California Department of Fish and Game

Klamath River Project

Recovery of Fall-run Chinook and Coho Salmon at Iron Gate Hatchery

September 24, 2010 to December 15, 2010

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ABSTRACT

A total of 11,347 fall-run Chinook salmon, (Chinook, *Oncorhynchus tshawytscha,* entered Iron Gate Hatchery (IGH) during the fall 2010 spawning season from September 24, 2010 through November 29, 2010. Klamath River Project (KRP) staff systematically (random) sampled 1 in every 10 Chinook as well as all adipose-clipped (AD) Chinook during recovery efforts, for a sample size of 1,980. Scale samples, sex, and fork length data were collected for all sampled Chinook. Analysis of the length-frequency distribution for randomly sampled Chinook males indicates that the cutoff point between grilse and adults occurred at ≤ 62 cm fork length. Randomly sampled male Chinook ranged in size from 48 to 105 cm. fork length, and randomly sampled female Chinook ranged from 60 to 94 cm. fork length. Based on length frequency analysis, KRP staff estimated that 9.4% (1,071) of the run were grilse. Females accounted for 50.2% (5,692) of the run while males accounted for 49.8% (5,655). The 2010 return of fall Chinook to IGH contributed roughly 10.5% to the total (Klamath basin) in-river run and 16.3% to the total spawner escapement. Based on coded wire tag expansion, KRP staff estimated that 94% of the Chinook entering IGH during the 2010 season were of hatchery origin.

485 coho salmon (coho, *Oncorhynchus kisutch*) entered IGH during the 2010-11 spawning season. The recorded dates for the coho run were from October 21, 2010 to December 15, 2010. KRP staff collected biological data (sex, fork length, presence of marks or clips, scale samples, and tissue sample) on 431 coho that entered the hatchery, including some that were not held but released to the river, and otoliths from coho used for spawning. Males ranged in size from 34 to 80 cm. fork length, while females ranged in size from 46 to 80 cm. fork length. Based on the length frequency distribution of 111 male coho, grilse were estimated to be ≤ 58 cm. fork length. Of the 111 males sampled by the KRP, 15 (13.5%) were estimated to be grilse. IGH counts for the 2010-11 coho spawning season included 235 adult females, 193 adult males, and 57 grilse. Of 258 coho sampled by KRP staff (spawned fish or pre-spawning mortality) 222 (86%) had left maxillary clips and 36 (14%) had no clips. One right maxillary-clipped (Trinity River Hatchery) coho grilse entered IGH but was not used for spawning. No adipose-clipped or coded wire tagged coho were recovered at IGH during the 2010 season. In 2010, coho were spawned at IGH using a spawning matrix provided weekly by NOAA Fisheries Salmon Genetics Repository in Santa Cruz, CA., using tissue samples obtained from coho as they entered IGH. These sampled fish were Floy-tagged and held for possible spawning upon receipt of genetic results.

INTRODUCTION

Iron Gate Hatchery

The Iron Gate Hatchery (IGH) is located adjacent to the Klamath River (river mile 190), in Siskiyou County, CA, approximately 120 miles north of Redding, near the Oregon border (Figure 1). This hatchery was established in 1963 to mitigate for loss of habitat between Iron Gate Dam and Copco Dam. The production goals for the hatchery are listed in Table 1 (CDFG and PP&L 1996).

Table 1. Production goals for anadromous salmonid releases from Iron Gate Hatchery, Klamath River.

Species	Number released	Released	Run timing
Chinook Salmon	5,100,000 smolts	May-June	mid September to early November
	900,000 yearlings	November	
Coho	75,000 yearlings	March	late October to early January
Steelhead	200,000 yearlings	March-May	November to March

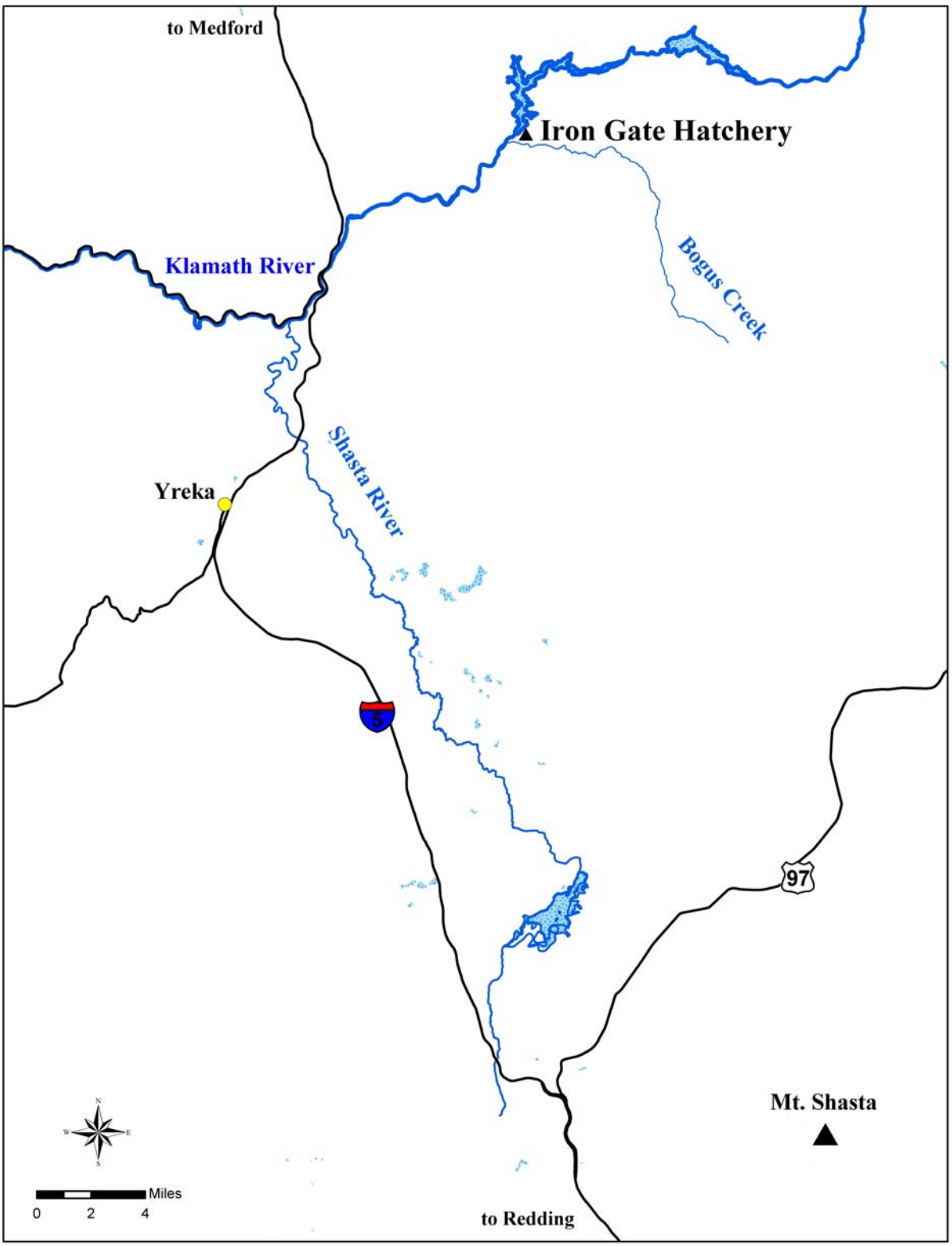

Figure 1. Location of Iron Gate Hatchery, Siskiyou County, California.

