



California Department of Fish and Game

Klamath River Project

Recovery of Fall-run Chinook and Coho Salmon at Iron Gate Hatchery
September 25, 2009 to December 15, 2009



Photo by Joelle Adams

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March 2010

ABSTRACT

A total of 13,492 fall-run Chinook salmon, (Chinook, *Oncorhynchus tshawytscha*, entered Iron Gate Hatchery (IGH) during the fall 2009 spawning season from September 25, 2009 through November 30, 2009. Klamath River Project (KRP) staff systematically sampled 1 in every 10 Chinook as well as all adipose-clipped (AD) Chinook during recovery efforts, for a sample size of 2,158. Scale samples and 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 ≤ 58 cm fork length. Randomly sampled male Chinook ranged in size from 41 to 101 cm. fork length, and randomly sampled female Chinook ranged from 56 to 92 cm. fork length. Based on length frequency analysis, KRP staff estimated that 8.4% (1,132) of the run were grilse. Females accounted for 53.9% (7,268) of the run while males accounted for 46.1% (6,224). The 2009 return to IGH contributed roughly 12% to the total (Klamath basin) in-river run and 18% to the total spawner escapement. Based on coded wire tag expansion, KRP staff estimated that 88% of the Chinook entering IGH during the 2009 season were of hatchery origin.

70 coho salmon (coho, *Oncorhynchus kisutch*) entered IGH during the 2009-10 spawning season, the lowest return since 1966. The recorded dates for the coho run were from October 16, 2009 to December 15, 2009. KRP staff collected biological data (sex, fork length, presence of marks or clips, scale samples, and tissue sample) on every fifth coho that entered the hatchery and every coho used for spawning. Otoliths were collected from every 10th random coho. The total number of coho sampled was 45. Males ranged in size from 38 to 75 cm. fork length, while females ranged in size from 54 to 71 cm. fork length. Based on the length frequency distribution of 22 male coho, grilse were estimated to be ≤ 53 cm. fork length. Of the 22 males sampled by the KRP, 9 (41%) were estimated to be grilse. IGH counts for the 2009-10 coho spawning season included 25 adult females, 21 adult males, and 24 grilse. Of the coho sampled by KRP staff, 29 had left maxillary clips, 7 had right maxillary clips, and 9 had no clips. No adipose-clipped or coded wire tagged coho were recovered at Iron Gate Hatchery during the 2009-10 season.

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

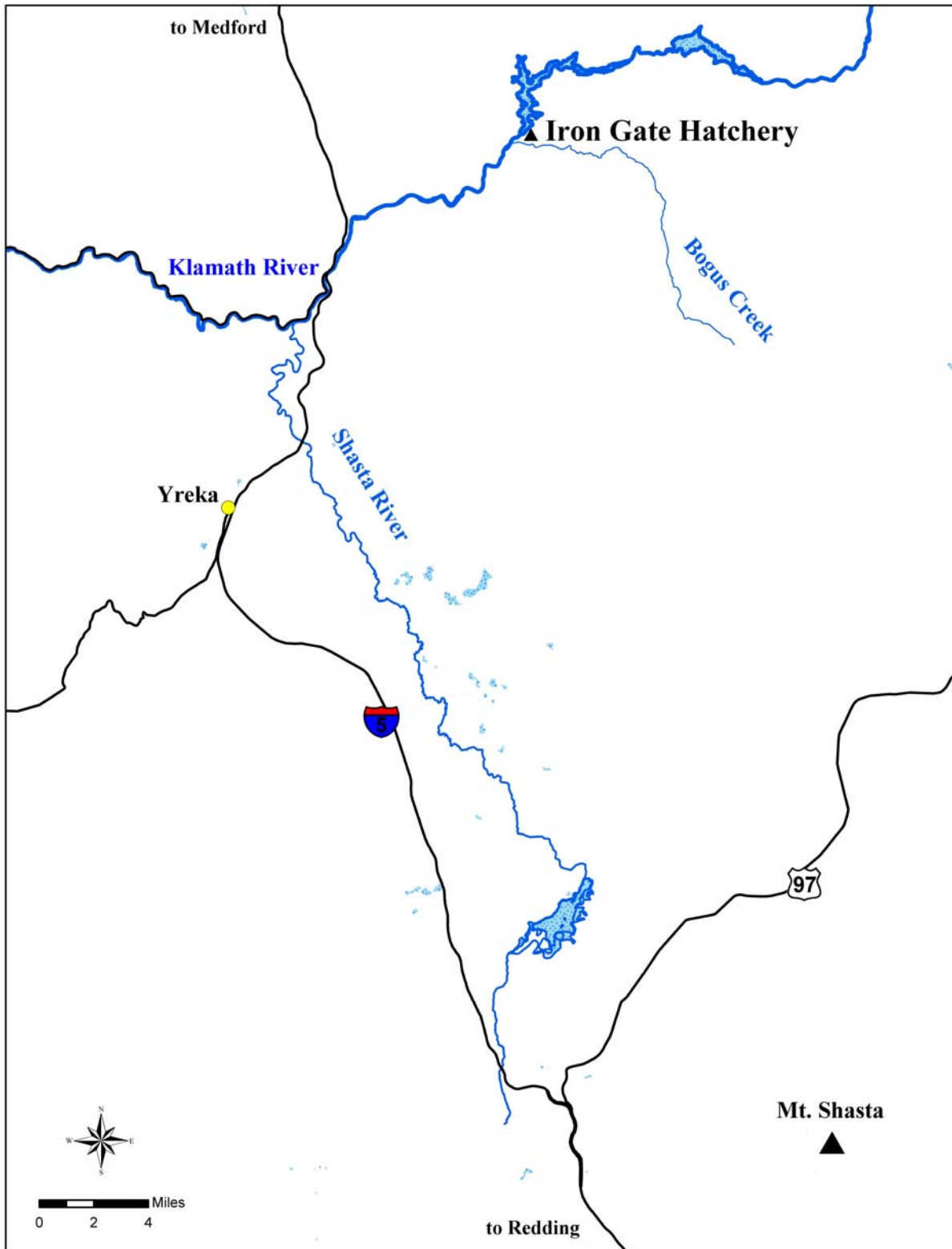


Figure 1. Location of Iron Gate Hatchery (California Department of Fish and Game, Siskiyou County).

