

California Department of Fish and Game

Klamath River Project

Chinook and Coho Salmon Recovery at Iron Gate Hatchery

October 7, 2002 to January 3, 2003

ABSTRACT

The California Department of Fish and Game's (CDFG), Klamath River Project (KRP) conducts random sampling of fall-run Chinook salmon (*Oncorhynchus tshawytscha*) annually, during the Chinook spawning season. The purpose of the sampling is to determine the abundance of adult fall-run Chinook salmon entering Iron Gate Hatchery (IGH), to characterize the run in terms of age and sex composition, and to recover all coded-wire tags (from random and non-random fish) from adipose fin clipped (ad-clipped) Chinook. Fall-run Chinook salmon began entering IGH on September 16, 2002. A total of 24,961 Chinook salmon returned to IGH during the fall 2002 spawning season. Of these, KRP staff collected scale samples, determined sex, and measured fork lengths for 2,419 Chinook salmon and recovered heads from 707 ad-clipped salmon. Analysis of the length frequency distribution for randomly sampled fall-run Chinook males indicates that the cutoff point between grilse and adults occurs at 62 cm (Fig. 2). Based on the length frequency distribution as well as the sex composition determined by IGH staff, KRP staff estimated that 1,296 grilse and 23,665 adult Chinook returned to IGH in 2002. Females accounted for 48.9% (12,214 fish) of the run while males accounted for 51.1% (12,747 fish). The last Chinook of the 2002 spawning season was observed on November 12, 2002. The 2002 run (24,961) of fall-run Chinook salmon recovered at IGH was the third largest run recorded at IGH in the last 25 years (Fig. 7), since the beginning of the Klamath River Project, surpassed only by 2001 (38,568) and 2000 (72,474). Although 2002 ranked 3rd highest for IGH total run numbers, percent contributions to total (Klamath basin) in-river run and total spawner escapement were only 11th highest and 7th highest, respectively (Table 3). Klamath River Project staff continued data collection efforts through the coho salmon (*Oncorhynchus kisutch*) run, collecting scale samples and fork lengths for 785 coho. A total of 1,301 coho salmon entered IGH during the 2002-2003 spawning season, which is approximately half of the number observed during the 2001-2002 spawning season (2,573). The first coho was observed on October 21, 2002 and the last coho of the 2002-03 spawning season was observed on January 3, 2003.

INTRODUCTION

Iron Gate Hatchery

The Iron Gate Hatchery is located adjacent to the Klamath River (river mile 190), in Siskiyou County, CA, approximately 120 miles north of Redding, near the Oregon border (Fig. 1). This hatchery was established in 1963 in order to mitigate for the effects of Iron Gate Dam on anadromous species. The production goals (CDFG and PP&L 1996) for the hatchery are listed in Table 1 (the Steelhead Research and Monitoring Program collects data on the steelhead run).

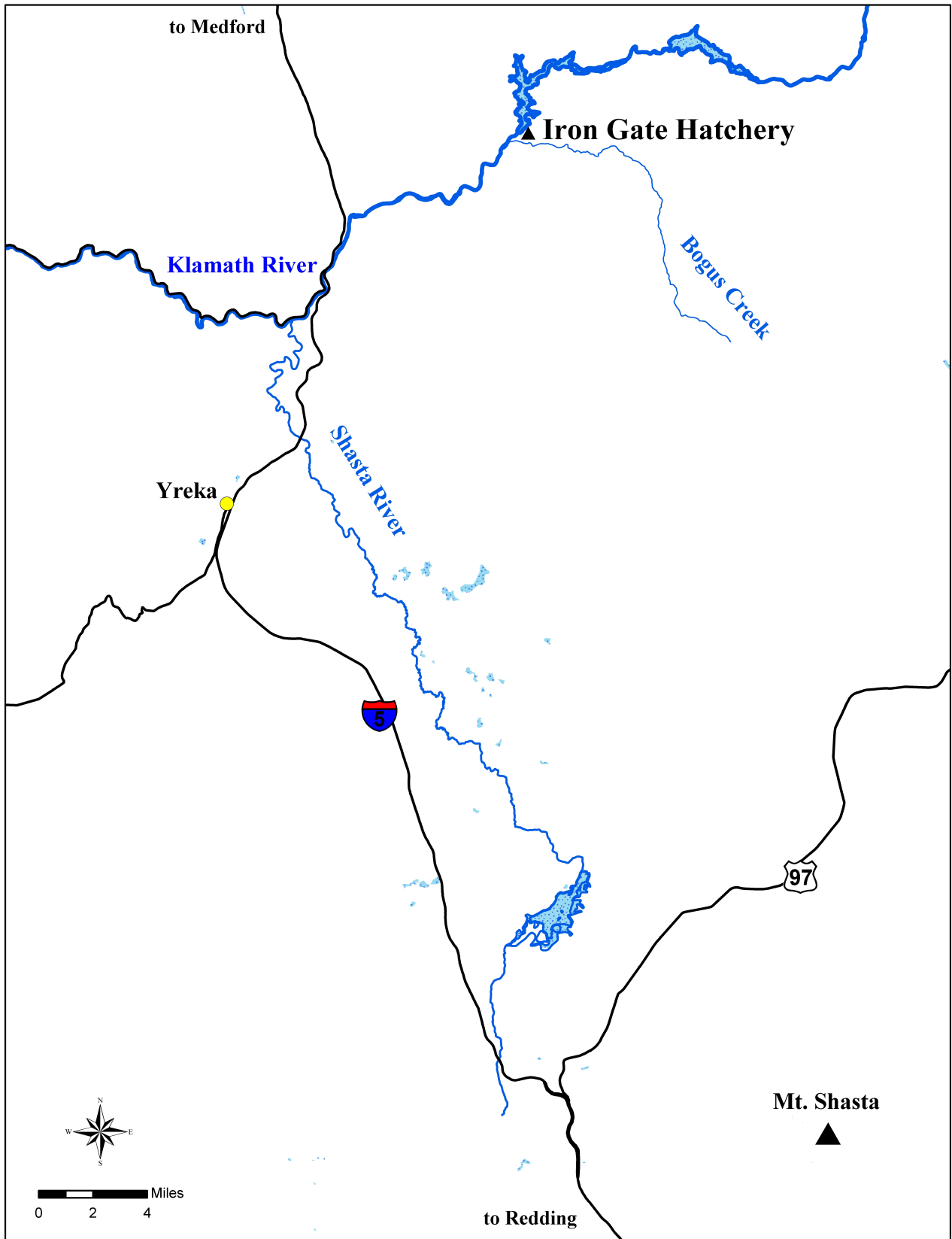


Figure 1. Location of Iron Gate Hatchery (California Department of Fish and Game, Siskiyou County).

Table 1. Production goals for Iron Gate Hatchery (California Department of Fish and Game, Siskiyou County).

Species	Number released	Released	Run timing
Chinook Salmon	4,920,000 smolts	May-June	mid September to early November
	1,080,000 yearlings	November	
Coho	75,000 yearlings	March	late October to early January
Steelhead	200,000 yearlings	March-May	November to March

Klamath River Project

All tagged Chinook are marked with an adipose fin clip, which allows identification and recovery of the coded-wire tags (CWTs) when the Chinook return to the hatchery during subsequent spawning seasons. The goals of the recovery project are to collect biological data on a random sample of Chinook and coho (a much higher percentage of coho were sampled, due to lower numbers) returning to IGH and recover all coded wire tags identified. These tagged fish provide a reference of known age fish which is used, along with scale samples and analysis of length frequency distribution, for the determination of age composition.

MATERIALS AND METHODS

Coded-Wire Tagging

During April and May of every year (since 1979), staff of the KRP insert coded wire tags (CWTs) into 200,000 Chinook smolt (90 fish/lb) and 120,000 yearling Chinook salmon. Smolts (fingerlings) receive a half length tag; yearlings receive a full length tag. These tags contain a code that allows for the identification of four separate groups of fingerlings and three groups of yearlings (which correspond to different raceways). One of the goals of the tagging program is to determine the success of the early release strategy. Formerly, smolts were released from IGH from June 1 to June 15. At the recommendation of the Joint Hatchery Review Committee (2001), CDFG developed this early release strategy (Hampton 2001) which allows for the release of smolts in four 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 lower water temperatures and higher flows). One of these yearling groups are raised at Fall Creek Hatchery, which is adjacent to Fall Creek (a tributary to Iron Gate Reservoir), an excellent source of high quality water. 2002 was the first year that Fall Creek yearlings were tagged with a unique code. This code may provide the necessary data to determine if Fall Creek yearlings have a higher survival rate than IGH yearlings.

Random Sampling and Coded Wire Tag Recovery

All Chinook are allowed to enter the hatchery. Upon entering IGH in the fall of 2002, Chinook salmon 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. Once the fish were spawned, they were counted, sexed and examined for clips and/or marks, by staff of the KRP. Excess fish are killed and added to the post-spawned fish. All fish are processed and donated to local food banks, churches, and the public. During each sampling day, a random sample (every 10th or 20th

Chinook, depending on the number of fish present and available time) was processed. Fork length and sex were determined and a scale sample was collected for each of these random fish. Heads containing CWTs and scale samples, as well as fork length measurements and sex determinations, were collected from all ad-clipped Chinook (random and non-random fish).

Coho

In addition to collecting biological data for the Chinook run, staff of the KRP collected biological data (sex, fork length, presence of marks or clips and scale samples) for a large portion of the coho which entered IGH (62%). Each coho was inspected for the presence of marks and clips (adipose and right or left maxillary). Since 1995, all hatchery reared coho salmon within the Klamath River basin have been marked with a maxillary clip prior to release. IGH coho receive a left maxillary clip; Trinity River Hatchery (TRH) coho are marked with a right maxillary clip.

