# U.S. Fish and Wildlife Service Supplemental Upper Sacramento River Fall Chinook Salmon Carcass Survey

# 2012 Annual Report

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**Abstract**
Central Valley fall Chinook salmon *Oncorhynchus tshawytscha* are an important species for commercial and recreational fishing and fulfill important roles in the river and marine ecosystems. To mitigate for habitat losses resulting from water development projects, more than 32 million fall Chinook salmon are produced annually in California's Central Valley hatcheries. A large percentage of hatchery-origin fall Chinook salmon juveniles are transported to San Pablo Bay for release, which increases their survival and availability for harvest. Transporting juvenile salmon, however, disrupts their natural outmigration process, which can lead to reduced imprinting on their natal water source and result in increased rates of straying (Quinn 1993; Dittman and Quinn 1996). Elevated rates of straying by hatchery-origin fall Chinook salmon negatively impact natural-origin salmon populations (Quinn et al. 1991; Williamson and May 2005). To evaluate straying of hatchery-origin fall Chinook salmon, a carcass survey was performed weekly from mid-October through mid-December in 2012 on 48 miles of the upper Sacramento River in California's Central Valley. Coded-wire tags, biological and genetic samples, and associated information were collected from carcasses to characterize and compare attributes of hatchery-and natural-origin salmon. We observed 578 carcasses during the survey period. The peak of fresh carcasses observed occurred during the week of November 13, 2012. A total of 474 carcasses were sampled, and 57.2% of those were estimated to be of hatchery origin. The highest concentration of carcasses was found upstream of river mile 263, an area where Battle Creek enters the Sacramento River (river mile 271). All of the hatchery-origin salmon observed in the survey area were fall Chinook salmon, and the majority (62%) originated from Coleman National Fish Hatchery, which is located on Battle Creek. The remainder of hatchery-origin fall Chinook salmon were from Feather River Fish Hatchery (24%), Nimbus Fish Hatchery (3%), Mokelumne River Fish Hatchery (2%) or no coded wire tag was recovered (9%). Nearly all of hatchery-origin salmon observed were age-3. Future surveys will provide insight into annual variation of straying, spawn timing, spawning distribution, and proportion of hatchery-origin fall Chinook salmon in the Sacramento River, and assist in assessing potential negative impacts on native salmonid populations resulting from straying hatchery-origin salmon.

**Introduction**
Annually, more than 32 million fall Chinook salmon (FCS) are currently produced at five fish hatcheries in the Central Valley of California, including Coleman National Fish Hatchery (NFH) on Battle Creek, Feather River Fish Hatchery and Feather River Hatchery Annex, Nimbus Fish Hatchery on the American River, Mokelumne River Fish Hatchery, and Merced River Fish Hatchery. Hatchery production of Central Valley FCS contributes substantially to sport and commercial fisheries in ocean and inland areas. Releasing large numbers of hatchery-origin salmonids, however, can result in negative effects to natural-origin salmonids. For example, artificial propagation can pose genetic risks to natural-origin salmonids, which can affect locally adapted gene complexes and have deleterious effects on fitness or survivorship (Hard et al. 1992; Cuenco et al. 1993; Waples et al. 2007).

The potential for hatchery-origin salmon to negatively affect natural-origin salmonids is reduced when hatchery-origin salmon return, as adults, to their hatchery of origin, or "home", and is greater when hatchery-origin salmon spawn in non-natal streams, or "stray" (Quinn et al. 1991; Williamson and May 2005). Natural-origin salmon typically show a high level of fidelity to their natal spawning areas, which results from imprinting on environmental cues during juvenile

rearing and emigration (Dittman and Quinn 1996). Imprinting is disrupted and straying is increased for hatchery-origin salmon that are released at locations distant from the hatchery (Quinn 1993; Dittman and Quinn 1996).

In recent years, many of the FCS produced at Central Valley hatcheries have been transported by truck to San Pablo Bay, where they are typically acclimated to estuarine water conditions for several hours in net pens prior to being liberated. This practice has been shown to increase survival of juveniles by bypassing mortality that would otherwise occur during emigration, resulting in an increased abundance of salmon available for harvest (Kormos et al. 2012). At the same time, the practice of transporting juvenile salmon has also raised concerns about negative effects to natural-origin salmon spawning populations that may result from straying of adult hatchery-origin FCS (Williamson and May 2005).

