



# California Department of Fish and Game

## Klamath River Project

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

2008



Photo by Brad Klosner

Prepared by:

Diana Chesney

California Department of Fish and Game

Klamath River Project

303 South Street

Yreka, CA 96097

January 2009

## ABSTRACT

A total of 11,231 fall-run Chinook salmon (*Chinook*) entered IGH during the fall 2008 spawning season. Chinook (*Oncorhynchus tshawytscha*) began entering Iron Gate Hatchery (IGH) on September 29, 2008, and the last was observed on December 4, 2008. Klamath River Project (KRP) staff systematically sampled 1 in every 10 Chinook as well as all adipose-clipped Chinook during recovery efforts. The sex was determined, scale samples were taken and fork length (FL) was measured for all sampled Chinook. Randomly sampled male Chinook ranged in size from 35 cm to 100 cm fork length, and randomly sampled female Chinook ranged from 42 cm to 90 cm fork length. Analysis of the length-frequency distribution for randomly sampled Chinook males indicates that the cutoff point between grilse and adults occurred at  $\leq 59$  cm fork length. During the 2008 spawning season, KRP staff estimated that 2,414 (21.5%) of the run were grilse according to length frequency analysis. Females accounted for 42.3% (4,750) of the run while males accounted for 57.7% (6,481). The 2008 run total contributed roughly 12% to the total (Klamath basin) in-river run and 17% to the total spawner escapement. Based on coded wire tag expansion, KRP staff estimated that 100% of the Chinook entering IGH during the 2008 season were of hatchery origin.

A total of 1,296 coho salmon (*Oncorhynchus kisutch*) (coho) entered IGH during the 2008 spawning season. The recorded dates for the coho run were from October 22, 2008 to December 18, 2008. KRP staff collected biological data (sex determination, FL, presence of marks or clips and scale samples) on 713 coho, which represented 100% of the coho that were spawned upon returning to IGH. Males ranged in size from 32 cm to 80 cm fork length, while female coho ranged in size from 52 cm to 79 cm fork length. Analysis of the fork length distribution for 343 male coho indicates that the cutoff point between grilse and adults occurred at  $< 58$  cm. FL. IGH counts for the 2008 coho spawning season included 770 adult females, 508 adult males, and 18 grilse. IGH staff counted 1,268 coho with left maxillary clips, 2 with a right maxillary clip, and 1 with both a left maxillary and right maxillary clip. No adipose-clipped coho were observed in 2008. A total of 15 unmarked coho salmon were caudal clipped, floy tagged and released from IGH to the Klamath River. Of these, none returned to IGH, one was recovered as a carcass on nearby Bogus Creek, and one was observed passing through the video weir on Bogus Creek (possibly the same fish). No floy tags were recovered during spawning ground surveys on either the Scott River or Shasta River. Additionally, no fish marked with floy tags were observed passing through the weirs or sampled as washbacks at either the Shasta River or Scott River Fish Counting Facilities. All unmarked coho returning to IGH during the 2008 season were checked for coded wire tags (CWT's) and none were found

## 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

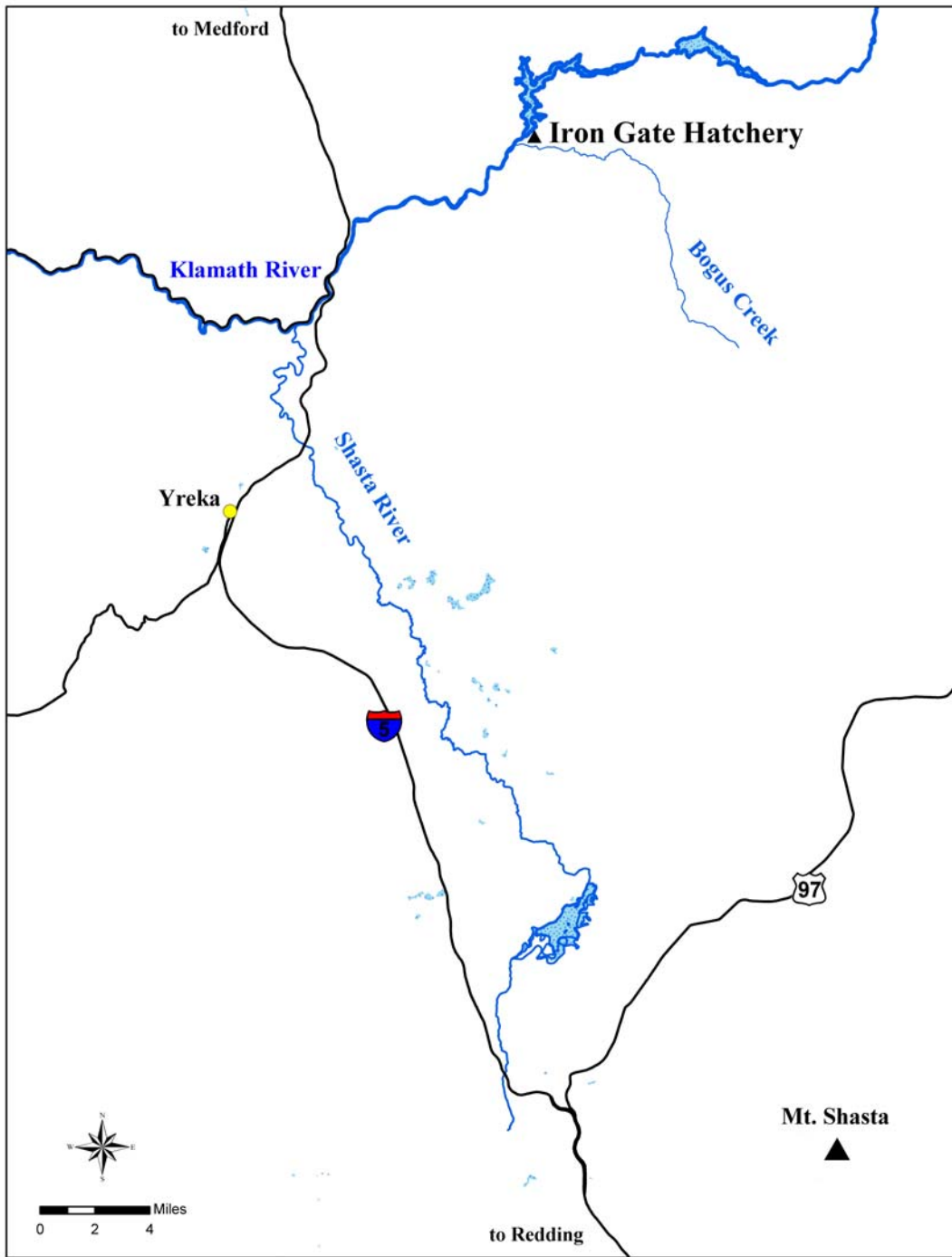


Figure 1. Location of Iron Gate Hatchery (California Department of Fish and Game, Siskiyou County).