RESULTS

Chinook

Chinook began entering IGH on September 16, 2002. A total of 24,961 Chinook salmon returned to IGH during the fall 2002 spawning season. Of these, Klamath River Project staff collected scale samples, determined sex, and measured fork lengths for 2,419 Chinook. Random male Chinook ranged in size from 40 cm to 103 cm (Fig. 2). Analysis of the length frequency distribution for these randomly sampled fall-run Chinook males indicated that the cutoff point between grilse and adults occurs at 62 cm in fork length. Based on the length frequency distribution as well as the sex composition determined by IGH staff, the KRP staff estimated that 1,296 grilse and 23,665 adult fall-run Chinook returned to IGH in 2002. Females accounted for 48.9% (12,214 fish) of the run and males accounted for 51.1% (12,747 fish). Random female Chinook ranged in size from 52 to 96 cm (Fig. 3). The last Chinook of the 2002 spawning season was observed on November 12, 2002.

In addition to the random sampling, heads from 707 ad-clipped Chinook salmon (from random and non-random fish) were recovered for CWT recovery. Based on expansion of CWTs, KRP staff estimated that 17,749 (71%) of the Chinook entering IGH were of hatchery origin (Table 2). It is more common to observe a TRH Chinook straying to IGH than vice versa.

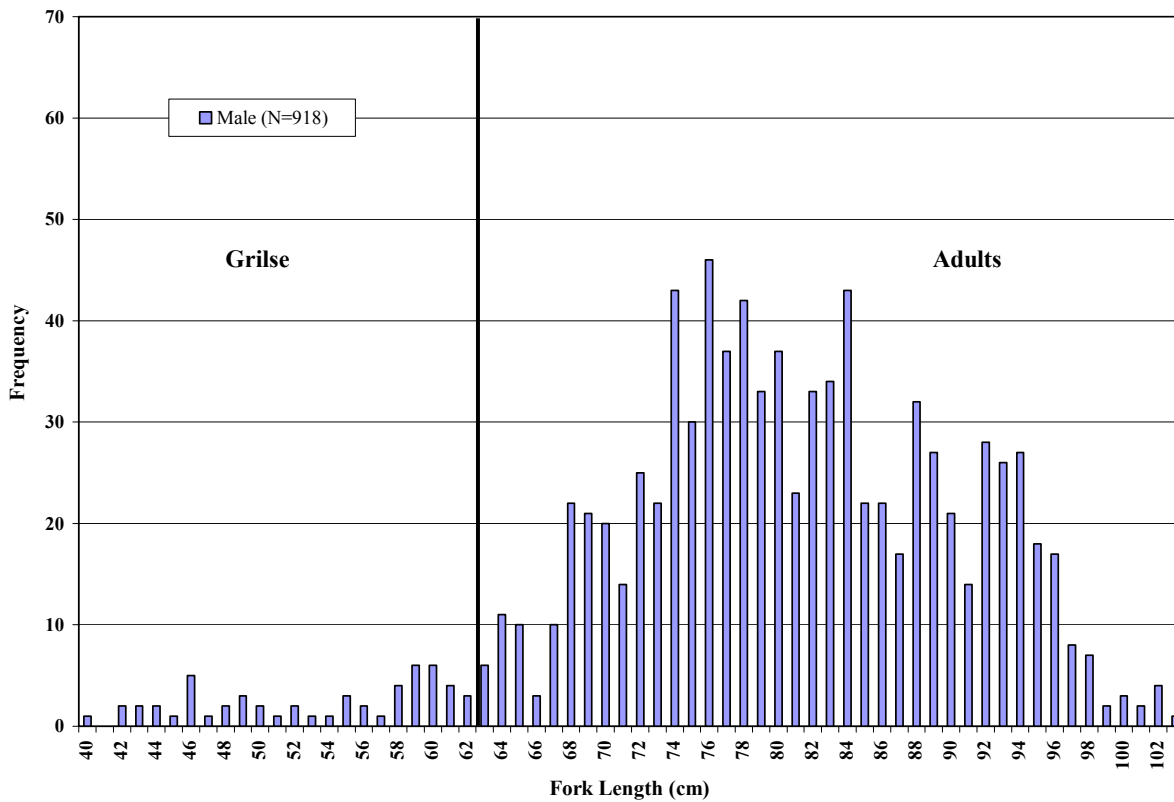


Figure 2. Length frequency distribution for random male Chinook salmon recovered at IGH during the 2002 spawning season.

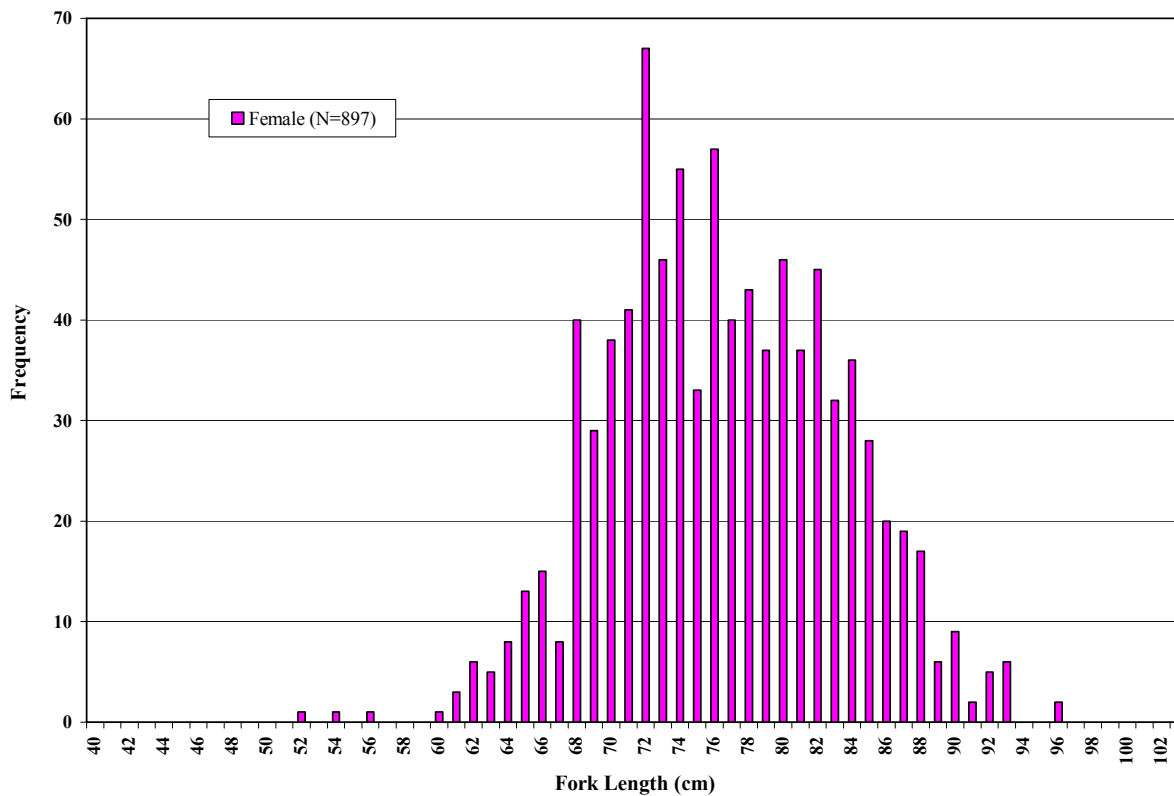


Figure 3. Length frequency distribution for random female Chinook salmon recovered at IGH, during the 2002 spawning season.

Table 2. 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 at Iron Gate Hatchery, during the 2002 spawning season.

CWT	Release Location	Brood Year	Age	Release Type	Number Recovered	Production Multiplier	Expanded Estimate
601020305	IGH	2000	2	Ff	2	17.69	35
601020306	IGH	2000	2	Ff	2	17.76	36
601020307	IGH	2000	2	Ff	1	39.30	39
601020308	IGH	2000	2	Ff	2	32.44	65
66353	IGH	2000	2	Fy	8	9.64	77
66354	IGH	2000	2	Fy	3	8.51	26
601020309	IGH	1999	3	Ff	81	27.49	2,227
601020310	IGH	1999	3	Ff	91	27.49	2,502
601020311	IGH	1999	3	Ff	101	27.49	2,777
601020312	IGH	1999	3	Ff	44	27.49	1,210
66351	IGH	1999	3	Fy	42	11.46	481
66352	IGH	1999	3	Fy	37	11.46	424
100000	IGH	1999	3	Ff	71	27.49	1,952
200000	IGH	1999	3	Ff	17	27.49	467
300000	IGH	1999	3	Ff	7	27.49	192
400000	IGH	1999	3	Ff	14	27.49	385
601020301	IGH	1998	4	Ff	38	26.38	1,002
601020302	IGH	1998	4	Ff	54	26.38	1,425
601020303	IGH	1998	4	Ff	54	26.38	1,425
601020304	IGH	1998	4	Ff	37	26.38	976
601020214	IGH	1997	5	Ff	1	26.39	26
Total Estimated Hatchery Contribution =							17,749
CWT codes 100000-400000 assumed 1999 Ff expansion rate.							
Unreadable CWTs: 100000=No CWT, 200000=CWT lost, 300000=head lost (or not collected), 400000=CWT unreadable.							
Ff = Fall-run Chinook fingerling, Fy = Fall-run Chinook yearling.							
The production multiplier value is the inverse of the proportion initially tagged.							