Klamath River Project

The California Department of Fish and Game's (CDFG), Klamath River Project (KRP) conducts systematic random sampling of fall-run Chinook (Chinook) salmon annually during the Chinook spawning season. The purpose of the sampling is to characterize the adult Chinook entering IGH in terms of age and sex composition, and to recover data from all coded wire tags (CWT) recovered from the heads of adipose fin clipped (AD) Chinook. All Chinook tagged at IGH are marked with an adipose fin clip to identify the CWT salmon when they return to the hatchery or other locations during subsequent spawning seasons. Data from CWT fish provide a reference of known-age fish which is used, along with scale samples and analysis of length frequency distribution, to determine the age composition of the run. KRP staff also sample coho salmon that enter IGH, typically from mid October through December.

Coded Wire Tagging

2010 was the second year of 25 percent constant fractional marking at IGH. A total of 1,374,458 juvenile Chinook (1,119,054 to be released as fingerlings and 220,501 to be released as yearlings) were adipose clipped and coded wire tagged in 2010, which represented 25 percent of the total releases of 4,528,056 fingerlings and 855,000 yearlings. The smolt release groups each had a unique tag code, and the yearling groups (a portion of each raceway was retained to be released as yearlings) shared one tag code. In 2010, tagging operations at IGH were conducted by Pacific States Marine Fisheries Commission personnel in collaboration with CDFG.

Release of the Chinook smolts are subject to constraints including a target minimum size at release (defined as 90/lb) and minimum river temperatures. (CDFG, PP&L 1996) If minimum river temperatures exceed 65 degrees F, the smolts may be released at a size smaller than 90/lb.

Prior to the acquisition of a marking trailer, from 1978 to 2008, staff of the KRP tagged between 300,000 and 400,000 juvenile Chinook salmon yearly, which represented 3 to 9 percent of the release groups.

MATERIALS AND METHODS

Chinook Salmon

Starting in 1997 all Chinook entering the fish ladders have been allowed to enter IGH. Upon entering the hatchery, Chinook were held until they were ready to spawn. Readiness to spawn was determined by hatchery staff and based on timing, firmness of the ovaries, and ease of stripping eggs when handled. KRP staff conducted a systematic random sample of every 10th Chinook during each sampling day. A KRP employee was designated each day to identify every 10th Chinook on the process line, as well as all AD Chinook. These random and non-random fish were set aside for sampling. Sampling included collection of data on fork length, sex, and presence or

absence of clips and/or marks. Chinook used for spawning were identified as “spawned” by KRP staff. All Chinook leaving the hatchery building were put on ice and trucked to a processing plant for eventual distribution.

Heads were taken from all AD Chinook (random and non-random fish) as well as data on fork length and sex, and scale samples. Heads collected from ad-clipped fish were run through a tag detector prior to freezing, and whether a tag was detected was noted on the data sheets. All heads were sent to the KRP’s Arcata office for tag extraction and reading.

Coho Salmon

As coho salmon (coho) entered IGH in 2010, hatchery personnel examined the fish for clips or tags, identified the sex, then sent the fish to the sorting table, where KRP staff measured fork length, collected tissue samples and applied floy tags with unique numerical codes. The floy-tagged fish were then sent to hatchery holding tanks, and the tissue samples and corresponding floy tag numbers and sex and fork length information were sent via overnight Federal Express to the NOAA Fisheries Salmon Genetics Repository in Santa Cruz, CA. Using these samples, NOAA staff developed a spawning matrix designed to minimize the spawning of closely related individuals. The resulting weekly matrix, sent via e-mail to the KRP, displayed a series of columns with floy tag numbers of female coho at the top of each column, and floy tag numbers of males in descending order of spawning suitability for that female. Males which were determined to be too closely related to spawn with any given female were denoted with an asterisk as “do not spawn” and were listed at the bottom of each column.

On subsequent spawning days, coho were brought into the hatchery from the holding tanks and spawning readiness was determined by IGH personnel. Each female which was determined ready to spawn was killed and held on the spawning table; then as spawning-ready males were brought in, floy tag numbers were matched with the spawning matrix to find the best-suited male for each female. All coho crosses were 1 x 1 (one male to one female). IGH personnel tracked the pairings of marked vs. unmarked individuals (LM x LM, LM x unmarked, unmarked x unmarked, etc.). KRP staff recorded information on the spawned pairs, including sex ,fork length and presence of any clips or marks. Scales, tissue samples and otoliths were collected from all spawned coho.

After IGH reached its egg-taking goal, all coho not used in spawning were released into the river. KRP personnel recorded the floy tag numbers of released fish. Any returns of released floy-tagged released coho were recorded as well. All coho tissue samples were sent at the end of the season to the NOAA facility in Santa Cruz.

RESULTS

Chinook Salmon

Chinook began entering IGH on September 24, 2010. A total of 11,347 Chinook returned to IGH during the fall 2010 spawning season. Of these, KRP staff collected scale samples, determined sex, and measured fork lengths for 1,980 Chinook. Randomly sampled male Chinook ranged in size from 48 to 105 cm. fork length (Figure 2), and randomly sampled female Chinook ranged from 60 to 94 cm. fork length (Figure 3). Analysis of the length frequency distribution for 575 randomly sampled Chinook males indicated that the cutoff point between grilse and adults occurred at ≤ 62 cm. in fork length, yielding approximately 9.4% grilse. Therefore, staff estimates that 1,071 grilse and 10,276 adults entered IGH during the 2010 season. Females accounted for 50.2% (5,692) of the run and males accounted for 49.8% (5,655). The last Chinook of the season entered IGH on November 29, 2010.

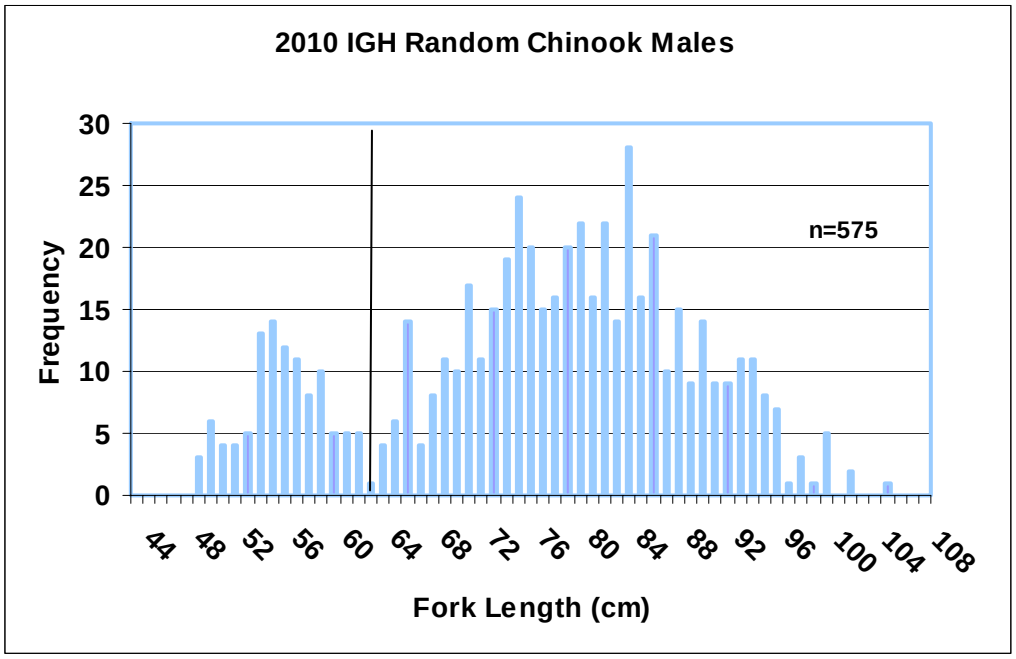

Figure 2. Length frequency distribution for systematic sample of male Chinook salmon recovered at IGH during the 2010 spawning season.