## **Klamath River Project**

The California Department of Fish and Game's (CDFG), Klamath River Project (KRP) conducts systematic random sampling of Chinook annually during the spawning season. The purpose of the sampling is to characterize the adult Chinook run 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-clipped) Chinook. All Chinook tagged at IGH are marked with an adipose fin clip to identify them as CWT salmon when they return to the hatchery or are recovered in other locations. 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**

Since 1978, during April and May of each year, staff of the KRP have inserted CWTs into juvenile Chinook. The number of tags applied has varied over the years but currently 300,000 Chinook fingerlings and 108,000 yearling Chinook are tagged annually. These tags contain a code that allows for the identification of six separate groups of fingerlings, corresponding to different rearing raceways. Yearling groups are also divided among the six raceways, but share the same tag code and release date. One of the goals of the tagging program is to determine the success of the early release strategy (Hampton 2001). Formerly, smolts were released at IGH from June 1 to June 15. At the recommendation of the Joint Hatchery Review Committee (2001), CDFG developed an early release strategy, which allows for the release of smolts in multiple groups, each separated by approximately 1 week, beginning around mid-May. There are several benefits to the early release strategy, including reduced competition with natural salmonids and improved survival of smolts due to cooler water temperatures and higher flows.

Release of Chinook smolts are subject to constraints including size at release (defined as 90/lb) and minimum in-river temperatures. (CDFG, PP&L 1996) Smolts may be released at a size smaller than 90/lb if minimum Klamath River water surface temperatures exceed 65 degrees F.

Until 2009 4 to 6 percent of IGH produced Chinook have been coded wire tagged annually. In the spring of 2009, the Klamath River Project will begin a constant fractional marking program (CFM). Under that program 25 percent of IGH Chinook production will be marked and tagged. This change has been made possible by CDFG's acquisition of an Auto Fish trailer, an automated fish clipping and tagging system manufactured by Northwest Marine Technology (NMT), Inc.<sup>1</sup>

---

<sup>1</sup> Use of trade names in this report does not imply endorsement by the California Department of Fish and Game.

## MATERIALS AND METHODS

### Chinook Salmon

In 2008, the fish ladders leading to the lower trap and spawning building remained open throughout the season 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 sample of every 10<sup>th</sup> Chinook during each sampling day. A KRP employee was designated each day to identify every 10<sup>th</sup> Chinook on the process line, as well as all adipose-clipped Chinook. These random and non-random fish were set aside for sampling. After the fish were spawned, KRP staff collected data on FL, sex, and presence or absence of clips and/or marks. Heads were taken from all ad-clipped Chinook (random and non-random fish) as well as data on FL and sex, and scale samples.

### Coho Salmon

In 2008, staff of the KRP collected biological data (sex, fork length, presence of marks or clips and scale samples) for all coho which were spawned at IGH. Since 1995, all hatchery origin coho salmon 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 their coho with an adipose clip, all adipose-clipped coho are checked for the presence of a coded wire tag by passing them through a tag detector. Some Oregon hatcheries tag but don't mark a portion of their coho release. In an effort to account for these "blind" tagged coho that could enter IGH, all unmarked coho that enter IGH are also checked for the presence of a coded wire tag by passing them through a tag detector.

The protocol developed in 2004 by National Oceanic and Atmospheric Administration (NOAA) Fisheries and CDFG to reduce potential take of naturally produced coho was followed at IGH in 2008. The goals of the protocol are to incorporate unmarked coho into the spawning matrix, to release unmarked coho not spawned at the facility, and to monitor unmarked coho releases. The protocol described in detail in the CDFG annual report for Iron Gate Hatchery (Hampton, 2005).

Application of a caudal clip and insertion of an individually numbered Floy tag to unmarked coho provides an opportunity to monitor the movement of these coho after release. Once released, these coho may return to the hatchery, spawn in the Klamath River downstream of IGH, or enter a tributary stream downstream of Iron Gate Dam. Application of the caudal clip serves as a backup mark, in case the Floy tag is shed. The caudal clip also provides CDFG with the ability to identify these coho should they pass through one of the video fish counting facilities located in Bogus Creek, the Shasta River and Scott River (Figure 2). Serially numbered Floy tags provide the ability to track



individual coho as they return to the hatchery or are recovered in one of the spawning ground surveys.



**Figure 2. Floy-tagged, caudal-clipped coho salmon swimming through the Bogus Creek Fish Counting Facility's video weir on November 14, 2008.**

## **RESULTS**

### **Chinook Salmon**

Chinook began entering IGH on September 29, 2008. A total of 11,231 Chinook returned to IGH during the fall 2008 spawning season. Of these, KRP staff collected scale samples, determined sex, and measured FL for 1,149 Chinook. Randomly sampled male Chinook ranged in size from 35 cm to 100 cm in fork length (Figure 3).

Analysis of the length frequency distribution for randomly sampled fall-run Chinook males indicated that the cutoff point between grilse and adults occurred at  $\leq 59$  cm in fork length, yielding approximately 21.5% grilse. Therefore, staff estimates that 2,414 grilse and 8,817 adults entered IGH during the 2008 season. Females accounted for 42.3% (4,750) of the run and males accounted for 57.7% (6,481). Randomly sampled female Chinook ranged in size from 42 cm to 90 cm in fork length (Figure 4). The last Chinook to enter IGH for the 2008 spawning season was observed on December 4, 2008.

