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# 2005 Annual Report of Winter Chinook Propagation Activities

A U.S. Fish & Wildlife Service Report

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## INTRODUCTION

Due to severe declines in adult returns, the National Marine Fisheries Service listed Sacramento River winter Chinook salmon as threatened under the emergency listing procedures for the Endangered Species Act (16 U.S.C.R. 1531-1543) on August 4, 1989 (54 Federal Register 32085). Winter Chinook were formally added to the list of federally threatened species by final rule on November 5, 1990 (55 Federal Register 46515). Despite early efforts to restore the population, adult returns of winter Chinook continued to decline. In January 1994, the National Marine Fisheries Service reclassified winter Chinook salmon as endangered.

To supplement natural production and reduce the risk of extinction, the U.S. Fish and Wildlife Service (Service) developed an artificial propagation program for winter Chinook salmon in 1989. The program was located at Coleman National Fish Hatchery (NFH), on Battle Creek, a tributary of the Sacramento River. However, fish reared at Coleman NFH tended to return to Battle Creek rather than the Sacramento River as desired. To alleviate this problem, a new hatchery facility, Livingston Stone National Fish Hatchery (NFH), was established in 1998 along the Sacramento River at the base of Shasta Dam. To ensure that the hatchery program spawned only winter Chinook, the Service implemented a genetic-based screening process to identify winter Chinook salmon.

In addition to the hatchery supplementation program, an experimental captive broodstock program was cooperatively developed in 1991 with Bodega Marine Lab (BML) and partner agencies of the winter Chinook captive brood stock technical committee. The winter Chinook captive broodstock program is sustained by rearing a small number of hatchery-origin juveniles to maturity at Livingston Stone NFH or the BML. The primary objective of the winter Chinook captive broodstock program is to determine if a captive brood program could be used to prevent extinction of the run by ensuring a source of gametes for the supplementation program in the event that run sizes continue to decline and too few fish are available for hatchery broodstock (in 1991 the winter Chinook run estimate was less than 200 individuals). The year 2005 marks the fifth year of juvenile releases for a study to evaluate the efficacy of fish produced from the captive-brood program to produce returning adults (USFWS 2003).

## METHODS

### **Broodstock**

#### *Collection*

Before collection of winter Chinook broodstock began in 2005, the Service developed a broodstock collection plan that defined brood fish collection targets spread throughout the run. The broodstock collection guidelines for winter Chinook allow capture of up to 15% of the run size, up to a maximum of 120 fish. A run size of 800 or greater, would allow for 120 fish to be retained as brood stock. In 2005, the pre-season run estimate was much greater than 800; therefore, up to 120 adult winter Chinook salmon could be collected. The timing of broodstock collection was scheduled to mimic the historic migration timing past the Red Bluff Diversion

Dam as follows: 1.8% (2 fish) in December, 5.1% (6 fish) in January, 9.6% (12 fish) in February, 36.0% (43 fish) in March, 28.6% (34 fish) in April, 8.9% (11 fish) in May, 6.8% (8 fish) in June, and 3.4% (4 fish) in July. Deviation from the broodstock collection plan can occur due to limitations of the available traps to function during the entire run, under all flow conditions, and other factors. The Keswick trap is operational only when discharge from Keswick dam is less than 32,000 cubic feet per second. As such, trap operation is affected by reservoir management. The Keswick Dam fish trap was the only trap used to collect winter Chinook broodstock in 2005 and was operated by Service personnel. The alternate trap located at the Red Bluff Diversion Dam was not used in 2005 because sufficient numbers of broodstock were collected at the Keswick Dam trap.

### *Handling and Transportation*

Once trapped in the Keswick Dam fish trap, the fish remained in water at all times. From the trap they swam into a 1,000 gallon bail-lift from which they were transferred directly into an aerated and insulated 1,200 or 1,600-gallon transport tank and driven a short distance to Livingston Stone NFH. At Livingston Stone NFH the fish were anaesthetized with CO<sub>2</sub> while still in the transport tank, after which they were handled and a preliminary run assignment was made (i.e., winter-run or non-winter-run) based on phenotypic characteristics (e.g., color, degree of ripeness, fish size, amount of fungus, and collection date). All fish received a floy tag below the dorsal fin, and a small piece of fin tissue was taken for genetic analysis. Fish classified as non-winter-run were transported back to the Sacramento River the same day they were removed from the trap, or were transported to Coleman NFH for use in the late-fall Chinook broodstock program. Fish classified as phenotypically winter-run were quarantined in a 20-foot circular tank pending genetic confirmation of their run type. Fish genetically confirmed as winter-run were transferred into a 20-foot circular adult holding tank until spawned. Those identified as non-winter-run were returned to the Sacramento River.

### *Run Identification*

A genetic-based run assignment was used to classify fish as either winter-run or non-winter-run Chinook (University of California, Davis - Bodega Marine Laboratory 2001). Analyses were conducted at the Service's Abernathy Fish Technology Center. Tissue samples were analyzed at a suite of microsatellite markers selected for their diagnostic power in distinguishing winter Chinook from other Chinook salmon populations (University of California – Davis Bodega Marine Laboratory 2001). Following the methods described by Banks et al. (1999) and Greig and Banks (1999), extracted DNA from samples was amplified by polymerase chain reaction, analyzed, and overall genotypes converted to GENPOPOP format. Duplicate samples were run to confirm genotypes. A log-of-the-odds (LOD) score was generated using the computer software WHICHRUN (Banks and Eichert 2000) and used to assign individual Chinook as either winter-run or non-winter-run. A LOD score of two or greater, based on seven loci, was used to determine which fish would be retained as broodstock. Run-assignments for individual fish were transmitted back to Livingston Stone NFH usually within 24 hours of receipt of the tissue sample by the Abernathy Fish Technology Center.

## Health

Various therapeutic and prophylactic treatments were used on winter Chinook salmon broodstock to increase survival of adults and reduce risks of disease transmission to offspring (Table 1). Additionally, effects of stress on broodstock were reduced with salt, Poly Aqua, and anesthetics. Hatchery personnel and staff from the California-Nevada Fish Health Center closely monitored fish health. Broodstock were treated with malachite green to prevent fungal infections and erythromycin injections (target dosage of 20 mg/kg) were used to prevent transmission of *Renibacterium salmoninarum* to the progeny. No chemical treatments were administered to fish while held in quarantine and fish returned to the river were not subjected to chemical treatments. California-Nevada Fish Health Center personnel tested for the presence of pathogens in the broodstock.

Table 1. Drugs and treatments that may be applied to maintain the health of winter Chinook salmon held at Livingston Stone National Fish Hatchery.

Drug/Treatment	Dosage	Administered by	Use
Erythromycin	20 mg/kg	dorsal sinus injection	antibacterial
Iodophor	75 ppm	bath	antibacterial
Liquamycin	20 mg/kg	Intraperitoneal injection	antibacterial
Malachite green	1 ppm	bath	antifungal
Formalin	167 ppm	flow through	antifungal
MS-222		bath	anesthetic
Poly Aqua	1 qt/1,200 gallons	bath/flow through	stress reducer
Salt		bath/flow through	stress reducer
Chloramine-T	15 ppm	bath	antibacterial

## Spawning

Winter Chinook held as broodstock were examined twice weekly to assess their state of sexual maturity. Fish were crowded into a pie-shaped containment area using a hinged crowder consisting of two solid vinyl-covered screens. Tricane methanesulfonate (MS-222) was added to anaesthetize the fish so they could be examined for maturity and overall fish health.

Luteinizing Hormone-Releasing Hormone analogue (LH-RH<sub>a</sub>) implants were administered to accelerate final gamete maturation in fish that had already undergone gametogenesis and to synchronize maturation of broodstock (Tables 2 and 3). The LH-RH<sub>a</sub> implants release 30% of their content in the first three days after injection and the remaining hormone over a 20-day period to sustain an effective concentration within the fish. The implant dosage was 150 or 250 µg (supplied by Syndel International Inc.). Implants were injected into the dorsal muscle lateral and anterior to the dorsal fin with the use of a Ralgro pellet injector. Thirty-nine females and 10 males received LH-RH<sub>a</sub> injections.

When a female salmon was identified as being sexually mature, it was euthanized, removed from the tank, and rinsed in fresh water to remove any remaining MS-222. Each female was assigned

a number and each male was assigned a letter. The caudal artery of the female was severed so that blood would not mix into the eggs. Eggs were removed by making an incision from the vent to the pectoral fin and separated into two approximately equal groups. Each group was fertilized with semen from a different male, forming two half-sibling family groups. For example, when female 1 was spawned with males A and B, “family groups” 1A and 1B were created. After mixing semen and eggs, tris-glycine buffer was added to extend sperm life and motility. Spawned males were either returned to the holding tank for additional spawning or euthanized. Males were spawned a maximum of four times. When possible, each fish captured from the Sacramento River was spawned with at least two others. Captive-origin females were only spawned with natural-origin males.



Table 2. Spawning and drug treatment history of individual female Chinook salmon held at Livingston Stone National Fish Hatchery, 2005.

Tag Number	Date Captured	Trap Location	Fork Length (mm)	Weight (lb)	Date Spawmed	Date Died	Days in Captivity	Erythromycin		Liquamycin		LH-RHa		No. of Malachite Green Treatments
								Dose (ml)	Injections	Dose (ml)	Injections	Dose (ml)	Injections	
Y-038	1/11/05	Keswick	780	14.1	4/27/05	4/27/05	105	0.65	1	n/a <sup>a</sup>	0	250	2	36
Y-007	1/11/05	Keswick	776	13.5	5/23/05	5/23/05	131	0.65	2	n/a	0	250	1	43
Y-199	2/8/05	Keswick	797	15.6	6/13/05	6/13/05	124	0.75	2	n/a	0	250	1	41
Y-228	2/8/05	Keswick	875	20.62	6/13/05	6/13/05	124	0.9	2	n/a	0	250	1	41
Y-229	2/8/05	Keswick	838	19.48	7/5/05	7/5/05	146	0.9	2	n/a	0	250	1	47
Y-291	2/15/05	Keswick	740	13.1	PSM <sup>b</sup>	3/24/05	36	n/a	0	n/a	0	n/a	0	13
Y-277	2/15/05	Keswick	746	11.3	PSM <sup>b</sup>	5/7/05	80	n/a	0	1	1	250	1	30
Y-283	2/15/05	Keswick	808	15.4	5/26/05	5/26/05	99	0.65	2	n/a	0	250	1	34
Y-276	2/15/05	Keswick	771	13.1	6/9/05	6/9/05	113	0.65	2	n/a	0	n/a	0	39
Y-280	2/15/05	Keswick	833	17.06	6/9/05	6/9/05	113	0.9	2	n/a	0	250	1	39
Y-320	2/22/05	Keswick	768	13.4	5/16/05	5/16/05	82	0.65	2	n/a	0	150	1	28
Y-336	2/22/05	Keswick	761	13.92	6/16/05	6/16/05	113	0.65	2	n/a	0	150	1	37
Y-369	3/1/05	Keswick	778	12.66	PSM <sup>b</sup>	5/7/05	66	0.65	1	n/a	0	150	1	24
Y-361	3/1/05	Keswick	660	8.58	4/27/05	4/27/05	56	0.5	1	n/a	0	150	1	23
Y-370	3/1/05	Keswick	725	10.84	5/10/05	5/10/05	69	0.5	1	n/a	0	250	1	25
Y-368	3/1/05	Keswick	780	14	5/23/05	5/23/05	82	0.65	2	n/a	0	250	1	28
Y-366	3/1/05	Keswick	763	13.68	6/16/05	6/16/05	106	0.65	2	n/a	0	n/a	0	35
Y-378	3/1/05	Keswick	858	20.32	6/16/05	6/16/05	106	0.9	2	n/a	0	n/a	0	35
Y-363	3/1/05	Keswick	750	13.3	6/30/05	6/30/05	120	0.65	2	n/a	0	250	1	38
Y-362	3/1/05	Keswick	755	12.52	6/30/05	6/30/05	120	0.65	2	n/a	0	250	1	38
Y-397	3/8/05	Keswick	767	12.1	6/20/05	6/20/05	103	0.65	2	n/a	0	n/a	0	34
Y-407	3/15/05	Keswick	810	16.52	5/23/05	5/23/05	68	0.75	2	0.75	1	250	1	23
Y-414	3/15/05	Keswick	819	16.1	7/5/05	7/5/05	111	0.75	2	n/a	0	250	1	35
Y-455	3/22/05	Keswick	840	21.04	PSM <sup>b</sup>	4/19/05	27	n/a	0	n/a	0	250	1	9
Y-427	3/22/05	Keswick	875	20.3	PSM <sup>b</sup>	4/21/05	29	1	1	1	1	250	1	10
Y-462	3/22/05	Keswick	760	13.3	5/23/05	5/23/05	61	0.65	2	n/a	0	150	1	20
Y-461	3/22/05	Keswick	763	12.8	6/9/05	6/9/05	78	0.65	2	n/a	0	150	2	25
Y-460	3/22/05	Keswick	750	14.02	7/5/05	7/5/05	104	0.65	2	n/a	0	n/a	0	31
Y-493	4/5/05	Keswick	696	10.24	6/9/05	6/9/05	64	0.5	2	n/a	0	150	1	20

Table 2 (cont.)