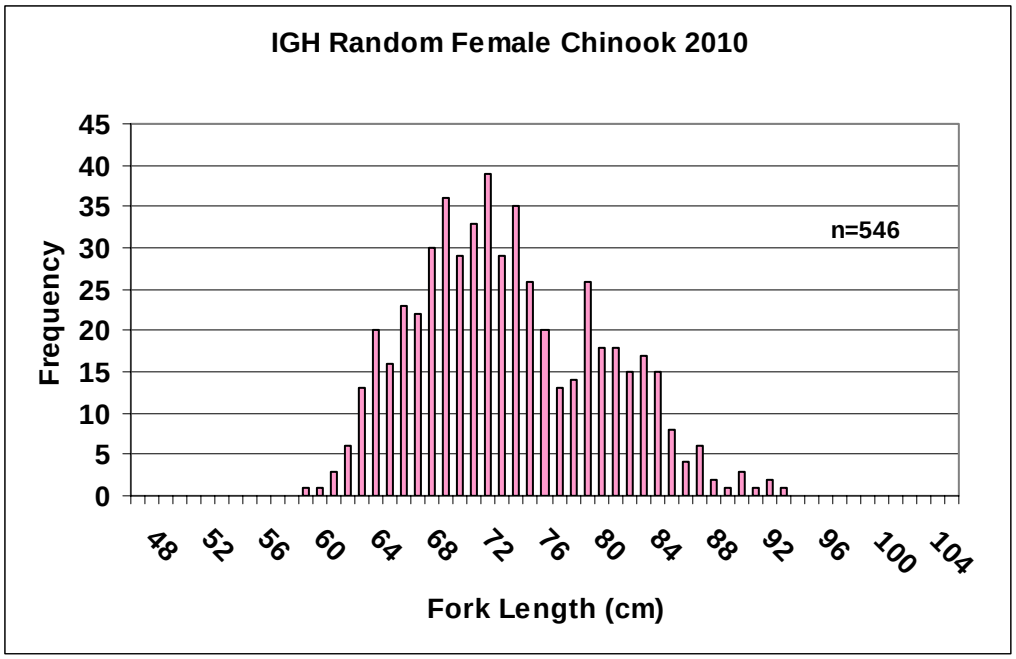

Figure 3. Length frequency distribution for systematic sample of female Chinook salmon recovered at IGH during the 2010 spawning season.

Heads from 950 AD Chinook (from random and non-random fish) were collected for CWT recovery. Of these, 53 CWTs were lost during dissection and 4 CWTs were unreadable. The contribution of lost or unreadable CWTs was estimated by applying the proportions of known CWTs (878) to the 57 lost or unreadable CWTs. (Table 2). There were also 14 AD Chinook with no CWT, indicating that the tags had been shed. There was no expansion done for these codes, as the shed rate is determined by quality control prior to release of each tag group, and this shed tag rate is expanded for the entire release group and incorporated into the production multiplier. In 2010, AD Chinook with shed tags represented 1.47% of the AD returns.

The estimated contribution of unknown CWTs was then added to the contribution of known CWTs to determine the total contribution of hatchery Chinook entering IGH . All but 3 of the 878 CWTs recovered (and successfully read) originated from IGH**,** and the remaining 3 originated from Trinity River Hatchery (TRH). Based on the expansion of CWTs, KRP staff estimated that 94% of the Chinook entering IGH during the 2010 season were of hatchery origin. Of the expanded CWT returns in 2010, 3,693 (37%) were from yearling release groups and 6,278 (63%) were from smolt release groups (Table 3).

Table 2. Estimated contribution of 57 Ad-clipped Chinook salmon with unknown coded wire tag (CWT) codes (lost or unreadable) that were recovered at Iron Gate Hatchery (IGH) based on the proportional distribution of known CWTs recovered at IGH during the 2010 season.

Estimated contribution of 57 Ad-clipped Chinook salmon with unknown coded wire tag (CWT) codes (lost or unreadable) that were recovered at Iron Gate Hatchery (IGH) based on the proportional distribution of known CWTs recovered at IGH during the 2010 season.						
CWT	**BY**	**# CWTs Recovered**	**Proportion of CWTs recovered**	**Estimated Number**	**Production Multiplier**	**Expanded Estimate**
601020607	2005	1	0.001138952	0.06492	9.22	**1**
601020608	2006	11	0.012528474	0.71412	20.81	**15**
601020609	2006	18	0.020501139	1.16856	15.93	**19**
601020700	2006	7	0.007972665	0.45444	16.61	**8**
601020701	2006	13	0.014806378	0.84396	16.54	**14**
601020702	2006	15	0.017084282	0.97380	16.65	**16**
601020703	2006	14	0.015945330	0.90888	18.23	**17**
601020704	2006	212	0.241457859	13.76310	9.58	**132**
608020000	2007	32	0.036446469	2.07745	19.84	**41**
608020001	2007	52	0.059225513	3.37585	18.10	**61**
608020002	2007	20	0.022779043	1.29841	15.93	**21**
608020003	2007	39	0.044419134	2.53189	16.26	**41**
608020004	2007	49	0.055808656	3.18109	16.66	**53**
608020005	2007	47	0.053530752	3.05125	17.59	**54**
608020006	2007	152	0.173120729	9.86788	10.64	**105**
065353	2006	1	0.001138952	0.06492	3.99	**0**
065361	2006	1	0.001138952	0.06492	4.05	**0**
68809	2007	1	0.001138952	0.06492	4.07	**0**
068642	2008	9	0.010250569	0.58428	4.02	**2**
068643	2008	10	0.011389522	0.64920	4.02	**3**
068644	2008	25	0.028473804	1.62301	4.03	**7**
068645	2008	48	0.054669704	3.11617	4.02	**13**
068646	2008	45	0.051252847	2.92141	4.03	**12**
068647	2008	49	0.055808656	3.18109	4.06	**13**
068648	2008	5	0.005694761	0.32460	4.02	**1**
068661	2008	1	0.001138952	0.06492	4.02	**0**
068662	2008	1	0.001138952	0.06492	4.03	**0**
Totals		**878**	**1.0000**	**57**		**647**

Table 3. Estimated contribution of hatchery origin Chinook salmon that returned to Iron Gate Hatchery during the 2010 spawning season.