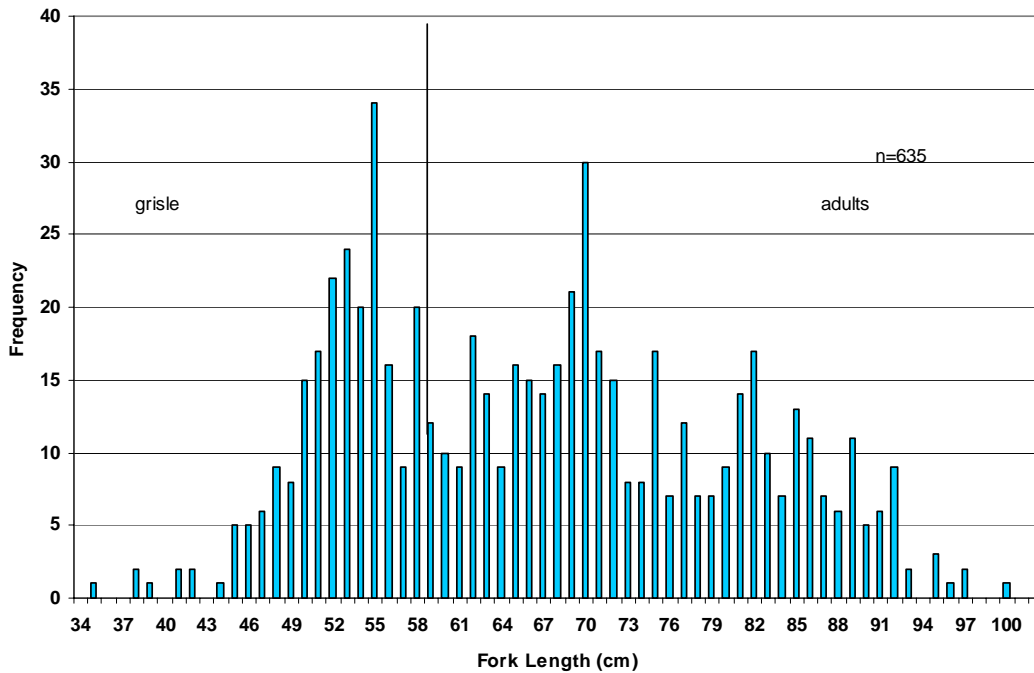
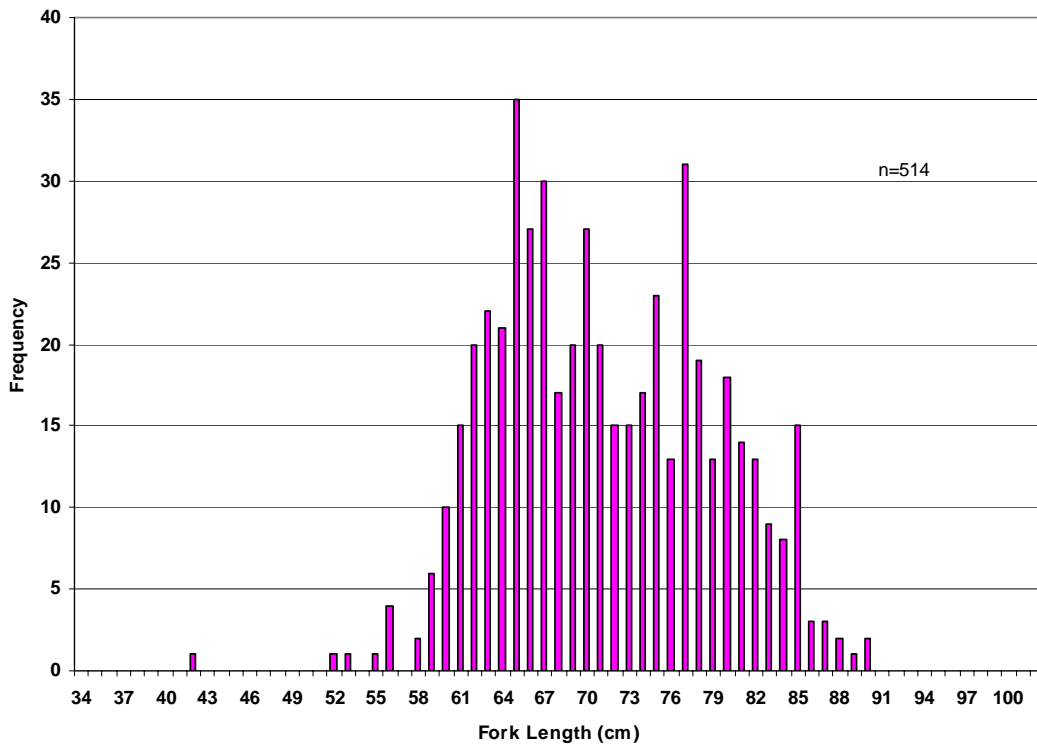


Figure 3. Length frequency distribution for systematic sample of male Chinook salmon recovered at IGH during the 2008 spawning season.



**Figure 4. Length frequency distribution for systematic sample of female Chinook salmon recovered at IGH during the 2008 spawning season.**

Heads from 789 ad-clipped Chinook (from random and non-random fish) were collected for CWT recovery. Of these, 51 heads contained no tags, 10 CWTs were lost during dissection and 32 CWTs were unreadable. The contribution of lost or unreadable CWTs was estimated by applying the proportions of known CWTs (696) to the 42 lost or unreadable CWT ad-clipped Chinook (Table 2).



**Table 2. Estimated contribution of 42 AD-clipped Chinook salmon with unknown coded wire targe (CWT) codes (lost or unreadable) that were recovered at Iron Gate Hatchery,(IGH), based on the proportional distribution of known CWT recoveries at IGH during the 2008 season.**

<b>CWT</b>	<b>BY</b>	<b># CWTs Recovered</b>	<b>Proportion of CWTs recovered</b>	<b>Estimated Number</b>	<b>Production Multiplier</b>	<b>Expanded Estimate</b>
601020503	2003	1	0.001445087	0.06069	21.42	<b>1</b>
601020504	2004	13	0.018786127	0.78902	17.12	<b>14</b>
601020505	2004	19	0.027456647	1.15318	16.61	<b>19</b>
601020506	2004	31	0.044797688	1.8815	34.04	<b>64</b>
601020507	2004	37	0.053468208	2.24566	37.42	<b>84</b>
601020508	2004	30	0.043352601	1.82081	9.09	<b>17</b>
601020509	2004	47	0.067919075	2.8526	8.00	<b>23</b>
601020602	2005	56	0.080924855	3.39884	18.01	<b>61</b>
601020603	2005	44	0.063583815	2.67052	18.67	<b>50</b>
601020604	2005	25	0.036127168	1.51734	37.01	<b>56</b>
601020605	2005	8	0.011560694	0.48555	46.33	<b>22</b>
601020606	2005	75	0.108381503	4.55202	9.24	<b>42</b>
601020607	2005	187	0.270231214	11.3497	9.22	<b>105</b>
601020608	2006	20	0.028901734	1.21387	20.81	<b>25</b>
601020609	2006	35	0.050578035	2.12428	15.93	<b>34</b>
601020700	2006	14	0.020231214	0.84971	16.61	<b>14</b>
601020701	2006	13	0.018786127	0.78902	16.54	<b>13</b>
601020702	2006	11	0.015895954	0.66763	16.65	<b>11</b>
601020703	2006	13	0.018786127	0.78902	18.23	<b>14</b>
601020704	2006	13	0.018786127	0.78902	9.58	<b>8</b>
<b>Totals</b>		<b>692</b>	<b>1</b>	<b>42</b>		<b>677</b>

The estimated contribution of unknown CWT Chinook 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 the CWTs recovered (and successfully read) originated from IGH. Based on expansion of CWTs KRP staff estimated that 100% of the Chinook entering IGH during the 2008 season were of hatchery origin (Table 3).