Tag Number	Date Captured	Trap Location	Fork Length (mm)	Weight (lb)	Date Spawned	Date Died	Days in Captivity	Erythromycin		Liquamycin		LH-RHa		No. of Malachite Green Treatments
								Dose (ml)	Injections	Dose (ml)	Injections	Dose (ml)	Injections	
OR-006	4/12/05	Keswick	815	18.18	5/31/05	5/31/05	48	0.9	2	n/a	0	250	1	16
OR-008	4/12/05	Keswick	770	14.2	6/13/05	6/13/05	61	0.65	2	n/a	0	250	1	19
OR-007	4/12/05	Keswick	808	15.7	6/16/05	6/16/05	64	0.75	2	n/a	0	150	1	20
OR-042	4/26/05	Keswick	830	15	4/28/05	4/28/05	1	n/a	0	n/a	0	n/a	0	0
OR-057	4/26/05	Keswick	790	17.2	5/5/05	5/5/05	8	n/a	0	n/a	0	250	1	2
OR-033	4/26/05	Keswick	868	20.3	5/10/05	5/10/05	13	n/a	0	n/a	0	250	1	4
OR-063	4/26/05	Keswick	837	20.3	5/10/05	5/10/05	13	n/a	0	n/a	0	250	1	4
OR-049	4/26/05	Keswick	858	20.5	5/16/05	5/16/05	19	n/a	0	n/a	0	250	1	5
OR-044	4/26/05	Keswick	798	18.4	5/19/05	5/19/05	22	n/a	0	n/a	0	250	1	6
OR-050	4/26/05	Keswick	806	18.3	5/25/05	5/25/05	28	0.75	2	n/a	0	250	2	8
OR-039	4/26/05	Keswick	810	19.8	6/6/05	6/6/05	40	0.9	1	n/a	0	250	1	11
OR-059	4/26/05	Keswick	818	19.5	6/6/05	6/6/05	40	0.9	2	n/a	0	250	1	11
OR-061	4/26/05	Keswick	820	18.9	6/9/05	6/9/05	43	0.9	2	n/a	0	250	1	12
OR-048	4/26/05	Keswick	806	16.9	6/13/05	6/13/05	47	0.75	2	n/a	0	250	1	13
OR-040	4/26/05	Keswick	736	13.9	6/20/05	6/20/05	54	0.65	2	n/a	0	n/a	0	15
OR-119	5/10/05	Keswick	781	13.3	5/26/05	5/26/05	15	0.65	1	n/a	0	150	1	4
OR-120	5/10/05	Keswick	727	11.1	6/16/05	6/16/05	36	0.5	2	n/a	0	150	1	10
OR-106	5/10/05	Keswick	775	13.3	6/27/05	6/27/05	47	0.65	2	n/a	0	n/a	0	13
OR-176	6/14/05	Keswick	810	14.3	6/16/05	6/16/05	1	n/a	0	n/a	0	n/a	0	0
OR-183	6/14/05	Keswick	890	16.4	6/16/05	6/16/05	1	n/a	0	n/a	0	n/a	0	0
OR-173	6/14/05	Keswick	780	11.8	6/16/05	6/16/05	1	n/a	0	n/a	0	n/a	0	0
OR-214	6/28/05	Keswick	770	12.6	6/30/05	6/30/05	1	n/a	0	n/a	0	n/a	0	0
OR-213	6/28/05	Keswick	760	12.7	6/30/05	6/30/05	1	n/a	0	n/a	0	n/a	0	0
OR-228	6/28/05	Keswick	710	8.46	6/30/05	6/30/05	1	n/a	0	n/a	0	n/a	0	0
OR-210	6/28/05	Keswick	760	12.02	7/5/05	7/5/05	6	n/a	0	n/a	0	n/a	0	1
OR-272	7/12/05	Keswick	850	14.6	7/14/05	7/14/05	1	n/a	0	n/a	0	n/a	0	0

<sup>a</sup> not applicable; <sup>b</sup> Pre-spawning mortality

Table 3. Spawning and drug treatment history of individual male Chinook salmon held at Livingston Stone National Fish Hatchery, 2005.

Tag Number	Date Captured	Trap Location	Fork Length (mm)	Weight (lb)	Date Spawned	Date Died	Days in Captivity	Liquamycin		LH-RHa		No. of Malachite Green Treatments
								Dose (ml)	Injections	Dose (ml)	Injections	
Y-057	1/11/05	Keswick	716	14.94	PSM <sup>a</sup>	1/28/05	16	n/a <sup>b</sup>	none	n/a	none	4
Y-008	1/11/05	Keswick	824	16.9	4/27/05	5/12/05	120	n/a	none	250	1	40
Y-204	2/8/05	Keswick	830	20.1	5/23/05	6/6/05	117	n/a	none	n/a	none	39
Y-192	2/8/05	Keswick	870	21.5	5/10/05 6/6/05 6/9/05	7/17/05	158	n/a	none	n/a	none	51
Y-290	2/15/05	Keswick	870	19.62	5/23/05	6/9/05	113	n/a	none	n/a	none	38
Y-295	2/22/05	Keswick	900	23.5	5/26/05 6/9/05	4/7/05	43	n/a	none	n/a	none	15
Y-386	3/1/05	Keswick	860	18.6	PSM	5/16/05	75	n/a	none	n/a	none	26
Y-375	3/1/05	Keswick	910	21.5	PSM	6/6/05	96	n/a	none	n/a	none	32
Y-374	3/1/05	Keswick	860	20.4	4/27/05	5/12/05	71	1	1	250	1	24
Y-371	3/1/05	Keswick	850	17.96	5/10/05	5/4/05	63	n/a	none	250	1	22
Y-367	3/1/05	Keswick	878	19.36	5/16/05 5/19/05	5/23/05	82	n/a	none	250	1	26
Y-372	3/1/05	Keswick	830	17.8	6/9/05	7/6/05	126	n/a	none	n/a	none	41
Y-373	3/1/05	Keswick	898	21.76	6/13/05 6/16/05	7/6/05	126	n/a	none	n/a	none	41
Y-384	3/1/05	Keswick	809	15.7	6/9/05 6/6/05	7/3/05	123	n/a	none	n/a	none	39
Y-379	3/1/05	Keswick	848	20.88	6/20/05	7/24/05	144	n/a	none	n/a	none	46
					6/30/05 7/5/05							

Table 3 (cont.)

Tag Number	Date Captured	Trap Location	Fork Length (mm)	Weight (lb)	Date Spawned	Date Died	Days in Captivity	Liquamycin		LH-RHa		No. of Malachite Green Treatments
								Dose (ml)	Injections	Dose (ml)	Injections	
Y-413	3/15/05	Keswick	888	22.06	6/6/05	7/26/05	132	1	1	250	1	41
Y-410	3/15/05	Keswick	908	21.2	6/9/05 6/13/05 6/9/05 6/16/05 6/16/05	7/21/05	127	n/a	none	n/a	none	40
Y-463	3/22/05	Keswick	811	15.8	PSM	4/18/05	26	n/a	none	n/a	none	9
Y-453	3/22/05	Keswick	870	22.5	PSM	4/11/05	19	n/a	none	n/a	none	7
Y-454	3/22/05	Keswick	928	24.9	4/27/05 5/5/05	5/12/05	50	n/a	none	150	1	17
Y-425	3/22/05	Keswick	875	20.46	5/16/05 5/16/05	5/17/05	55	n/a	none	250	1	18
Y-426	3/22/05	Keswick	812	14.76	5/23/05 5/26/05 5/31/05	6/2/05	71	n/a	none	n/a	none	23
Y-474	3/29/05	Keswick	910	20.2	6/13/05 6/16/05	7/5/05	97	n/a	none	n/a	none	29
Y-490	4/5/05	Keswick	1000	28	4/27/05 4/28/05	5/5/05	29	n/a	none	250	1	10
OR-009	4/12/05	Keswick	911	20.12	5/23/05 5/26/05 5/31/05	6/2/05	50	n/a	none	n/a	none	16
OR-015	4/12/05	Keswick	880	18.74	5/5/05	5/8/05	25	n/a	none	n/a	none	9
OR-019	4/12/05	Keswick	919	22.9	5/10/05 5/19/05	5/23/05	40	n/a	none	n/a	none	13
OR-014	4/12/05	Keswick	846	17.8	7/5/05 7/5/05 7/14/05	7/17/05	95	n/a	none	n/a	none	29
OR-029	4/19/05	Keswick	530	6.75	5/10/05 5/16/05 5/23/05	5/26/05	36	n/a	none	150	1	11

Table 3 (cont.)

Tag Number	Date Captured	Trap Location	Fork Length (mm)	Weight (lb)	Date Spawned	Date Died	Days in Captivity	Liquamycin		LH-RHa		No. of Malachite Green Treatments
								Dose (ml)	Injections	Dose (ml)	Injections	
OR-032	4/19/05	Keswick	840	16.9	5/23/05 5/26/05 6/9/05	6/8/05	49	n/a	none	n/a	none	15
OR-037	4/26/05	Keswick	808	22.5	PSM	6/19/05	53	n/a	none	n/a	none	15
OR-047	4/26/05	Keswick	710	12.7	4/28/05 5/10/05	5/12/05	15	n/a	none	n/a	none	4
OR-056	4/26/05	Keswick	980	27.8	5/23/05 5/26/05	6/5/05	39	n/a	none	n/a	none	11
OR-034	4/26/05	Keswick	943	25	5/25/05	5/26/05	29	n/a	none	n/a	none	8
OR-036	4/26/05	Keswick	791	16.6	5/25/05	5/25/05	28	n/a	none	250	1	8
OR-068	4/26/05	Keswick	891	20	6/6/05 6/9/05 6/9/05	6/26/05	60	n/a	none	n/a	none	20
OR-035	4/26/05	Keswick	860	19	6/13/05 6/16/05	6/30/05	64	n/a	none	n/a	none	18
OR-055	4/26/05	Keswick	923	25.75	6/16/05 6/27/05 7/5/05	7/19/05	83	n/a	none	n/a	none	24
OR-058	4/26/05	Keswick	875	20.5	6/16/05 6/20/05 6/30/05	7/19/05	83	n/a	none	n/a	none	23
OR-062	4/26/05	Keswick	915	23.2	6/16/05 6/27/05 6/30/05	7/18/05	82	n/a	none	n/a	none	23
OR-060	4/26/05	Keswick	805	22	6/16/05 6/16/05	6/19/05	53	n/a	none	n/a	none	15
OR-045	4/26/05	Keswick	768	13.6	6/16/05 6/16/05	7/10/05	74	n/a	none	n/a	none	21
OR-038	4/26/05	Keswick	863	21	6/16/05 6/20/05 7/5/05	7/17/05	81	n/a	none	n/a	none	23

Table 3 (cont.)

Tag Number	Date Captured	Trap Location	Length (mm)	Weight (lb)	Date Spawned	Date Died	Days in Captivity	Liquamycin		LH-RHa		No. of Malachite Green Treatments
								Dose (ml)	Injections	Dose (ml)	Injections	
OR-046	4/26/05	Keswick	845	19.4	6/13/05 6/16/05 7/5/05	7/24/05	88	n/a	none	n/a	none	25
OR-064	4/26/05	Keswick	872	19.1	6/20/05 6/30/05	7/11/05	75	n/a	none	n/a	none	21
OR-101	5/10/05	Keswick	840	17	5/23/05 5/26/05	6/6/05	26	n/a	none	n/a	none	7
OR-215	6/28/05	Keswick	624	5.64	6/30/05 6/30/05	7/10/05	11	n/a	none	n/a	none	4
OR-229	6/28/05	Keswick	495	3.26	6/30/05 6/30/05	7/10/05	11	n/a	none	n/a	none	3
OR-240	6/28/05	Keswick	543	4.3	6/30/00 7/5/05	7/14/05	15	n/a	none	n/a	none	4
OR-218	6/28/05	Keswick	558	4.44	6/30/05 7/5/05	7/12/05	13	n/a	none	n/a	none	3
OR-261	7/12/05	Keswick	884	13.4	7/14/05	7/20/05	7	n/a	none	n/a	none	2

<sup>a</sup> Pre-spawn mortality; <sup>b</sup> not applicable

## **Progeny**

### *Eggs and Juvenile Rearing*

After fertilization, winter Chinook eggs were placed in Heath incubator trays and disinfected with a 75 parts per million (ppm) iodophor bath for 15 minutes. Incubating eggs were treated twice a week with a 15 minute flow-through treatment of 1,400 ppm formalin to prevent excessive fungus. Initial water flow in the incubator trays was four gallons per minute (gpm) and later increased to six gpm at eye-up. After eye-up, eggs were shocked and non-viable eggs were removed. Formalin treatments were discontinued once eggs had hatched. Sac fry were left in the incubator trays until button-up, at which time they were transferred to 30-inch diameter (10.2 cubic foot) circular tanks and started on commercial feed.

Juveniles were initially fed Bio-Oregon's starter #1. *Artemia nauplii* (Cyclop-eeze™ from Argent Chemical Laboratories) were added to increase interest in the feed. The fish were subsequently fed Bio-Oregon's starter #2 and starter #3 fish feed. Once they attained a size of approximately 500 to-the-pound, they were fed Bio-Oregon's Biodiet grower, size 1.3 mm pellets. At a size of about 250 to-the-pound they were fed Biodiet grower, size 1.5 mm pellets, until released. Feeding rates were determined using Bio-Oregon's feeding guidelines, which indicate the appropriate feed ration based on average monthly water temperature. Due to tank space limitations at Livingston Stone NFH, family groups were combined as fish size increased.