CWT	Release Location	Brood Year	Age	Release Type	Number Recovered	Production Multiplier	Expanded Estimate
Estimated contribution of known CWTs:							
601020607	IGH	2005	**5**	Fy	1	9.22	**9**
601020608	IGH	2006	**4**	Ff	11	20.81	**229**
601020609	IGH	2006	**4**	Ff	18	15.93	**287**
601020700	IGH	2006	**4**	Ff	7	16.61	**116**
601020701	IGH	2006	**4**	Ff	13	16.54	**215**
601020702	IGH	2006	**4**	Ff	15	16.65	**250**
601020703	IGH	2006	**4**	Ff	14	18.23	**255**
601020704	IGH	2006	**4**	Fy	212	9.58	**2,031**
608020000	IGH	2007	**3**	Ff	32	19.84	**635**
608020001	IGH	2007	**3**	Ff	52	18.10	**941**
608020002	IGH	2007	**3**	Ff	20	15.93	**319**
608020003	IGH	2007	**3**	Ff	39	16.26	**634**
608020004	IGH	2007	**3**	Ff	49	16.66	**816**
608020005	IGH	2007	**3**	Ff	47	17.59	**827**
608020006	IGH	2007	**3**	Fy	152	10.64	**1,617**
065353	TRH	2006	**4**	Ff	1	3.99	**4**
065361	TRH	2006	**4**	Fy	1	4.05	**4**
68809	TRH	2007	**3**	Fy	1	4.07	**4**
068642	IGH	2008	**2**	Ff	9	4.02	**36**
068643	IGH	2008	**2**	Ff	10	4.02	**40**
068644	IGH	2008	**2**	Ff	25	4.03	**101**
068645	IGH	2008	**2**	Ff	48	4.02	**193**
068646	IGH	2008	**2**	Ff	45	4.03	**181**
068647	IGH	2008	**2**	Ff	49	4.06	**199**
068648	IGH	2008	**2**	Fy	5	4.02	**20**
068661	IGH	2008	**2**	Fy	1	4.02	**4**
068662	IGH	2008	**2**	Fy	1	4.03	**4**
				Subtotal	**878**		**9,972**
Estimated contribution of unknown CWTs							
200000					53		
400000					4		
				Subtotal	**57**		**647**
		Total Estimated Hatchery Contribution =					**10,619**
Unreadable CWTs: 200000=CWT lost, 400000=CWT unreadable							

The Klamath River Technical Advisory Team (KRTAT) met in February of 2011 to review the 2010 Chinook run monitoring efforts and estimate the age composition of the 2010 run (KRTAT 2011). The KRTAT used scale age proportions for developing adult structure and length frequency analysis for the grilse cutoff point for the 2010 IGH fall Chinook returns (Table 4).

Table 4. Age composition of the 2010 Chinook salmon run that entered Iron Gate Hatchery (IGH), as developed by the Klamath River Technical Advisory Team (KRTAT).

Age 2	Age 3	Age 4	Age 5	Total Adults	Total Run
1,071	6,899	3,376	1	10,276	11,347
9.4%	60.8%	29.7%	.00009%	90.6%	

Coho Salmon

Four hundred eighty five (485) coho entered IGH during the fall 2010 season between October 21, 2010 and December 15, 2010. Of these, KRP staff collected biological data from 258 coho, which included 100% of the spawned coho, and obtained tissue samples and fork lengths from another 173 coho salmon as they entered the hatchery, but which were not used for spawning. Of the 258 sampled coho, 222 (86%) had left maxillary (LM) clips, indicating they were of IGH origin, and 36 (14%) were unmarked. Of the total number of coho salmon that entered IGH (485), 397 (82%) had LM clips, 87 (18%) were unmarked and one (.002%) had a right maxillary (RM) clip indicating TRH origin. Male coho ranged in size from 34 to 80 cm. in fork length (Figure 4). Female coho ranged in size from 46 to 80 cm. in fork length (Figure 5). Based on the length frequency distribution of 111 male coho, grilse were estimated to be $\leq$ 57 cm fork length. Of the 111 males sampled by the KRP, 15 (13.5%) were grilse.

Because of ongoing CDFG coho life history studies in the Shasta River, in which juvenile coho are pit tagged with no external mark, unmarked coho which entered IGH in 2010 were run through a pit tag detector. There were no positive readings for PIT tags in any unmarked adult coho returning to IGH during 2010. No coded wire tags were recovered from coho entering Iron Gate Hatchery during the 2010 season.

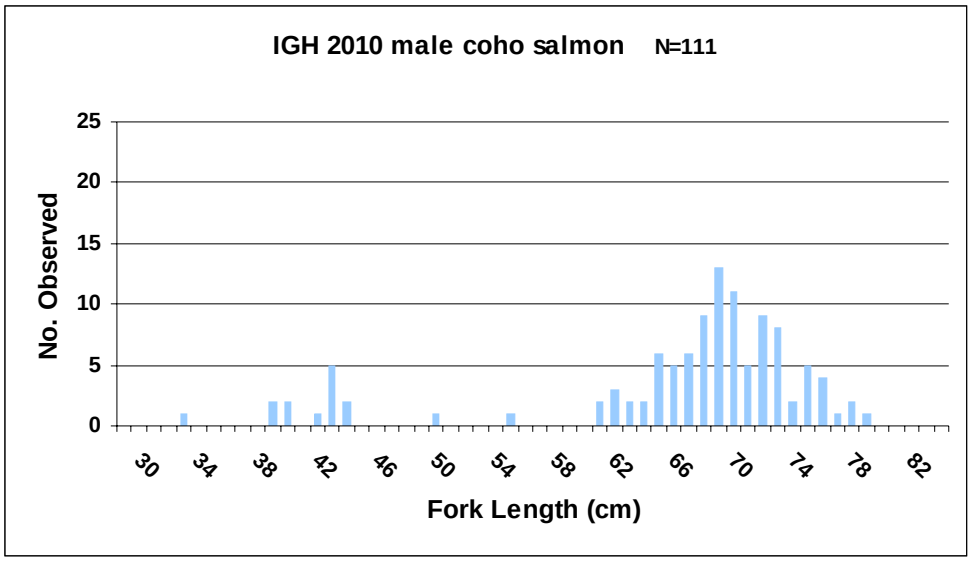

Figure 4. Length frequency distribution for male coho salmon sampled at Iron Gate Hatchery during the 2010 spawning season.

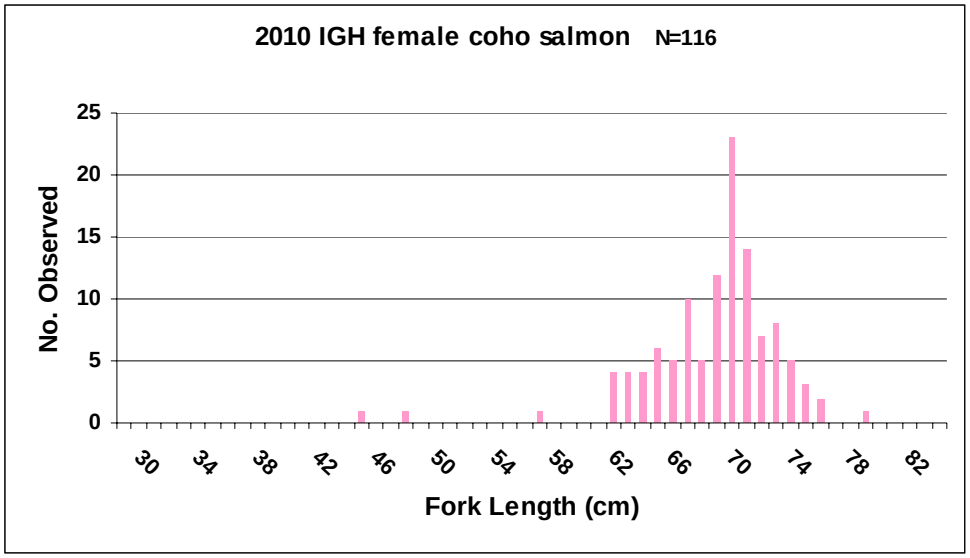

Figure 5. Length frequency distribution for female coho salmon sampled at Iron Gate Hatchery during the 2010 spawning season.