**Table 3. Estimated contribution of Chinook from Iron Gate Hatchery (IGH) to total run at IGH, based on coded-wire tags recovered from fall-run Chinook salmon recovered at IGH during the 2008 spawning season.**

CWT	Release Location	Brood Year	Age	Release Type	Number Recovered	Production Multiplier	Expanded Estimate
<b>Estimated contribution of known CWTs:</b>							
601020503	IGH	2003	5	Ff	1	21.42	21
601020504	IGH	2004	4	Ff	13	17.12	223
601020505	IGH	2004	4	Ff	19	16.61	316
601020506	IGH	2004	4	Ff	31	34.04	1,055
601020507	IGH	2004	4	Ff	37	37.42	1,385
601020508	IGH	2004	4	Fy	30	9.09	273
601020509	IGH	2004	4	Fy	47	8.00	376
601020602	IGH	2005	3	Ff	56	18.01	1,009
601020603	IGH	2005	3	Ff	44	18.67	821
601020604	IGH	2005	3	Ff	25	37.01	925
601020605	IGH	2005	3	Ff	8	46.33	371
601020606	IGH	2005	3	Fy	75	9.24	693
601020607	IGH	2005	3	Fy	187	9.22	1,724
601020608	IGH	2006	2	Ff	20	20.81	416
601020609	IGH	2006	2	Ff	35	15.93	558
601020700	IGH	2006	2	Ff	14	16.61	233
601020701	IGH	2006	2	Ff	13	16.54	215
601020702	IGH	2006	2	Ff	11	16.65	183
601020703	IGH	2006	2	Ff	13	18.23	237
601020704	IGH	2006	2	Fy	13	9.58	125
				<b>Subtotal</b>	<b>692</b>		<b>11,157</b>
<b>Estimated contribution of unknown CWTs</b>							
200000					10		
400000					32		
				<b>Subtotal</b>	<b>42</b>		<b>677</b>
<b>Total Estimated Hatchery Contribution =</b>							<b>11,834</b>
Unreadable CWTs: 200000=CWT lost, 400000=CWT unreadable							

The Klamath River Technical Advisory Team (KRTAT) met in January of 2009 to review the 2008 Chinook run monitoring efforts and estimate the age composition of the 2008 run (KRTAT 2009). The KRTAT used scale age proportions for developing adult structure and length frequency analysis for the grilse cutoff point for the 2008 IGH fall

Chinook returns (Table 4).

**Table 4. Age composition of the 2008 Chinook salmon run that entered Iron Gate Hatchery (IGH), as developed by the Klamath River Technical Advisory Team (KRTAT).**

	Age				Total Adults	Total Run
	2	3	4	5		
Number of Chinook	2130	5530	3551	21	9,101	11,231
Percent of Total Run	18.96	49.24	31.62	0.18		

### Coho Salmon

The first coho returning to IGH was observed on October 22, 2008 and the last coho was observed on December 18, 2008. A total of 1,296 coho entered IGH during the 2008 season. Of these, KRP staff collected biological data from 713 coho, which represents 100% of the spawned coho and 55% of the total coho run. Of the 713 sampled, 96.3% (687) had left maxillary clips, indicating they were of IGH origin. One coho (0.14%) had a right maxillary clip, indicating it was of TRH origin. One coho (0.14%) had both a right and left maxillary clip. The remaining 24 coho (3.4%) were unmarked. No adipose-clipped coho were recovered at IGH in 2008. Male coho ranged in size from 32 cm to 80 cm in fork length (Figure 6). Female coho ranged in size from 52 cm to 79 cm in fork length (Figure 7). Based on the length frequency distribution of 343 male coho, grilse were estimated to be  $\leq 57$  cm fork length (Figure 6). Of the 343 males, 22 (6%) were grilse.

A total of 15 unmarked coho were Floy tagged and released from IGH to the Klamath River in 2008. Of these, none re-entered IGH, 1 was recovered from as a carcass in nearby Bogus Creek, and 1 was observed passing through the video weir on Bogus Creek (possibly the same fish). No floy tags were recovered during the Shasta River or Scott River spawning ground surveys. Additionally no floy tagged coho were observed passing through the Shasta River or Scott River Fish Counting Facilities or recovered as washbacks on any of the weirs. All unmarked coho were run through a tag detector prior to release, and there were no positive readings in 2008. No coded wire tags were recovered from coho entering Iron Gate Hatchery during the 2008 season.

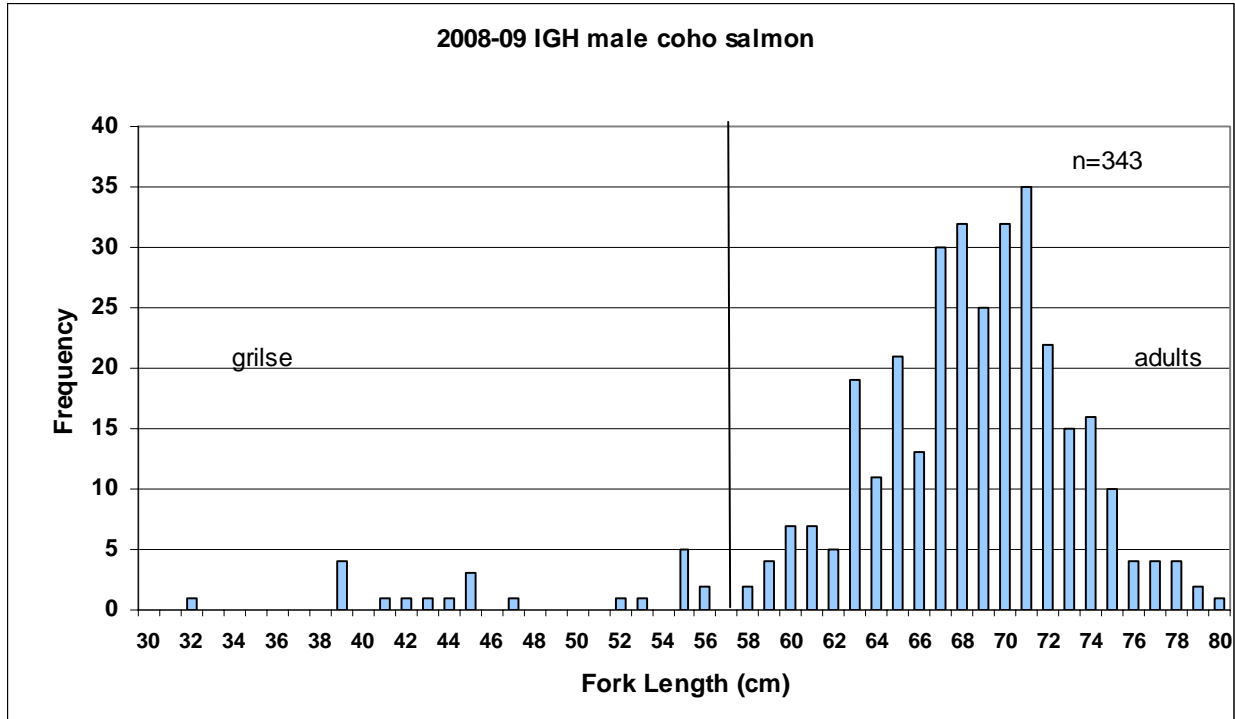


Figure 6. Length frequency distribution for male coho salmon sampled at Iron Gate Hatchery during the 2008 spawning season.