### *Health*

To maintain sanitary rearing environments, rearing units were typically cleaned two to five times per week. Juvenile winter Chinook were tested for the presence of pathogens by California-Nevada Fish Health Center personnel.

### *Marking and Tagging*

All winter Chinook juveniles were coded-wire tagged between December 20, 2005 and January 6, 2006. Each of the 16 natural-origin by natural-origin family group combinations received a unique tag code as did the one hatchery-origin by natural-origin family group combination and the one captive-origin by natural-origin family group combination (Table 4).

Table 4. Brood year 2005 winter Chinook salmon released by coded-wire tag (CWT) code, family group, and parental origin and length (mm).

Tag Code	Family Group	Parental Origin	Number Tagged	Tagging Mortalities	Proportion Tags Retained	Tagged Fish Released	Number Released	Avg Fork Length (mm)	Min Fork Length (mm)	Max Fork Length (mm)
052478	29BB, 29CC, 30Y, 34CC	N x N	9,576	4	0.975	9,333	9,572	86	59	107
052479	26V, 27AA, 28U, 11K, 12M, 13O, 16L, 16O, 17N	N x N	9,648	9	0.955	9,205	9,639	84	57	111
052480	6B, 9G, 14P, 18M, 47OO, 49KK	N x N	9,730	8	0.905	8,798	9,722	85	62	104
052481	24M, 24N, 30DD, 5G, 6H, 17P	N x N	9,794	7	0.865	8,466	9,787	89	65	107
052482	22U, 22X, 3E, 5F	N x N	9,993	5	0.920	9,189	9,988	86	67	103
052483	41EE, 38AA, 8H, 10G	N x N	9,219	5	0.885	8,154	9,214	87	60	109
052484	20K, 20U, 27Z, 23Y, 26AA	N x N	9,778	30	0.945	9,212	9,748	84	52	103
052485	19O, 19L, 21V, 33Y, 36X	N x N	9,875	9	0.915	9,027	9,866	87	64	103
052486	50EE	N x N	2,566	2	0.855	2,192	2,564	84	53	96
052487	1A, 1B, 1C, 2E, 3F, 4A	N x N	9,670	5	0.950	9,182	9,665	91	64	111
052488	48PP, 49BB, 35HH, 35II	N x N	9,117	6	0.990	9,020	9,111	80	62	96
052774	34HH, 33GG, 32FF, 37DD	N x N	9,024	3	0.985	8,886	9,021	89	70	104
052775	31EE, 36II, 37JJ, 40JJ	N x N	10,004	14	0.975	9,740	9,990	83	63	100
052776	38BB, 39LL, 44MM, 44NN, 45FF, 46LL, 32Y, 40FF, 45GG	N x N	8,294	18	0.985	8,152	8,276	87	60	102
052777	39KK, 41GG, 46KK, 48QQ, 47QQ, 50JJ	N x N	8,251	4	0.975	8,041	8,247	84	66	105
053074	2D, 4R, 7C, 7I, 8J, 9J, 10I, 11L, 12H, 13N, 14Q, 15T, 18Q, 21W, 23W	N x N	15,603	36	0.940	14,633	15,567	86	61	109
			Subtotal	165		141,230	149,977			
053072	42NN, 43OO, 43PP, 51QQ, 51RR, 42MM	H x N	10,297	1	0.980	10,090	10,296	82	60	105
053073	LSNFH 1-36, 39-46	C x N	13,115	44	0.965	12,614	13,071	73	46	91



## Assessment of Potential Genetic Impacts

Prior to and following the release of juvenile winter Chinook into the Sacramento River, the Service estimated the “effective population size” of the winter Chinook salmon population, both with and without the influence of hatchery-origin fish. The effective population size estimate ( $N_e$ ) measures the rate of genetic drift within a population and provides an assessment of risk of inbreeding resulting from the release of the juveniles from the hatchery propagation program. The  $N_e$  is directly related to the rate of loss of genetic diversity and the rate of increase in inbreeding within a population (Riemann and Allendorf 2001), and is an important concept in managing conservation programs for threatened or endangered salmonid populations, including Sacramento River winter Chinook. In most cases  $N_e$  is expected to be smaller than the actual number of adults in a spawning population.

The estimation of  $N_e$  was based on the estimated total run size of winter Chinook salmon to the Sacramento River in 2005. Two estimates of  $N_e$  were calculated: one assuming genetic contribution by 10% of the run size estimate (Bartley et al., 1992) and one assuming genetic contribution by 33% of the run size estimate (Robin Waples, NMFS, Northwest Fisheries Center, Seattle, WA, personal communication). The Service’s estimate of effective population size was sent to NOAA Fisheries and the California Department of Fish and Game for review and approval prior to releasing juvenile winter Chinook.

## RESULTS

### Broodstock

#### *Collection and Disposition*

The first winter-run Chinook was captured on December 28 and the last was captured on July 19 (Table 5, Figure 1). Winter Chinook were collected at a relatively constant rate throughout the trapping season (Table 5, Figure 1). Most non-winter Chinook were collected during January and February (Table 5, Figure 1). A total of 809 Chinook salmon were captured at the Keswick Dam trap (Table 6). Of those, 48.6% ( $n = 393$ ) were identified as winter-run based on genetic data or phenotypic characteristics. Females comprised 57.0% ( $n = 224$ ) of the winter Chinook salmon captured, males comprised 43.0% ( $n = 169$ ). Hatchery-origin fish comprised 57.8% ( $n = 227$ ) of the winter Chinook captured and 71.2% ( $n = 576$ ) of all Chinook captured.

Two hundred fifty-four winter-run Chinook, 15 non-winter-run Chinook, and 320 Chinook of undetermined run were collected and released without being quarantined (Table 6). Thirty-two Chinook were held in quarantine and later released back into the Sacramento River; thirty of these fish were winter-run, and two were non-winter-run (Table 6). Quarantined fish were held for no more than 2 days. One hundred and nine winter Chinook salmon were retained for broodstock. Among these, 95 were spawned and fourteen died before they could be spawned.

Thirty-three non-winter Chinook were transferred to Coleman NFH for use as late-fall Chinook salmon broodstock and 46 non-winter Chinook were euthanized.

Table 5. Chinook salmon captured and tissue sampled for genetic run assignment and final disposition. Fish with adipose fin status “present” were natural-origin, fish with adipose fin status “absent” were hatchery-origin.

Date Captured	Genetic Sample ID	Individual Tag Code	Adipose Fin Status	Sex	Fork Length (mm)	Run Assignment	Final Disposition
12/28/04	81504	W-473	Present	Female	595	Winter Ph	Released
12/28/04	81542	W-464	Present	Female	720	Non-Winter	Transferred to CNFH <sup>a</sup>
12/28/04	81544	W-463	Present	Male	770	Non-Winter	Transferred to CNFH
12/28/04	81546	W-465	Present	Male	810	Non-Winter	Transferred to CNFH
12/28/04	81541	W-472	Present	Male	610	Non-Winter	Transferred to CNFH
12/28/04	81543	W-475	Present	Male	710	Non-Winter	Transferred to CNFH
12/28/04	81549	W-482	Present	Male	640	Non-Winter	Transferred to CNFH
12/28/04	81510	none	Absent	Female	780	Non-Winter	Sacrificed
12/28/04	81514	none	Absent	Female	710	Non-Winter	Sacrificed
12/28/04	81516	none	Absent	Female	690	Non-Winter	Sacrificed
12/28/04	81517	none	Absent	Female	870	Non-Winter	Sacrificed
12/28/04	81518	none	Absent	Female	810	Non-Winter	Sacrificed
12/28/04	81508	none	Absent	Female	710	Non-Winter	Sacrificed
12/28/04	81509	none	Absent	Male	790	Non-Winter	Sacrificed
12/28/04	81511	none	Absent	Male	780	Non-Winter	Sacrificed
12/28/04	81512	none	Absent	Male	710	Non-Winter	Sacrificed
12/28/04	81513	none	Absent	Male	750	Non-Winter	Sacrificed
12/28/04	81515	none	Absent	Male	870	Non-Winter	Sacrificed
12/28/04	81519	none	Absent	Male	810	Non-Winter	Sacrificed
12/28/04	81501	W-466	Present	Female	not measured	undetermined	Released
12/28/04	81502	W-468	Present	Female	not measured	undetermined	Released
12/28/04	81506	W-478	Present	Female	not measured	undetermined	Released
12/28/04	81503	W-470	Partial	Female	not measured	undetermined	Released
12/28/04	81505	W-476	Present	Male	not measured	undetermined	Released
12/28/04	81507	W-480	Absent	Male	not measured	undetermined	Released
1/4/05	81592	W-487	Present	Female	690	Non-Winter	Transferred to CNFH
1/4/05	81545	W-490	Present	Female	890	Non-Winter	Transferred to CNFH
1/4/05	81591	W-494	Present	Female	850	Non-Winter	Transferred to CNFH
1/4/05	81547	W-491	Present	Female	800	Non-Winter	Transferred to CNFH
1/4/05	81593	W-493	Present	Female	740	Non-Winter	Transferred to CNFH
1/4/05	81550	W-498	Present	Female	850	Non-Winter	Transferred to CNFH
1/4/05	81595	W-486	Present	Male	570	Non-Winter	Transferred to CNFH
1/4/05	81594	W-497	Present	Male	730	Non-Winter	Transferred to CNFH
1/4/05	81548	W-500	Present	Male	920	Non-Winter	Transferred to CNFH
1/4/05	80001	W-483	Absent	Female	not measured	Non-Winter	Sacrificed
1/4/05	80002	W-484	Absent	Female	not measured	Non-Winter	Sacrificed
1/4/05	80004	W-488	Absent	Female	not measured	Non-Winter	Sacrificed
1/4/05	80005	W-489	Absent	Female	not measured	Non-Winter	Sacrificed
1/4/05	80007	W-499	Absent	Female	not measured	Non-Winter	Sacrificed

Table 5 (cont.)

Date Captured	Genetic Sample ID	Individual Tag Code	Adipose Fin Status	Sex	Fork Length (mm)	Run Assignment	Final Disposition
1/4/05	80009	Y-002	Absent	Female	not measured	Non-Winter	Sacrificed
1/4/05	80003	W-485	Absent	Male	not measured	Non-Winter	Sacrificed
1/4/05	80008	Y-001	Absent	Male	not measured	Non-Winter	Sacrificed
1/4/05	80006	W-495	Present	Female	990	Non-Winter	Released
1/4/05	80010	Y-003	Present	Female	not measured	Non-Winter	Released
1/11/05	80011	Y-007	Present	Female	776	Winter	Spawned
1/11/05	80029	Y-038	Present	Female	780	Winter	Spawned
1/11/05	80024	Y-027	Present	Female	not measured	Winter	Released
1/11/05	80030	Y-039	Present	Female	815	Winter	Released
1/11/05	80026	Y-031	Partial	Female	710	Winter	Released
1/11/05	80014	Y-011	Absent	Female	820	Winter	Released
1/11/05	80017	Y-015	Absent	Female	730	Winter	Released
1/11/05	80019	Y-018	Absent	Female	900	Winter	Released
1/11/05	80020	Y-020	Absent	Female	810	Winter	Released
1/11/05	80023	Y-025	Absent	Female	not measured	Winter	Released
1/11/05	80027	Y-034	Absent	Female	780	Winter	Released
1/11/05	80033	Y-043	Absent	Female	780	Winter	Released
1/11/05	80035	Y-045	Absent	Female	770	Winter	Released
1/11/05	80036	Y-049	Absent	Female	800	Winter	Released
1/11/05	80038	Y-053	Absent	Female	820	Winter	Released
1/11/05	80041	Y-058	Absent	Female	800	Winter	Released
1/11/05	80042	Y-060	Absent	Female	750	Winter	Released
1/11/05	80043	Y-062	Absent	Female	780	Winter	Released
1/11/05	80044	Y-064	Absent	Female	730	Winter	Released
1/11/05	80047	Y-068	Absent	Female	780	Winter	Released
1/11/05	80012	Y-008	Present	Male	824	Winter	Spawned
1/11/05	80013	Y-009	Absent	Male	1000	Winter	Released
1/11/05	80015	Y-013	Absent	Male	800	Winter	Released
1/11/05	80021	Y-023	Absent	Male	790	Winter	Released
1/11/05	80025	Y-029	Absent	Male	850	Winter	Released
1/11/05	80028	Y-036	Absent	Male	805	Winter	Released
1/11/05	80037	Y-051	Absent	Male	840	Winter	Released
1/11/05	80039	Y-055	Absent	Male	830	Winter	Released
1/11/05	80045	Y-066	Absent	Male	800	Winter	Released
1/11/05	80046	Y-067	Absent	Male	810	Winter	Released
1/11/05	80040	Y-057	Present	Male	716	Winter	DIP <sup>b</sup>
1/11/05	81520	Y-006	Present	Female	720	Non-Winter	Transferred to CNFH
1/11/05	81521	Y-037	Present	Male	940	Non-Winter	Transferred to CNFH
1/11/05	81522	Y-005	Present	Male	790	Non-Winter	Transferred to CNFH
1/11/05	81523	Y-041	Present	Male	780	Non-Winter	Transferred to CNFH
1/11/05	81524	Y-033	Present	Male	1100	Non-Winter	Transferred to CNFH
1/11/05	80016	Y-014	Absent	Female	775	Non-Winter	Sacrificed
1/11/05	80022	Y-024	Absent	Female	850	Non-Winter	Sacrificed
1/11/05	80031	Y-040	Absent	Female	855	Non-Winter	Sacrificed
1/11/05	80032	Y-042	Absent	Female	840	Non-Winter	Sacrificed

Table 5 (cont.)