Coho

Klamath River Project staff continued data collection efforts through the coho salmon run, collecting biological data for 785 coho. The first coho was observed on October 21, 2002 and the last coho of the 2002-03 spawning season was observed on January 3, 2003. A total of 1,301 coho salmon entered IGH during this period. Male coho ranged in size from 23 cm to 86 cm (Fig. 4). Female coho ranged in size from 61 cm to 93 cm (Fig 5). 1,076 marked coho were recovered at IGH. Of these, 1,006 (93.5%) were progeny of IGH (marked with a left maxillary clip, Fig. 6). In addition to IGH returns, 25 (2.3%) coho originating from Trinity River Hatchery (right maxillary clip) were observed.

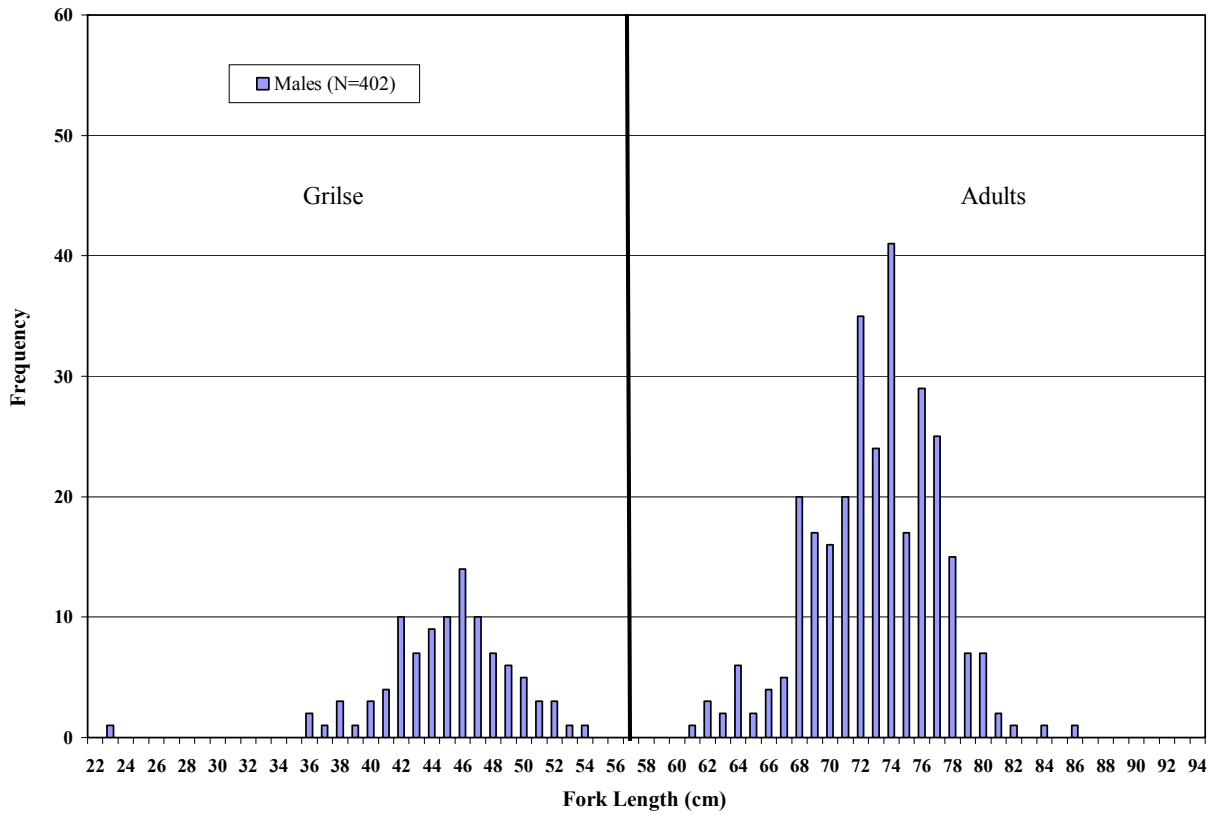


Figure 4. Length frequency distribution for male coho salmon recovered at Iron Gate Hatchery during the 2002-03 spawning season.

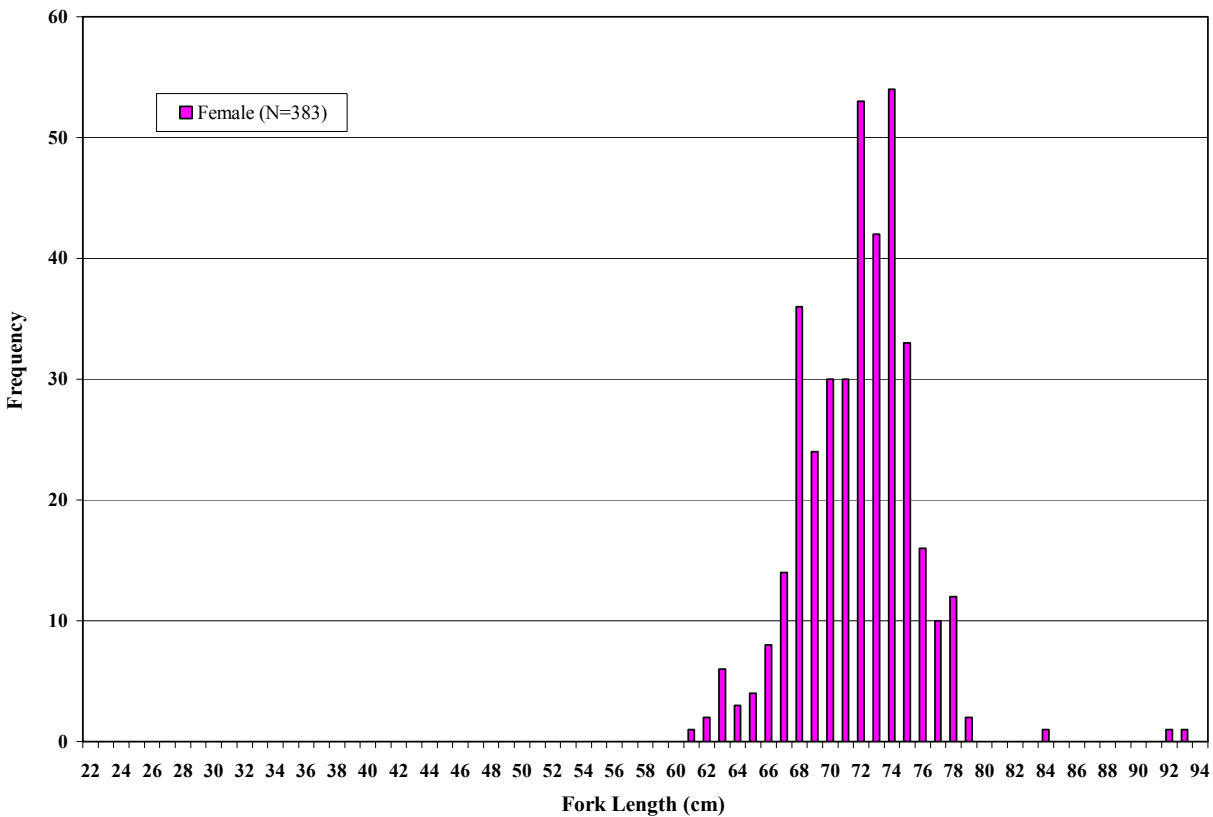


Figure 5. Length frequency distribution for female coho salmon recovered at Iron Gate Hatchery during the 2002-03 spawning season.

