2005 Feather River Chinook Salmon Spawning Escapement Summary

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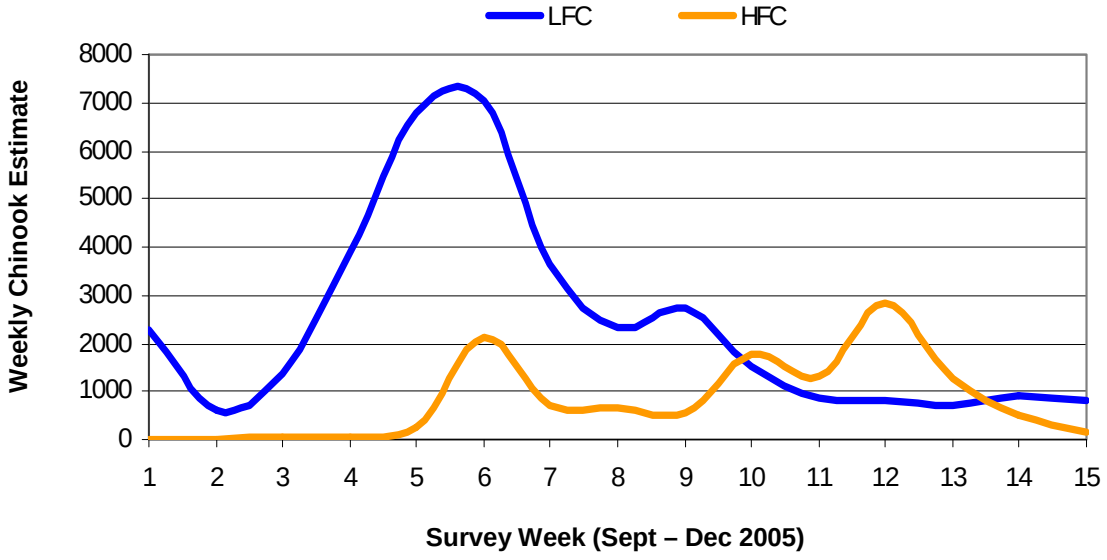
The Chinook salmon spawning escapement survey began September 6 and continued through December 16, 2005.

Population Estimate:

The Low Flow Channel (LFC) included the area in the Feather River from the Fish Barrier Dam downstream to the Thermalito Outlet. Salmon carcass mark recapture, using the Schaefer method, resulted in a population estimate for the LFC of 36,384 salmon composed of 33,073 adults and 3,311 grilse (fish ≤ 65 cm fork length). The High Flow Channel (HFC) survey extended from the Thermalito Outlet downstream to the Gridley Bridge. The population estimate for the HFC was 12,202 salmon with about 10,665 adults and 1,537 grilse. Total in-river spawning for the Feather River (LFC + HFC) was 48,586 which consisted of an estimated 43,738 adults and 4,848 grilse. These estimates include both fall-run and spring-run Chinook salmon since their spawning is currently not fully segregated on the Feather River.

Overall, spawning peaked six weeks earlier in the LFC than the HFC (Figure 1). However, it does appear there was a bimodal spawning peak in the HFC during Week 6, which coincides with the LFC, and a larger peak at Week 12 (Figure 1). The six week gap between peaks is consistent with last year, but occurred two weeks later this year. Race does not appear to be a factor given that the CWTs collected during Week 6 were almost 50/50 spring-run/fall-run (see the subsequent Spring and Fall Chinook CWT Composition Section).

Figure 1. Weekly population estimates in the LFC and HFC of the lower Feather River during the 2005 Chinook salmon escapement survey.