Date Captured	Genetic Sample ID	Individual Tag Code	Adipose Fin Status	Sex	Fork Length (mm)	Run Assignment	Final Disposition
1/11/05	80034	Y-047	Absent	Female	780	Non-Winter	Sacrificed
1/11/05	80018	Y-017	Absent	Male	795	Non-Winter	Sacrificed
1/11/05	80048	Y-022	Absent	Male	805	Non-Winter	Sacrificed
1/18/05	80055	Y-082	Present	Female	730	Winter	Released
1/18/05	80059	Y-091	Present	Female	730	Winter	Released
1/18/05	80057	Y-087	Absent	Female	742	Winter	Released
1/18/05	80049	Y-076	Present	Male	750	Winter	Released
1/18/05	80056	Y-085	Absent	Male	775	Winter	Released
1/18/05	80058	Y-089	Absent	Male	880	Winter	Released
1/18/05	81555	Y-084	Present	Female	680	Non-Winter	Transferred to CNFH
1/18/05	80050	Y-077	Absent	Female	750	Non-Winter	Sacrificed
1/18/05	80051	Y-078	Absent	Female	730	Non-Winter	Sacrificed
1/18/05	80052	Y-079	Absent	Female	760	Non-Winter	Sacrificed
1/18/05	80053	Y-080	Absent	Male	720	Non-Winter	Sacrificed
1/18/05	80054	Y-081	Absent	Male	710	Non-Winter	Sacrificed
1/18/05	80060	Y-093	Absent	Male	660	Non-Winter	Sacrificed
1/25/05	80076	Y-126	Present	Female	not measured	Winter	Released
1/25/05	80062	Y-102	Absent	Female	680	Winter	Released
1/25/05	80063	Y-104	Absent	Female	810	Winter	Released
1/25/05	80064	Y-106	Absent	Female	760	Winter	Released
1/25/05	80067	Y-111	Absent	Female	800	Winter	Released
1/25/05	80071	Y-116	Absent	Female	780	Winter	Released
1/25/05	80075	Y-124	Absent	Female	780	Winter	Released
1/25/05	80077	Y-128	Absent	Female	700	Winter	Released
1/25/05	80078	Y-130	Absent	Female	740	Winter	Released
1/25/05	80073	Y-119	Present	Male	780	Winter	Released
1/25/05	80074	Y-122	Partial	Male	1000	Winter	Released
1/25/05	80079	Y-132	Absent	Male	790	Winter	Released
1/25/05	81556	Y-110	Present	Female	750	Non-Winter	Transferred to CNFH
1/25/05	81557	Y-136	Present	Female	710	Non-Winter	Transferred to CNFH
1/25/05	81559	Y-101	Present	Male	670	Non-Winter	Transferred to CNFH
1/25/05	81558	Y-135	Present	Male	940	Non-Winter	Transferred to CNFH
1/25/05	81561	Y-121	Present	Male	860	Non-Winter	Transferred to CNFH
1/25/05	81560	Y-096	Present	Male	1000	No Call	Transferred to CNFH
1/25/05	80065	Y-108	Absent	Female	708	Non-Winter	Sacrificed
1/25/05	80066	Y-109	Absent	Female	710	Non-Winter	Sacrificed
1/25/05	80068	Y-113	Absent	Female	710	Non-Winter	Sacrificed
1/25/05	80070	Y-115	Absent	Female	760	Non-Winter	Sacrificed
1/25/05	80069	Y-114	Absent	Female	850	Non-Winter	Sacrificed
1/25/05	80072	Y-118	Absent	Male	970	Non-Winter	Sacrificed
1/25/05	80061	Y-097	Present	Female	1000	Non-Winter	Released
2/1/05	80088	Y-149	Present	Female	830	Winter	Released
2/1/05	80083	Y-141	Partial	Female	745	Winter	Released
2/1/05	80080	Y-137	Absent	Female	740	Winter	Released
2/1/05	80084	Y-143	Absent	Female	775	Winter	Released

Table 5 (cont.)

Date Captured	Genetic Sample ID	Individual Tag Code	Adipose Fin Status	Sex	Fork Length (mm)	Run Assignment	Final Disposition
2/1/05	80091	Y-154	Absent	Female	790	Winter	Released
2/1/05	80094	Y-159	Absent	Female	770	Winter	Released
2/1/05	80095	Y-161	Absent	Female	805	Winter	Released
2/1/05	80096	Y-163	Absent	Female	720	Winter	Released
2/1/05	80097	Y-165	Absent	Female	750	Winter	Released
2/1/05	80098	Y-167	Absent	Female	870	Winter	Released
2/1/05	80101	Y-173	Absent	Female	780	Winter	Released
2/1/05	80103	Y-176	Absent	Female	750	Winter	Released
2/1/05	80104	Y-178	Absent	Female	820	Winter	Released
2/1/05	80105	Y-180	Absent	Female	840	Winter	Released
2/1/05	80081	Y-139	Absent	Male	800	Winter	Released
2/1/05	80087	Y-147	Absent	Male	800	Winter	Released
2/1/05	80092	Y-156	Absent	Male	805	Winter	Released
2/1/05	80093	Y-157	Absent	Male	810	Winter	Released
2/1/05	80099	Y-169	Absent	Male	820	Winter	Released
2/1/05	80100	Y-171	Absent	Male	830	Winter	Released
2/1/05	80082	Y-140	Absent	Female	800	Non-Winter	Sacrificed
2/1/05	80085	Y-145	Absent	Female	780	Non-Winter	Sacrificed
2/1/05	80089	Y-151	Absent	Female	880	Non-Winter	Sacrificed
2/1/05	80086	Y-146	Absent	Male	840	Non-Winter	Sacrificed
2/1/05	80102	Y-175	Absent	Male	760	Non-Winter	Sacrificed
2/1/05	80090	Y-152	Present	Female	810	Non-Winter	Released
2/8/05	80116	Y-199	Present	Female	797	Winter	Spawned
2/8/05	80132	Y-228	Present	Female	875	Winter	Spawned
2/8/05	80133	Y-229	Present	Female	838	Winter	Spawned
2/8/05	80115	Y-198	Present	Female	820	Winter	Released
2/8/05	80135	Y-232	Present	Female	850	Winter	Released
2/8/05	80107	Y-184	Absent	Female	800	Winter	Released
2/8/05	80109	Y-188	Absent	Female	760	Winter	Released
2/8/05	80113	Y-195	Absent	Female	880	Winter	Released
2/8/05	80118	Y-202	Absent	Female	790	Winter	Released
2/8/05	80123	Y-211	Absent	Female	720	Winter	Released
2/8/05	80124	Y-213	Absent	Female	not measured	Winter	Released
2/8/05	80125	Y-215	Absent	Female	690	Winter	Released
2/8/05	80126	Y-217	Absent	Female	780	Winter	Released
2/8/05	80127	Y-219	Absent	Female	820	Winter	Released
2/8/05	80130	Y-224	Absent	Female	780	Winter	Released
2/8/05	80134	Y-230	Absent	Female	800	Winter	Released
2/8/05	80136	Y-233	Absent	Female	750	Winter	Released
2/8/05	80137	Y-235	Absent	Female	870	Winter	Released
2/8/05	80138	Y-237	Absent	Female	800	Winter	Released
2/8/05	80140	Y-241	Absent	Female	750	Winter	Released
2/8/05	80141	Y-243	Absent	Female	770	Winter	Released
2/8/05	80144	Y-249	Absent	Female	820	Winter	Released
2/8/05	80145	Y-251	Absent	Female	800	Winter	Released

Table 5 (cont.)

Date Captured	Genetic Sample ID	Individual Tag Code	Adipose Fin Status	Sex	Fork Length (mm)	Run Assignment	Final Disposition
2/8/05	80147	Y-255	Absent	Female	840	Winter	Released
2/8/05	80148	Y-257	Absent	Female	790	Winter	Released
2/8/05	80150	Y-261	Absent	Female	800	Winter	Released
2/8/05	80151	Y-263	Absent	Female	840	Winter	Released
2/8/05	80111	Y-192	Present	Male	870	Winter	Spawned
2/8/05	80119	Y-204	Present	Male	830	Winter	Spawned
2/8/05	80110	Y-190	Partial	Male	840	Winter	Released
2/8/05	80108	Y-186	Absent	Male	870	Winter	Released
2/8/05	80117	Y-200	Absent	Male	690	Winter	Released
2/8/05	80128	Y-221	Absent	Male	780	Winter	Released
2/8/05	80131	Y-226	Absent	Male	830	Winter	Released
2/8/05	80139	Y-239	Absent	Male	740	Winter	Released
2/8/05	80142	Y-245	Absent	Male	840	Winter	Released
2/8/05	80143	Y-247	Absent	Male	910	Winter	Released
2/8/05	80146	Y-253	Absent	Male	890	Winter	Released
2/8/05	80149	Y-259	Absent	Male	not measured	Winter	Released
2/8/05	80152	Y-265	Absent	Male	850	Winter	Released
2/8/05	80153	Y-267	Absent	Male	780	Winter	Released
2/8/05	80114	Y-197	Absent	Female	880	Non-Winter	Sacrificed
2/8/05	80106	Y-269	Absent	Female	800	Non-Winter	Sacrificed
2/8/05	80120	Y-205	Present	Female	1000	Non-Winter	Released
2/8/05	80121	Y-207	Present	Female	1000	Non-Winter	Released
2/8/05	80122	Y-209	Present	Female	1000	Non-Winter	Released
2/8/05	80129	Y-223	Present	Female	800	Non-Winter	Released
2/8/05	80112	Y-193	Present	Male	1000	Non-Winter	Released
2/15/05	80155	Y-276	Present	Female	771	Winter	Spawned
2/15/05	80159	Y-280	Present	Female	833	Winter	Spawned
2/15/05	80161	Y-283	Present	Female	808	Winter	Spawned
2/15/05	80154	Y-275	Present	Female	795	Winter	Released
2/15/05	80157	Y-278	Present	Female	745	Winter	Released
2/15/05	80158	Y-279	Present	Female	810	Winter	Released
2/15/05	80160	Y-281	Present	Female	850	Winter	Released
2/15/05	80162	Y-286	Present	Female	840	Winter	Released
2/15/05	80163	Y-288	Present	Female	876	Winter	Released
2/15/05	80156	Y-277	Present	Female	746	Winter	DIP
2/15/05	80165	Y-291	Present	Female	740	Winter	DIP
2/15/05	80166		Absent	Female	750	Winter	DIP
2/15/05	80164	Y-290	Present	Male	870	Winter	Spawned
2/15/05	81527	Y-273	Present	Female	920	Non-Winter	Transferred to CNFH
2/15/05	81525	Y-274	Present	Male	660	Non-Winter	Transferred to CNFH
2/15/05	81526	Y-285	Present	Male	1190	Non-Winter	Transferred to CNFH
2/22/05	80179	Y-320	Present	Female	768	Winter	Spawned
2/22/05	80187	Y-336	Present	Female	761	Winter	Spawned
2/22/05	80169	Y-300	Partial	Female	802	Winter	Released
2/22/05	80184	Y-330	Absent	Female	820	Winter	Released

Table 5 (cont.)

Date Captured	Genetic Sample ID	Individual Tag Code	Adipose Fin Status	Sex	Fork Length (mm)	Run Assignment	Final Disposition
2/22/05	80172	Y-306	Absent	Female	820	Winter	Released
2/22/05	80173	Y-308	Absent	Female	770	Winter	Released
2/22/05	80174	Y-310	Absent	Female	730	Winter	Released
2/22/05	80175	Y-312	Absent	Female	800	Winter	Released
2/22/05	80178	Y-318	Absent	Female	810	Winter	Released
2/22/05	80182	Y-325	Absent	Female	680	Winter	Released
2/22/05	80186	Y-334	Absent	Female	720	Winter	Released
2/22/05	80188	Y-337	Absent	Female	740	Winter	Released
2/22/05	80189	Y-339	Absent	Female	810	Winter	Released
2/22/05	80190	Y-341	Absent	Female	not measured	Winter	Released
2/22/05	80191	Y-344	Absent	Female	790	Winter	Released
2/22/05	80192	Y-346	Absent	Female	740	Winter	Released
2/22/05	80193	Y-348	Absent	Female	760	Winter	Released
2/22/05	80194	Y-351	Absent	Female	750	Winter	Released
2/22/05	80195	Y-353	Absent	Female	750	Winter	Released
2/22/05	80196	Y-355	Absent	Female	790	Winter	Released
2/22/05	80170	Y-302	Absent	Male	870	Winter	Released
2/22/05	80171	Y-304	Absent	Male	830	Winter	Released
2/22/05	80176	Y-314	Absent	Male	810	Winter	Released
2/22/05	80177	Y-316	Absent	Male	840	Winter	Released
2/22/05	80180	Y-321	Absent	Male	640	Winter	Released
2/22/05	80181	Y-323	Absent	Male	810	Winter	Released
2/22/05	80183	Y-327	Absent	Male	770	Winter	Released
2/22/05	80185	Y-332	Absent	Male	925	Winter	Released
2/22/05	80167	Y-295	Present	Male	900	Winter	DIP
2/22/05	81562	Y-297	Present	Female	910	Non-Winter	Transferred to CNFH
2/22/05	81563	Y-329	Present	Female	840	Non-Winter	Transferred to CNFH
2/22/05	80168	Y-298	Present	Female	1000	Non-Winter	Released
3/1/05	80199	Y-361	Present	Female	660	Winter	Spawned
3/1/05	80200	Y-362	Present	Female	755	Winter	Spawned
3/1/05	80201	Y-363	Present	Female	750	Winter	Spawned
3/1/05	80203	Y-366	Present	Female	763	Winter	Spawned
3/1/05	80205	Y-368	Present	Female	780	Winter	Spawned
3/1/05	80207	Y-370	Present	Female	725	Winter	Spawned
3/1/05	80214	Y-378	Present	Female	858	Winter	Spawned
3/1/05	80218	Y-383	Present	Female	750	Winter	Released
3/1/05	80220	Y-385	Present	Female	715	Winter	Released
3/1/05	80197	Y-357	Absent	Female	760	Winter	Released
3/1/05	80198	Y-359	Absent	Female	800	Winter	Released
3/1/05	80206	Y-369	Present	Female	778	Winter	DIP
3/1/05	80216	Y-380	Present	Female	740	Winter	DIP
3/1/05	80204	Y-367	Present	Male	878	Winter	Spawned
3/1/05	80208	Y-371	Present	Male	850	Winter	Spawned
3/1/05	80209	Y-372	Present	Male	830	Winter	Spawned
3/1/05	80210	Y-373	Present	Male	898	Winter	Spawned

Table 5 (cont.)