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.

Coded Wire Tagging

In 2009, the KRP's coded wire tagging effort at IGH was expanded to include 25 percent of the release groups. This was made possible by the acquisition of an automated tagging trailer made by Northwest Marine Technologies¹. A total of 1,185,904 juvenile Chinook (fingerlings and yearlings) were adipose clipped and coded wire tagged in 2009, which represented 25 percent of the total 2009 releases of 4,749,470. The smolt release groups each had a unique tag code. The yearling groups had three tag codes: individual codes for the C and D raceway yearlings and a shared code for the E, F G and H series.

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.

From 1978 to 2008, staff of the KRP tagged between 300,000 and 400,000 juvenile Chinook salmon yearly, which represented 3 to 5 percent of the release groups. The smolt release groups generally had four to six unique codes which allowed for the identification of up to six separate groups of fingerlings, corresponding to individual or grouped raceways. Yearling groups were also divided among the six raceways, but shared a tag code and a November release date.

MATERIALS AND METHODS

Chinook Salmon

In 2009, fish ladders remained open and all Chinook were 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

¹ Use of product name in this report does not imply endorsement by the California Department of Fish and Game.

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. Chinook not used for spawning were killed and added to the conveyor belt, where they were sampled 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

In 2009, staff of the KRP collected biological data (sex, fork length, presence of marks or clips and scale samples) from every fifth coho salmon (coho) which entered IGH, and for all coho used for spawning. Since 1995, all hatchery-reared coho within the Klamath River basin have been marked with a maxillary clip prior to release. IGH coho receive a left maxillary clip and Trinity River Hatchery (TRH) coho are marked with a right maxillary clip. Because some Oregon and Washington hatcheries mark and tag a portion of their coho with an adipose clip or CWT, all AD and unmarked coho that return to IGH are checked for the presence of a coded wire tag by passing them through a tag detector.

In 2009, coho were spawned at a 1:1 ratio, pairing unmarked individuals with marked fish and pairing two year olds with three year olds whenever possible. No floy tagging and releasing of unmarked coho was done in 2009.

RESULTS

Chinook Salmon

Chinook began entering IGH on September 25, 2009. A total of 13,492 Chinook returned to IGH during the fall 2009 spawning season. Of these, KRP staff collected scale samples, determined sex, and measured fork lengths for 2,158 Chinook. Randomly sampled male Chinook ranged in size from 41 to 101 cm. in fork length (Figure 3). Analysis of the length frequency distribution for 648 randomly sampled Chinook males indicated that the cutoff point between grilse and adults occurred at ≤ 58 cm. in fork length, yielding approximately 8.4% grilse. Therefore, staff estimates that 1,132 grilse and 12,360 adults entered IGH during the 2009 season. Females accounted for 53.9% (7,268) of the run and males accounted for 46.1% (6,224). Randomly sampled female Chinook ranged in size from 56 to 92 cm. in fork length (Figure 4). The last Chinook of the season entered IGH on November 30, 2009.

2009 IGH Random Chinook Males

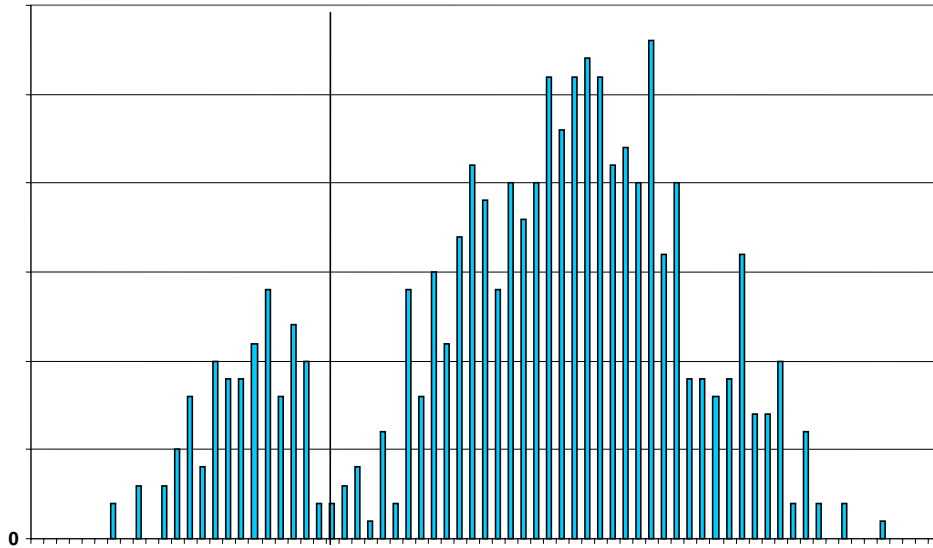


Figure 3. Length frequency distribution for systematic sample of male Chinook salmon recovered at IGH during the 2009 spawning season.

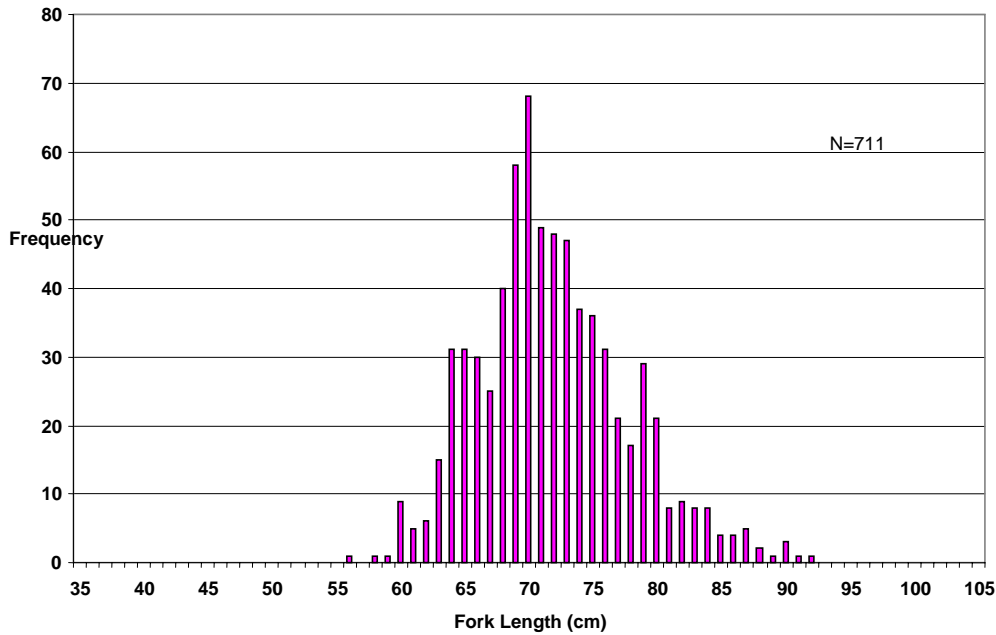


Figure 4. Length frequency distribution for systematic sample of female Chinook salmon recovered at IGH during the 2009 spawning season.