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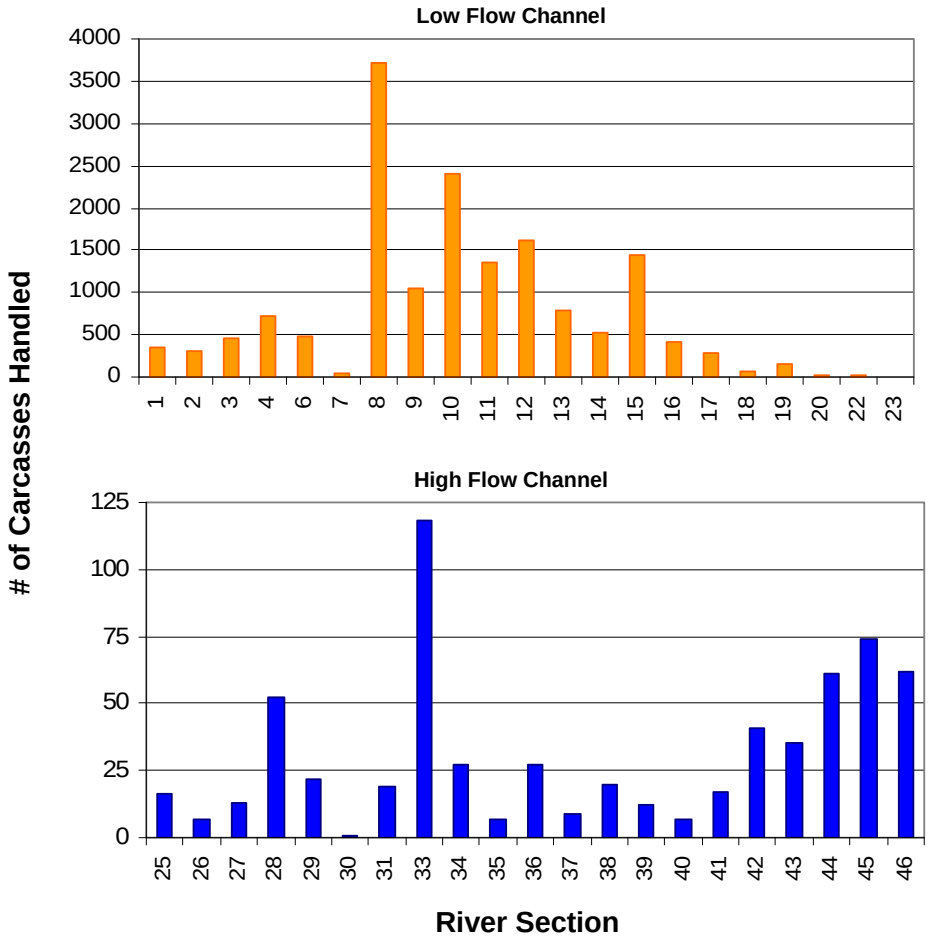
Approximately 75% of the spawning population utilized the LFC. This is higher than any of the previous years monitored by DWR (began surveys in 2000). The long term average for the LFC's spawning population since 2000 is 62%. The difference in counts between the LFC and HFC is dramatic considering they range from the 1,000s to the 100s, respectively (Figure 2). Section 8, known as Auditorium Riffle, had the highest carcass concentration while Section 10, or Bedrock Park, had the second highest concentration of Chinook salmon throughout the LFC (Figure 2). Section 33 at Hour Riffle had the greatest concentration of carcasses in the HFC while other high concentrations were found among the most downstream reaches near Gridley (Figure 2).

Figure 2. Carcasses recovered by survey section in the LFC and HFC of the lower Feather River during the 2005 Chinook salmon escapement survey. Note: Section 1 in the LFC and Section 25 in the HFC are the most upstream areas surveyed in each reach. Also note difference in scale between the two river reaches.