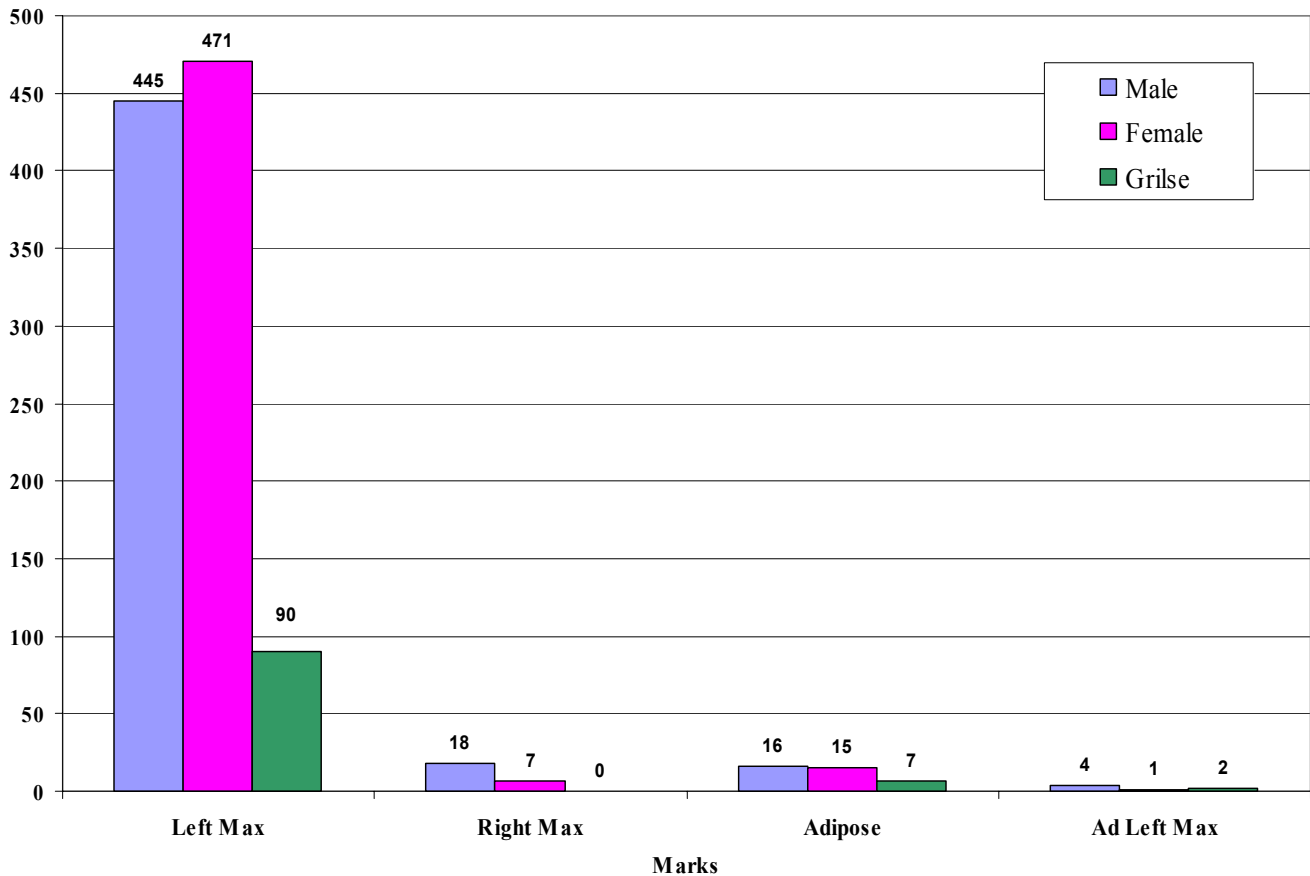


Figure 6. Marked (maxillary and adipose clips) coho salmon recovered at Iron Gate Hatchery during the 2002-03 spawning season.

DISCUSSION

Historic Chinook Runs

The 2002 run (24,961) of fall-run Chinook salmon recovered at IGH was the third largest run recorded at IGH in the last 25 years (Fig. 7), since the beginning of the Klamath River Project, surpassed only by 2001 (38,568) and 2000 (72,474). Although 2002 ranked 3rd highest for IGH total run numbers, percent contributions to total (Klamath basin) in-river run and total spawner escapement were only 11th highest and 7th highest, respectively (Table 3). During the 1995 Chinook salmon spawning season, the gates at IGH were closed at times; therefore a significant portion of the IGH Chinook returns were diverted to nearby Bogus Creek (Fig. 1). The largest in-river run of Chinook also occurred in 1995 (245,427), which was double the average run (123,281) for the same period (Table 3 and Fig. 8). As expected, total Chinook spawner escapement for this period also peaked in 1995 (Table 3). The percent contribution of Bogus Creek escapement to total in-river run and spawner escapement also peaked in 1995, at 19% and 21%, respectively (Fig. 9). In comparison, the peak contribution of IGH to total in-river run and spawner escapement (34% and 44%, respectively) occurred in 1993 (Fig. 10). However, if all of the Chinook returning to IGH in 1995 had entered IGH, then the contribution rates for IGH would have been much higher in 1995.

Table 3. 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 (IGH)			Bogus Creek		
Low flow years	Totals	Totals	% of IRR	Totals	% of IRR	% of SE	Totals	% of IRR	% of SE
1978	115,587	90,135	78.0	7,870	6.8	8.7	5,579	4.8	6.2
1979	62,864	42,255	67.2	2,558	4.1	6.1	5,938	9.4	14.1
1980	82,318	57,683	70.1	2,863	3.5	5.0	5,070	6.2	8.8
1981	108,171	56,333	52.1	2,595	2.4	4.6	3,642	3.4	6.5
1982	105,900	67,076	63.3	10,186	9.6	15.2	7,143	6.7	10.6
1983	61,335	47,960	78.2	8,885	14.5	18.5	3,048	5.0	6.4
1984	55,408	30,375	54.8	6,094	11.0	20.1	3,504	6.3	11.5
1985	133,730	104,487	78.1	22,110	16.5	21.2	4,647	3.5	4.4
1986	239,366	180,263	75.3	18,557	7.8	10.3	7,308	3.1	4.1
1987	227,799	143,890	63.2	17,014	7.5	11.8	10,956	4.8	7.6
1988	215,322	130,749	60.7	16,715	7.8	12.8	16,440	7.6	12.6
1989	133,117	72,438	54.4	11,690	8.8	16.1	2,662	2.0	3.7
1990	40,214	25,705	63.9	7,040	17.5	27.4	785	2.0	3.1
1991	34,353	19,121	55.7	4,067	11.8	21.3	1,281	3.7	6.7
1992	40,346	28,479	70.6	7,318	18.1	25.7	1,154	2.9	4.1
1993	64,740	48,945	75.6	21,711	33.5	44.4	3,716	5.7	7.6
1994	78,269	60,850	77.7	14,566	18.6	23.9	8,260	10.6	13.6
1995	245,427	217,312	88.5	22,940	9.3	10.6	46,432	18.9	21.4
1996	184,903	108,325	58.6	14,165	7.7	13.1	10,797	5.8	10.0
1997	91,642	70,303	76.7	13,727	15.0	19.5	10,030	10.9	14.3
1998	95,210	75,157	78.9	15,326	16.1	20.4	6,835	7.2	9.1
1999	70,190	50,088	71.4	14,120	20.1	28.2	6,165	8.8	12.3
2000	228,114	188,642	82.7	72,474	31.8	38.4	35,051	15.4	18.6
2001	198,398	142,323	71.7	38,568	19.4	27.1	12,575	6.3	8.8
2002	169,297	99,045	58.5	24,961	14.7	25.2	17,835	10.5	18.0
Average	123,281	86,318	69.0	15,925	13.4	19.0	9,474	6.9	9.8
MAX	245,427	217,312	88.5	72,474	33.5	44.4	46,432	18.9	21.4
MIN	34,353	19,121	52.1	2,558	2.4	4.6	785	2.0	3.1
STDEV	69,718	53,994	10.0	14,459	7.8	9.9	10,517	4.1	4.9

*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.

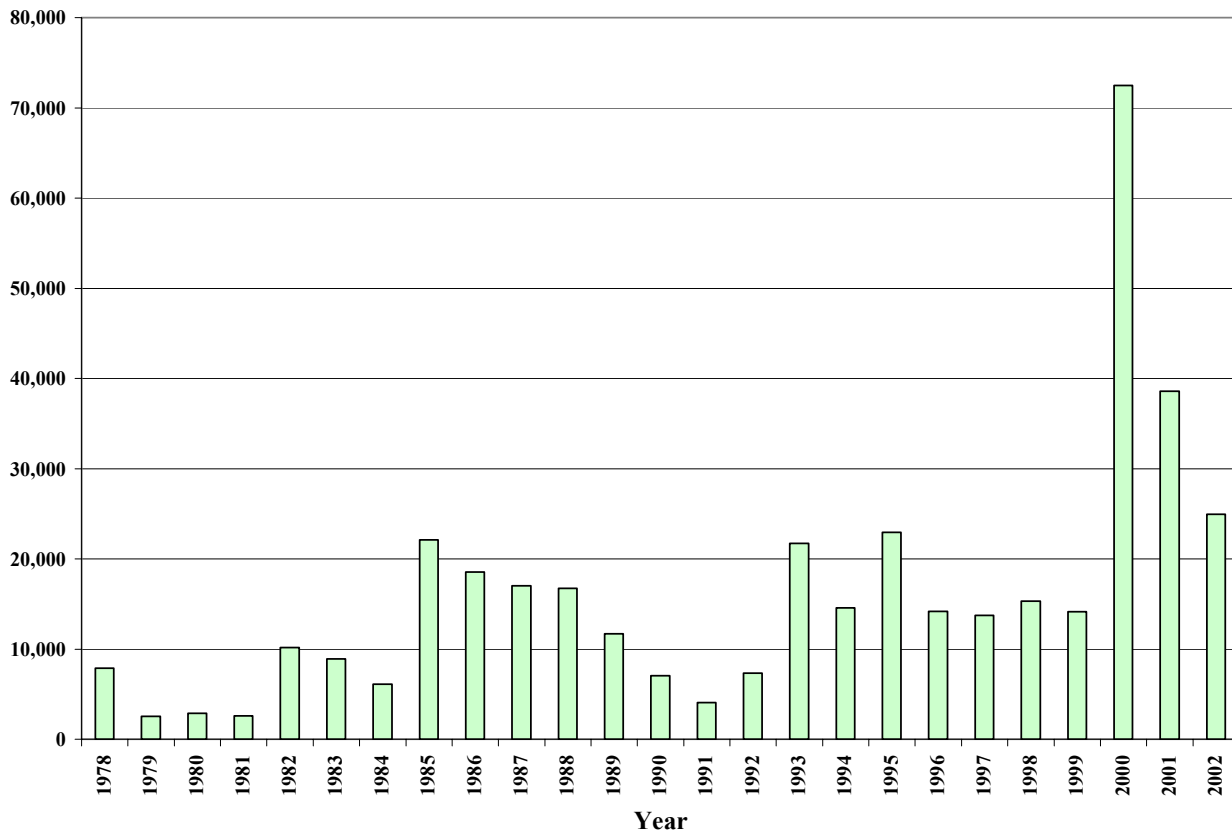


Figure 7. Total Chinook salmon escapement to Iron Gate Hatchery, 1978 to 2002.