Heads from 897 AD Chinook (from random and non-random fish) were collected for CWT recovery. Of these, 75 heads contained no tags, 7 CWTs were lost during dissection and 9 CWTs were unreadable. The contribution of lost or unreadable CWTs was estimated by applying the proportions of known CWTs (806) to the 16 lost or unreadable CWTs. (Table 2).

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 (Table 3). One hundred percent of CWTs recovered (and successfully read) originated from IGH. Based on the expansion of CWTs, KRP staff estimated that 88% of the Chinook entering IGH during the 2009 season were of hatchery origin (Table 3).

Table 2. Estimated contribution of 16 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 CWT recovered at IGH during the 2009 season.						
CWT	BY	# CWTs Recovered	Proportion of CWTs recovered	Estimated Number	Production Multiplier	Expanded Estimate
601020504	2004	2	0.002481390	0.03970	17.12	1
601020505	2004	0	0.000000000	0.00000	16.61	0
601020506	2004	2	0.002481390	0.03970	34.04	1
601020507	2004	1	0.001240695	0.01985	37.42	1
601020508	2004	1	0.001240695	0.01985	9.09	0
601020509	2004	0	0.000000000	0.00000	8.00	0
601020602	2005	24	0.029776675	0.47643	18.01	9
601020603	2005	17	0.021091811	0.33747	18.67	6
601020604	2005	13	0.016129032	0.25806	37.01	10
601020605	2005	4	0.004962779	0.07940	46.33	4
601020606	2005	55	0.068238213	1.09181	9.24	10
601020607	2005	118	0.146401985	2.34243	9.22	22
601020608	2006	64	0.079404467	1.27047	20.81	26
601020609	2006	98	0.121588089	1.94541	15.93	31
601020700	2006	57	0.070719603	1.13151	16.61	19
601020701	2006	45	0.055831266	0.89330	16.54	15
601020702	2006	42	0.052109181	0.83375	16.65	14
601020703	2006	44	0.054590571	0.87345	18.23	16
601020704	2006	174	0.215880893	3.45409	9.58	33
608020000	2007	8	0.009925558	0.15881	19.84	3
608020001	2007	10	0.012406948	0.19851	18.10	4
608020002	2007	2	0.002481390	0.03970	15.93	1
608020003	2007	6	0.007444169	0.11911	16.26	2
608020004	2007	6	0.007444169	0.11911	16.66	2
608020005	2007	8	0.009925558	0.15881	17.59	3
608020006	2007	5	0.006203474	0.09926	10.64	1
Totals		806	1	16		232

Table 3. Estimated contribution of Chinook from Iron Gate Hatchery to total run at Iron Gate Hatchery, based on coded-wire tags (CWT) recovered from fall-run Chinook salmon recovered at Iron Gate Hatchery, during the 2009 spawning season.

CWT	Release Location	Brood Year	Age	Release Type	Number Recovered	Production Multiplier	Expanded Estimate
Estimated contribution of known CWTs:							
601020504	IGH	2004	5	Ff	2	17.12	34
601020505	IGH	2004	5	Ff	0	16.61	-
601020506	IGH	2004	5	Ff	2	34.04	68
601020507	IGH	2004	5	Ff	1	37.42	37
601020508	IGH	2004	5	Fy	1	9.09	9
601020509	IGH	2004	5	Fy	0	8.00	-
601020602	IGH	2005	4	Ff	24	18.01	432
601020603	IGH	2005	4	Ff	17	18.67	317
601020604	IGH	2005	4	Ff	13	37.01	481
601020605	IGH	2005	4	Ff	4	46.33	185
601020606	IGH	2005	4	Fy	55	9.24	508
601020607	IGH	2005	4	Fy	118	9.22	1,088
601020608	IGH	2006	3	Ff	64	20.81	1,332
601020609	IGH	2006	3	Ff	98	15.93	1,561
601020700	IGH	2006	3	Ff	57	16.61	947
601020701	IGH	2006	3	Ff	45	16.54	744
601020702	IGH	2006	3	Ff	42	16.65	699
601020703	IGH	2006	3	Ff	44	18.23	802
601020704	IGH	2006	3	Fy	174	9.58	1,667
608020000	IGH	2007	2	Ff	8	19.84	159
608020001	IGH	2007	2	Ff	10	18.10	181
608020002	IGH	2007	2	Ff	2	15.93	32
608020003	IGH	2007	2	Ff	6	16.26	98
608020004	IGH	2007	2	Ff	6	16.66	100
608020005	IGH	2007	2	Ff	8	17.59	141
608020006	IGH	2007	2	Fy	5	10.64	53
				Subtotal	806		11,676
Estimated contribution of unknown CWTs							
200000					7		
400000					9		
				Subtotal	16		232

Total Estimated Hatchery Contribution = 11,908

Unreadable CWTs: 200000=CWT lost, 400000=CWT unreadable

The Klamath River Technical Advisory Team (KRTAT) met in January of 2010 to review the 2009 Chinook run monitoring efforts and estimate the age composition of the 2009 run (KRTAT 2010). The KRTAT used scale age proportions for developing adult structure and length frequency analysis for the grilse cutoff point for the 2009 IGH fall Chinook returns (Table 4).

Table 4. Age composition of the 2009 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
1,234	8,989	3,176	92	12,258	13,492

Of the expanded CWT returns in 2009, 3,325 (29%) were from yearling release groups and 8,351 (71%) were from smolt release groups.