DISCUSSION

Chinook Salmon

Since 1978, KRP has been monitoring the escapement of fall-run Chinook in the Klamath River basin, excluding the Trinity River. The Trinity River Project (TRP) has been monitoring salmon returns in the Trinity River basin during the same period, and the combined run size information generated from these two efforts is summarized in

the CDFG "Mega Table" each year. Chinook run size data are compiled and reviewed by the KRTAT during their annual age composition meeting in late January or early February. During the age composition meeting, results of the scale analysis are integrated into run size data to estimate the age structure for each of the various stocks within the basin. This allows for age-specific estimates of escapement coupled with data from CWT recoveries from hatchery stocks and for cohort reconstruction of both hatchery and natural components of Klamath River fall-run Chinook. The results of cohort reconstruction allow model-based forecasting of next year's abundance in the ocean, ocean fishery contact rates, and percentage of spawners escaping to natural areas (KRTAT 2011).

These forecasts are input by the KRTAT into the Klamath Stock Projection Model, which is used to predict abundance of Klamath River fall run Chinook at sea. This information is then modeled using the Klamath Ocean Harvest Model to determine fishery allocation levels and determine the potential effects of harvest options upon salmon fisheries along the Pacific Coast. Thus, the run size estimates that are compiled each year provide a critical source of data necessary for the effective management of fall Chinook each year.

The 2010 run (11,347) of Chinook salmon at IGH falls below the 33-year average of 15,852 by 4,505 fish (Figure 6). In 2010 IGH Chinook comprised roughly 10.5% of the total (Klamath basin) in-river run (107,624) and 16.3% of the total spawner escapement (69,580) (Table 5).

The percentage of grilse returning to IGH in 2010 (9.4%) is close to the 33-year average of grilse returns (9.8%), while the return of grilse to nearby Bogus Creek (8%) was below its 33-year average of 12.8%. The highest percentage (51.1%) of grilse returning to IGH was observed in 1992 and the lowest percentage (0.3%) in 2005 (Table 6). In 2010, the 3-year old component accounted for approximately 61% of the IGH Chinook run, 43% of the TRH run and 43% of the total in-river run.

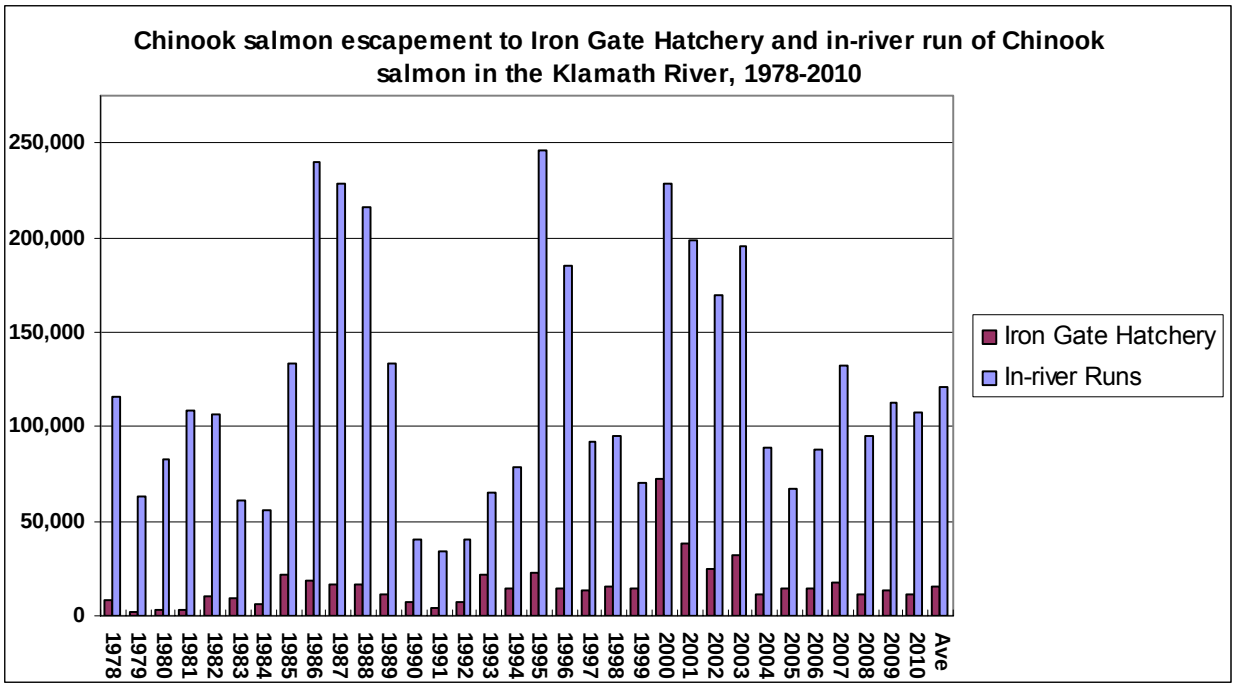

Figure 6. Chinook salmon escapement to Iron Gate Hatchery and in-river runs of Chinook salmon in the Klamath River, 1978 to 2010.

The Chinook salmon releases from IGH include both smolt and yearling releases. The current production goals include releases of 5,100,000 Chinook smolts in May and June and 900,000 yearlings the following November. In 2010, 4,528,056 Chinook smolts and 855,000 yearling Chinook were released from IGH. This was the second year that a total count of Chinook smolts in the raceways was made by the automated tagging trailer, which counts all fish that are pumped into the trailer and diverts 25% for clipping and tagging. This more accurate method of counting fish in the raceways shows that in 2009 and 2010, had the tagging trailer not been used IGH releases would have been overestimated by roughly 15 to 20 percent.

Table 5 Historic fall-run Chinook salmon totals (includes adults and grilse) for the Klamath Basin, Iron Gate Hatchery, and Bogus Creek.