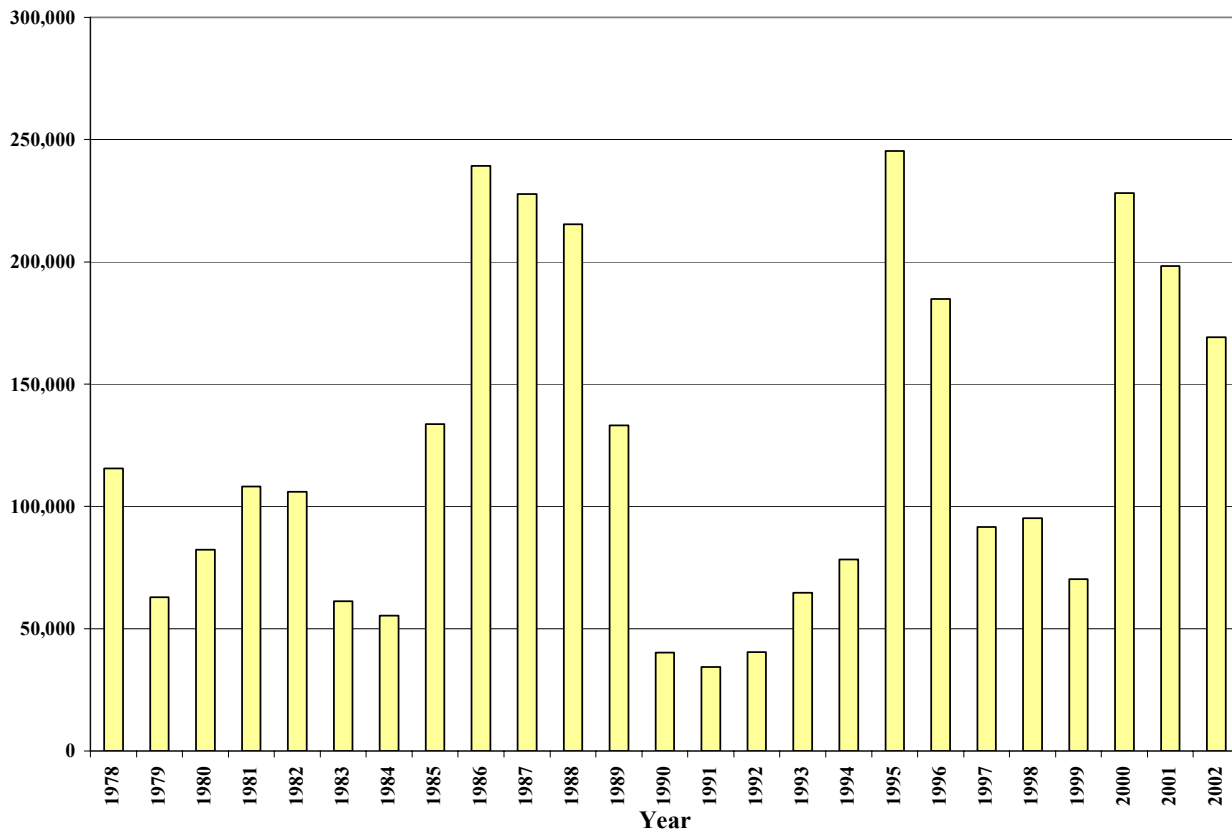


Figure 8. Total in-river run of Chinook salmon in the Klamath River, 1978 to 2002.

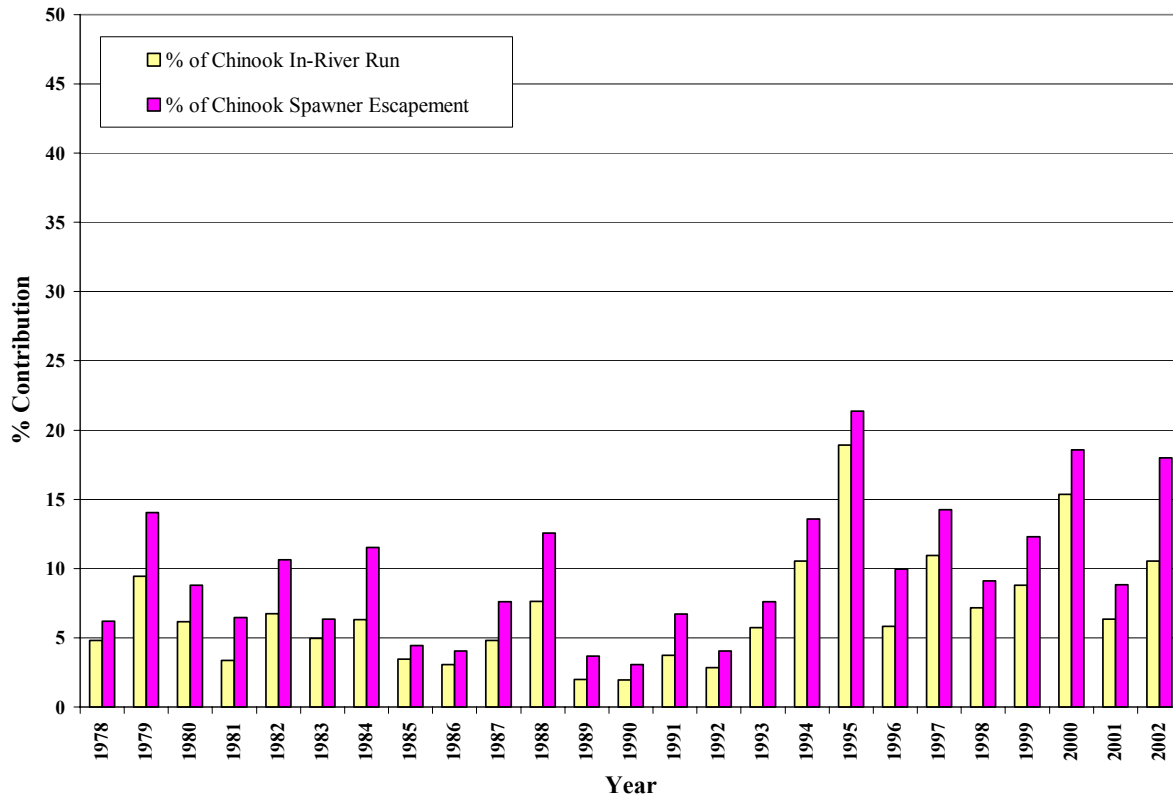


Figure 9. Percent contribution of Bogus Creek Chinook salmon to total Chinook spawner escapement and total Chinook in-river run (Klamath basin) 1978 to 2002.

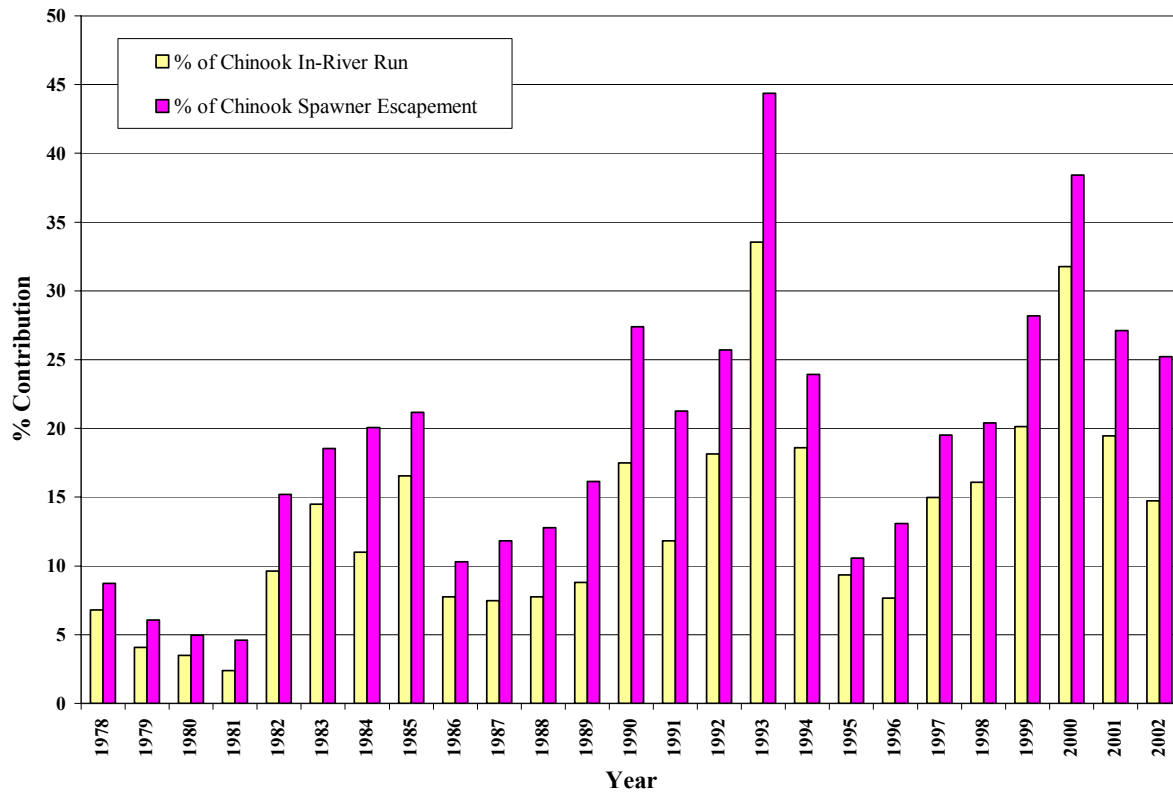


Figure 10. Percent contribution of Iron Gate Hatchery Chinook salmon to total Chinook spawner escapement and total Chinook in-river run (Klamath basin) 1978 to 2002.