Pre-spawning Mortality:

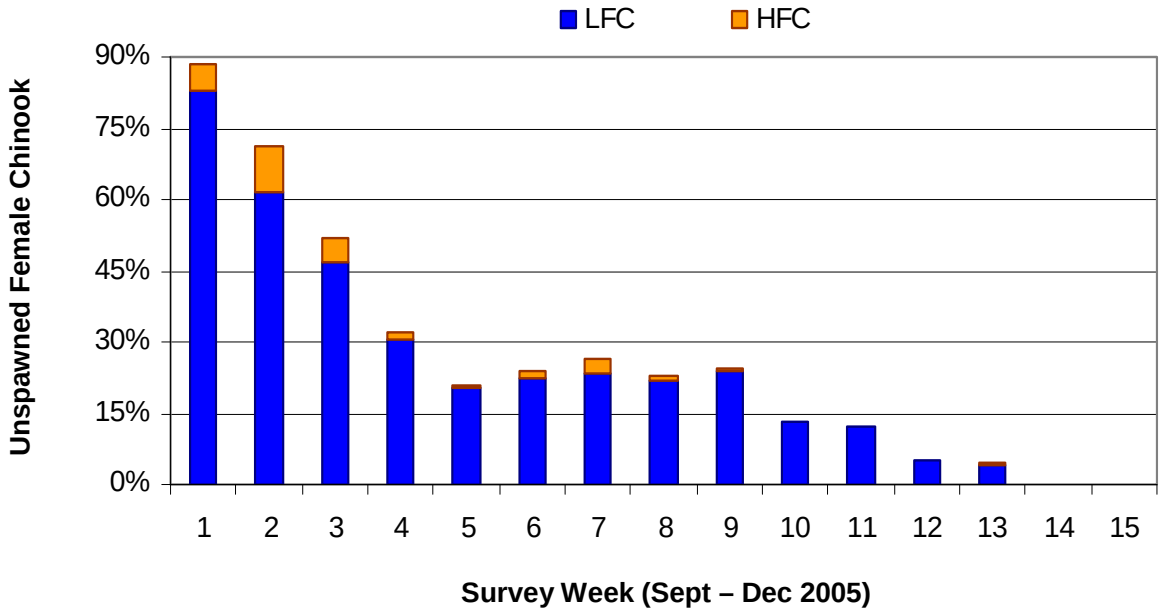
Since we began monitoring in 2000, the long-term average for pre-spawn mortality is 41%. This year had the lowest percentage of spawning mortality. On average, 20.5% of the 2,308 female salmon examined in-river died before the majority of their eggs were deposited

(Table 1). Pre-spawning mortality was higher in September (Figure 3) and in the LFC (Table 1 & Figure 3). The cause of pre-spawning mortality is unclear, but likely results from stresses associated with upstream migration, water temperatures, angling pressure, and intense competition for limited spawning habitat. However, the increased rate of spent females during years with smaller populations and in the HFC (2004 & 2005) suggests that fish density may be a large factor. Furthermore, it appears that Chinook exhibiting the spring-run phenotype are more likely to spawn than their fall-run counterparts (see Spring and Fall Chinook CWT Composition section for additional detail).

Table 1. Spawning status of female Chinook salmon examined during the 2005 escapement survey in the lower Feather River.

River Section	# Spawned	# Unspawned	Total	Unspawned
LFC (Sect. 1-23)	1950	560	2510	22.3%
HFC (Sect. 24-46)	358	36	394	9.1%
Overall	2308	596	2904	20.5%

Figure 3. Weekly percentage of unspawned females in the lower Feather River during the 2005 Chinook salmon escapement survey.



CWT Sampling:

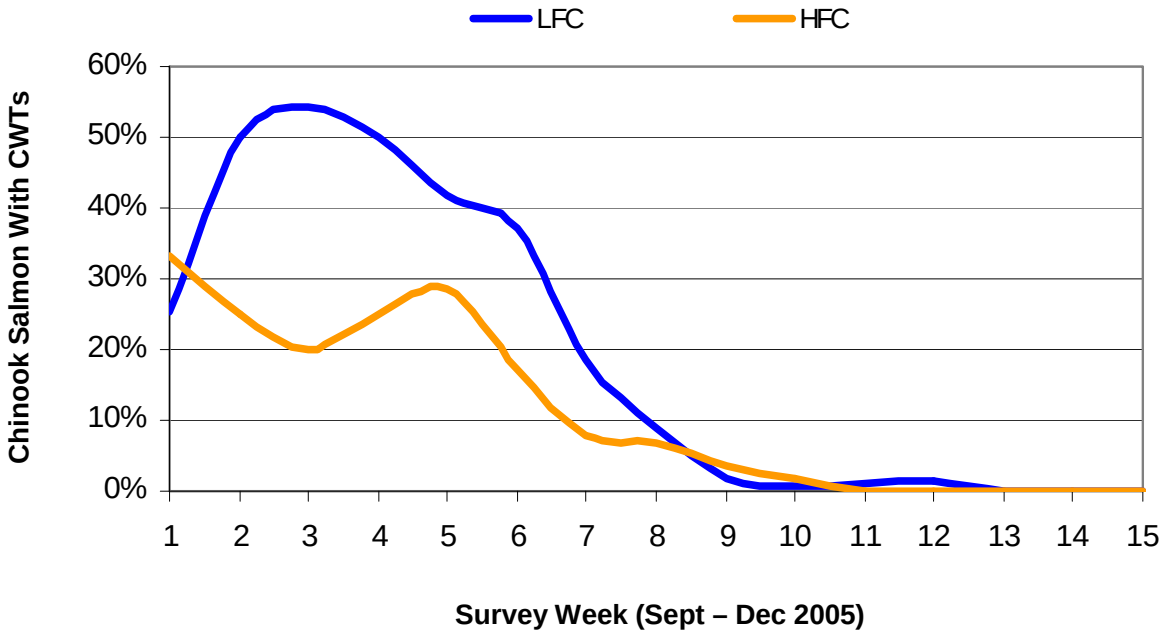
Of the 3,795 salmon checked for presence of an adipose fin clip (an external mark which indicates a CWT should be present), a definitive assessment (clipped or not) was made on 3,107 fish. The other 688 fish were removed from analysis because adipose classification was confounded by uncertainty of adipose regeneration or decomposition. Overall, one in five fish were adipose fin clipped (Table 2). However, Table 2 indicates that only about 3% of the fish in the HFC were clipped. The lower CWT rate may be due to the fact that this area is further

downstream from the hatchery than the LFC or possibly that fall-run, which have much lower tagging rates, are more likely to utilize this section of the river. Most CWTs were collected before Week 6 and became fairly rare after Week 9 (Figure 4). No CWTs were collected in the HFC after Week 11 or in the LFC after Week 13 (Figure 4).

Table 2. Adipose fin presence/absence summary from Chinook salmon examined in the Feather River during the 2005 escapement survey.

River Section	Clipped	Non-clipped	CWT Rate
LFC (Sect. 1-23)	788	2671	22.8%
HFC (Sect. 23-46)	21	608	3.3%
Overall	809	3279	19.8%

Figure 4. Weekly percentage of examined Chinook salmon with CWTs in the LFC and HFC of lower Feather River during the 2005 Chinook salmon escapement survey.



The spawning population was assessed using CWTs from Feather River Hatchery origin fish recovered from the in-river escapement surveys in the LFC and HFC and from the Feather River Hatchery (Hatchery). Heads were collected and sent to the CA Department of Fish & Game's Ocean Salmon Project for CWT retrieval and reading. Of the 641 in-river adipose clipped fish processed, 551 CWT tags (86%) were recovered. Of the 5655 adipose clipped fish processed from the Hatchery, 4941 CWT tags (87%) were recovered. The last CWTs of Feather River Hatchery origin were recovered in-river on November 17 and from the Hatchery on November 12, 2005.

The majority (>97%) of the CWTs recovered in-river were in the LFC (Table 3A). Table 3A shows the in-river spawning population of Chinook was heavily dominated by age-3 salmon

(94.7%). While age-4 (4.7%) fish were more common than age-2 fish (0.5%), both made up a small portion of the population. No CWT age-5 fish were recovered in-river while a few were sampled at the Hatchery (Table 3A & B). The hatchery population was fairly comparable to the in-river population (Table 3A & B). The hatchery population was dominated by age-3 Chinook salmon (96.1%). Both age-2 (1.8%) and age-4 fish (2.1%) made up a minor portion of the population while age-5 fish were uncommon (Table 3B). There were no age-1 fish in either the in-river or hatchery populations. However, it is important to note that an inconsistent tagging rate for each brood year does affect the overall proportions of each age-class represented. In addition, a very small percentage of fall-run get tagged (~10%) compared to spring-run (~95%).

