998	L2	5
121	H119	11/3/2003	F	641	1	1998	L1	4
122	H120	11/3/2003	M	670	1	1998	M1	5
123	H121	11/10/2003	F	620	0			5
124	H122	11/3/2003	M	685	0			4
125	H123	11/3/2003	M	695	1	1998	M1	4
126	H124	12/2/2003	M	620	0			4
127	N/A	11/3/2003	M	630	999			
128	H125	11/3/2003	M	625	1	1998	L1	4
129	H126	11/3/2003	M	620	0			4
130	H127	11/3/2003	M	720	1	1998	L2	4
131	H128	11/3/2003	F	611	1	1998	L1	4
132	H129	11/3/2003	M	665	1	1999	M2	4
133	H130	11/3/2003	F	585	0			4
134	H131	11/3/2003	M	700	1	1998	M3	5
135	H132	11/10/2003	F	520	1	1999	M2	4
136	H133	11/3/2003	M	620	0			4
137	H134	11/3/2003	M	695	1	1998	L1	4
138	H135	11/3/2003	F	605	1	1998	L1	4

139	H136	11/3/2003	M	690	0			5
140	H137	11/3/2003	M	675	1	1998	M2	4
141	H138	11/3/2003	F	610	0			4
142	H139	11/3/2003	F	610	0			4
143	H140	11/3/2003	M	640	0			4
144	H141	11/3/2003	F	580	0			4
145	H142	11/3/2003	M	691	1	1998	M2	5
146	H143	11/3/2003	F	570	1	1999	M2	4
147	H144	11/3/2003	M	701	0			5
148	H145	11/3/2003	M	600	0			4
149	H146	11/3/2003	M	620	1	1999	M2	4
150	H147	11/3/2003	F	630	1	1998	M2	5
151	H148	11/3/2003	M	630	1	1998	E3	4
152	H149	11/3/2003	M	600	1	1998	M1	VAT
153	H150	11/3/2003	F	650	1	1998	L2	4
154	H151	11/3/2003	F	620	1	1998	L1	4
155	H152	11/3/2003	M	700	0			VAT
156	H153	11/3/2003	F	600	0			4
157	H154	11/3/2003	M	580	0			4
158	H155	11/3/2003	M	630	1	1998	M2	4
159	H156	11/3/2003	M	670	0			4
160	H157	11/3/2003	M	640	1	1998	L2	5
161	H158	11/3/2003	F	630	1	1998	L1	5
162	H159	11/3/2003	F	610	1	1998	L1	5
163	H160	11/3/2003	M	620	0			4
164	H161	11/3/2003	M	660	1	1998	M2	4
165	H162	11/3/2003	M	580	1	1999	M2	4
166	H163	11/3/2003	M	580	1	1999	M2	4
167	H164	12/2/2003	M	575	0			4
168	N/A	11/3/2003	M	680	999			
169	H165	12/02/200.	M	670	1	1998	L1	4
170	N/A	11/3/2003	F	520	999			
171	H166	11/3/2003	F	540	0			4
172	H167	11/3/2003	M	670	0			5
173	H168	11/3/2003	F	590	0			4
174	H169	11/3/2003	M	680	0			5
175	H170	11/3/2003	F	700	0			5
176	H171	11/3/2003	F	550	0			4
177	H172	11/3/2003	M	620	0			4
178	H173	11/3/2003	F	641	0			4
179	H174	11/3/2003	F	610	1	1998	L2	4
180	H175	11/3/2003	M	440	0			4
181	H176	11/6/2003	F	650	0			5
182	H177	11/6/2003	M	610	1	1998	M2	4
183	H178	11/6/2003	F	580	1	1998	M2	4
184	H179	12/2/2003	M	655	0			5
185	N/A	11/6/2003	M	610	999			
186	H180	11/6/2003	F	670	0			5
187	H181	11/6/2003	M	610	0			4