Coho Salmon

Seventy (70) coho entered IGH during the fall 2009 season between October 19, 2009 and November 19, 2009. Of these, KRP staff collected biological data from 45 coho, which included 100% of the spawned coho and 64% of the total coho run. Of the 70 coho which entered IGH, 41 (59%) had left maxillary clips, indicating they were of IGH origin, 13 coho (18%) had a right maxillary clip, indicating TRH origin and the remaining 16 coho (23%) were unmarked. No AD coho were recovered at IGH in 2009-10. Male coho ranged in size from 38 to 75 cm. in fork length (Figure 6). Female coho ranged in size from 54 to 71 cm. in fork length (Figure 7). Based on the length frequency distribution of 22 male coho, grilse were estimated to be ≤ 53 cm fork length (Figure 6). Of the 22 males sampled by the KRP, 9 (41%) were grilse.

Unmarked coho were run through a tag detector, and there were no positive readings in 2009. No coded wire tags were recovered from coho entering Iron Gate Hatchery during the 2009-10 season.

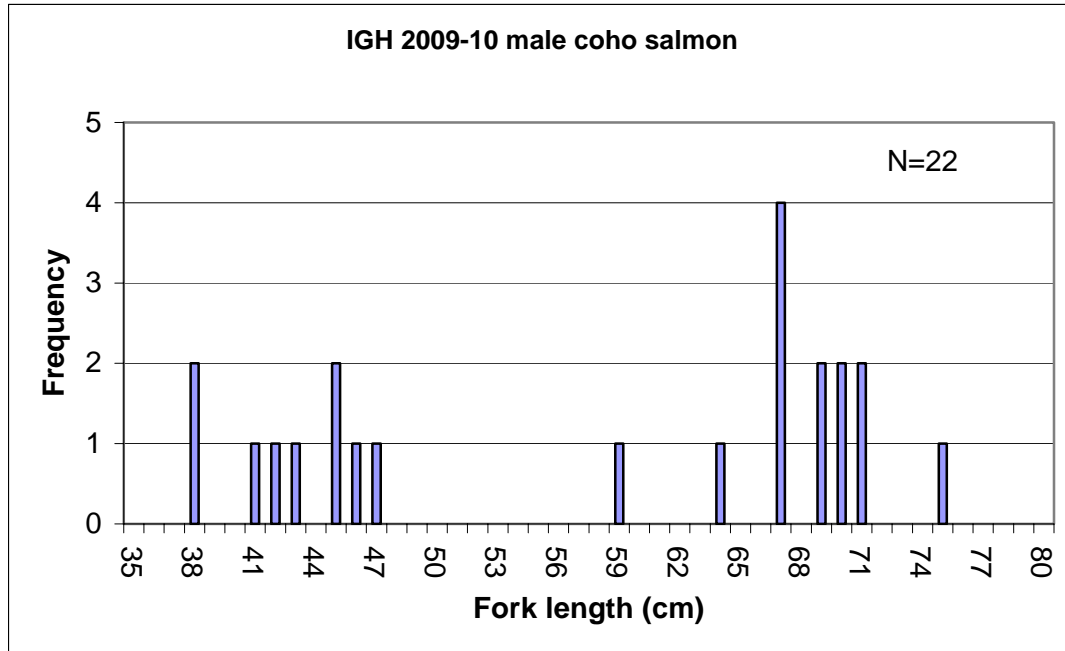


Figure 6. Length frequency distribution for male coho salmon sampled at Iron Gate Hatchery during the 2009-10 spawning season.

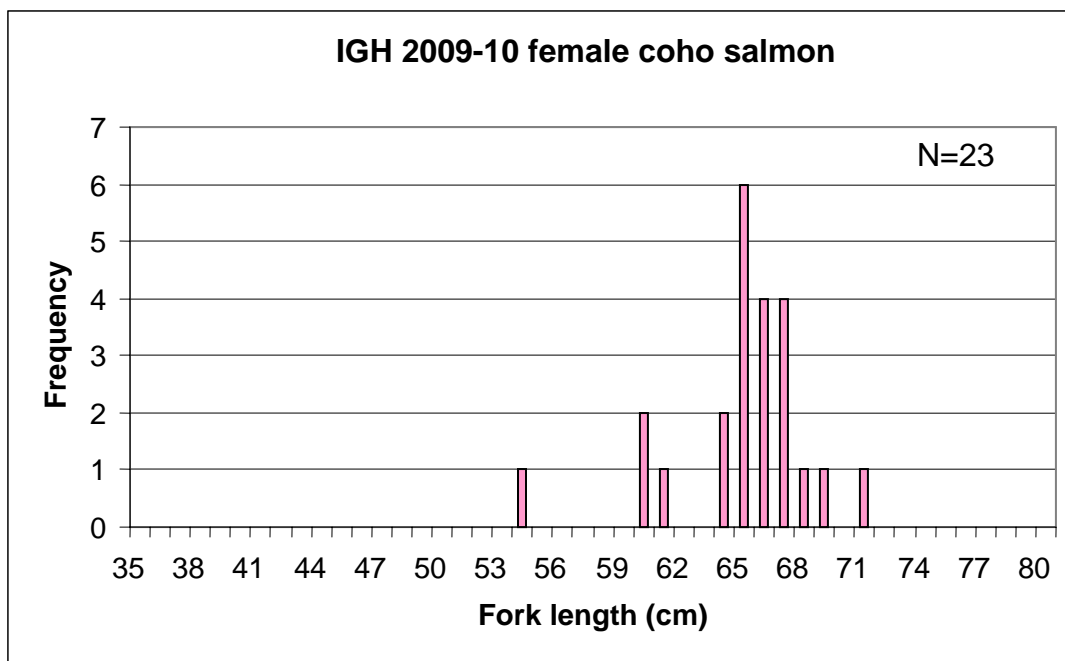


Figure 7. Length frequency distribution for female coho salmon sampled at Iron Gate Hatchery during the 2009-10 spawning season.

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 provided in the Mega Table is 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. Age-specific estimates of escapement for 2009 and previous years, coupled with data from CWT recoveries from hatchery stocks, allow 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 2010).