Table 3. Age composition of Feather River Hatchery origin Chinook salmon recovered during 2005 from the A) in-river escapement survey including both the LFC and HFC, and B) the Feather River Hatchery.

A) In-river

Age	HFC CWT Recoveries	LFC CWT Recoveries	Total	%
2	0	3	3	0.5
3	11	511	522	94.7
4	2	24	26	4.7

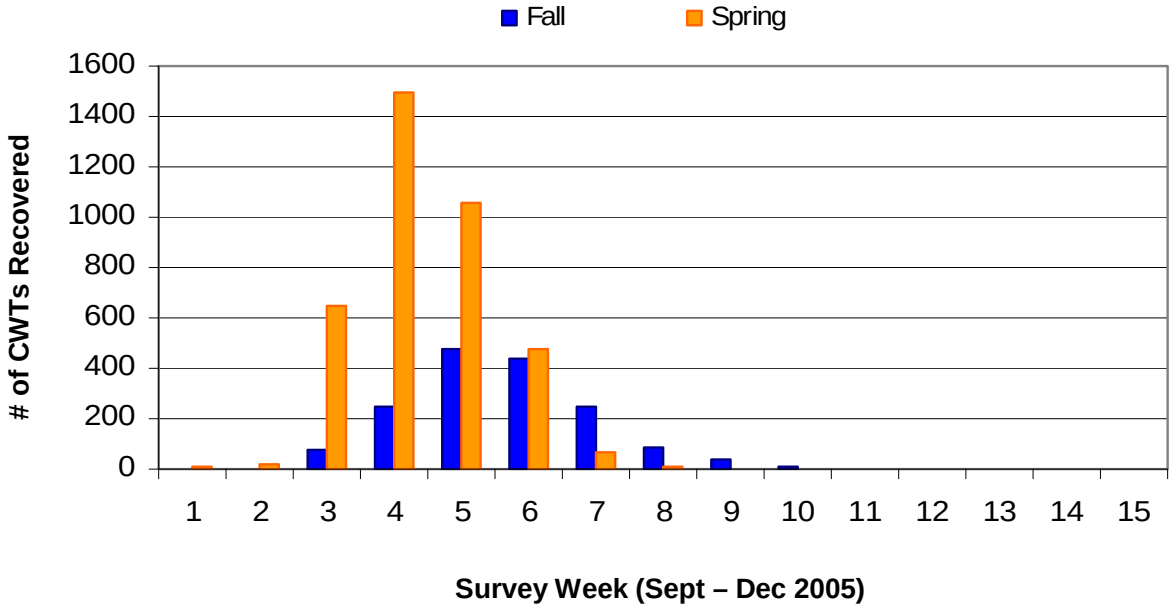
B) Hatchery

Age	CWT Recoveries	%
2	90	1.8
3	4676	96.1
4	100	2.1
5	2	0.0

Spring and Fall Chinook CWT Composition:

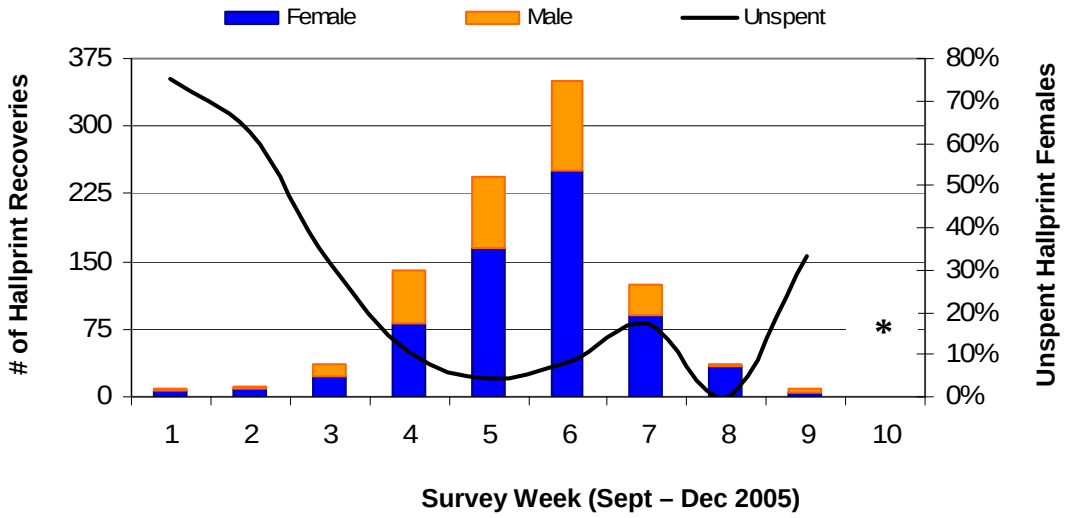
Salmon tagged as spring-run and fall-run at the Feather River Hatchery demonstrated considerable overlap in their temporal distribution. Occurrence of spring-run Chinook CWTs peaked at Week 4 which was only one week before that of fall-run Chinook CWTs (Figure 5). All, but one, spring-run CWTs were collected before Week 9 (Figure 5). The same temporal trend was exhibited by both the in-river and the hatchery recoveries. No CWTs were collected after Week 11 therefore race examination could not be conducted on the second population peak in the HFC at Week 12 (Figures 1 & 5). While it would seem apparent that the fish comprising this peak were fall-run, the only tag collected in Week 11 was from a spring-run Chinook salmon. Furthermore, this fish was also Hallprint tagged as part of the Hatchery spring-run investigations in May and June which indicated it demonstrated phenotypic spring-run behavior. Hallprint tags applied to returning spring-run adults indicated that almost 11% (149 out of 1404) of these fish were originally tagged (with CWTs) fall-run as juveniles.

Figure 5. Weekly CWT Chinook salmon recoveries by run of Feather River Hatchery origin fish from the Feather River, both in-river and hatchery, during the 2005 spawning season.