188	H182	11/6/2003	F	600	0			4
189	H183	11/6/2003	F	580	1	1998	M3	4
190	H184	11/6/2003	F	680	0			4
191	H185	12/2/2003	F	565	0			4
192	N/A	11/6/2003	F	591	999			
193	H186	11/6/2003	M	740	1	1998	E3	4
194	H187	11/6/2003	M	615	0			4
195	H188	11/6/2003	M	711	0			4
196	H189	11/6/2003	M	660	1	1998	M2	4
197	H190	11/6/2003	F	589	0			4
198	H191	11/6/2003	M	610	1	1998	L1	4
199	H192	11/6/2003	F	560	0			4
200	H193	11/6/2003	F	580	0			4
201	H194	11/6/2003	F	560	0			4
202	H195	11/6/2003	F	540	0			4
203	H196	11/6/2003	F	610	1	1998	M3	5
204	H197	11/6/2003	M	490	1	2000	L1	4
205	H198	11/6/2003	F	490	1	1999	M2	4
206	H199	11/6/2003	F	540	0			4
207	H200	11/6/2003	F	510	0			4
208	H201	11/6/2003	F	620	0			4
209	H202	11/6/2003	F	590	1	1998	L1	5
210	H203	11/6/2003	F	550	1	1999	E2	4
211	H204	11/6/2003	F	570	1	1998	M2	4
212	H205	11/6/2003	F	590	0			5
213	H206	11/6/2003	M	640	0			4
214	H207	11/6/2003	M	670	1	1998	L1	4
215	H208	11/6/2003	F	550	1	1998	M1	4
216	H209	11/6/2003	M	630	0			4
217	H210	11/6/2003	M	660	0			4
218	H211	11/6/2003	M	560	0			4
219	H212	11/6/2003	F	570	0			5
220	H213	12/2/2003	M	630	1	1998	L1	4
221	N/A	11/6/2003	F	590	999			
222	H214	11/6/2003	M	620	1	1998	M2	5
223	H215	11/6/2003	M	620	1	1998	L2	5
224	H216	11/6/2003	F	620	0			4
225	H217	11/6/2003	F	630	1	1998	M2	4
226	H218	11/6/2003	F	560	1	1998	M3	4
227	H219	11/6/2003	F	500	0			4
228	H220	11/6/2003	M	560	0			4
229	H221	11/6/2003	M	625	1	1998	M1	4
230	H222	11/6/2003	F	575	0			4
231	H223	11/6/2003	M	672	1	1998	M3	4
232	H224	11/6/2003	M	567	0			4
233	H225	11/6/2003	F	571	0			4
234	H226	11/6/2003	F	610	0			5
235	H227	12/2/2003	F	555	0			4
236	N/A	11/6/2003	M	578	999			