Date Captured	Genetic Sample ID	Individual Tag Code	Adipose Fin Status	Sex	Fork Length (mm)	Run Assignment	Final Disposition
3/1/05	80211	Y-374	Present	Male	860	Winter	Spawned
3/1/05	80215	Y-379	Present	Male	848	Winter	Spawned
3/1/05	80219	Y-384	Present	Male	809	Winter	Spawned
3/1/05	80213	Y-376	Present	Male	820	Winter	Released
3/1/05	80217	Y-381	Partial	Male	930	Winter	Released
3/1/05	80212	Y-375	Present	Male	910	Winter	DIP
3/1/05	80221	Y-386	Present	Male	860	Winter	DIP
3/1/05	80202	Y-364	Present	Female	820	Non-Winter	Released
3/8/05	80226	Y-397	Present	Female	767	Winter	Spawned
3/8/05	80224	Y-393	Absent	Female	850	Winter	Released
3/8/05	80222	Y-389	Absent	Male	770	Winter	Released
3/8/05	80223	Y-391	Absent	Male	850	Winter	Released
3/8/05	80225	Y-395	Present	Female	830	Non-Winter	Released
3/15/05	80231	Y-407	Present	Female	810	Winter	Spawned
3/15/05	80236	Y-414	Present	Female	819	Winter	Spawned
3/15/05	80227	Y-398	Absent	Female	690	Winter	Released
3/15/05	80228	Y-400	Absent	Female	830	Winter	Released
3/15/05	80229	Y-403	Absent	Female	750	Winter	Released
3/15/05	80232	Y-408	Absent	Female	750	Winter	Released
3/15/05	80237	Y-415	Absent	Female	730	Winter	Released
3/15/05	80238	Y-417	Absent	Female	770	Winter	Released
3/15/05	80240	Y-421	Absent	Female	650	Winter	Released
3/15/05	80233	Y-410	Present	Male	908	Winter	Spawned
3/15/05	80235	Y-413	Present	Male	888	Winter	Spawned
3/15/05	80230	Y-405	Absent	Male	780	Winter	Released
3/15/05	80234	Y-411	Absent	Male	850	Winter	Released
3/15/05	80239	Y-419	Absent	Male	915	Winter	Released
3/15/05	80241	Y-423	Absent	Male	660	Winter	Released
3/22/05	80263	Y-460	Present	Female	750	Winter	Spawned
3/22/05	80264	Y-461	Present	Female	763	Winter	Spawned
3/22/05	80265	Y-462	Present	Female	760	Winter	Spawned
3/22/05	80252	Y-443	Present	Female	790	Winter	Released
3/22/05	80254	Y-445	Present	Female	840	Winter	Released
3/22/05	80255	Y-447	Present	Female	780	Winter	Released
3/22/05	80256	Y-449	Present	Female	770	Winter	Released
3/22/05	80261	Y-456	Present	Female	780	Winter	Released
3/22/05	80262	Y-458	Present	Female	750	Winter	Released
3/22/05	80267	Y-464	Present	Female	780	Winter	Released
3/22/05	80268	Y-465	Present	Female	760	Winter	Released
3/22/05	80257	Y-451	Partial	Female	740	Winter	Released
3/22/05	80245	Y-428	Absent	Female	820	Winter	Released
3/22/05	80247	Y-432	Absent	Female	780	Winter	Released
3/22/05	80248	Y-434	Absent	Female	740	Winter	Released
3/22/05	80249	Y-436	Absent	Female	820	Winter	Released
3/22/05	80250	Y-438	Absent	Female	800	Winter	Released



Table 5 (cont.)

Date Captured	Genetic Sample ID	Individual Tag Code	Adipose Fin Status	Sex	Fork Length (mm)	Run Assignment	Final Disposition
3/22/05	80251	Y-441	Absent	Female	not measured	Winter	Released
3/22/05	80269	Y-466	Absent	Female	710	Winter	Released
3/22/05	80242	Y-425	Present	Male	875	Winter	Spawned
3/22/05	80243	Y-426	Present	Male	812	Winter	Spawned
3/22/05	80259	Y-454	Present	Male	928	Winter	Spawned
3/22/05	80246	Y-430	Absent	Male	900	Winter	Released
3/22/05	80253	Y-444	Absent	Male	765	Winter	Released
3/22/05	80244	Y-427	Present	Male	875	Winter	DIP
3/22/05	80258	Y-453	Present	Male	870	Winter	DIP
3/22/05	80260	Y-455	Present	Male	850	Winter	DIP
3/22/05	80266	Y-463	Present	Male	811	Winter	DIP
3/29/05	80273	Y-479	Partial	Female	870	Winter	Released
3/29/05	80274	Y-477	Absent	Female	730	Winter	Released
3/29/05	80276	Y-483	Absent	Female	710	Winter	Released
3/29/05	80271	Y-474	Present	Male	910	Winter	Spawned
3/29/05	80275	Y-481	Present	Male	840	Winter	Released
3/29/05	80270	Y-472	Absent	Male	860	Winter	Released
3/29/05	80272	Y-475	Absent	Male	840	Winter	Released
4/5/05	80282	Y-493	Present	Female	696	Winter	Spawned
4/5/05	80277	Y-485	Present	Female	805	Winter	Released
4/5/05	80280	Y-490	Present	Male	1000	Winter	Spawned
4/5/05	80281	Y-491	Present	Male	550	Winter	Released
4/5/05	80278	Y-486	Absent	Male	830	Winter	Released
4/5/05	80279	Y-488	Absent	Male	825	Winter	Released
4/5/05	80283	Y-494	Absent	Male	530	Winter	Released
4/12/05	80287	OR-006	Present	Female	815	Winter	Spawned
4/12/05	80288	OR-007	Present	Female	808	Winter	Spawned
4/12/05	80289	OR-008	Present	Female	770	Winter	Spawned
4/12/05	80296	OR-018	Present	Female	765	Winter	Spawned
4/12/05	80285	OR-003	Present	Female	840	Winter	Released
4/12/05	80291	OR-010	Present	Female	800	Winter	Released
4/12/05	80298	OR-021	Present	Female	845	Winter	Released
4/12/05	80299	OR-022	Present	Female	820	Winter	Released
4/12/05	80290	OR-009	Present	Male	911	Winter	Spawned
4/12/05	80293	OR-014	Present	Male	846	Winter	Spawned
4/12/05	80294	OR-015	Present	Male	880	Winter	Spawned
4/12/05	80297	OR-019	Present	Male	919	Winter	Spawned
4/12/05	80295	OR-016	Present	Male	530	Winter	Released
4/12/05	80284	OR-001	Absent	Male	920	Winter	Released
4/12/05	80286	OR-004	Absent	Male	910	Winter	Released
4/12/05	80292	OR-011	Absent	Male	860	Winter	Released
4/19/05	80301	OR-029	Present	Male	530	Winter	Spawned
4/19/05	80303	OR-032	Present	Male	840	Winter	Spawned
4/19/05	80300	OR-027	Absent	Male	780	Winter	Released
4/19/05	80302	OR-030	Absent	Male	475	Winter	Released

Table 5 (cont.)

Date Captured	Genetic Sample ID	Individual Tag Code	Adipose Fin Status	Sex	Fork Length (mm)	Run Assignment	Final Disposition
4/26/05	80304	OR-033	Present	Female	868	Winter	Spawned
4/26/05	80310	OR-039	Present	Female	810	Winter	Spawned
4/26/05	80311	OR-040	Present	Female	736	Winter	Spawned
4/26/05	80313	OR-042	Present	Female	830	Winter	Spawned
4/26/05	80315	OR-044	Present	Female	798	Winter	Spawned
4/26/05	80319	OR-048	Present	Female	806	Winter	Spawned
4/26/05	80320	OR-049	Present	Female	858	Winter	Spawned
4/26/05	80321	OR-050	Present	Female	806	Winter	Spawned
4/26/05	80326	OR-057	Present	Female	790	Winter	Spawned
4/26/05	80328	OR-059	Present	Female	818	Winter	Spawned
4/26/05	80330	OR-061	Present	Female	820	Winter	Spawned
4/26/05	80332	OR-063	Present	Female	837	Winter	Spawned
4/26/05	80322	OR-051	Present	Female	890	Winter	Released
4/26/05	80323	OR-053	Present	Female	not measured	Winter	Released
4/26/05	80338	OR-071	Present	Female	not measured	Winter	Released
4/26/05	80339	OR-073	Present	Female	not measured	Winter	Released
4/26/05	80340	OR-075	Present	Female	not measured	Winter	Released
4/26/05	80342	OR-082	Present	Female	not measured	Winter	Released
4/26/05	80305	OR-034	Present	Male	943	Winter	Spawned
4/26/05	80306	OR-035	Present	Male	860	Winter	Spawned
4/26/05	80307	OR-036	Present	Male	791	Winter	Spawned
4/26/05	80309	OR-038	Present	Male	863	Winter	Spawned
4/26/05	80316	OR-045	Present	Male	768	Winter	Spawned
4/26/05	80317	OR-046	Present	Male	845	Winter	Spawned
4/26/05	80318	OR-047	Present	Male	710	Winter	Spawned
4/26/05	80324	OR-055	Present	Male	923	Winter	Spawned
4/26/05	80325	OR-056	Present	Male	980	Winter	Spawned
4/26/05	80327	OR-058	Present	Male	875	Winter	Spawned
4/26/05	80329	OR-060	Present	Male	805	Winter	Spawned
4/26/05	80331	OR-062	Present	Male	915	Winter	Spawned
4/26/05	80333	OR-064	Present	Male	872	Winter	Spawned
4/26/05	80336	OR-068	Present	Male	891	Winter	Spawned
4/26/05	80312	OR-041	Present	Male	975	Winter	Released
4/26/05	80314	OR-043	Present	Male	950	Winter	Released
4/26/05	80334	OR-065	Present	Male	805	Winter	Released
4/26/05	80335	OR-066	Present	Male	not measured	Winter	Released
4/26/05	80337	OR-069	Present	Male	not measured	Winter	Released
4/26/05	80341	OR-079	Present	Male	not measured	Winter	Released
4/26/05	80343	OR-084	Present	Male	not measured	Winter	Released
4/26/05	80308	OR-037	Present	Male	808	Winter	DIP
5/10/05	80354	OR-106	Present	Female	775	Winter	Spawned
5/10/05	80360	OR-119	Present	Female	781	Winter	Spawned
5/10/05	80361	OR-120	Present	Female	727	Winter	Spawned
5/10/05	80345	OR-091	Absent	Female	780	Winter	Released
5/10/05	80348	OR-097	Absent	Female	840	Winter	Released

Table 5 (cont.)