These forecasts are used by the KRTAT as essential inputs to the Klamath Ocean Harvest Model to predict abundance of Klamath River fall run Chinook at sea. This information is then used 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 2009 run (13,492) of Chinook salmon at IGH falls below the 32-year average of 15,939 by 2,447 fish (Figure 8). In 2009 IGH Chinook comprised roughly 11.9% of the total (Klamath basin) in-river run (112,685) and 18.3% of the total spawner escapement (73,688) (Table 6).

During the 2009 spawning season 8.4% (1,132) of the run was composed of grilse, below the 32-year average of 9.8%. The highest percentage (51.1%) of grilse was observed in 1992 and the lowest percentage (0.3%) in 2005 (Figure 8). Table 7 shows grilse and adult returns to Iron Gate Hatchery and Bogus Creek from 1978 to 2009. In 2009, the 3-year old component accounted for approximately 67% of the IGH Chinook run, 91.6% of the TRH run and 69.8 % of the total in-river run.

In April 2009 the Pacific Fishery Management Council (PFMC) approved a ban on ocean commercial harvest of Chinook of the California Coast for the second consecutive season, with the 2008 ocean closure being the first in California history. This ban was enacted in order to protect the Sacramento fall run Chinook stocks, which experienced a sharp decline in 2007. The federal ban extended from three to 200 miles off the coasts of California and Oregon, and the California Fish and Game Commission (CFGC) voted to prohibit commercial Chinook harvest in the state's waters, which extend three miles offshore. A very limited ocean sport season was allowed in the

Klamath Management Zone during 2009. An in-river sport fishery and tribal fishery took place on the Klamath River in 2009.

In April of every year the PFMC adopts the pacific salmon regulations for the upcoming season.

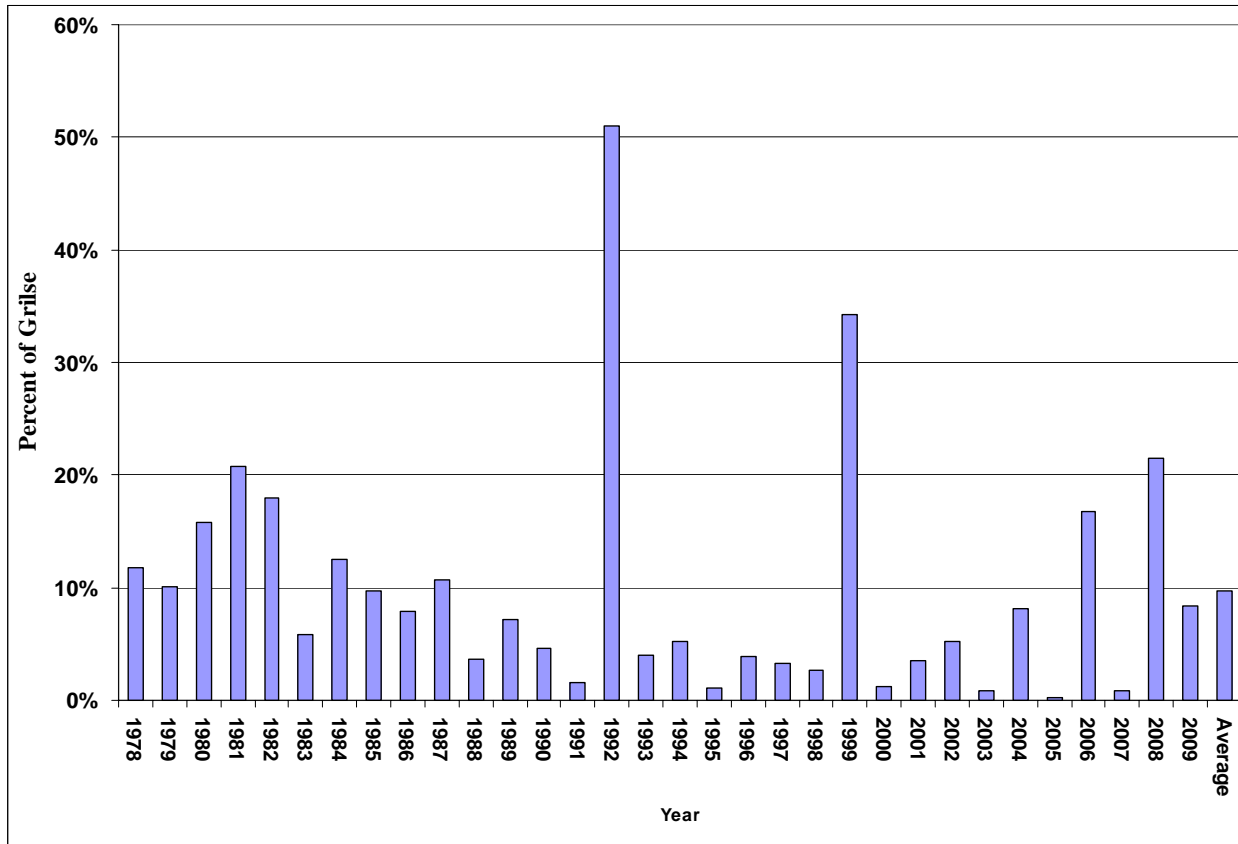


Figure 8. Historical percentages of Chinook grilse observed at Iron Gate Hatchery, Siskiyou County.