Historic Coho and Chinook Releases and Returns

For the period of 1991 to 2002, IGH Chinook smolt releases have varied from a low of 3,300,312 in 1993 to a high of 5,626,408 in 1996 (Fig. 11). For this same period, Chinook yearling releases have varied from 407,177 in 1996 to 1,155,096 in 1993. The largest run of Chinook to IGH, from 1962 to 2002, occurred in 2000 (72,474), the lowest in 1965 (678) (Fig. 12). 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 Chinook would have already left the Klamath Basin.” (CDFG and NMFS 2001).

Analysis of Brood Year (BY) 1979-1984 CWTs recovered from Chinook salmon 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). Therefore, yearling releases provide a combined benefit of lower competition/interaction with natural production and higher percent returns.

IGH coho yearling releases, for the period from 1991 to 2002, ranged from 46,254 in 2001 to 144,998 in 1993 (Fig. 11). IGH coho runs, for the same period, peaked in 1996 (4,097) and were lowest in 1999 (169) (Fig. 13). The average number of coho entering IGH from 1978 to 2002 was 1,458, while the Chinook average was 15,925 (Fig. 12). For coho release years 1969 to 2001, the highest percent return of coho (assuming 3-year-old females) was the release year 1973 (BY 1972), when 5.26% of the coho returned to IGH (Fig. 14 and Appendix A). The lowest percent return was release year 1971, when 0.01% of the coho returned. The average return rate for coho during this period was 1.5%. No coho were released from IGH in 1976. These percentages should be adjusted since they are based on the assumption that all coho entering the hatchery are hatchery returns. Since 1995 all IGH coho have been marked with a left-maxillary clip. The average return rate of (marked) clipped coho to IGH from 1997 to 2002 is 82.4% (Appendix B). Therefore, up to 18% of the coho entering IGH could be naturally produced.

TRH coho receive a right maxillary clip (Fig. 6). The adipose left maxillary and adipose right maxillary clipped coho are either Cole M. Rivers Hatchery fish without maxillaries due to injury, IGH coho that birds may have dropped into the steelhead ponds prior to steelhead clipping (steelhead are marked with an adipose left maxillary or right maxillary clip, depending on the year), or improperly marked coho. Cole M. Rivers Hatchery is located on the Rogue River, at the base of Lost Creek Dam, 153 river miles from the ocean. Cole M. Rivers Hatchery is the largest hatchery on the west coast. Their annual releases include 320,000 coho smolts and 2,212,000 spring-run and fall-run Chinook smolts, compared to the 75,000 coho yearlings and 4,920,000 fall-run Chinook smolts and 1,080,000 Chinook yearlings released at IGH.

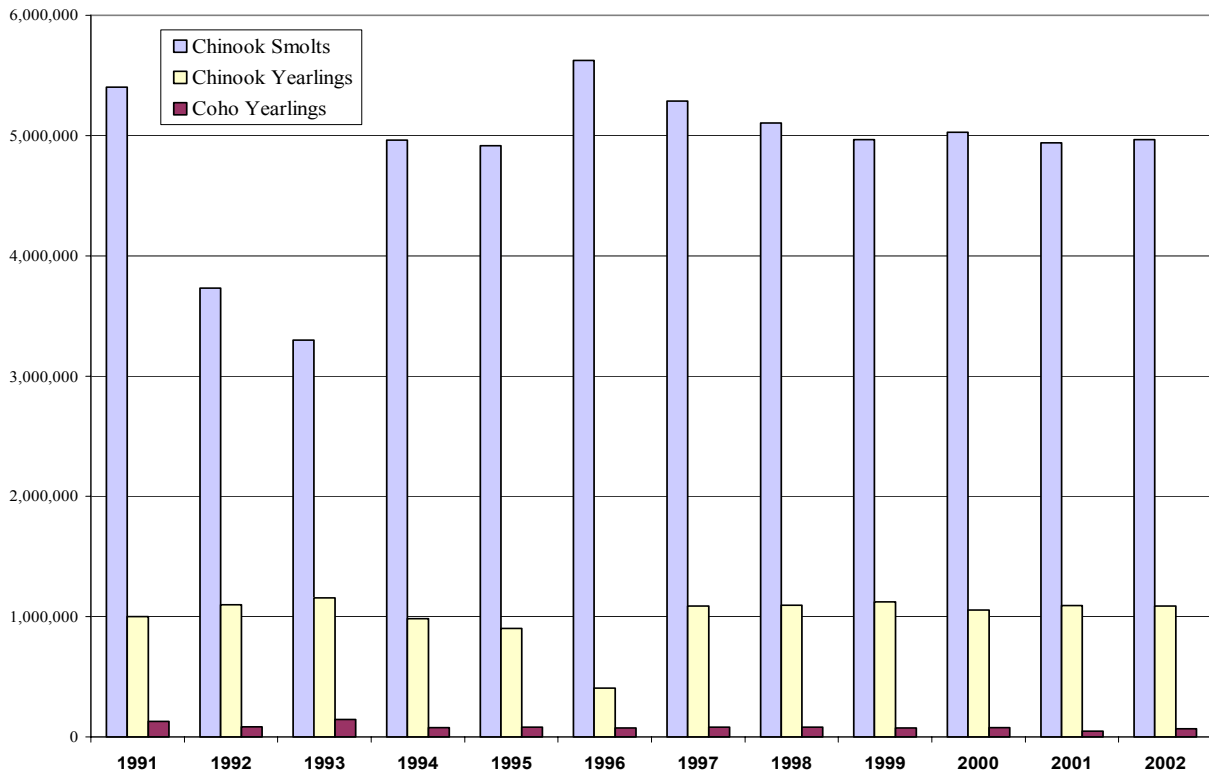


Figure 11. Iron Gate Hatchery (California Department of Fish and Game) Chinook and coho salmon releases, 1991 to 2002.

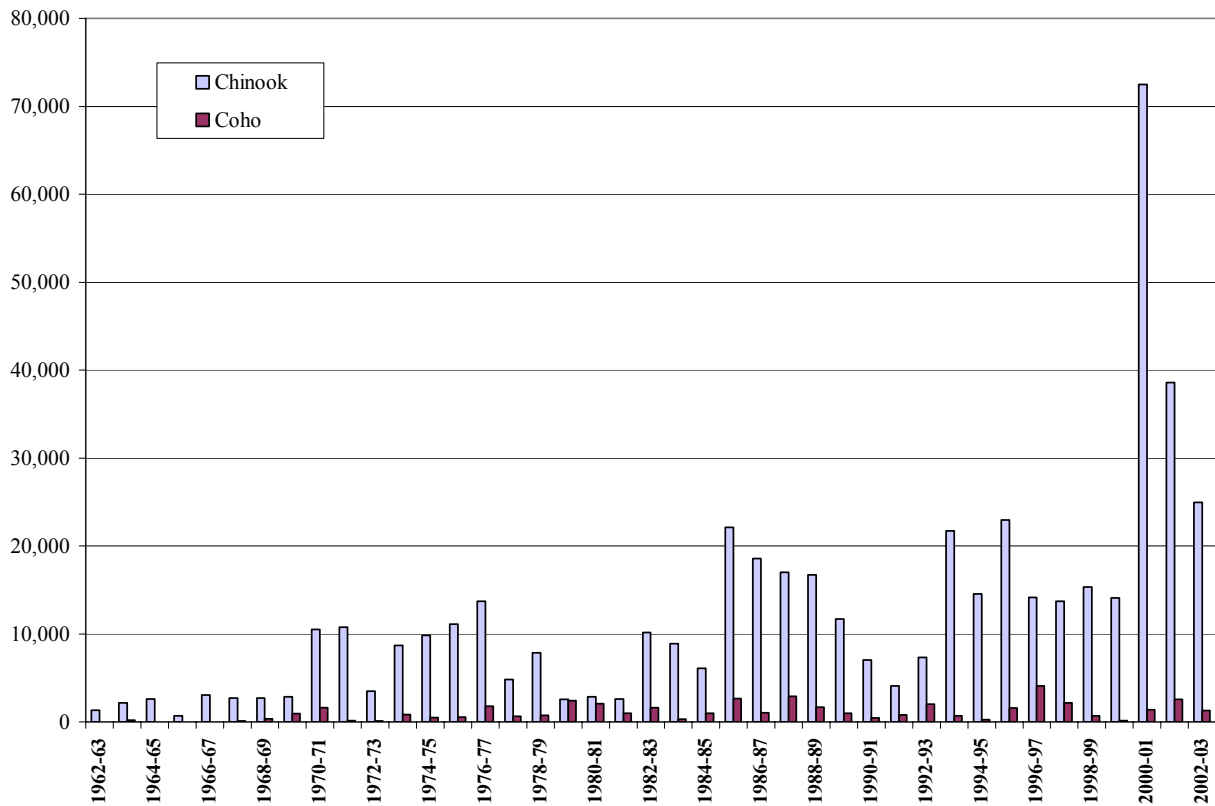


Figure 12. Chinook and coho salmon runs at Iron Gate Hatchery (California Department of Fish and Game), 1962 to 2003.