Date Captured	Genetic Sample ID	Individual Tag Code	Adipose Fin Status	Sex	Fork Length (mm)	Run Assignment	Final Disposition
5/10/05	80349	OR-099	Absent	Female	820	Winter	Released
5/10/05	80351	OR-102	Absent	Female	820	Winter	Released
5/10/05	80353	OR-107	Absent	Female	760	Winter	Released
5/10/05	80363	OR-122	Absent	Female	620	Winter	Released
5/10/05	80365	OR-126	Absent	Female	730	Winter	Released
5/10/05	80366	OR-128	Absent	Female	730	Winter	Released
5/10/05	80350	OR-101	Present	Male	840	Winter	Spawned
5/10/05	80356	OR-111	Present	Male	500	Winter	Released
5/10/05	80357	OR-113	Present	Male	520	Winter	Released
5/10/05	80362	OR-121	Present	Male	805	Winter	Released
5/10/05	80344	OR-089	Absent	Male	850	Winter	Released
5/10/05	80346	OR-093	Absent	Male	700	Winter	Released
5/10/05	80347	OR-095	Absent	Male	820	Winter	Released
5/10/05	80352	OR-104	Absent	Male	590	Winter	Released
5/10/05	80355	OR-109	Absent	Male	900	Winter	Released
5/10/05	80358	OR-115	Absent	Male	600	Winter	Released
5/10/05	80359	OR-117	Absent	Male	630	Winter	Released
5/10/05	80364	OR-124	Absent	Male	800	Winter	Released
5/10/05	80367	OR-130	Absent	Male	805	Winter	Released
5/10/05	80368	OR-132	Absent	Male	490	Winter	Released
5/10/05	80369	OR-134	Absent	Male	550	Winter	Released
5/10/05	80370	OR-136	Absent	Male	610	Winter	Released
5/31/05	80371	OR-041	Absent	Male	685	Winter	Released
6/7/05	80377	OR-153	Present	Female	780	Winter	Released
6/7/05	80374	OR-147	Partial	Female	700	Winter	Released
6/7/05	80375	OR-149	Absent	Female	910	Winter	Released
6/7/05	80380	OR-159	Absent	Female	770	Winter	Released
6/7/05	80372	OR-143	Absent	Male	790	Winter	Released
6/7/05	80373	OR-145	Absent	Male	610	Winter	Released
6/7/05	80376	OR-151	Absent	Male	880	Winter	Released
6/7/05	80378	OR-155	Absent	Male	595	Winter	Released
6/7/05	80379	OR-157	Absent	Male	900	Winter	Released
6/7/05	80381	OR-161	Present	Female	642	Non-Winter	Released
6/14/05	80385	OR-173	Present	Female	780	Winter	Spawned
6/14/05	80387	OR-176	Present	Female	810	Winter	Spawned
6/14/05	80391	OR-183	Present	Female	890	Winter	Spawned
6/14/05	80392	OR-184	Present	Female	770	Winter	Released
6/14/05	80382	OR-167	Absent	Female	720	Winter	Released
6/14/05	80386	OR-174	Absent	Female	820	Winter	Released
6/14/05	80389	OR-179	Absent	Female	820	Winter	Released
6/14/05	80393	OR-186	Absent	Female	830	Winter	Released
6/14/05	80383	OR-169	Present	Male	810	Winter	Released
6/14/05	80388	OR-177	Present	Male	815	Winter	Released
6/14/05	80384	OR-171	Absent	Male	790	Winter	Released
6/14/05	80390	OR-181	Absent	Male	790	Winter	Released

Table 5 (cont.)

Date Captured	Genetic Sample ID	Individual Tag Code	Adipose Fin Status	Sex	Fork Length (mm)	Run Assignment	Final Disposition
6/14/05	80394	OR-188	Absent	Male	490	Winter	Released
6/14/05	80395	OR-190	Absent	Male	840	Winter	Released
6/21/05	80399	OR-198	Absent	Female	780	Winter	Released
6/21/05	80400	OR-200	Present	Male	915	Winter	Released
6/21/05	80401	OR-202	Present	Male	850	Winter	Released
6/21/05	80396	OR-192	Absent	Male	820	Winter	Released
6/21/05	80398	OR-196	Absent	Male	860	Winter	Released
6/21/05	80402	OR-204	Absent	Male	530	Winter	Released
6/21/05	80403	OR-206	Absent	Male	820	Winter	Released
6/21/05	80397	OR-194	Present	Male	920	Non-Winter	Released
6/28/05	80404	OR-210	Present	Female	760	Winter	Spawned
6/28/05	80414	OR-228	Present	Female	710	Winter	Spawned
6/28/05	80406	OR-213	Absent	Female	760	Winter	Spawned
6/28/05	80407	OR-214	Absent	Female	770	Winter	Spawned
6/28/05	80412	OR-223	Absent	Female	750	Winter	Released
6/28/05	80417	OR-233	Absent	Female	750	Winter	Released
6/28/05	80418	OR-235	Absent	Female	730	Winter	Released
6/28/05	80419	OR-238	Absent	Female	760	Winter	Released
6/28/05	80425	OR-249	Absent	Female	740	Winter	Released
6/28/05	80408	OR-215	Present	Male	624	Winter	Spawned
6/28/05	80409	OR-218	Present	Male	558	Winter	Spawned
6/28/05	80415	OR-229	Present	Male	495	Winter	Spawned
6/28/05	80420	OR-240	Present	Male	543	Winter	Spawned
6/28/05	80411	OR-221	Present	Male	790	Winter	Released
6/28/05	80416	OR-230	Present	Male	750	Winter	Released
6/28/05	80421	OR-241	Present	Male	570	Winter	Released
6/28/05	80410	OR-219	Absent	Male	495	Winter	Released
6/28/05	80422	OR-243	Absent	Male	610	Winter	Released
6/28/05	80423	OR-245	Absent	Male	545	Winter	Released
6/28/05	80424	OR-247	Absent	Male	556	Winter	Released
6/28/05	80426	OR-251	Absent	Male	880	Winter	Released
6/28/05	80427	OR-253	Absent	Male	485	Winter	Released
6/28/05	80428	OR-255	Absent	Male	500	Winter	Released
6/28/05	80413	OR-226	Present	Female	725	Non-Winter	Released
6/28/05	80405	OR-211	Present	Male	730	Non-Winter	Released
7/12/05	80435	OR-272	Absent	Female	850	Winter	Spawned
7/12/05	80430	OR-262	Absent	Female	740	Winter	Released
7/12/05	80432	OR-266	Absent	Female	760	Winter	Released
7/12/05	80433	OR-268	Absent	Female	750	Winter	Released
7/12/05	80434	OR-270	Absent	Female	780	Winter	Released
7/12/05	80436	OR-273	Absent	Female	790	Winter	Released
7/12/05	80437	OR-275	Absent	Female	800	Winter	Released
7/12/05	80438	OR-277	Absent	Female	630	Winter	Released
7/12/05	80439	OR-279	Absent	Female	700	Winter	Released
7/12/05	80429	OR-261	Present	Male	884	Winter	Spawned

Table 5 (cont.)

Date Captured	Genetic Sample ID	Individual Tag Code	Adipose Fin Status	Sex	Fork Length (mm)	Run Assignment	Final Disposition
7/12/05	80431	OR-264	Absent	Male	570	Winter	Released
7/12/05	80440	OR-281	Absent	Male	480	Winter	Released
7/19/05	80441	OR-286	Absent	Female	680	Winter	Released
7/19/05	80442	OR-288	Absent	Female	670	Winter	Released
7/19/05	80443	OR-290	Present	Male	750	Non-Winter	Released

<sup>a</sup> Coleman National Fish Hatchery; <sup>b</sup> dead in pond

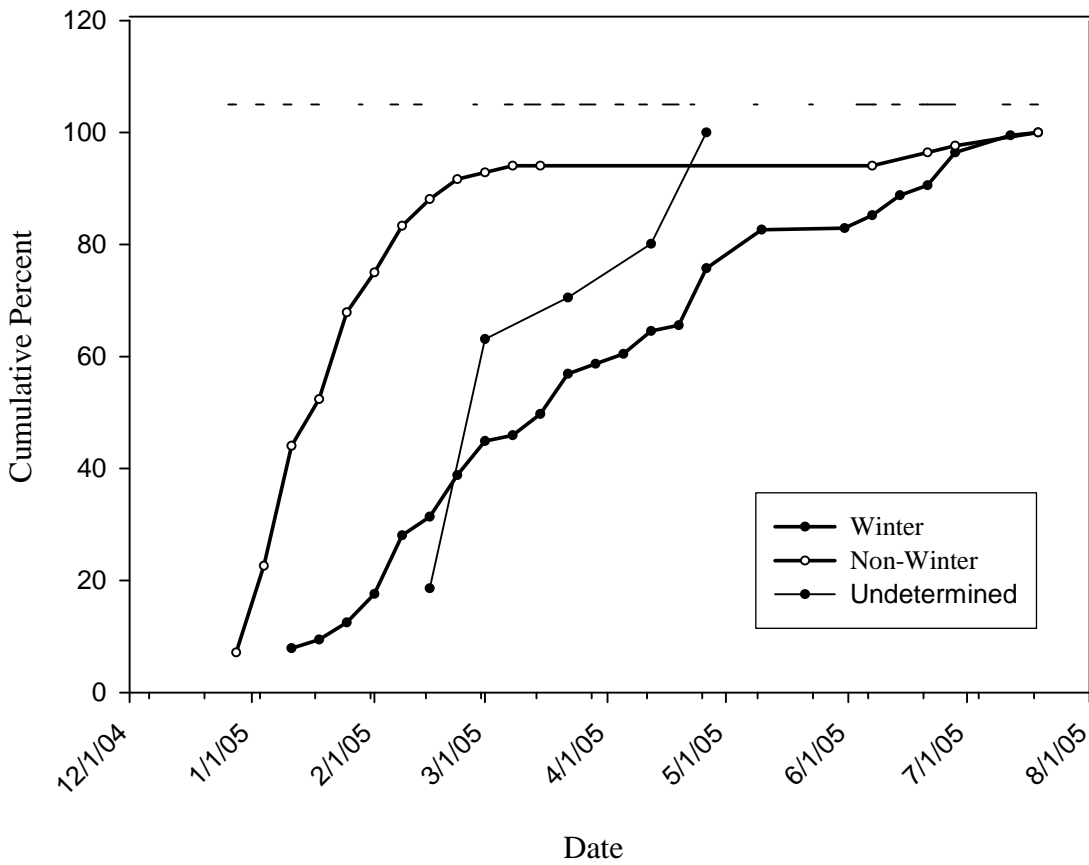


Figure 1. Capture timing of Chinook salmon from Keswick Dam trap by run-type, 2005.

Table 6. Disposition of Chinook salmon trapped at the Keswick Dam trap, January 11, 2005 – July 12, 2005, by run identity and gender. Numbers in parentheses indicate the number of hatchery-origin fish included in the category total.

Run Identity	Disposition	Keswick Trap <sup>a</sup>		
		Total	Males	Females
Winter	Trapped and spawned	95 (3)	44 (0)	51 (3)
Winter	Pre-spawn mortality	14 (1)	9 (0)	5 (1)
Winter	Trapped, quarantined, and released back into river	30 (10)	12 (8)	18 (2)
Winter	Trapped and released back into river without quarantine	254 (213)	104 (85)	150 (128)
	Subtotal	393 (227)	169 (93)	224 (134)
Non-winter	Pre-spawn mortality	0 (0)	0 (0)	0 (0)
Non-winter	Trapped, quarantined, and released back into river	2 (0)	0 (0)	2 (0)
Non-winter	Trapped and released back into river without quarantine	15 (0)	4 (0)	11 (0)
Non-winter	Transferred to Coleman National Fish Hatchery	33 (1)	18 (0)	15 (1)
Non-winter	Euthanized	46 (46)	16 (16)	30 (30)
	Subtotal	96 (47)	38 (16)	58 (31)
Undetermined	Pre-spawn mortality	0 (0)	0 (0)	0 (0)
Undetermined	Trapped, quarantined, and released back into river	0 (0)	0 (0)	0 (0)
Undetermined	Trapped and released back into river without quarantine	320 (302)	269 (256)	51 (46)
	Subtotal	320 (302)	269 (256)	51 (46)
				51
	Total	809 (576)	476 (365)	333 (211)

<sup>a</sup> One non-winter, natural-origin female Chinook was captured at the Red Bluff Diversion Dam trap, quarantined, and released back into the Sacramento River. This fish is included in the table.

## Health

The causative agent of bacterial kidney disease (*Renibacterium salmoninarum*) was present in broodstock from the Sacramento River and Livingston Stone NFH (Table 7). Sacramento River broodstock also tested positive for infectious hematopoietic necrosis virus and *Aeromonas salmonicida* (Table 7).

Table 7. Test results (positive or negative) for fish pathogens in brood year 2005 winter Chinook salmon brood stock and juveniles, conducted by the USFWS California - Nevada Fish Health Center.

Pathogen	Brood stock origin		Juveniles <sup>a</sup> positive / negative
	Sacramento River positive / negative	Livingston Stone Captive positive / negative	
<i>Aeromonas salmonicida</i>	positive	negative	negative
<i>Yersinia ruckeri</i>	negative	negative	negative
<i>Renibacterium salmoninarum</i>	positive	positive	positive
Infectious hematopoietic necrosis virus	positive	negative	negative
Viral hemorrhagic septicemia virus	no test	no test	negative
Infectious pancreatic necrosis virus	no test	no test	negative
<i>Oncorhynchus masou</i> virus	no test	no test	no test
<i>Ceratomyxa shasta</i>	no test	no test	negative
<i>Sphaerothecum destruens</i> (Rosette Agent)	no test	no test	no test

<sup>a</sup> Juvenile progeny of the brood stock origin types were combined for the assay.

## Spawning & Production- Non-captive Broodstock

In 2005, winter Chinook salmon were spawned between April 27 and July 14 and spawning occurred at a relatively constant rate between those dates (Tables 2 and 3, Figure 2). A total of 51 female (Table 2) and 44 male (Table 3) winter Chinook salmon were spawned in 2005 producing 102 family groups (Table 8). Fork length of spawned females ranged from 660 to 890 mm and averaged 789 mm (Table 2). Fork length of spawned males ranged from 495 to 1,000 mm and averaged 833 mm (Table 3). Females produced an average of 5,251 green eggs yielding a total of 267,803 green eggs with 90.9% of these developing into eyed eggs (Table 8). The percent of green eggs that hatched averaged 87.7%, and 73.3% of the green eggs resulted in juveniles that were transferred to rearing tanks (Table 8).