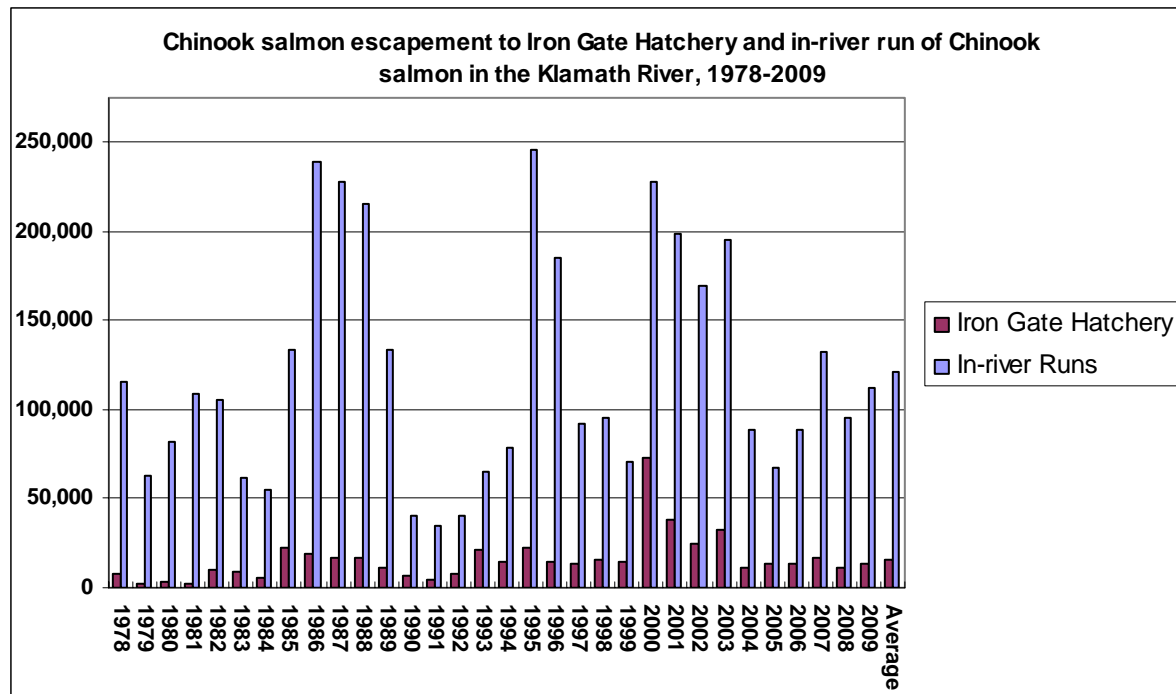


Figure 9. Chinook salmon escapement to Iron Gate Hatchery and in-river runs of Chinook salmon in the Klamath River (California Department of Fish and Game), 1978 to 2009.

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. For the period of 1991 to 2009, IGH Chinook smolt releases have varied from a low of 3,300,312 in 1993 to a high of 6,171,838 in 2006. In 2009, 3,976,305 Chinook smolts were released from IGH. For this same period, Chinook yearling releases have varied from a low of 407,177 in 1996 to a high of 1,155,096 in 1993. In 2009, 773,165 yearling Chinook were released. The average smolt and yearling releases are 4,983,927 and 970,499, respectively. The largest in-river Chinook run (1995) occurred two years after the largest yearling release (1993).

2009 was the first year that a total count of fish 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. In 2009, unusually high losses occurred due to coldwater disease (*Flavobacterium psychrophilum*) and other bacterial infections in Chinook yearling groups, especially those in D series. The D series yearlings were the only series to receive a low phosphorus diet in a feed trial that began in June, 2009 and were slower to respond to treatment than the other groups. As a result, the D series yearlings were released ten days later than the other groups.

One of the recommendations of the Joint Hatchery Review Committee is for IGH to produce more yearlings and less smolts: “DFG should consider the desirability of expanding the Chinook yearling program at IGH and reducing the smolt production. Releasing fewer smolts and more yearlings would relieve some of the hatchery-natural interactions that occur during the low-flow and poor water quality conditions present in

the Klamath River during June and July. The time of the release from IGH occurs during October 15 – November 15, which coincides with flow release increases from Iron Gate Dam, increased precipitation in the Klamath Basin, and substantially improved water quality conditions in the Klamath River. Interactions between hatchery and natural Chinook would be minimized as a result of improved water quality and because most natural produced Chinook would have already left the Klamath Basin.” (CDFG and NMFS 2001). Table 5 shows a comparison of return rates between CWT Chinook released as smolts and as yearlings. An exception to the higher return of yearling releases occurred in 2009, as expanded CWT returns show that 3,349 (29%) were from yearling release groups and 8,351 (71%) were from smolt release groups.

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 5. Return rates of IGH smolt and yearling CWT releases for brood years 1990 to 1996, 1999, 2000 and 2002-2005

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%	95,880.00	740	0.772%	2.04
1991	191,200	96	0.050%	90,982.00	167	0.184%	3.66
1992	185,464	1015	0.547%	74,024.00	269	0.363%	0.66
1993	188,562	40	0.021%	98,099.00	196	0.200%	9.42
1994	194,644	94	0.048%	86,564.00	453	0.523%	10.84
1995	191,799	85	0.044%	90,172.00	954	1.058%	23.87
1996	196,648	162	0.082%	95,396.00	581	0.609%	7.39
1999	182,131	686	0.377%	91,220.00	514	0.563%	1.50
2000	187,417	277	0.148%	100,702.00	707	0.702%	4.75
2002	210,114	367	0.175%	109,711.00	295	0.269%	1.54
2003	261,888	70	0.027%	48,592.00	60	0.123%	4.62
2004	205,950	691	0.336%	98,752.00	215	0.218%	0.65
2005	209,754	194	0.092%	103,157.00	445	0.431%	4.66
AVERAGE			0.186%			0.463%	5.82

Table 6. 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
Average	120,853	85,160	69.7	15,992	14	19	8,782	6.6	9.3
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	64,387	49,131	9.7	13,126	7.0	8.8	9,527	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 7. Adult and grilse components of Chinook salmon returns to Iron Gate Hatchery and Bogus Creek, 1978-2009.

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%
Average	1,103	14,879	15,993	9.8%	689	8093	8782	13.0%

Coho Salmon

A total of 70 coho entered IGH during the 2009-10 spawning season, the lowest return since 1966. Forty-five of these were sampled by KRP staff, which included all 40 of the fish used for spawning. Returns of coho were low basin-wide, with only 9 returning to the Shasta River, 6 to Bogus Creek and 81 to the Scott River.

Due to the low returns in 2009, adjustments were made to the coho spawning protocol at IGH. While IGH has traditionally excluded grilse from its broodstock, in 2009 grilse were used in 8 of 20 (35%) spawning pairs in an effort to improve genetic diversity (Table 8).

Table 8. Coho pairings during the 2009 IGH coho spawning season. 40 coho were spawned.