Year	In-River Run (IRR)	Spawner Escapement (SE)		Iron Gate Hatchery			Bogus Creek		
	Totals	Totals	%IRR	Totals	%IRR	%SE	Totals	%IRR	%SE
1978	115,728	90,135	77.9	7,870	6.8	8.7	5,579	4.8	6.2
1979	62,970	42,255	67.1	2,558	4.1	6.1	5,938	9.4	14.1
1980	82,413	57,683	70	2,863	3.5	5	5,070	6.2	8.8
1981	108,422	56,333	52	2,595	2.4	4.6	3,642	3.4	6.5
1982	106,020	67,076	63.3	10,186	9.6	15.2	7,143	6.7	10.6
1983	61,392	47,960	78.1	8,885	14.5	18.5	3,048	5	6.4
1984	55,542	30,375	54.7	6,094	11	20.1	3,504	6.3	11.5
1985	133,827	104,487	78.1	22,110	16.5	21.2	4,647	3.5	4.4
1986	239,559	180,263	75.2	18,557	7.7	10.3	7,308	3.1	4.1
1987	228,182	143,890	63.1	17,014	7.5	11.8	10,956	4.8	7.6
1988	215,696	130,749	60.6	16,715	7.7	12.8	16,440	7.6	12.6
1989	133,440	72,438	54.3	11,690	8.8	16.1	2,662	2	3.7
1990	40,274	25,705	63.8	7,040	17.5	27.4	785	1.9	3.1
1991	34,425	19,121	55.5	4,067	11.8	21.3	1,281	3.7	6.7
1992	40,391	28,479	70.5	7,318	18.1	25.7	1,154	2.9	4.1
1993	64,810	48,945	75.5	21,711	33.5	44.4	3,716	5.7	7.6
1994	78,354	60,850	77.7	14,566	18.6	23.9	8,260	10.5	13.6
1995	245,542	217,312	88.5	22,940	9.3	10.6	46,432	18.9	21.4
1996	185,305	108,325	58.5	14,165	7.6	13.1	10,797	5.8	10
1997	91,729	70,303	76.6	13,727	15	19.5	10,030	10.9	14.3
1998	95,286	75,157	78.9	15,326	16.1	20.4	6,835	7.2	9.1
1999	70,296	50,088	71.3	14,120	20.1	28.2	6,165	8.8	12.3
2000	228,323	188,642	82.6	72,474	31.7	38.4	35,051	15.4	18.6
2001	198,676	142,324	71.6	38,568	19.4	27.1	12,575	6.3	8.8
2002	170,014	99,016	58.2	24,961	14.7	25.2	17,834	10.5	18
2003	195,791	152,390	77.8	32,260	16.5	21.2	15,610	8	10.2
2004	88,589	53,478	60.4	11,519	13	21.5	3,788	4.3	7.1
2005	67,579	56,188	83.1	13,997	20.7	24.9	5,397	8	9.6
2006	88,258	70,986	80.4	13,990	15.8	19.7	4,132	4.6	5.8
2007	132,167	95,998	72.6	17,149	12.9	17.8	4,741	3.6	4.9
2008	95,619	64,487	67.4	11,231	11.7	17.4	4,566	4.7	7.1
2009	112,685	73,688	65.4	13,492	11.9	18.3	5,926	5.3	8
2010	107,624	69,580	64.7	11,347	10.5	16.3	4,566	4.2	6.6
Average	**120,452**	**84,688**	**69.6**	**15,852**	**14**	**19**	**8,654**	**6.5**	**9.2**
MAX	**245,542**	**217,312**	**88.5**	**72,474**	**33.5**	**44.4**	**46,432**	**18.9**	**21.4**
MIN	**34,425**	**19,121**	**52**	**2,558**	**2.4**	**4.6**	**54**	**1.9**	**3.1**
ST DEV	**63,415**	**48,454**	**9.6**	**12,944**	**6.9**	**8.6**	**9,405**	**3.7**	**4.5**

1/ For the 1995 season the gates at IGH were closed at times, therefore a significant portion of the IGH returns were diverted to Bogus Creek.

Table 6. Adult and grilse components of Chinook salmon returns to Iron Gate Hatchery and Bogus Creek, 1978-2010.

Year	Iron Gate Hatchery				Bogus Creek			
	Grilse	Adults	Total	% Grilse	Grilse	Adults	Total	% Grilse
1978	925	6,945	7,870	11.8%	651	4,928	5,579	11.7%
1979	257	2,301	2,558	10.0%	494	5,444	5,938	8.3%
1980	451	2,412	2,863	15.8%	1,749	3,321	5,070	34.5%
1981	540	2,055	2,595	20.8%	912	2,730	3,642	25.0%
1982	1,833	8,353	10,186	18.0%	2,325	4,818	7,143	32.5%
1983	541	8,371	8,912	6.1%	335	2,713	3,048	11.0%
1984	764	5,330	6,094	12.5%	465	3,039	3,504	13.3%
1985	2,159	19,951	22,110	9.8%	1,156	3,491	4,647	24.9%
1986	1,461	17,096	18,557	7.9%	1,184	6,124	7,308	16.2%
1987	1,825	15,189	17,014	10.7%	1,208	9,748	10,956	11.0%
1988	609	16,106	16,715	3.6%	225	16,215	16,440	1.4%
1989	831	10,589	11,690	7.1%	444	2,218	2,662	16.7%
1990	321	6,719	7,040	4.6%	53	732	785	6.8%
1991	65	4,002	4,067	1.6%	20	1,261	1,281	1.6%
1992	3,737	3,581	7,318	51.1%	556	598	1,154	48.2%
1993	883	20,828	21,711	4.1%	431	3,285	3,716	11.6%
1994	758	13,808	14,566	5.2%	443	7,817	8,260	5.4%
1995	259	22,681	22,940	1.1%	1,207	45,225	46,432	2.6%
1996	543	13,622	14,165	3.8%	377	10,420	10,797	3.5%
1997	452	13,275	13,727	3.3%	221	9,809	10,030	2.2%
1998	403	14,923	15,326	2.6%	205	6,630	6,835	3.0%
1999	4,830	9,290	14,120	34.2%	2,628	3,537	6,165	42.6%
2000	839	71,635	72,474	1.2%	373	34,678	35,051	1.1%
2001	1,364	37,204	38,568	3.5%	648	11,927	12,575	5.2%
2002	1,294	23,667	24,961	5.2%	304	17,530	17,834	1.7%
2003	290	31,970	32,260	0.9%	188	15,422	15,610	1.2%
2004	937	10,582	11,519	8.1%	295	3,493	3,788	7.8%
2005	42	13,955	13,997	0.3%	58	5,339	5,397	1.1%
2006	2,386	11,604	13,990	17.1%	764	3,368	4,132	18.5%
2007	154	16,995	17,145	0.9%	95	4,646	4,741	2.0%
2008	2,414	8,817	11,231	21.5%	1,565	3,001	4,566	34%
2009	1,132	12,258	13,492	8.4%	471	5,455	5,926	8%
2010	1,071	10,276	11,347	9.4%	292	3,179	3,471	8%
Average	1,102	14,739	15,852	9.8%	677	7944	8621	12.8%

One of the recommendations of the Joint Hatchery Review Committee is for IGH to produce more yearlings and less smolts, to reduce hatchery-origin/natural-origin interactions during the typically low flow and poor water quality months of June and July. Flows during the mid-October to mid-November yearling release period are typically higher, and water quality better, resulting in less competition for food and space during out-migration. (CDFG and NMFS 2001). Returns from brood years 1990 to 2006 show an overall higher rate of returns for yearlings over smolts (Table 7).

At this time there are physical and funding constraints that limit the Department's ability

to implement an increased rearing program for yearling Chinook salmon.

Table 7. Return rates of IGH smolt and yearling CWT releases for brood years 1990-1996, 1999, 2000 and 2002-2006.

Brood Year	IGH Smolt Releases			IGH Yearling Releases			Ratio of yearling/smolt return rates
	# CWTs Released	# CWTs Returned	% Return	# CWTs Released	# CWTs Returned	% Return	
1990	188,595	713	0.378%	95,880	740	0.772%	2.04
1991	191,200	96	0.050%	90,982	167	0.184%	3.66
1992	185,464	1015	0.547%	74,024	269	0.363%	0.66
1993	188,562	40	0.021%	98,099	196	0.200%	9.42
1994	194,644	94	0.048%	86,564	453	0.523%	10.84
1995	191,799	85	0.044%	90,172	954	1.058%	23.87
1996	196,648	162	0.082%	95,396	581	0.609%	7.39
1999	182,131	686	0.377%	91,220	514	0.563%	1.50
2000	187,417	277	0.148%	100,702	707	0.702%	4.75
2002	210,114	367	0.175%	109,711	295	0.269%	1.54
2003	261,888	70	0.027%	48,592	60	0.123%	4.62
2004	205,950	691	0.336%	98,752	215	0.218%	0.65
2005	209,754	194	0.092%	103,157	445	0.431%	4.66
2006	309,671	224	0.072%	103,361	230	0.223%	3.08
AVERAGE			**0.186%**			**0.446%**	**5.62**

Coho Salmon

Returns of coho salmon to IGH (Figure 7) have been more stable than returns throughout the basin. Returns of naturally produced adult coho salmon in the mid Klamath Basin have been decreasing in recent years (Chesney, D. et al 2009; Knechtle, M. et al 2009), prompting concern that immediate intervention is needed to conserve the remaining genetic resources to prevent short-term risk of extinction.