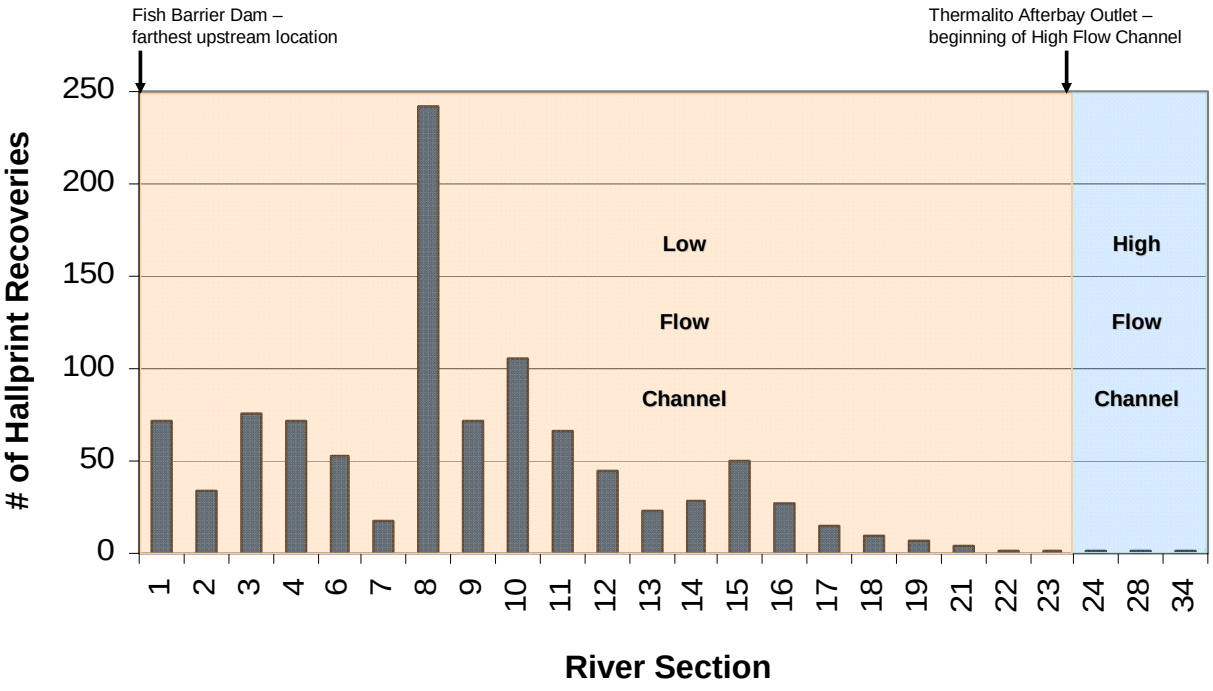
Further analysis of retrieved Hallprint Chinook salmon for the in-river survey indicated that carcass retrieval of phenotypic spring-run fish peaked around Week 6 (Figure 6) like the rest of the spawning population (Figure 1). Where assessments could be made, about 54% of the fish had adipose clips. There was approximately a two-to-one ratio of females to males. Pre-spawn mortality was the highest at the beginning of the season with a slight increase also near the end of the phenotypic spawning season (Figure 6). Yet, the overall pre-spawn mortality of the female Hallprint Chinook averaged around 11% which is lower than the general spawning population. While it appears these fish may spawn more successfully, other issues which factor into progeny outcomes are unknown such as superimposition and hatch rates. Whether superimposition affects these fish more than the rest of the population is unknown, but seems likely due to the number of fish spawning during the last six weeks of the survey.

Figure 6. Weekly in-river Hallprints (i.e., phenotypic spring-run) recovered and percentage of unspent Hallprint female Chinook salmon during the 2005 spawning season. * Note: only one male was recovered during Week 10.



Besides providing basic population estimates for spring-run, the Hallprint information will aid management in the future placement of a segregation weir. Like the general population, Section 8 had the highest concentration and Section 10 the second highest concentration of spring-run throughout the Low Flow Channel (Figure 7). Only three Hallprint spring-run were recovered in the High Flow Channel. While carcass recovery is hampered slightly by the turbidity of the water in the High Flow Channel, it should not have that large of a consequence. Radio telemetry tagged fish confirm the much higher use of the Low Flow Channel.

Figure 7. In-river locations of Hallprint Chinook salmon recovered during the 2005 Feather River spawning season. Note: Due to the Fish Barrier Dam, Section 1 is the most upstream location available. Section 24 is just downstream of the Thermalito Afterbay Outlet which is the start of the High Flow Channel.



Strays:

The majority (94%) of the tagged Chinook that returned to the lower Feather River and Feather River Hatchery in 2005 were of Feather River Hatchery Origin. Thirty-five tagged fish consisted of strays from Coleman National Fish Hatchery, Merced River Fish Facility, and Mokelumne River Fish Instillation (Table 4). They were collected from Week 5 through Week 12. Two of these fish, late-fall from Coleman National Fish Hatchery, were recovered four weeks later by the hatchery during the last week of the survey. This was the start of the influx of an additional 38 late-fall Coleman stock Chinook that were accumulated through mid-February at the Feather River Hatchery.

Table 4. Weekly strays recovered by hatchery-origin during the 2005 Chinook salmon spawning season. Note: River = in-river recoveries and FRH = Feather River Hatchery.

	River	FRH	Total
Coleman	1	9	10
Merced R	2	22	24
Mokelumne R		1	1
Total	3	32	35