Pairing	# Pairs	Percentage
LM X LM adults	5	25%
LM adult X LM grilse	5	25%
RM adult X RM adult	1	5%
RM adult X LM adult	1	5%
LM adult X RM grilse	1	5%
LM adults X unmarked adults	3	15%
LM grilse X unmarked adult	2	10%
RM adult X unmarked adult	2	10%

LM= Left maxillary clip, IGH origin RM=Right maxillary clip, TRH origin Unmarked= presumed non-hatchery origin

Starting with the 1994 brood year all hatchery reared coho released within the Klamath Basin have been maxillary clipped. All coho released from TRH receive a right maxillary clip (RM) and all coho released from IGH receive a left maxillary clip (LM). Production goals for coho within the Klamath Basin call for the release of 75,000 yearlings from IGH and 500,000 yearlings from TRH. Cole Rivers Hatchery, located at the base of Lost Creek Dam on the Rogue River in Oregon, releases about 200,000 coho annually, which include approximately 175,000 fish with an ad-clip only and 25,000 fish with an ad-clip and CWT. Until 2007, Cole Rivers also released 25,000 fish that were tagged with a CWT but not ad-clipped ("blind" tags). These blind-tagged fish would have last entered IGH during the 2009-10 season, but none were detected. CWTs recovered from both AD and unmarked coho at IGH have typically been progeny from Cole Rivers Hatchery. .

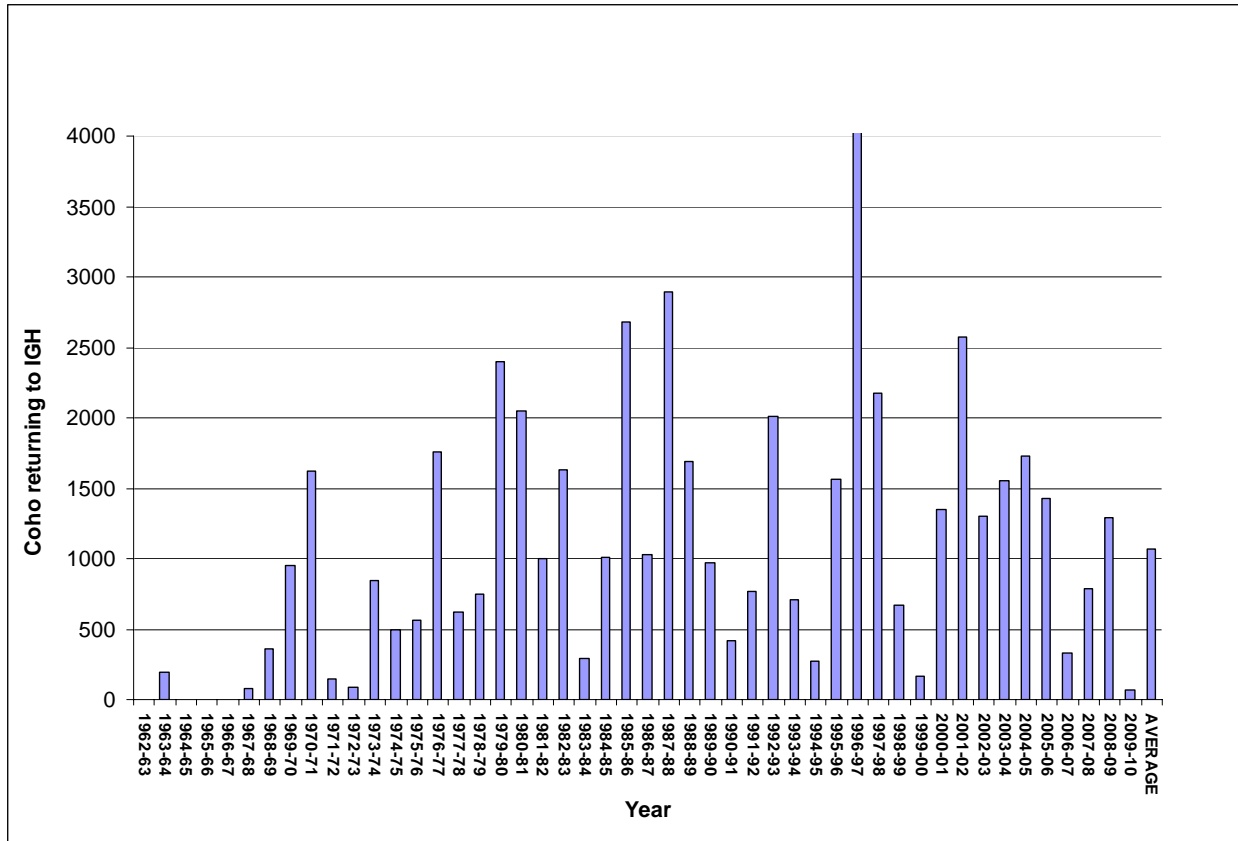


Figure 10. Coho salmon runs at Iron Gate Hatchery (California Department of Fish and Game), 1962 to 2009.

There is some uncertainty regarding the origin of unmarked coho that return to IGH each year. Both naturally produced coho salmon and those of hatchery origin are potentially present within these returns. Returns of unmarked coho of hatchery origin may be related to clipping error within IGH and TRH, or are unmarked coho that are released from hatcheries located outside the basin. Estimates of clipping error are provided by IGH staff.

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 (Table 9). 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 9. Iron Gate Hatchery (IGH) coho salmon yearling release numbers, LM clip return rates, and expanded return estimates with estimated and observed number of unmarked coho that have returned to IGH.

Brood Year	Release Year	Yearling Release	Proportion Marked	Marked Release	Unmarked Release	Marked Return	Unmarked Expansion	Expanded Return	Percent Survival	Unmarked returns of IGH origin	Unmarked Returns	Proportion of unmarked returns explained by unmarked IGH releases
1995	1997	81,498	0.990	80,683	815	556	1.0101	562	0.689	6	251	0.022
1996	1998	79,607	0.985	78,413	1,194	213	1.0152	216	0.272	3	94	0.035
1997	1999	75,156	0.954	71,699	3,457	515	1.0482	540	0.718	25	201	0.124
1998	2000	77,147	0.984	75,913	1,234	2621	1.0163	2664	3.453	43	281	0.152
1999	2001	46,254	0.985	45,560	694	992	1.0152	1007	2.177	15	245	0.062
2000	2002	67,933	0.970	65,895	2,038	710	1.0309	732	1.077	22	584	0.038
2001	2003	74,271	0.994	73,825	446	1208	1.0060	1215	1.636	7	415	0.018
2002	2004	109,374	0.900	98,437	10,937	1467	1.1111	1630	1.490	163	163	1.000
2003	2005	74,716	0.998	74,567	149	204	1.0020	204	0.274	0	74	0.006
2004	2006	89,482	0.990	88,587	895	514	1.0101	519	0.580	5	143	0.036
2005	2007	118,187	0.975	115,232	2,955	190	1.0256	195	0.165	5	25	0.195
2006	2008	53,950	1.000	53,950	0	68	1.0000	68	0.126	0	12	0.000

Prior to 2006, the Department did not scan unmarked coho that entered IGH to determine the presence of CWTs. Therefore, an unknown number of unmarked coho that returned to IGH during those years also may have been of hatchery origin. The number of unmarked coho of hatchery origin that return to IGH in any given year is likely very small (depending on the clip expansion rate) and for most years a comparison of the number of marked versus unmarked coho can be used to conservatively estimate the number of naturally produced coho that enter IGH annually.