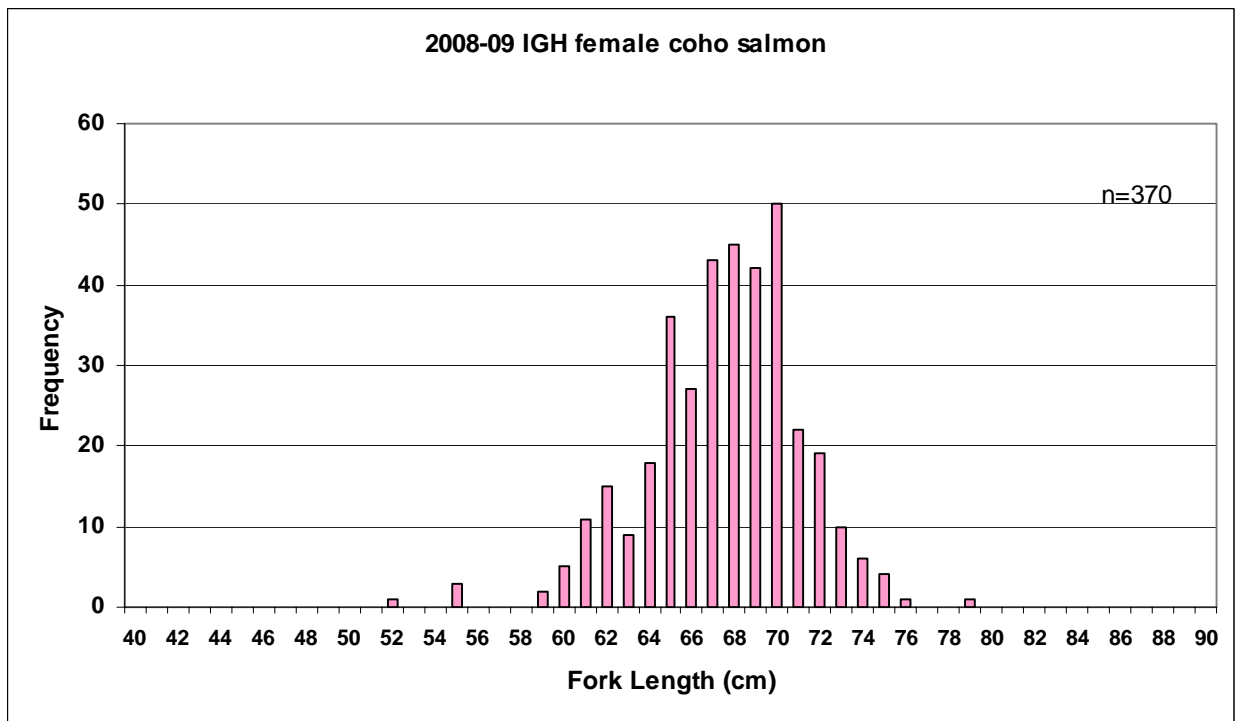


Figure 7. Length frequency distribution for female coho salmon sampled at Iron Gate Hatchery during the 2008 spawning season

## DISCUSSION

### Chinook Salmon

The Klamath River Project has been monitoring the escapement of fall-run Chinook in the Klamath River basin, excluding the Trinity River, since 1978. 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 2008 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 2008).

These forecasts are used by the KRTAT as essential inputs to the Klamath Ocean Harvest Model to predict abundance of 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 2008 run (11,231) of fall Chinook at IGH was the 11<sup>th</sup> lowest run in the 31-year period from 1979 to 2008, and 4,842 fish below the average of 16,073. In 2008 IGH Chinook comprised roughly 11.7% of the total Klamath basin in-river run (95,619) and 17.4% of the total spawner escapement (64,487) (Table 6).

During the 2008 spawning season 21.5% (2,414) of the run was composed of grilse, above the 30-year average of 9.7%. The highest percentage (51.1%) of grilse was observed in 1992 and the lowest percentage (0.3%) in 2005 (Figure 8). From 1978 to 1990, at least 10% of the run were grilse in 7 out of 13 years. In contrast, from 1991 to 2008 the proportion of grilse exceeded 10% for only 4 of the 17 years (Table 7). This proportion is similar to what has been observed in nearby Bogus Creek during those same time periods. From 1978 to 1990, at least 10% of the Bogus Creek run were grilse in 10 out of 13 years. In contrast, from 1991 to 2008 the proportion of grilse in Bogus Creek exceeded 10% for only 5 of the 17 years (Table 7). The average percentage of grilse Chinook in Bogus Creek during this 27 year period was 13.0%.

In 2008, the 3-year old component accounted for approximately 49.2 % of the IGH Chinook run, in contrast to only 19 percent of the total river run (KRTAT, 2009). During December of 2005, it is speculated that high flows in the Shasta and Scott Rivers

possibly destroyed salmon redds by scouring, resulting in the lowest incidence of juvenile Chinook observed in seven years of juvenile sampling near the mouths of the Shasta River and Scott River (W. Chesney, 2006). Since IGH-reared Chinook smolts were not subjected to those same December flow conditions that limited the survival of natural area spawners, this may help to explain the higher rate of return of 3-year olds to IGH.

The 3-year old age class constituted 28% of the 2008 TRH Chinook run, which was dominated by age 4 fish at 56%. In the previous year, 2007, the 3-year old component of the run was by far the largest age class: 85% of the in-river run and 96% of the IGH run, so the strong basin-wide return of 4year olds (52% of the in-river run) is not surprising.

In April 2008 the Pacific Fishery Management Council (PFMC) approved a ban on ocean recreational and commercial harvest of Chinook for the 2008 season, the first such ocean closure 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 voted to prohibit recreational and commercial Chinook harvest in the state's waters, which extend to three miles offshore. An in-river sport fishery and tribal fishery took place on the Klamath River in 2008.