In 2009, a DRAFT Hatchery Genetic Management Plan (HGMP) was developed for IGH as part of the CDFG's application for an ESA Section 10(a)(1)(A) permit for hatchery operation. The HGMP is intended to guide hatchery practices toward the conservation and recovery of listed species, specifically, the upper Klamath River coho population unit. Changes to the management of IGH coho, including the use of NOAA's spawning matrix and the addition of bird exclusion netting, were recommendations of the draft HGMP, and were implemented in 2010. The HGMP covers hatchery practices for the period between 2010 and 2020, and does not address hatchery operations beyond 2020, when the mainstem Klamath River dams may be removed pursuant to the Klamath Hydroelectric Settlement Agreement (KHSA).

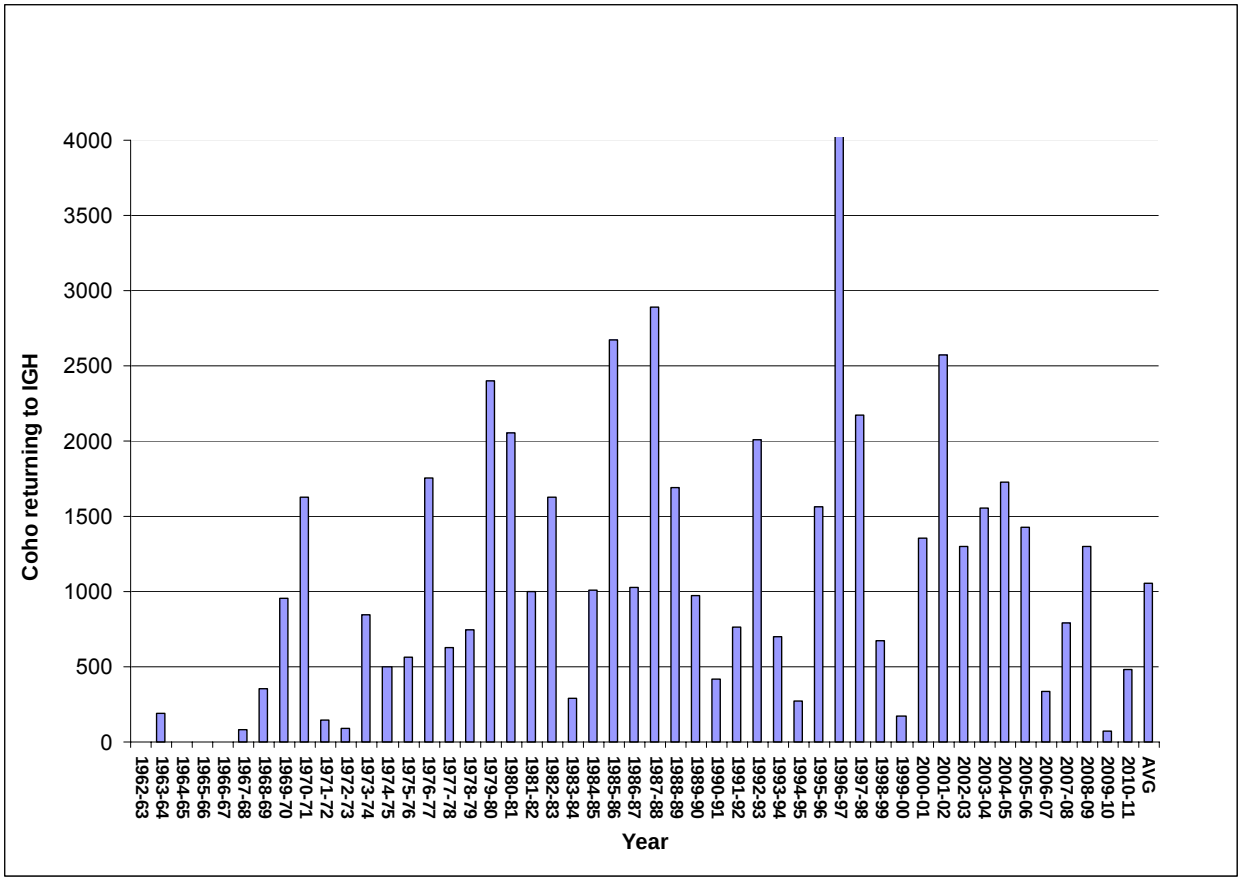

Figure 7. Coho salmon returns at Iron Gate Hatchery from 1962 to 2010.

Figure 8, provided by the NOAA salmon genetics repository, shows the relatedness of pairs of coho salmon spawned (yellow bars) at IGH during the 2010 season with the use of the NOAA spawning matrix. The maroon bars represent the optimal pairings of males and females that could be achieved if the most unrelated male was spawned with its most unrelated female for each mating. In the absence of the spawning matrix and if pairs were selected purely at random the resulting Rxy values are represented by blue bars. Highly inbreed pairings result in Rxy values > 0.125 and as a result of utilizing the spawning matrix 14 inbred matings were prevented. In order to increase the number of optimal spawning pairs in future seasons, improvements to the IGH spawning facility are being made prior to the 2011 run which will minimize the handling of individual coho (thus decreasing pre-spawn mortality) and allow for the retrieval of the best mate for each female. This will be done with the use of smaller holding tanks which will allow the faster identification and retrieval of individual fish.