Table 10 contains a summary of the number of marked and unmarked coho that have returned to IGH since 1997. From 1997 to 2009 the percentage of marked coho that have returned to IGH has averaged 81%. The number of unmarked coho observed has ranged from a low of 15 in 1999 to a high of 589 in 2003. As previously discussed, these estimates are conservative as they do not account for clipping error or unmarked coho from outside the basin that are of hatchery origin, mainly from Cole Rivers Hatchery.

Acknowledgments

The KRP would like to thank the staff of Iron Gate Hatchery and Joelle Adams, Barbara Hagedorn and Lou Uecker for their assistance and cooperation during the 2009 sampling season, and the Pacific States Marine Fisheries Commission for funding the Iron Gate Hatchery sampling and recovery efforts.

1997/1998				1998/1999				1999/2000			
FIN CLIPS	ADULTS	GRILSE	Total	FIN CLIPS	ADULTS	GRILSE	Total	FIN CLIPS	ADULTS	GRILSE	Total
Unmarked	121	44	165	Unmarked	207	82	289	Unmarked	12	3	15
LM	1,717	253	1,970	LM	303	75	378	LM	138	15	153
RM	5		5	RM			0	RM			0
AD	24	4	28	AD	1	1	2	AD	1		1
ADLM	5	1	6	ADLM			0	ADLM			0
ADRM			0	ADRM			0	ADRM			0
Total Clipped	1,751	258	2,009	Total Clipped	304	76	380	Total Clipped	139	15	154
Total Returns	1,872	302	2,174	Total Return	511	158	669	Total Return	151	18	169
2000/2001				2001/2002				2002/2003			
FIN CLIPS	ADULTS	GRILSE	Total	FIN CLIPS	ADULTS	GRILSE	Total	FIN CLIPS	ADULTS	GRILSE	Total
Unmarked	198	64	262	Unmarked	217	29	246	Unmarked	216	9	225
LM	500	567	1,067	LM	2,054	76	2,130	LM	916	90	1,006
RM	4		4	RM	136	2	138	RM	25	0	25
AD	13		13	AD	51		51	AD	31	7	38
ADLM	8		8	ADLM	7		7	ADLM	5	2	7
ADRM			0	ADRM	1		1	ADRM			0
Total Clipped	525	567	1,092	Total Clipped	2,249	78	2,327	Total Clipped	977	99	1,076
Total Returns	723	631	1,354	Total Return	2,466	107	2,573	Total Return	1,193	108	1,301
2003/2004				2004/2005				2005/2006			
FIN CLIPS	ADULTS	GRILSE	Total	FIN CLIPS	ADULTS	GRILSE	Total	FIN CLIPS	ADULTS	GRILSE	Total
Unmarked	575	14	589	Unmarked	399	25	424 ^{*1}	Unmarked	138	2	140
LM	620	218	838	LM	990	213	1,203	LM	1,254	28	1,282
RM	66	3	69	RM	31	1	32	RM	2	0	2
AD	52	6	58	AD	69	0	69	AD	1	0	1
ADLM	2	0	2	ADLM	0	0	0	ADLM	0	0	0
ADRM	2	0	2	ADRM	1	0	1	ADRM	0	0	0
Total Clipped	742	227	969	Other	5	0	5	Other	0	0	0
Total Returns	1,317	241	1,558	Total Clipped	1,096	214	1,310	Total Clipped	1,257	28	1,285
				Total Return	1,495	239	1,734	Total Return	1,395	30	1,425
2006/2007				2007/2008				2008/2009			
FIN CLIPS	ADULTS	GRILSE	Total	FIN CLIPS	ADULTS	GRILSE	Total	FIN CLIPS	ADULTS	GRILSE	Total
Unmarked	72	8	80	Unmarked	135	2	137	Unmarked	23	1	24
LM	176	27	203	LM	480	163	643	LM	1224	44	1268
RM	1	1	2	RM	6	0	6	RM	0	2	2
AD	16	0	16	AD	2	0	2	AD	0	0	0
ADLM	0	0	0	ADLM	1	0	1	ADLM	0	0	0
ADRM	0	0	0	ADRM	0	0	0	ADRM	0	0	0
								LMRM	2	0	2
Total Clipped	193	28	221	Total Clipped	489	163	652	Total Clipped	1226	46	1272
Total Returns	265	36	301	Total Return	624	165	789	Total Return	1249	47	1296
2009/2010				Proportion of clipped to unclipped coho							
FIN CLIPS	ADULTS	GRILSE	Total	Season	Clipped	Total	% Clipped				
Unmarked	11	5	16	1997/1998	2,009	2,174	92.4%				
LM	24	17	41	1998/1999	380	669	56.8%				
RM	11	2	13	1999/2000	154	169	91.1%				
AD	0	0	0	2000/2001	1,092	1,354	80.6%				
ADLM	0	0	0	2001/2002	2,327	2,573	90.4%				
ADRM	0	0	0	2002/2003	1,076	1,301	82.7%				
				2003/2004	969	1,558	62.2%				
Total Clipped	35	19	54	2004/2005	1,310	1,734	75.5%				
Total Returns	46	24	70	2005/2006	1,285	1,425	90.2%				
				2006/2007	221	301	73.4%				
				2007/2008	652	789	82.6%				
				2008/2009	1272	1296	98.1%				
				2009/2010	54	70	77.1%				
				Average	985	1,186	81.0%				

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 = Multiple clips observed, either result of tag error, injury, or unknown origin

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