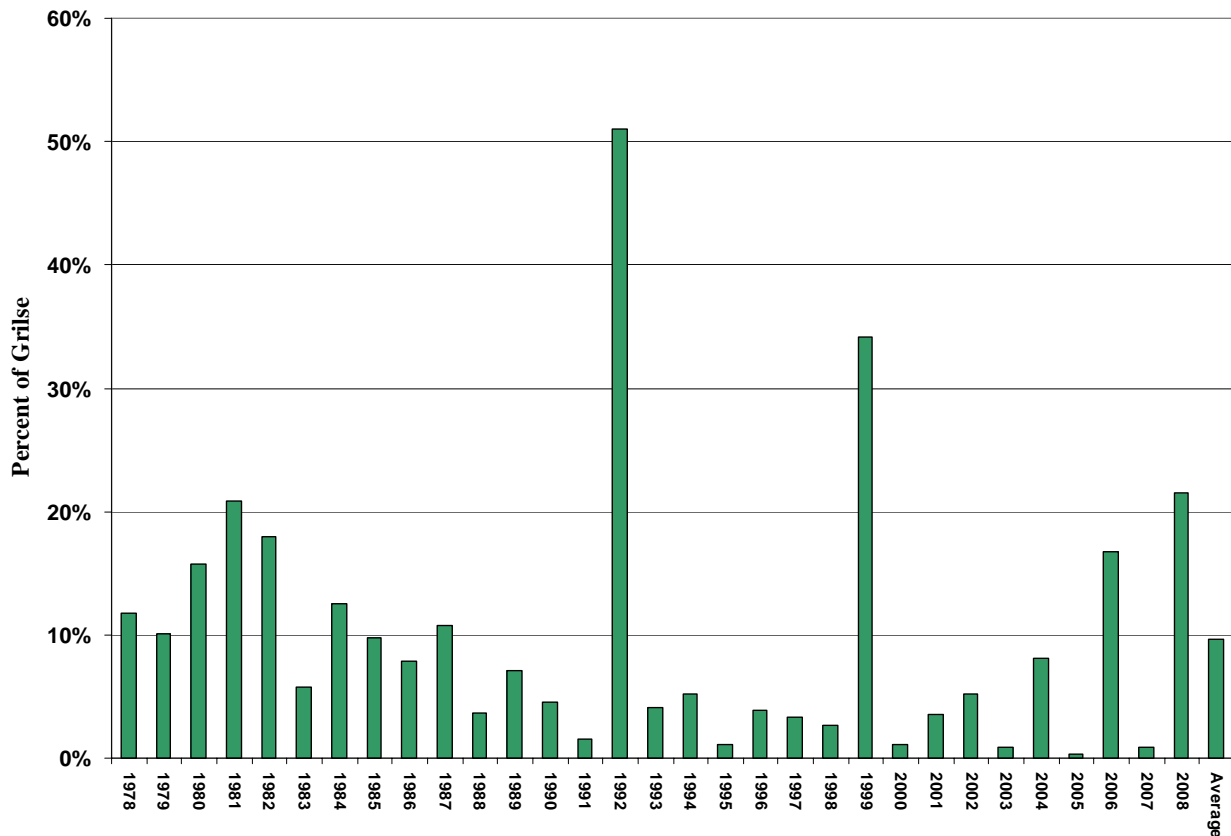


Figure 8. Historical percentages of Chinook grilse observed at Iron Gate Hatchery, Siskiyou County.



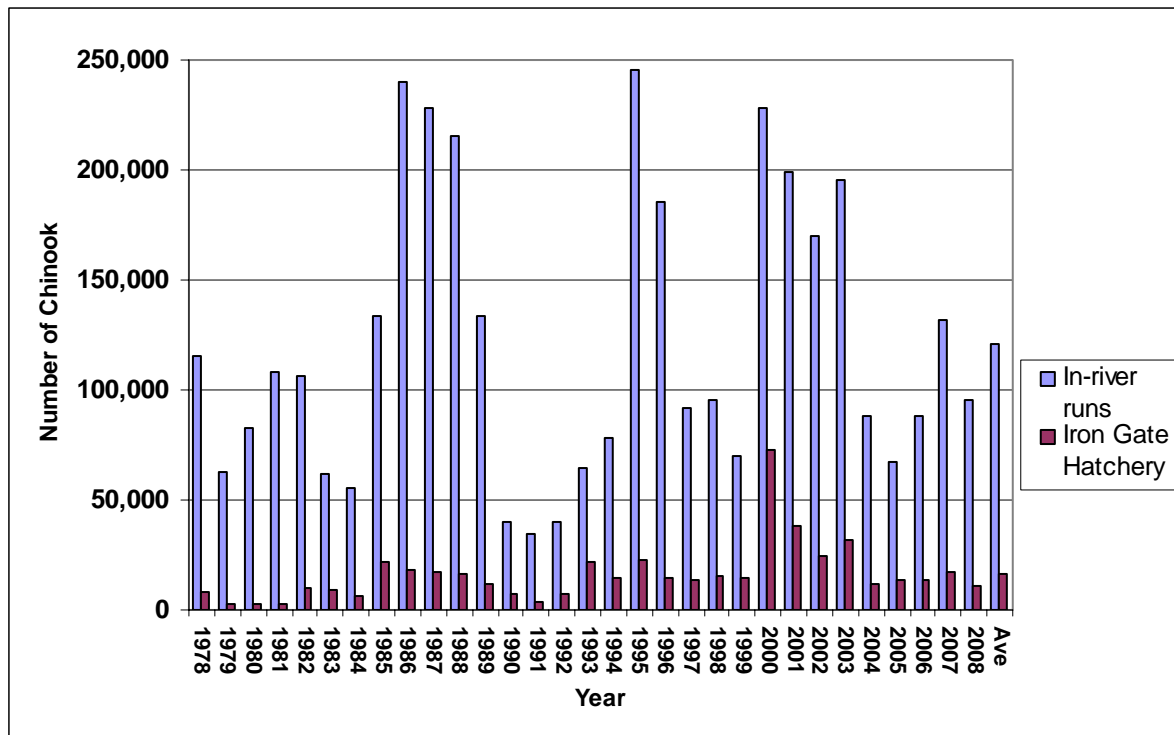


Figure 9. Chinook salmon escapement to Iron Gate Hatchery and in-river runs of Chinook salmon in the Klamath River (California Department of Fish and Game), 1978 to 2008.

The Chinook 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 2008, 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 2008, 5,290,005 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 2008, 1,104,870 yearling Chinook were released. The average smolt and yearling releases for this period are 5,030,797 and 981,475, respectively. The largest run of Chinook to IGH, from 1962 to 2008, occurred in 2000 (72,474), the lowest in 1965 (678) (Figure 9). The largest in-river Chinook run (1995) occurred two years after the largest yearling release (1993).

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). At this time there are physical and funding constraints that limit the Department’s ability to implement an increased rearing program for yearling Chinook.

Analysis of Brood Year (BY) 1979-1984 CWTs recovered from Chinook that were released as yearlings from IGH indicates that yearlings outperform fingerlings roughly 4 to 1 in both ocean fisheries and river returns (Baracco 1990. Analysis of a subset (BY 1990-2004) of Chinook CWT returns to IGH yields similar results (Table 5). Yearlings were not tagged in 1998 or 1999 (BY 1997 and 1998) due to budget constraints, therefore, contribution rates for these two brood year yearling releases is unknown. Brood Year 1990 through 2003 CWT returns contain the most recent data that includes all potential returns (age-classes: 2, 3, 4, and 5).

**Table 5. Return rates of IGH smolt and yearling CWT releases for brood years 1990 to 1996 and 1999 through 2004, There were no yearling CWT releases for Brood Years 1997 and 1998 due to budget constraints.**

Brood Year	IGH Smolt Releases			IGH Yearling Releases			Ratio of yearling/smolt return rates
	# CWT's Released	# CWT's Returned	Percent Return	# CWT's Released	# CWT's Returned	Percent Return	
1990	188,595	713	0.3781	95,880	740	0.7718	2.04
1991	191,200	96	0.0502	90,982	167	0.1836	3.66
1992	185,464	1,015	0.5473	74,024	269	0.3634	0.66
1993	188,562	40	0.0212	98,099	196	0.1998	9.42
1994	194,644	94	0.0483	86,564	453	0.5233	10.84
1995	191,799	85	0.0443	90,172	954	1.0580	23.87
1996	196,648	162	0.0824	95,396	581	0.6090	7.39
1999	182,131	686	0.3767	91,220	514	0.5635	1.50
2000	187,417	277	0.1478	100,702	707	0.7021	4.75
2001	198,761	13	0.0065	110,167	756	0.6862	104.92
2002	210,113	361	0.171812	109711	296	0.2698	1.57
2003	261,888	70	0.026729	48,592	60	0.123477	4.62
2004 *	205,950	686	0.333091	98,752	214	0.216704	0.65
						<b>Average:</b>	<b>13.53</b>

\* BY 2004 returns include only ages 2, 3 and 4.