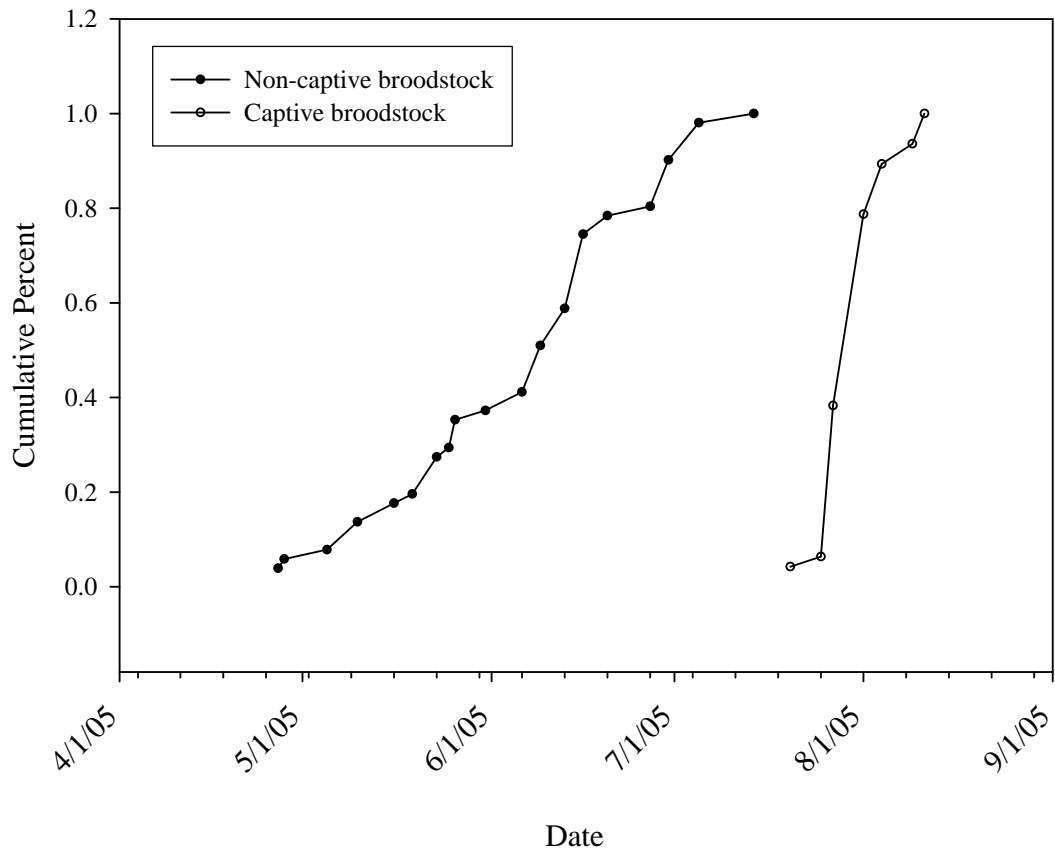


Figure 2. Spawning of winter Chinook salmon at Livingston Stone National Fish Hatchery, 2005.



Table 8. Early survival of eggs and fry from winter Chinook salmon captured from the wild and spawned at Livingston Stone National Fish Hatchery, 2005.

Crosses by tag number		Family Group	Date Spawned	Green Eggs	Eyed Eggs	Percent Eyed	Number Hatched	Percent Green Eggs Hatched	Number Tanked	Percent Tanked from Green Eggs	Percent Tanked from Eyed Eggs
Female	Male										
Y-038	Y-454	1A	4/27/05	3,153	3,018	95.7	2,937	93.1	2,878	91.3	95.4
Y-038	Y-374	1B	4/27/05	1,571	1,530	97.4	1,496	95.2	1,375	87.5	89.9
Y-038	Y-008	1C	4/27/05	1,391	1,360	97.8	1,324	95.2	1,333	95.8	98.0
Y-361	Y-371	2D	4/27/05	1,312	1,212	92.4	1,164	88.7	1,122	85.5	92.6
Y-361	Y-490	2E	4/27/05	1,695	1,518	89.6	1,456	85.9	1,354	79.9	89.2
OR-042	Y-490	3E	4/28/05	2,570	2,555	99.4	2,542	98.9	2,531	98.5	99.1
OR-042	OR-047	3F	4/28/05	3,156	3,112	98.6	3,107	98.4	3,117	98.8	100.2
OR-057	Y-454	4A	5/5/05	2,495	2,413	96.7	2,239	89.7	2,234	89.5	92.6
OR-057	OR-015	4R	5/5/05	3,248	2,896	89.2	2,744	84.5	2,700	83.1	93.2
OR-033	OR-047	5F	5/10/05	3,114	3,083	99.0	3,072	98.7	3,069	98.6	99.5
OR-033	Y-367	5G	5/10/05	3,265	3,233	99.0	3,221	98.7	3,212	98.4	99.4
OR-063	Y-374	6B	5/10/05	3,041	2,192	72.1	1,745	57.4	1,732	57.0	79.0
OR-063	OR-029	6H	5/10/05	3,222	2,115	65.6	1,638	50.8	1,520	47.2	71.9
Y-370	Y-008	7C	5/10/05	2,280	848	37.2	467	20.5	450	19.7	53.1
Y-370	OR-019	7I	5/10/05	1,958	823	42.0	482	24.6	441	22.5	53.6
OR-049	OR-029	8H	5/16/05	3,563	3,459	97.1	3,452	96.9	3,427	96.2	99.1
OR-049	Y-425	8J	5/16/05	3,406	3,337	98.0	3,307	97.1	3,301	96.9	98.9
Y-320	Y-367	9G	5/16/05	2,447	2,354	96.2	2,336	95.5	2,315	94.6	98.3
Y-320	Y-425	9J	5/16/05	2,369	2,339	98.7	2,322	98.0	2,318	97.8	99.1
OR-044	Y-367	10G	5/19/05	2,586	2,353	91.0	2,342	90.6	2,300	88.9	97.7
OR-044	OR-019	10I	5/19/05	2,428	2,129	87.7	2,082	85.7	2,081	85.7	97.7
Y-368	Y-204	11K	5/23/05	2,835	1,735	61.2	1,639	57.8	93	3.3	5.4
Y-368	OR-009	11L	5/23/05	2,839	1,957	68.9	1,800	63.4	106	3.7	5.4
Y-407	OR-029	12H	5/23/05	3,251	3,144	96.7	3,064	94.2	262	8.1	8.3
Y-407	Y-290	12M	5/23/05	3,021	2,862	94.7	2,799	92.7	874	28.9	30.5
Y-462	OR-032	13N	5/23/05	2,507	2,473	98.6	2,463	98.2	936	37.3	37.8
Y-462	Y-426	13O	5/23/05	2,298	2,268	98.7	2,265	98.6	1,736	75.5	76.5
Y-007	OR101	14P	5/23/05	2,812	2,779	98.8	2,769	98.5	745	26.5	26.8
Y-007	OR-056	14Q	5/23/05	2,282	2,270	99.5	2,265	99.3	6	0.3	0.3
OR-050	OR-034	15S	5/25/05	1,471	0	0.0	0	0.0	0	0.0	0.0
OR-050	OR-036	15T	5/25/05	1,791	994	55.5	712	39.8	438	24.5	44.1
OR-018	OR-009	16L	5/26/05	1,714	942	55.0	887	51.8	785	45.8	83.3

Table 8 (cont.)

Crosses by tag number		Family Group	Date Spawned	Green Eggs	Eyed Eggs	Percent Eyed	Number Hatched	Percent Green Eggs Hatched	Number Tanked	Percent Tanked from Green Eggs	Percent Tanked from Eyed Eggs
Female	Male										
OR-018	Y-426	16O	5/26/05	1,555	691	44.4	623	40.1	662	42.6	95.8
OR-119	OR-032	17N	5/26/05	2,945	2,849	96.7	2,807	95.3	2,290	77.8	80.4
OR-119	OR101	17P	5/26/05	2,391	2,239	93.6	2,192	91.7	1,890	79.0	84.4
Y-283	Y-290	18M	5/26/05	2,615	2,527	96.6	2,389	91.4	1,352	51.7	53.5
Y-283	OR-056	18Q	5/26/05	2,849	2,731	95.9	2,543	89.3	988	34.7	36.2
OR-006	OR-009	19L	5/31/05	2,848	2,166	76.1	1,856	65.2	1,733	60.8	80.0
OR-006	Y-426	19O	5/31/05	2,898	2,093	72.2	1,700	58.7	1,525	52.6	72.9
OR-039	Y-204	20K	6/6/05	2,871	1,621	56.5	1,603	55.8	1,578	55.0	97.3
OR-039	Y-413	20U	6/6/05	2,847	2,506	88.0	2,488	87.4	2,408	84.6	96.1
OR-059	OR-068	21V	6/6/05	2,990	2,750	92.0	2,671	89.3	2,603	87.1	94.7
OR-059	Y-384	21W	6/6/05	2,824	2,482	87.9	2,420	85.7	2,408	85.3	97.0
Y-461	Y-413	22U	6/9/05	2,526	2,417	95.7	2,404	95.2	2,403	95.1	99.4
Y-461	Y-192	22X	6/9/05	2,173	2,076	95.5	2,053	94.5	2,041	93.9	98.3
Y-276	Y-384	23W	6/9/05	2,649	2,640	99.7	2,637	99.5	2,596	98.0	98.3
Y-276	Y-410	23Y	6/9/05	2,500	2,490	99.6	2,487	99.5	2,456	98.2	98.6
Y-280	Y-290	24M	6/9/05	3,351	3,308	98.7	3,255	97.1	897	26.8	27.1
Y-280	OR-032	24N	6/9/05	2,946	2,919	99.1	2,870	97.4	351	11.9	12.0
Y-493	OR-068	25V	6/9/05	2,327	1,695	72.8	1,614	69.4	750	32.2	44.2
Y-493	Y-372	25Z	6/9/05	2,300	1,364	59.3	1,269	55.2	572	24.9	41.9
OR-061	OR-068	26V	6/9/05	2,776	2,574	92.7	2,526	91.0	2,503	90.2	97.2
OR-061	Y-373	26AA	6/9/05	3,178	2,909	91.5	2,875	90.5	2,851	89.7	98.0
OR-048	Y-372	27Z	6/13/05	2,074	1,671	80.6	1,573	75.8	1,555	75.0	93.1
OR-048	Y-373	27AA	6/13/05	2,620	2,025	77.3	1,931	73.7	1,944	74.2	96.0
OR-008	Y-413	28U	6/13/05	1,635	1,341	82.0	1,006	61.5	955	58.4	71.2
Y-199	OR-046	29BB	6/13/05	2,812	2,799	99.5	2,794	99.4	2,786	99.1	99.5
Y-199	Y-474	29CC	6/13/05	2,583	2,571	99.5	2,565	99.3	2,519	97.5	98.0
Y-228	Y-192	30X	6/13/05	2,637	2,624	99.5	2,599	98.6	2,552	96.8	97.3
Y-228	OR-035	30DD	6/13/05	2,829	2,814	99.5	2,774	98.1	2,763	97.7	98.2
OR-176	Y-372	31Z	6/16/05	3,334	3,313	99.4	3,310	99.3	1,537	46.1	46.4
OR-176	OR-055	31EE	6/16/05	3,009	2,946	97.9	2,937	97.6	2,935	97.5	99.6
OR-183	Y-410	32Y	6/16/05	3,256	3,230	99.2	3,208	98.5	2,507	77.0	77.6
OR-183	OR-058	32FF	6/16/05	3,186	2,991	93.9	2,962	93.0	2,931	92.0	98.0
OR-173	Y-410	33Y	6/16/05	2,339	2,227	95.2	2,144	91.7	2,084	89.1	93.6

Table 8 (cont.)