237	H228	11/6/2003	M	594	0			4
238	H229	11/6/2003	M	595	1	1999	E3	4
239	H230	11/6/2003	F	469	0			4
240	H231	11/6/2003	M	635	~~0~~			4
241	H232	11/6/2003	F	623	1	1998	M2	4
242	H233	11/6/2003	F	538	0			4
243	H234	11/6/2003	M	634	1	1998	L1	4
244	H235	11/6/2003	M	626	0			4
245	H236	11/6/2003	M	611	1	1998	L1	4
246	H237	11/6/2003	M	620	0			4
247	H238	11/6/2003	M	619	1	1998	L1	5
248	H239	11/6/2003	M	605	1	1999	M2	4
249	H240	11/6/2003	M	642	0			5
250	H241	11/6/2003	M	656	1	1998	E2	4
251	H242	11/6/2003	M	585	0			4
252	H243	11/6/2003	M	615	0			4
253	H244	11/6/2003	F	600	1	1998	L1	4
254	H245	11/6/2003	M	600	1	1998	M3	4
255	H246	11/6/2003	M	678	0			4
256	H247	11/6/2003	M	565	0			4
257	H248	11/6/2003	M	645	0			5
258	H249	11/6/2003	M	605	0			4
259	H250	11/6/2003	M	630	0			4
260	H251	11/6/2003	M	650	0			4
261	H252	11/6/2003	M	620	1	1999	E2	4
262	H253	11/6/2003	M	462	0			4
263	H254	11/6/2003	M	555	1	1999	M2	4
264	H255	11/6/2003	M	600	1	1998	L2	4
265	H256	11/6/2003	F	635	1	1998	L1	4
266	H257	11/6/2003	M	440	0			4
267	H258	11/6/2003	M	545	1	1998	E2	4
268	H259	11/6/2003	M	645	0			5
269	H260	11/6/2003	M	555	0			4
270	H261	11/6/2003	M	618	1	1998	L1	4
271	H262	11/6/2003	M	596	0			4
272	H263	11/6/2003	M	615	0			4
273	H264	11/6/2003	M	595	0			4
274	H265	11/6/2003	M	605	0			4
275	H266	11/6/2003	M	670	0			4
276	H267	11/6/2003	M	665	0			4
277	H268	11/6/2003	M	675	1	1998	L1	5
278	H269	11/6/2003	M	665	1	1998	M3	5
279	H270	11/10/2003	F	618	0			5
280	H271	11/10/2003	F	638	0			4
281	H272	11/10/2003	F	600	1	1998	L1	5
282	H273	11/10/2003	F	590	1	1998	L3	4
283	H274	11/10/2003	F	511	0			4
284	H275	11/10/2003	F	555	0			4
285	H276	12/2/2003	M	665	0			4

286	H277	11/10/2003	M	700	0			5
287	N/A	11/10/2003	F	600	999			
288	H278	11/10/2003	F	555	0			4
289	H279	11/10/2003	F	565	0			4
290	H280	11/10/2003	F	557	0			4
291	H281	11/10/2003	F	629	0			5
292	H282	11/10/2003	F	618	1	1998	L1	5
293	H283	11/10/2003	M	620	999			4
294	H284	11/10/2003	M	580	0			4
295	H285	11/10/2003	M	508	0			4
296	H286	11/10/2003	M	580	1	1998	M1	4
297	H287	11/10/2003	F	610	1	1998	L2	4
298	H288	11/10/2003	F	571	0			4
299	H289	11/10/2003	M	620	1	1998	L1	4
300	H290	11/10/2003	F	590	0			5
301	H291	11/10/2003	F	640	0			5
302	H292	11/10/2003	F	600	1	1998	E2	5
303	H293	11/10/2003	F	540	0			4
304	H294	11/10/2003	M	640	0			4
305	H295	11/10/2003	M	541	0			4
306	H296	11/10/2003	M	610	0			4
307	H297	11/10/2003	M	540	999		frag	4
308	H298	11/10/2003	F	531	0			4
309	H299	11/10/2003	M	621	0			5
310	H300	11/10/2003	M	615	1	1998	L1	4
311	H301	11/10/2003	M	630	1	1998	M3	4
312	H302	11/10/2003	M	615	0			4
313	H303	11/10/2003	F	510	1	1999	E3	4
314	H304	11/10/2003	M	635	1	1998	M3	4
315	H305	11/10/2003	F	575	0			4
316	H306	11/10/2003	M	630	1	1998	M2	5
317	H307	11/10/2003	M	580	0			4
318	H308	11/10/2003	M	645	0			4
319	H309	11/13/2003	F	600	1	1998	L1	4
320	H310	11/13/2003	F	670	0			4
321	H311	11/13/2003	F	610	0			4
322	H312	11/13/2003	F	575	0			4
323	H313	11/13/2003	F	621	1	1998	L1	4
324	H314	11/13/2003	F	640	0			4
325	H315	11/13/2003	F	630	0			4
326	H316	11/13/2003	F	580	0			4
327	H317	11/13/2003	F	580	0			4
328	H318	11/13/2003	F	610	1	1998	L1	5
329	H319	11/13/2003	F	600	0			4
330	H320	12/2/2003	M	650	1	1998	L1	4
331	N/A	11/13/2003	F	625	~~0~~			
332	H321	11/13/2003	F	590	0			4
333	H322	11/13/2003	F	620	0			4
334	H323	11/13/2003	F	618	1	1998	L2	5