**Table 6. Fall-run Chinook salmon totals (includes adults and grilse) for the Klamath Basin, Iron Gate Hatchery, and Bogus Creek from 1978 through 2008.**

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
<b>Average</b>	<b>121,117</b>	<b>85,530</b>	<b>69.8</b>	<b>16,073</b>	<b>14</b>	<b>19</b>	<b>8,874</b>	<b>6.6</b>	<b>9.3</b>
<b>MAX</b>	<b>245,542</b>	<b>217,312</b>	<b>88.5</b>	<b>72,474</b>	<b>33.5</b>	<b>44.4</b>	<b>46,432</b>	<b>18.9</b>	<b>21.4</b>
<b>MIN</b>	<b>34,425</b>	<b>19,121</b>	<b>52</b>	<b>2,558</b>	<b>2.4</b>	<b>4.6</b>	<b>54</b>	<b>1.9</b>	<b>3.1</b>
<b>ST DEV</b>	<b>65,434</b>	<b>49,873</b>	<b>9.8</b>	<b>13,335</b>	<b>7.1</b>	<b>8.9</b>	<b>9,670</b>	<b>3.8</b>	<b>4.6</b>
<small>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.</small>									

Table 7. Summary of fall Chinook salmon escapement to Iron Gate Hatchery and Bogus Creek from 1978 to 2008.

Year	Iron Gate Hatchery				Bogus Creek			
	Grilse	Adults	Total	% Grilse	Grilse	Adults	Total	% Grilse
1978	925	6945	7870	11.8%	651	4928	5579	11.7%
1979	257	2301	2558	10.0%	494	5444	5938	8.3%
1980	451	2412	2863	15.8%	1749	3321	5070	34.5%
1981	540	2055	2595	20.8%	912	2730	3642	25.0%
1982	1833	8353	10186	18.0%	2325	4818	7143	32.5%
1983	541	8371	8912	6.1%	335	2713	3048	11.0%
1984	764	5330	6094	12.5%	465	3039	3504	13.3%
1985	2159	19951	22110	9.8%	1156	3491	4647	24.9%
1986	1461	17096	18557	7.9%	1184	6124	7308	16.2%
1987	1825	15189	17014	10.7%	1208	9748	10956	11.0%
1988	609	16106	16715	3.6%	225	16215	16440	1.4%
1989	831	10589	11690	7.1%	444	2218	2662	16.7%
1990	321	6719	7040	4.6%	53	732	785	6.8%
1991	65	4002	4067	1.6%	20	1261	1281	1.6%
1992	3737	3581	7318	51.1%	556	598	1154	48.2%
1993	883	20828	21711	4.1%	431	3285	3716	11.6%
1994	758	13808	14566	5.2%	443	7817	8260	5.4%
1995	259	22681	22940	1.1%	1207	45225	46432	2.6%
1996	543	13622	14165	3.8%	377	10420	10797	3.5%
1997	452	13275	13727	3.3%	221	9809	10030	2.2%
1998	403	14923	15326	2.6%	205	6630	6835	3.0%
1999	4830	9290	14120	34.2%	2628	3537	6165	42.6%
2000	839	71635	72474	1.2%	373	34678	35051	1.1%
2001	1364	37204	38568	3.5%	648	11927	12575	5.2%
2002	1294	23667	24961	5.2%	304	17530	17834	1.7%
2003	290	31970	32260	0.9%	188	15422	15610	1.2%
2004	937	10582	11519	8.1%	295	3493	3788	7.8%
2005	42	13955	13997	0.3%	58	5339	5397	1.1%
2006	2386	11604	13990	17.1%	764	3368	4132	18%
2007	154	16995	17145	0.9%	95	4646	4741	2.1%
2008	2414	8817	11231	21.5%	1430	3136	4566	31%
<b>Average</b>	<b>1,102</b>	<b>14,963</b>	<b>16,074</b>	<b>9.8%</b>	<b>692</b>	<b>8182</b>	<b>8874</b>	<b>13.0%</b>

## Coho Salmon

A total of 1,296 coho entered IGH during the 2008 spawning season, of which 713 (all of the spawned coho) were sampled by KRP staff. Since 1978 the number of coho entering IGH has ranged from a low of 169 in 1999 to a high of 4,097 in 1996 and has averaged 1,092 (Figure 10). The 2008 coho return was above the average at 1,296. There were poor returns of coho to the Shasta and Scott rivers in 2008. The survival of the 2005 brood year in these natural spawning areas may have been affected by the high flows of December 2005 in these natural spawning areas.

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 salmon 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, 150,000 fish with an ad-clip only, 25,000 fish with an ad-clip and CWT, and 25,000 fish that are tagged with a CWT and are not ad-clipped. CWTs recovered from both ad-clipped and unmarked coho salmon at IGH have typically found that these fish are progeny from Cole Rivers Hatchery on the Rogue River.

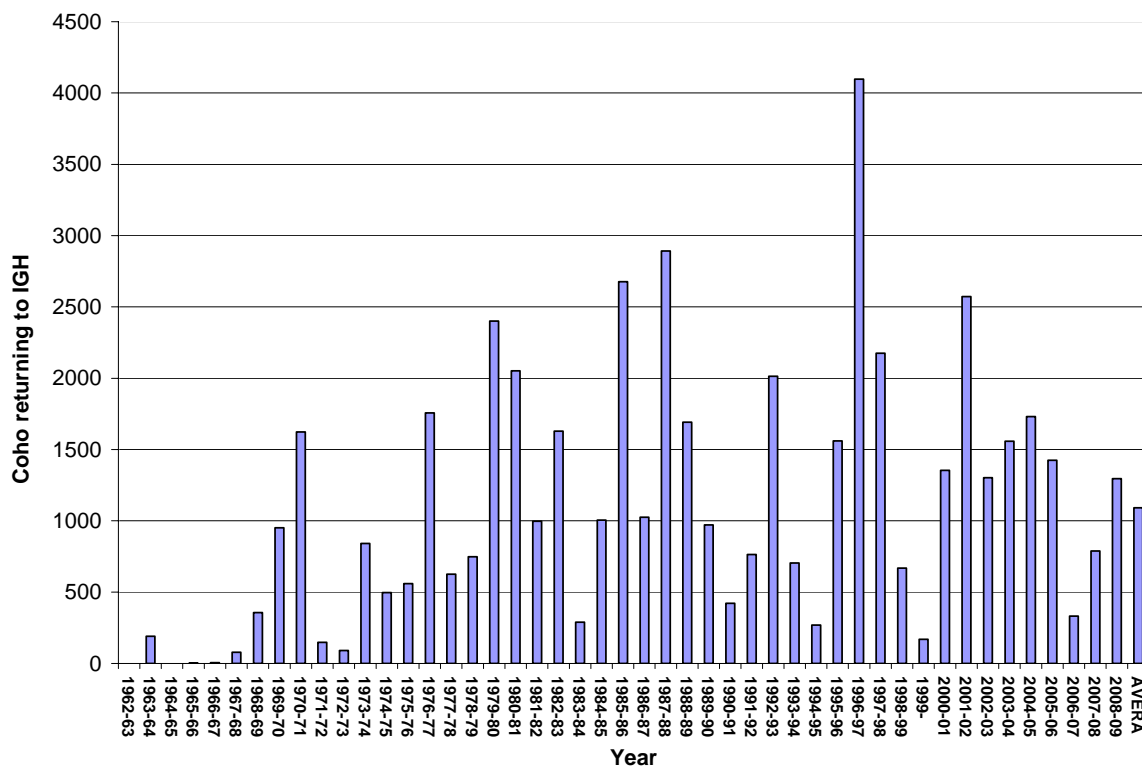


Figure 10. Coho salmon runs at Iron Gate Hatchery (California Department of Fish and Game), 1962 to 2008.