Crosses by tag number		Family Group	Date Spawned	Green Eggs	Eyed Eggs	Percent Eyed	Number Hatched	Percent Green Eggs Hatched	Number Tanked	Percent Tanked from Green Eggs	Percent Tanked from Eyed Eggs
Female	Male										
OR-173	OR-062	33GG	6/16/05	2,708	2,471	91.2	2,356	87.0	2,319	85.6	93.8
OR-007	Y-474	34CC	6/16/05	2,871	2,856	99.5	2,839	98.9	2,821	98.3	98.8
OR-007	OR-060	34HH	6/16/05	2,500	2,496	99.8	2,490	99.6	2,386	95.4	95.6
Y-336	OR-060	35HH	6/16/05	3,289	3,114	94.7	3,053	92.8	3,023	91.9	97.1
Y-336	OR-045	35II	6/16/05	2,680	2,563	95.6	2,534	94.6	2,554	95.3	99.6
Y-366	Y-192	36X	6/16/05	3,108	3,079	99.1	3,062	98.5	3,061	98.5	99.4
Y-366	OR-045	36II	6/16/05	2,995	2,947	98.4	2,937	98.1	2,810	93.8	95.4
Y-378	OR-035	37DD	6/16/05	3,267	3,232	98.9	3,229	98.8	3,238	99.1	100.2
Y-378	OR-038	37JJ	6/16/05	3,157	3,003	95.1	2,997	94.9	2,968	94.0	98.8
OR-120	Y-373	38AA	6/16/05	2,719	2,587	95.1	2,568	94.4	2,529	93.0	97.8
OR-120	OR-046	38BB	6/16/05	2,560	2,454	95.9	2,420	94.5	2,397	93.6	97.7
Y-397	Y-379	39KK	6/20/05	1,198	893	74.5	733	61.2	725	60.5	81.2
Y-397	OR-064	39LL	6/20/05	1,229	971	79.0	898	73.1	752	61.2	77.4
OR-040	OR-058	40FF	6/20/05	2,460	2,440	99.2	2,423	98.5	2,436	99.0	99.8
OR-040	OR-038	40JJ	6/20/05	2,019	2,000	99.1	1,995	98.8	1,897	94.0	94.9
OR-106	OR-055	41EE	6/27/05	2,523	2,517	99.8	2,506	99.3	2,506	99.3	99.6
OR-106	OR-062	41GG	6/27/05	2,944	2,925	99.4	2,917	99.1	2,894	98.3	98.9
OR-214	OR-215	42MM	6/30/05	3,243	3,220	99.3	3,214	99.1	3,216	99.2	99.9
OR-214	OR-229	42NN	6/30/05	2,382	2,365	99.3	2,355	98.9	2,342	98.3	99.0
OR-213	OR-240	43OO	6/30/05	2,742	2,707	98.7	2,691	98.1	2,565	93.5	94.8
OR-213	OR-218	43PP	6/30/05	2,742	2,672	97.4	2,643	96.4	2,580	94.1	96.6
OR-228	OR-215	44MM	6/30/05	1,944	1,876	96.5	1,023	52.6	44	2.3	2.3
OR-228	OR-229	44NN	6/30/05	1,888	1,782	94.4	925	49.0	257	13.6	14.4
Y-363	OR-058	45FF	6/30/05	2,062	1,579	76.6	1,350	65.5	1,305	63.3	82.6
Y-363	OR-062	45GG	6/30/05	3,045	2,661	87.4	2,514	82.6	1,917	63.0	72.0
Y-362	Y-379	46KK	6/30/05	2,323	2,307	99.3	2,292	98.7	171	7.4	7.4
Y-362	OR-064	46LL	6/30/05	2,295	2,253	98.2	2,245	97.8	106	4.6	4.7
Y-229	OR-240	47OO	7/5/05	3,343	3,287	98.3	3,273	97.9	2,590	77.5	78.8
Y-229	OR-014	47QQ	7/5/05	4,116	4,019	97.6	4,000	97.2	1,834	44.6	45.6
OR-210	OR-218	48PP	7/5/05	2,730	2,661	97.5	2,643	96.8	2,728	99.9	102.5
OR-210	OR-014	48QQ	7/5/05	2,373	2,301	97.0	2,282	96.2	2,266	95.5	98.5
Y-414	OR-046	49BB	7/5/05	3,131	3,106	99.2	3,089	98.7	3,095	98.9	99.6
Y-414	Y-379	49KK	7/5/05	2,989	2,969	99.3	2,965	99.2	2,937	98.3	98.9

Table 8 (cont.)

Crosses by tag number		Family	Date	Green	Eyed	Percent	Number	Percent Green	Number	Percent Tanked	Percent Tanked
Female	Male	Group	Spawned	Eggs	Eggs	Eyed	Hatched	Eggs Hatched	Tanked	from Green Eggs	from Eyed Eggs
Y-460	OR-055	50EE	7/5/05	2,730	2,716	99.5	2,714	99.4	2,686	98.4	98.9
Y-460	OR-038	50JJ	7/5/05	2,589	2,545	98.3	2,543	98.2	2,536	98.0	99.6
OR-272	OR-014	51QQ	7/14/05	2,605	2,553	98.0	2,548	97.8	2,521	96.8	98.7
OR-272	OR-261	51RR	7/14/05	2,540	2,496	98.3	2,493	98.1	2,483	97.8	99.5
Totals				267,803	243,525	.	234,982	.	196,211	.	.
Averages				5,251 <sup>b</sup>	4,775 <sup>b</sup>	90.9%	4,607 <sup>b</sup>	87.7%	3,847 <sup>b</sup>	73.3%	80.6

a Numbers of eggs, eggs hatched, and fish tanked are estimated. Error inherent in the estimates can result in anomalous results such as more fry tanked than there were eyed-eggs. <sup>b</sup> Averages derived from the number of females spawned (n = 51), not the number of family groups.

### *Spawning & Production- Captive Broodstock*

Captive-origin females were spawned with natural-origin males at Livingston Stone NFH July 20 through August 11 (Table 9, Figure 2). Spawn timing of captive-origin females was much more truncated than that observed in natural-origin females. A total of 46 captive-origin female and 24 natural-origin male winter Chinook salmon were spawned producing 47 family groups (Table 9). Forty of the 47 family groups were created with cryopreserved sperm. Females produced an average of 1,088 green eggs yielding a total of 50,063 green eggs with 40.0% of these developing into eyed eggs (Table 9). The percent of green eggs that hatched averaged 33.7%, and 30.1% of the green eggs resulted in juveniles that were transferred to rearing tanks (Table 9).

Table 9. Early survival of eggs and fry from winter Chinook salmon crosses of captive-brood females and natural-origin males, 2005.

Crosses by tag number		Family Group	Date Spawned	Green Eggs	Eyed Eggs	Percent Eyed	Number Hatched	Percent Green Eggs Hatched	Number Tanked	Percent Tanked from Green Eggs	Percent Tanked from Eyed Eggs
Female	Male										
443F7406D6A	Y-410	L1Y	7/20/05	407	358	88.0	338	83.0	348	85.5	97.2
443F7406D6A	Y-379	L1KK	7/20/05	448	371	82.8	345	77.0	325	72.5	87.6
4440370454	Y-413	L2U	7/25/05	938	117	12.5	95	10.1	59	6.3	50.4
434B6F7421	Y-413	L3U	7/27/05	1,112	490	44.1	476	42.8	462	41.5	94.3
431E1E0D09	Y-413	L4U	7/27/05	1,510	808	53.5	797	52.8	777	51.5	96.2
43486A4574	Y-413	L5U	7/27/05	1,338	471	35.2	381	28.5	316	23.6	67.1
444008164D	Y-413	L6U	7/27/05	1,013	40	3.9	33	3.3	31	3.1	77.5
4441524427	OR-101	L7Pcr	7/27/05	1,243	807	64.9	602	48.4	463	37.2	57.4
4323322444	OR-101	L8Pcr	7/27/05	1,323	960	72.6	940	71.1	920	69.5	95.8
4440095620	Y-204	L9Kcr	7/27/05	1,206	132	10.9	80	6.6	53	4.4	40.2
4440581474	Y-204	L10Kcr	7/27/05	1,022	111	10.9	64	6.3	51	5.0	45.9
4441295544	OR-209	L11Lcr	7/27/05	938	752	80.2	725	77.3	668	71.2	88.8
444149212C	OR-209	L12Lcr	7/27/05	973	689	70.8	628	64.5	202	20.8	29.3
434F7B270B	Y-426	L13Ocr	7/27/05	1,102	522	47.4	296	26.9	311	28.2	59.6
4440112D4E	Y-426	L14Ocr	7/27/05	1,160	685	59.1	628	54.1	573	49.4	83.6
4350044B7A	Y-367	L15Ger	7/27/05	964	655	67.9	620	64.3	249	25.8	38.0
4440246F60	Y-367	L16Ger	7/27/05	1,014	381	37.6	328	32.3	304	30.0	79.8
4440380C3A	OR-029	L17Hcr	7/27/05	857	368	42.9	351	41.0	338	39.4	91.8
444159430	Y-008	L18Ccr	8/1/05	1,227	654	53.3	602	49.1	598	48.7	91.4
NO TAG	Y-008	L19Ccr	8/1/05	1,251	592	47.3	466	37.3	342	27.3	57.8
434E040D2A	Y-490	L20Ecr	8/1/05	1,795	898	50.0	374	20.8	391	21.8	43.5
4440493C49	Y-490	L21Ecr	8/1/05	534	369	69.1	228	42.7	211	39.5	57.2
4441466567	Y-374	L22Bcr	8/1/05	650	143	22.0	107	16.5	97	14.9	67.8
4444362231	Y-374	L23Bcr	8/1/05	857	332	38.7	241	28.1	197	23.0	59.3
443F793861	Y-454	L24Acr	8/1/05	1,001	571	57.0	481	48.1	461	46.1	80.7
434951012C	Y-454	L25Acr	8/1/05	975	400	41.0	327	33.5	158	16.2	39.5
NO TAG	OR-047	L26Fer	8/1/05	1,237	702	56.8	663	53.6	656	53.0	93.4
4441567278	OR-047	L27Fer	8/1/05	1,214	704	58.0	642	52.9	619	51.0	87.9
444137533A	OR-032	L28Ncr	8/1/05	1,173	392	33.4	336	28.6	308	26.3	78.6
43525F7C54	OR-032	L29Ncr	8/1/05	822	576	70.1	491	59.7	552	67.2	95.8
444142356C	Y-290	L30Mcr	8/1/05	955	154	16.1	93	9.7	84	8.8	54.5
4351287838	Y-290	L31Mcr	8/1/05	600	133	22.2	120	20.0	110	18.3	82.7
434825231E	Y-413	L32Ucr	8/1/05	1,061	304	28.7	165	15.6	221	20.8	72.7

Table 9 (cont.)

Crosses by tag number		Family Group	Date Spawned	Green Eggs	Eyed Eggs	Percent Eyed	Number Hatched	Percent Green Eggs Hatched	Number Tanked	Percent Tanked from Green Eggs	Percent Tanked from Eyed Eggs
Female	Male										
434C223F68	Y-413	L33Ucr	8/1/05	897	408	45.5	356	39.7	329	36.7	80.6
4440313676	OR-068	L34Vcr	8/1/05	958	367	38.3	292	30.5	260	27.1	70.8
434B424E76	OR-068	L35Vcr	8/1/05	1,404	573	40.8	476	33.9	426	30.3	74.3
4441420F63	Y-372	L36Zcr	8/1/05	515	116	22.5	115	22.3	96	18.6	82.8
4322466813	OR-035	L37DDcr	8/4/05	1,240	0	0.0	0	0.0	0	0.0	0.0
434C0F0628	OR-035	L38DDcr	8/4/05	1,316	0	0.0	0	0.0	0	0.0	0.0
434B763E05	Y-372	L39Zcr	8/4/05	1,070	262	24.5	205	19.2	183	17.1	69.8
4322334B05	Y-192	L40Xcr	8/4/05	1,640	569	34.7	500	30.5	486	29.6	85.4
444011104C	Y-192	L41Xcr	8/4/05	1,002	325	32.4	294	29.3	269	26.8	82.8
434F784413	OR-046	L42AAcr	8/9/05	1,190	52	4.4	49	4.1	49	4.1	94.2
44402E3D63	OR-046	L43AAcr	8/9/05	1,124	51	4.5	50	4.4	49	4.4	96.1
43500F1531	OR-240	L44OOcr	8/11/05	1,339	883	65.9	814	60.8	784	58.6	88.8
4441433162	OR-240	L45OOcr	8/11/05	1,298	524	40.4	449	34.6	484	37.3	92.4
434A636E12	OR-055	L46EEcr	8/11/05	1,150	273	23.7	222	19.3	219	19.0	80.2
Totals				50,063	20,044	.	16,885	.	15,089	.	.
Averages				1,088 <sup>a</sup>	436 <sup>a</sup>	40.0	367 <sup>a</sup>	33.7	328 <sup>a</sup>	30.1	75.3

<sup>a</sup> Averages derived from the number of females spawned (n = 46), not the number of family groups.

## **Progeny**

### *Rearing*

Between the dates of initial feeding (July 12, 2005) and release (February 2, 2006), progeny of non-captive parents were fed a total of 2,259 pounds of fish feed, resulting in a total weight gain by the fish of 2,649 pounds (food conversion rate of 0.85). The average length increase of the fish from time of initial feeding to release was 59.6 mm.

Between the dates of initial feeding (October 1, 2005) and release (February 2, 2006), progeny of captive-females were fed a total of 117 pounds of fish feed, resulting in a total weight gain by the fish of 129 pounds (food conversion rate 0.91). The average length increase of the fish from time of initial feeding to release was 46.0 mm.

### *Marking and Tagging*

Coded-wire tagging of juvenile winter Chinook occurred between December 20, 2005 and January 16, 2006. At the time of tagging, adipose fins were removed from all fish so they could easily be identified as hatchery-origin fish upon return. Juveniles tagged and marked included: 141,230 natural-origin × natural-origin progeny, 10,090 natural-origin × hatchery-origin progeny, and 12,614 captive-origin × natural-origin progeny (Table 4). The marking and tagging mortality rate for all groups was less than 0.5%.

### *Health*

Juvenile progeny of all broodstock types (Sacramento River, Livingston Stone NFH, BML) were combined and tested for seven different pathogens. The only positive test result was for *Renibacterium salmoninarum* (Table 7).

### *Released*

A total of 173,344 juvenile winter Chinook were released at Caldwell Park (river mile 299) on February 2, 2006. Most (86.5%) of the fish released were from natural-origin × natural-origin parents, 5.9% were from natural-origin × hatchery-origin crosses and 7.5% were captive-origin × natural-origin crosses.

## **Assessment of Potential Genetic Impacts**

When brood year 2005 hatchery propagation data was applied to the population genetics model (Hedrick et al. 1995), the model indicated loss of genetic variation due to genetic drift was not likely to occur (Attachment A). Under the scenario that 10% of the naturally-spawning population was successful at producing progeny, the hatchery program increased the effective population size from 1,573 to 1,597 spawners. Under the scenario that 33% of the population was successful at producing progeny, the hatchery program increased the effective population size from 5,238 to 5,250 individuals.



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**Attachment A-- Brood Year 2005 Effective Population Size Methodology, Estimates, and Assumptions**

(Note: In the event of a data discrepancy, data presented in the Propagation Report supercedes data in the following attachment.)