335	H324	11/13/2003	F	553	0			4
336	H325	11/13/2003	F	N/A	0			4
337	H326	11/13/2003	M	683	1	1998	L2	4
338	H327	11/13/2003	F	565	0			4
339	H328	11/13/2003	F	552	0			4
340	H329	11/13/2003	M	598	0			4
341	H330	11/13/2003	M	635	0			4
342	H331	11/13/2003	M	634	0			4
343	H332	11/13/2003	M	623	0			4
344	H333	11/13/2003	M	685	0			5
345	H334	11/13/2003	M	586	0			4
346	H335	11/13/2003	M	655	1	1998	M3	4
347	H336	11/13/2003	M	530	0			4
348	H337	11/13/2003	M	645	0			5
349	H338	11/13/2003	M	612	0			4
350	H339	11/13/2003	M	695	1	1998	L1	4
351	H340	11/13/2003	M	679	0			4
352	H341	11/13/2003	M	703	0			5
353	H342	11/13/2003	M	640	0			5
354	H343	11/13/2003	M	668	1	1998	L1	4
355	H344	11/13/2003	M	658	1	1998	L1	4
356	H345	11/13/2003	M	543	0			4
357	H346	11/13/2003	M	635	0			5
358	H347	11/13/2003	M	635	1	1998	L2	5
359	H348	11/13/2003	M	538	0			4
360	H349	11/13/2003	M	630	0			4
361	H350	11/13/2003	M	590	0			5
362	H351	11/13/2003	M	658	0			5
363	H352	11/13/2003	M	618	0			4
364	H353	11/13/2003	M	650	1	1998	M3	4
365	H354	11/13/2003	M	655	1	1998	L1	4
366	H355	11/13/2003	M	495	0			4
367	H356	11/17/2003	M	610	0			4
368	H357	11/17/2003	M	606	0			4
369	H358	11/17/2003	M	618	0			4
370	H359	11/17/2003	M	638	1	1998	M2	4
371	H360	11/17/2003	M	628	1	1998	L2	4
372	H361	11/17/2003	M	619	0			4
373	H362	11/17/2003	M	655	0			5
374	H363	11/17/2003	M	600	1	1998	L2	4
375	H364	11/17/2003	M	600	0			4
376	H365	11/17/2003	M	629	0			4
377	H366	11/17/2003	M	627	0			4
378	H367	11/17/2003	M	530	0			4
379	H368	11/17/2003	M	660	0			4
380	H369	11/17/2003	M	655	0			4
381	H370	11/17/2003	M	598	0			4
382	H371	11/17/2003	M	592	0			4
383	H372	11/17/2003	M	637	0			4