Age 3 coho returns in 1997 represent the first adult returns that were marked with a LM clip prior to release from the hatchery. Therefore, survival estimates for coho releases from IGH can be calculated for brood years from 1994 to 2004. A summary of coho releases, adult returns, and survival of LM clipped coho to IGH is provided in Table 9. Survival of coho progeny released from IGH since the 1994 brood year has ranged from 0.3% to 3.5% and has averaged 1.50%.

There is some uncertainty regarding the origin of unmarked coho that return to IGH each year. Both naturally produced coho 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 and are represented in Table 9 as "proportion marked".

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. In 2008, 98% of coho recovered at IGH had an IGH left maxillary clip, 0.2% had a TRH right maxillary clip, and 0.2% had both right and left maxillary clips, which may be due to clipping error at either IGH or TRH. There were no adipose-clipped coho recovered at IGH in 2008, and no unmarked coho had a positive reading when scanned for a coded wire tag.

**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	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	81,498	0.990	80,683	815	556	1.0101	562	0.689	6	251	0.022
1996	79,607	0.985	78,413	1,194	213	1.0152	216	0.272	3	94	0.035
1997	75,156	0.954	71,699	3,457	515	1.0482	540	0.718	25	201	0.124
1998	77,147	0.984	75,913	1,234	2621	1.0163	2664	3.453	43	281	0.152
1999	46,254	0.985	45,560	694	992	1.0152	1007	2.177	15	245	0.062
2000	67,933	0.970	65,895	2,038	710	1.0309	732	1.077	22	584	0.038
2001	74,271	0.994	73,825	446	1208	1.0060	1215	1.636	7	415	0.018
2002	109,374	0.900	98,437	10,937	1467	1.1111	1630	1.490	163	163	1.000
2003	74,716	0.998	74,567	149	204	1.0020	204	0.274	0	74	0.006
2004	89,482	0.990	88,587	895	514	1.0101	519	0.580	5	142	0.037
2005	118,187	0.975	115,232	2,955	190	1.0256	195	0.165	5	143	0.034



During the last three years 100% of the unmarked coho returning to IGH have been passed by a tag detector to determine the presence or absence of a CWT. Of the 139, 67 and 138 unmarked coho that entered IGH during the 2005, 2006, and 2007 seasons respectively, not a single one bore a CWT indicating that it was from the unmarked and tagged group of 25,000 fish released from Cole River Hatchery. Therefore, it is possible that an unknown number of unmarked coho that returned to IGH during years prior to 2005 may have been of hatchery origin but their proportion is most likely very low. The number of unmarked coho that stray from hatchery facilities other than IGH and return to IGH in any given year is likely very small and for most years a comparison of the number of IGH (corrected for the unmarked portion) marked versus unmarked coho can be used to estimate the number of naturally produced coho that enter IGH.

Table 11 contains a summary of the number of marked and unmarked coho that have returned to IGH since 1997. From 1997 to 2008 the percentage of marked coho that have returned to IGH has averaged 81.4%. 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.

**Table 11. Summary of marked and unmarked coho salmon that have entered IGH from 1997 to 2008.**

1997/1998				1998/1999				1999/2000			
FIN CLIPS	ADULTS	GRILSE	Total	FIN CLIPS	ADULTS	GRILSE	Total	FIN CLIPS	ADULTS	GRILSE	Total
Unmarked			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 Return	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 Return	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 <sup>*1</sup>	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	Total Clipped	1,096	214	1,310	Total Clipped	1,257	28	1,285
Total Return	1,317	241	1,558	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
Total Clipped	193	28	221	Total Clipped	489	163	652	Total Clipped	1226	46	1272
Total Return	265	36	301	Total Return	624	165	789	Total Return	1249	47	1296
Proportion of clipped to unclipped coho											
Season	Clipped	Total	% Clipped								
1997/1998	2,009	2,174	92.4%								
1998/1999	380	669	56.8%								
1999/2000	154	169	91.1%								
2000/2001	1,092	1,354	80.6%								
2001/2002	2,327	2,573	90.4%								
2002/2003	1,076	1,301	82.7%								
2003/2004	969	1,558	62.2%								
2004/2005	1,310	1,734	75.5%								
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%								
<b>Average</b>	<b>1,062</b>	<b>1,279</b>	<b>81.4%</b>								

LM=Iron Gate Hatchery (left maxillary clip)  
 RM= Trinity River Hatchery (right maxillary clip)  
 AD = Cole M. Rivers Hatchery (adipose clip)  
 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

\*1 : 7 of these unmarked coho carried a cwt and were actually from Cole Rivers Hatchery

## REFERENCES

- Baracco, A. 1990. Performance of Fingerling and Yearling Fall Chinook Raised at Iron Gate Hatchery. California Department of Fish and Game memo. 1 pp.
- California Department of Fish and Game. 2004. Tagging Studies of Un-clipped Coho Salmon at Trinity River and Iron Gate Hatcheries, 2004. California Department of Fish and Game, Northern California-North Coast Region. 46 pp.
- California Department of Fish and Game, National Marine Fisheries Service Southwest Region Joint Hatchery Review Committee. 2001. Final Report on Anadromous Salmonid Fish Hatcheries in California. Review Draft June 27, 2001. 79pp.
- California Department of Fish and Game, Pacific Power and Light Company. 1996. Iron Gate Hatchery Production Goals and Constraints. 3pp.
- Chesney, W., et al, 2006. Shasta and Scott River Juvenile Salmonid Outmigrant Study, 2006. California Department of Fish and Game Annual Report. 62 pp.
- Hampton, M. 2001. Fall Chinook Salmon Tagging and Early Release Strategy at Iron Gate Fish Hatchery. California Department of Fish and Game Proposal. 7pp.
- Hampton, M. 2005. Recovery of Chinook and Coho Salmon at Iron Gate Hatchery. California Department of Fish and Game, Klamath River Project Annual Report. 24 pp.
- KRTAT (Klamath River Technical Advisory Team) 2009. Klamath River Fall Chinook Age-Specific Escapement, River Harvest, and Run Size Estimates, 2008 Run. 20pp.