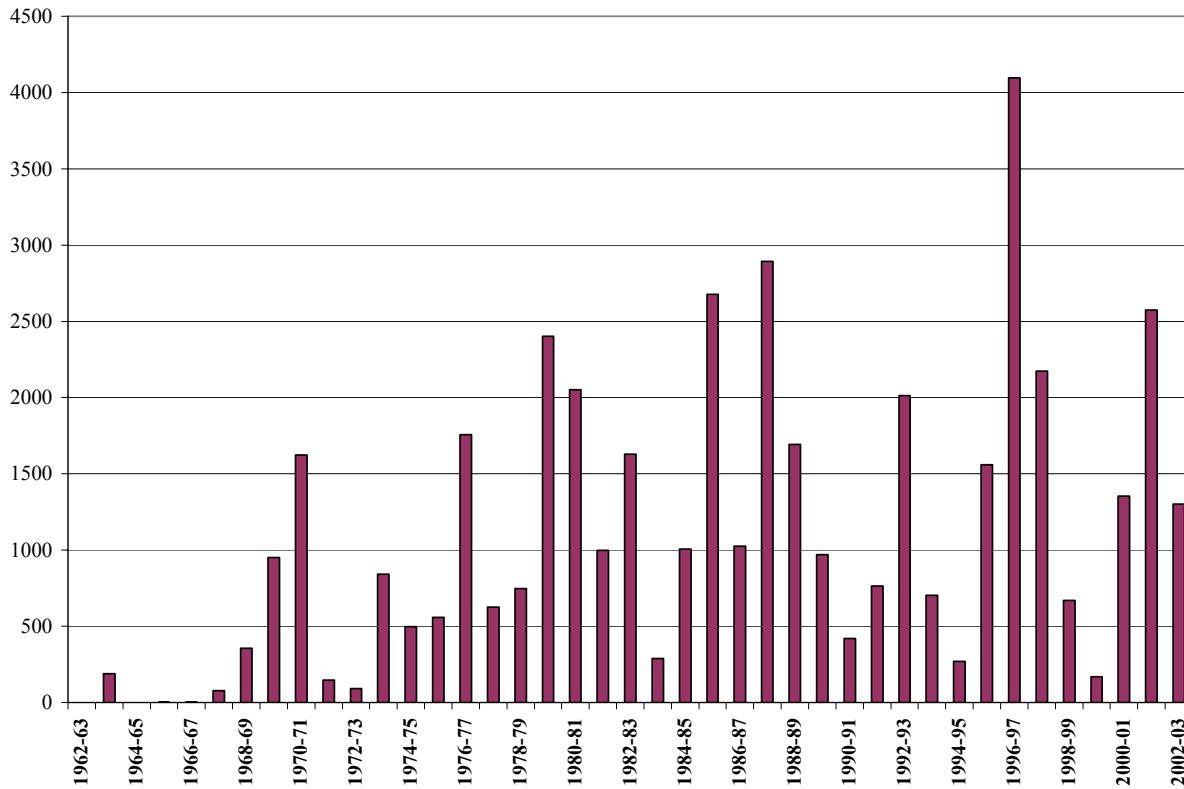


Figure 13. Coho salmon runs at Iron Gate Hatchery (California Department of Fish and Game), 1962 to 2003.

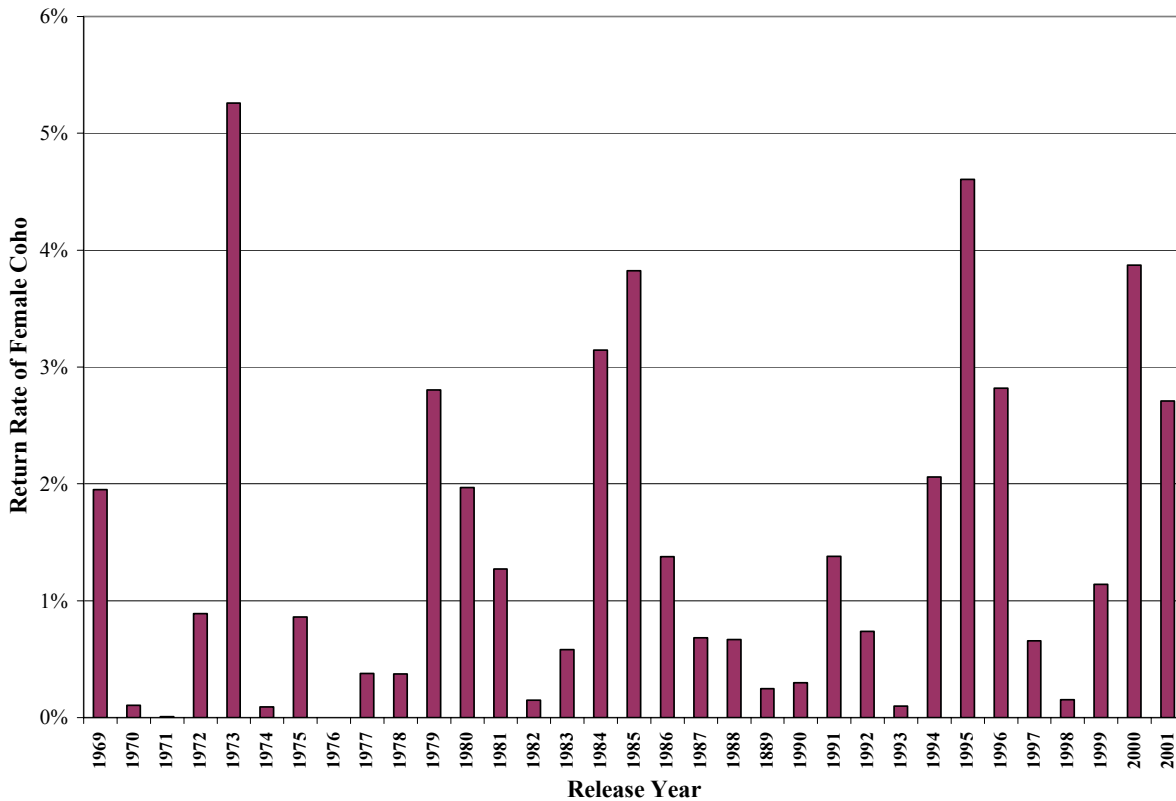


Figure 14. Return rates for female coho salmon (assuming 3-year-olds), by release year, at Iron Gate Hatchery (California Department of Fish and Game), 1969 to 2001 (refer to Appendix A).

Historic Proportions of Grilse

The length-frequency distribution for grilse observed during 2002 does not match the bell curve observed for adults, indicating a lower than normal number of grilse was observed. In comparison, the length-frequency distribution for male Chinook salmon observed during the 2001 spawning season reflects a normal, bimodal distribution, with one peak for grilse and the other for adults.

During the 2002 spawning season 5.2% of the run were grilse, compared to 2001 where 3.5% of the run were grilse. The lowest percentage of grilse, for the period of 1978 to 2002, was observed during the 1995 (1.1% of the total run) spawning season (Fig. 15). The highest percentage of grilse was observed in 1992 (51.1%). The average number of grilse during this 25 year period was 1,116 (10.2%). From 1978 to 1989, at least 10% of the run were grilse in 7 out of 12 years. In contrast, from 1990 to 2002 the proportion of grilse exceeded 10% for only 2 of the 13 years. This proportion is similar to what has been observed in Bogus Creek during those 2 periods of time. From 1978 to 1989, at least 10% of the Bogus Creek run were grilse in 10 out of 12 years. In contrast, from 1990 to 2002 the proportion of grilse in Bogus Creek exceeded 10% for only 3 of the 13 years. The average number of grilse in Bogus Creek during this 25 year period was 745 (13.7% of the total run).

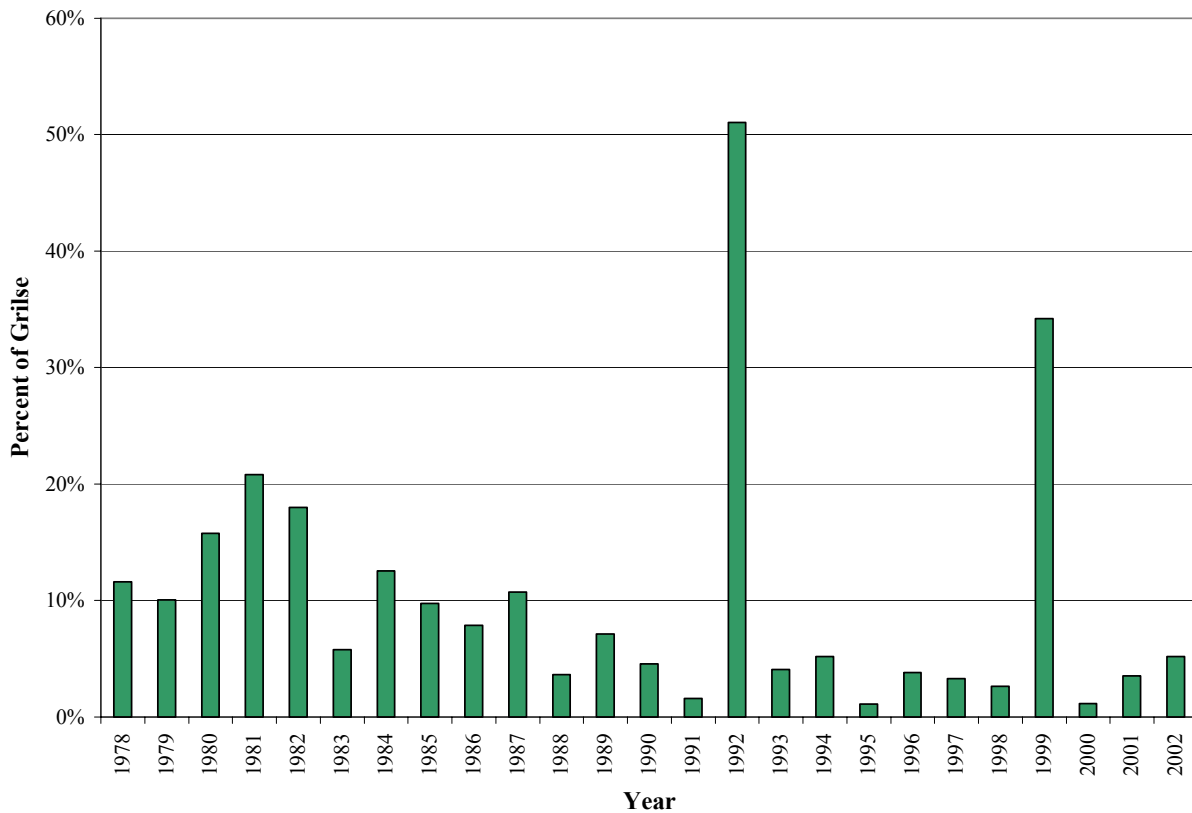


Figure 15. Historical percentages of Chinook grilse observed at Iron Gate Hatchery, Siskiyou County.