384	H373	11/17/2003	M	575	0			4
385	H374	11/17/2003	M	598	0			4
386	H375	11/17/2003	M	643	1	1998	L1	4
387	H376	11/17/2003	M	672	1	1998	L1	5
388	H377	11/17/2003	M	575	1	1999	M2	4
389	H378	11/17/2003	M	628	0			5
390	H379	11/17/2003	M	580	0			5
391	H380	11/17/2003	M	645	0			4
392	H381	11/17/2003	F	590	0			4
393	H382	11/17/2003	M	680	0			4
394	H383	11/17/2003	F	630	0			4
395	H384	11/17/2003	F	580	0			4
396	H385	11/17/2003	F	555	0			4
397	H386	11/17/2003	F	615	0			4
398	H387	11/17/2003	F	560	0			4
399	H388	11/17/2003	F	645	0			4
400	H389	11/17/2003	F	605	0			4
401	H390	11/17/2003	F	540	0			4
402	H391	11/17/2003	F	655	0			5
403	H392	11/17/2003	F	650	0			5
404	H393	11/17/2003	F	665	0			5
405	H394	11/17/2003	F	610	0			4
406	H395	11/17/2003	F	630	0			4
407	H396	11/17/2003	F	630	0			5
408	H397	11/24/2003	M	618	1	1998	L1	5
409	H398	11/24/2003	M	608	1	1998	L1	5
410	H399	11/24/2003	M	618	0			5
411	H400	11/24/2003	M	677	0			4
412	H401	11/24/2003	M	618	0			4
413	H402	12/2/2003	M	710	0			4
414	N/A	11/24/2003	M	461	999			
415	H403	11/24/2003	M	628	1	1998	L1	4
416	H404	11/24/2003	M	662	0			4
417	H405	11/24/2003	M	560	0			4
418	H406	11/24/2003	M	558	0			4
419	H407	11/24/2003	M	639	1	1998	L1	5
420	H408	12/2/2003	M	615	0			4
421	N/A	11/24/2003	M	635	999			
422	H409	11/24/2003	M	623	1	1998	L2	4
423	H410	11/24/2003	M	668	1	1998	L2	5
424	H411	11/24/2003	M	648	0			4
425	H412	11/24/2003	M	668	0			4
426	H413	11/24/2003	M	628	1	1998	L1	5
427	H414	11/24/2003	M	892	0			5
428	H415	11/24/2003	M	665	0			4
429	H416	11/24/2003	M	568	0			4
430	H417	11/24/2003	M	595	0			4
431	H418	11/24/2003	M	565	0			4
432	H419	11/24/2003	M	650	0			4

433	H420	11/24/2003	M	660	0			4
434	H421	11/24/2003	M	422	0			4
435	H422	11/24/2003	M	620	0			4
436	H423	11/24/2003	M	650	0			4
437	H424	11/24/2003	M	595	0			4
438	H425	11/24/2003	M	630	0			4
439	H426	11/24/2003	M	620	0			4
440	H427	11/24/2003	M	645	0			4
441	H428	11/24/2003	F	600	0			4
442	H429	11/24/2003	F	560	0			4
443	H430	11/24/2003	F	555	0			4
444	H431	11/24/2003	M	600	1	1998	L2	4
445	H432	11/24/2003	M	615	1	1998	L1	4
446	H433	11/24/2003	M	655	0			4
447	H434	11/24/2003	F	610	0			5
448	H435	11/24/2003	M	580	0			4
449	H436	11/24/2003	F	635	0			4
450	H437	11/24/2003	F	605	1	1998	L2	5
451	H438	11/24/2003	F	530	0			4
452	H439	11/24/2003	F	490	0			4
453	H440	11/24/2003	F	540	0			4
454	H441	11/24/2003	F	560	0			4
455	H442	11/24/2003	M	615	0			4
456	H443	11/24/2003	F	550	0			4
457	H444	11/24/2003	F	570	0			4
458	H445	11/24/2003	F	540	0			4
459	H446	11/24/2003	M	595	0			4
460	H447	11/24/2003	M	660	1	1998	L2	5
461	H448	11/24/2003	M	655	0			5
462	H449	11/24/2003	F	620	1	1998	M3	5
463	H450	11/24/2003	F	620	1	1998	M2	4
464	H451	11/24/2003	F	560	0			4
465	H452	12/2/2003	M	625	0			4
466	H453	12/2/2003	M	620	0			4
467	H454	12/2/2003	M	610	1	1998	M3	4
468	H455	12/2/2003	F	555	0			4
469	H456	12/2/2003	M	680	0			4
470	H457	12/2/2003	F	550	0			4
471	H458	12/2/2003	M	650	0			4
472	H459	12/2/2003	M	605	0			4

Lake Washington Sockeye
2004 Landsburg Ladder Broodstock
Summary of Otolith Examination (provided by WDFW Otolith Lab)

	Amount Recovered	Proportion Recovered
Otolith mark present	170	0.360
Otolith mark absent	287	0.608
No data	15	0.032
Total	472	1.000