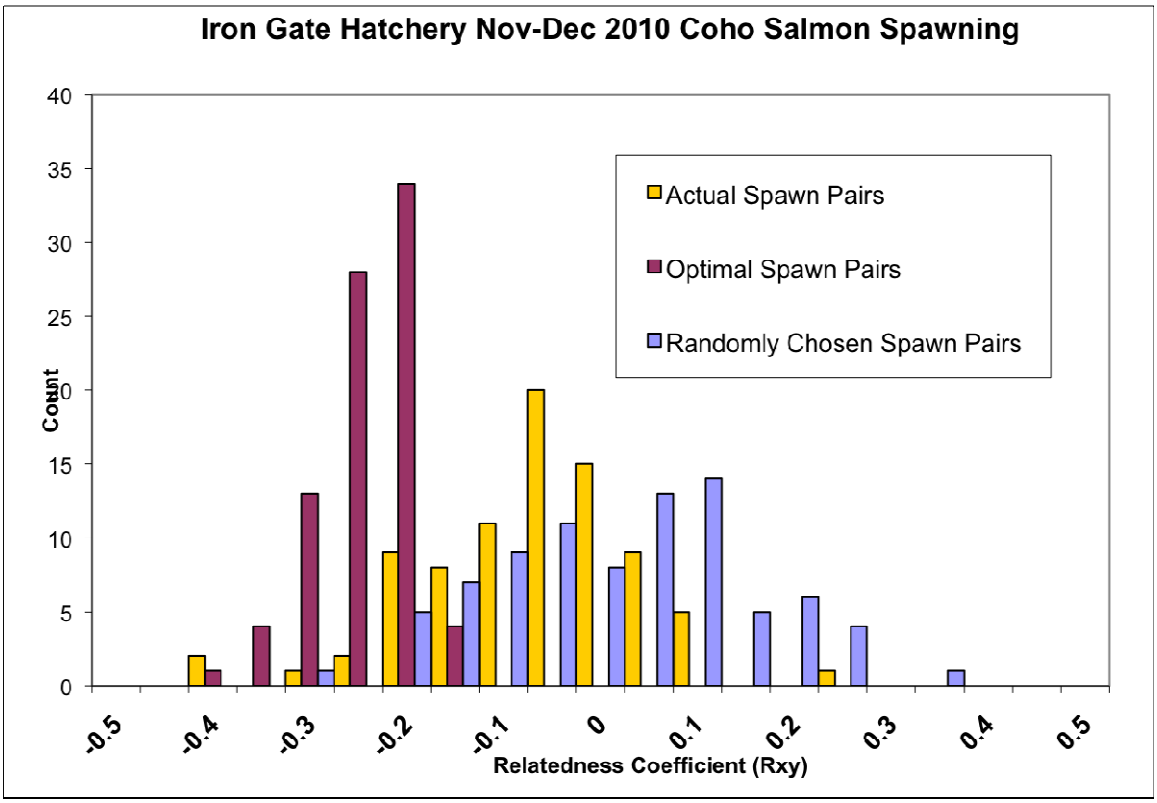

Figure 8. Observed relatedness Coefficients of actual spawned pairs, optimally spawned pairs and randomly chosen pairs for IGH coho during the 2010 season (Figure provided by NOAA Southwest Fisheries Science Center Salmonid Genetic Laboratory).

Beginning in 1997 all coho that entered IGH, whose origin was either IGH or TRH, would have been maxillary clipped prior to release. There are a small number of coho that may not have been clipped as a result of clipping error. As a result, the number of LM clips observed at IGH during recovery efforts slightly underestimates the actual number of hatchery origin coho present (Table 8).

Acknowledgments

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Table 8. Summary of marked and unmarked coho salmon that entered IGH, 1997- 2011.

1997/1998

FIN CLIPS	ADULTS	GRILSE	Total
Unmarked	121	44	165
LM	1,717	253	1,970
RM	5		5
AD	24	4	28
ADLM	5	1	6
ADRM			0
Total Clippe	1,751	258	2,009
Total Returr	1,872	302	**2,174**

1998/1999

FIN CLIPS	ADULTS	GRILSE	Total
Unmarked	207	82	289
LM	303	75	378
RM			0
AD	1	1	2
ADLM			0
ADRM			0
Total Clipped	304	76	380
Total Returns	511	158	**669**

1999/2000

FIN CLIPS	ADULTS	GRILSE	Total
Unmarked	12	3	15
LM	138	15	153
RM			0
AD	1		1
ADLM			0
ADRM			0
Total Clippe	139	15	154
Total Returr	151	18	**169**

2000/2001

FIN CLIPS	ADULTS	GRILSE	Total
Unmarked	198	64	262
LM	500	567	1,067
RM	4		4
AD	13		13
ADLM	8		8
ADRM			0
Total Clippe	525	567	1,092
Total Returr	723	631	**1,354**

2001/2002

FIN CLIPS	ADULTS	GRILSE	Total
Unmarked	217	29	246
LM	2,054	76	2,130
RM	136	2	138
AD	51		51
ADLM	7		7
ADRM	1		1
Total Clipped	2,249	78	2,327
Total Returns	2,466	107	**2,573**

2002/2003

FIN CLIPS	ADULTS	GRILSE	Total
Unmarked	216	9	225
LM	916	90	1,006
RM	25	0	25
AD	31	7	38
ADLM	5	2	7
ADRM			0
Total Clippe	977	99	1,076
Total Returr	1,193	108	**1,301**

2003/2004

FIN CLIPS	ADULTS	GRILSE	Total
Unmarked	575	14	589
LM	620	218	838
RM	66	3	69
AD	52	6	58
ADLM	2	0	2
ADRM	2	0	2
Total Clippe	742	227	969
Total Returr	1,317	241	**1,558**

2004/2005

FIN CLIPS	ADULTS	GRILSE	Total
Unmarked	399	25	424[*1]
LM	990	213	1,203
RM	31	1	32
AD	69	0	69
ADLM	0	0	0
ADRM	1	0	1
Other	5	0	5
Total Clipped	1,096	214	1,310
Total Returns	1,495	239	**1,734**

2005/2006

FIN CLIPS	ADULTS	GRILSE	Total
Unmarked	138	2	140
LM	1,254	28	1,282
RM	2	0	2
AD	1	0	1
ADLM	0	0	0
ADRM	0	0	0
Other	0	0	0
Total Clippe	1,257	28	1,285
Total Returr	1,395	30	**1,425**

2006/2007

FIN CLIPS	ADULTS	GRILSE	Total
Unmarked	72	8	80
LM	176	27	203
RM	1	1	2
AD	16	0	16
ADLM	0	0	0
ADRM	0	0	0
Total Clippe	193	28	221
Total Returr	265	36	**301**

2007/2008

FIN CLIPS	ADULTS	GRILSE	Total
Unmarked	135	2	137
LM	480	163	643
RM	6	0	6
AD	2	0	2
ADLM	1	0	1
ADRM	0	0	0
Total Clipped	489	163	652
Total Returns	624	165	**789**

2008/2009

FIN CLIPS	ADULTS	GRILSE	Total
Unmarked	23	1	24
LM	1224	44	1268
RM	0	2	2
AD	0	0	0
ADLM	0	0	0
ADRM	0	0	0
LMRM	2	0	2
Total Clippe	1226	46	1272
Total Returr	1249	47	**1296**

2009/2010

FIN CLIPS	ADULTS	GRILSE	Total
Unmarked	11	5	16
LM	24	17	41
RM	11	2	13
AD	0	0	0
ADLM	0	0	0
ADRM	0	0	0
Total Clippe	35	19	54
Total Returr	46	24	**70**

2010/2011

FIN CLIPS	ADULTS	GRILSE	Total
Unmarked	84	3	87
LM	344	53	397
RM	0	1	1
AD	0	0	0
ADLM	0	0	0
ADRM	0	0	0
Total Clipped	344	54	398
Total Returns	428	57	**485**

Proportion of clipped to unclipped coho

Season	Clipped	Total	% Clipped
1997/1998	2,009	2,174	92%
1998/1999	380	669	57%
1999/2000	154	169	91%
2000/2001	1,092	1,354	81%
2001/2002	2,327	2,573	90%
2002/2003	1,076	1,301	83%
2003/2004	969	1,558	62%
2004/2005	1,310	1,734	76%
2005/2006	1,285	1,425	90%
2006/2007	221	301	73%
2007/2008	652	789	83%
2008/2009	1272	1296	98%
2009/2010	54	70	77%
2010/2011	398	485	82%
Average	**943**	**1,136**	**81.1%**

LM=Iron Gate Hatchery (left maxillary clip)
RM= Trinity River Hatchery (right maxillary clip)
AD = Cole M. Rivers Hatchery (adipose clip)
*1 : 7 of these unmarked coho carried a cwt and were actually from Cole Rivers Hatchery

ADLM = Origin unknown, possible ODFW release or injury caused
ADRM = Origin unknown, possible ODFW release or injury caused
Other = Mutliple clips observed, either result of tag error, injury, or unkown origin

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