Fish Kills

Fish kills on the Klamath River have been documented in several years, most recently in September of 2002. Columnaris (*Flavobacter columnare*) and ICH (*Ichthyophthirius multifiliis*) were responsible for the 2002 fish kill, which resulted in the loss of at least 33,000 adult salmonids (CDFG 2003). The fish kill extended from the mouth of Klamath River to Coon Creek Falls (36 river miles). Low flows coupled with increased water temperature and fish densities (due to the low flows and potentially inadequate fish passage) stressed fish to the point that they were susceptible to the naturally occurring pathogens. If these fish kills had not occurred, the number of Chinook entering IGH during the 2002 spawning season would likely have been higher than 24,961.

Other recent fish kills include the June 2000 and June 1998 fish kills. The 2000 fish kill occurred in late June (CDFG 2000), in the mainstem of the Klamath River, between Coon Creek and Pecwan Creek (64 river miles). Estimates of the number of fish killed (primarily young-of-the-year) range from 10,000 to 300,000. Direct mortality was believed to be caused by two pathogens, ceratomyxosis (*Ceratomyxa shasta*) and columnaris, which occur naturally in the Klamath River. The presence of unseasonably high air temperatures during the spring and early of summer of 2000 lead to mainstem water temperatures above 24°C (75°F) in June. IGH Chinook tend to be resistant to *C. shasta* at temperatures ≤ 16 °C (61°F), therefore elevated river temperatures appear to exacerbate this disease (Foott et al. 1999). At least 240,000 juvenile Chinook perished during the June 1998 fish kill, caused by columnaris and bacterial septicemia (Williamson and Foott 1998).

Current and Future Studies

Staff of the KRP are currently analyzing historical CWT returns. The data from various CWT groups will provide information on return and straying rates for these groups.

There are several other areas to investigate in regards to Chinook observed at IGH :

1. Is there a relation between flow or water temperature and abundance of salmonids observed at IGH?
2. Has there been a shift in the size of Chinook? (A decrease in the size of coho salmon females has been observed in other areas).
3. Has there been a shift in the run timing for Chinook?

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. 2003. September 2002 Klamath River Fish Kill: Preliminary Analysis of Contributing Factors. 63pp.
- 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. 2000. Documentation of the Klamath River Fish Kill, June 2000. California Department of Fish and Game Memo. Redding, California. 27pp.
- California Department of Fish and Game, Pacific Power and Light Company. 1996. Iron Gate Hatchery Production Goals and Constraints. 3pp.
- Foott, J.S., J.D. Williamson, and K.C. True. 1999. Health, physiology and migration characteristics of Iron Gate Hatchery Chinook, 1995 Releases. U.S. Fish and Wildlife Service, California – Nevada Fish Health Center, Anderson, CA.
- Hampton, M. 2001. Fall Chinook Salmon Tagging and Early Release Strategy at Iron Gate Fish Hatchery. California Department of Fish and Game Proposal. 7pp.
- Williamson, J.D. and J.S. Foott. 1998. FY98 Investigational Report: DIAGNOSTIC EVALUATION OF MORIBUND JUVENILE SALMONIDS IN THE TRINITY AND KLAMATH RIVERS (JUNE – SEPTEMBER 1998). U.S. Fish and Wildlife Service, California – Nevada Fish Health Center, Anderson, CA.

Appendix A

Table 2. Return rates for coho salmon (females) returning to Iron Gate Hatchery, 1969-2001.

Yearling Releases			Coho Runs				Female Coho Returns	
Release Year	Total	*Females	Year	Females	Adult Total	% Female	Release Year	Return Rate
1969	68,848	34,424	1970-71	671	1,387	48%	1969	1.95%
1970	100,080	50,040	1971-72	52	126	41%	1970	0.10%
1971	519,835	259,918	1972-73	18	56	32%	1971	0.01%
1972	47,700	23,850	1973-74	212	413	51%	1972	0.89%
1973	10,000	5,000	1974-75	263	456	58%	1973	5.26%
1974	80,000	40,000	1975-76	37	82	45%	1974	0.09%
1975	185,000	92,500	1976-77	795	1,376	58%	1975	0.86%
1976	none	none	1977-78	159	251	63%	1976	N/A
1977	125,000	62,500	1978-79	236	499	47%	1977	0.38%
1978	151,326	75,663	1979-80	282	495	57%	1978	0.37%
1979	87,000	43,500	1980-81	1,220	1,800	68%	1979	2.80%
1980	51,000	25,500	1981-82	502	904	56%	1980	1.97%
1981	99,812	49,906	1982-83	634	1,133	56%	1981	1.27%
1982	121,856	60,928	1983-84	90	218	41%	1982	0.15%
1983	120,672	60,336	1984-85	350	794	44%	1983	0.58%
1984	78,042	39,021	1985-86	1,228	2,269	54%	1984	3.15%
1985	22,059	11,030	1986-87	422	737	57%	1985	3.83%
1986	179,760	89,880	1987-88	1,238	2,581	48%	1986	1.38%
1987	205,000	102,500	1988-89	700	1,369	51%	1987	0.68%
1988	135,000	67,500	1989-90	451	910	50%	1988	0.67%
1989	143,400	71,700	1990-91	178	378	47%	1989	0.25%
1990	122,962	61,481	1991-92	184	360	51%	1990	0.30%
1991	130,000	65,000	1992-93	897	1,697	53%	1991	1.38%
1992	84,999	42,500	1993-94	314	675	47%	1992	0.74%
1993	144,998	72,499	1994-95	72	172	42%	1993	0.10%
1994	76,999	38,500	1995-96	793	1,501	53%	1994	2.06%
1995	79,506	39,753	1996-97	1,831	3,546	52%	1995	4.61%
1996	74,250	37,125	1997-98	1,047	1,872	56%	1996	2.82%
1997	81,498	40,749	1998-99	268	511	52%	1997	0.66%
1998	79,607	39,804	1999-2000	61	151	40%	1998	0.15%
1999	75,156	37,578	2000-01	428	723	59%	1999	1.14%
2000	77,147	38,574	2001-02	1,494	2,466	61%	2000	3.87%
2001	46,254	23,127	2002-03	627	1,193	53%	2001	2.71%
Average			Average				Average	
112,649			538				1.47%	
56,324			1,003				51%	

*assumed 50% females, therefore restricted returns to 3-year-olds

Appendix B

Table 3. Proportions of clipped and unclipped coho entering Iron Gate Hatchery 1996 to 2002.

1996/1997				1997/1998				1998/1999			
FIN CLIPS	ADULTS	GRILSE	Total	FIN CLIPS	ADULTS	GRILSE	Total	FIN CLIPS	ADULTS	GRILSE	Total
Unmarked	3,545	228	3,773	Unmarked	121	44	165	Unmarked	207	82	289
LM	1	322	323	LM	1,717	253	1,970	LM	303	75	378
RM			0	RM	5		5	RM			0
AD		1	1	AD	24	4	28	AD	1	1	2
ADLM			0	ADLM	5	1	6	ADLM			0
ADRM			0	ADRM			0	ADRM			0
Total Clipped	1	323	324	Total Clipped	1,751	258	2,009	Total Clipped	304	76	380
Total Returns	3,546	551	4,097	Total Returns	1,872	302	2,174	Total Returns	511	158	669

1999/2000				2000/2001				2001/2002			
FIN CLIPS	ADULTS	GRILSE	Total	FIN CLIPS	ADULTS	GRILSE	Total	FIN CLIPS	ADULTS	GRILSE	Total
Unmarked	12	3	15	Unmarked	198	64	262	Unmarked	217	29	246
LM	138	15	153	LM	500	567	1,067	LM	2,054	76	2,130
RM			0	RM	4		4	RM	136	2	138
AD	1		1	AD	13		13	AD	51		51
ADLM			0	ADLM	8		8	ADLM	7		7
ADRM			0	ADRM			0	ADRM	1		1
Total Clipped	139	15	154	Total Clipped	525	567	1,092	Total Clipped	2,249	78	2,327
Total Returns	151	18	169	Total Returns	723	631	1,354	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 Clipped	977	99	1,076
Total Returns	1,193	108	1,301

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%
Average	1,173	1,373	82.4%

LM= Iron Gate Hatchery (left maxillary clip) ADLM *

RM = Trinity River Hatchery (right maxillary clip) ADRM *

AD = Cole M. Rivers Hatchery (adipose clip)

*The adipose left maxillary and adipose right maxillary clipped coho are either Cole M. Rivers Hatchery fish without maxillaries due to injury, IGH coho that birds may have dropped into the steelhead ponds prior to steelhead clipping (steelhead are marked with an adipose left maxillary or right maxillary clip, depending on the year), or improperly marked coho.