Previous assessments of straying of adult hatchery-origin FCS in the Central Valley have been limited by low and inconsistent rates of marking or tagging of hatchery-origin salmon. Inadequate marking and tagging programs result in the inability to distinguish hatchery-origin and natural-origin FCS when they return to hatcheries and to natural spawning areas. Beginning in 2007, however, a representative portion of all hatchery production of FCS in the Central Valley has been marked with an adipose fin-clip and a coded-wire tag (CWT) has been inserted in the nasal cartilage. This program, called the Constant Fractional Marking (CFM) Program, targets 25% of FCS production releases to be marked and tagged on an annual basis (Buttars 2012). The overall objectives of the CFM program are:

1. To evaluate the contribution rates of hatchery fish to Central Valley Chinook salmon populations;
2. To evaluate the Central Valley propagation program's genetic and ecological effects on natural Chinook salmon populations;
3. To estimate exploitation rates of hatchery and natural Central Valley Chinook salmon in ocean and inland fisheries;
4. To evaluate the success of restoration actions designed to increase natural production of Central Valley Chinook salmon;
5. To evaluate the relative impacts of water project operations on hatchery and naturally-produced Chinook salmon; and,
6. To evaluate the recovery of listed stocks of Chinook salmon (Buttars 2012).

To meet the objectives of the CFM program, rigorous field sampling programs are necessary to survey natural spawning areas. In 2011, the California Central Valley Salmonid Escapement Project Work Team distributed a plan to provide a framework for long-term monitoring programs to estimate, in a statistically valid manner, the abundance and trends in escapement of adult Central Valley Chinook salmon at the watershed level (Bergman et al. 2012). The main objective of this Central Valley In-river Chinook Salmon Escapement Monitoring Plan is to improve estimates of the total number of Chinook salmon that "escape" fisheries and return to natural spawning areas (i.e., 'escapement') and estimate the percent of escapement that are of hatchery origin. Biological data (e.g., sex ratios, age, and length distributions) and data collected during surveys of natural spawning areas are also used to enhance understanding of the life history, status, and health of each stock, and to improve the management of the salmon stocks.

This monitoring plan calls for systematic surveys of important spawning areas of the Central Valley to collect biological data and recover CWTs (Bergman et al. 2012).

This study was undertaken to supplement existing monitoring programs of FCS escapement, which are conducted annually by the California Department of Fish and Wildlife (CDFW). The CDFW conducts annual carcass surveys in the uppermost 26 miles of the Sacramento River which are accessible to anadromous fishes, extending from Balls Ferry Boat Launch [river mile (RM) 276] to Keswick Dam (RM 302). This area is believed to encompass the primary spawning areas for FCS in the upper Sacramento River (Killam and Johnson 2013). Beginning on November 5, 2012, however, the downstream 13 miles of the primary survey area were not surveyed by CDFW due to other monitoring priorities and budget concerns (Doug Killam, California Department of Fish and Wildlife, personal communication).

The present survey extends downstream from the area surveyed by the CDFW and supplements the data collected by CDFW. The goal of this monitoring project, which began in 2011, is to collect CWTs, biological and genetic samples, and associated information from FCS in areas of the upper Sacramento River that are not regularly surveyed. This information will be used to estimate the proportion of hatchery-origin and natural-origin FCS, estimate the sex ratio of FCS, determine the age class structure of hatchery-origin FCS and provide information on the spatial distribution of salmon carcasses within the survey area.

## Methods

### *Survey Area*

The survey area covered approximately 48 miles of the Sacramento River immediately downstream of the area surveyed by the CDFW. The survey area was divided into 2 reaches; Reach 1 extended from the Balls Ferry Boat Launch (RM 276) downstream to China Rapids (RM 254) (Figure 1), a distance of 22 river miles. Reach 2 extended from China Rapids (RM 254) to the boat launch at Mill Creek Park (RM 229), a distance of 26 river miles (Figure 1).

### *River Conditions*

River flow and water temperature data for the Sacramento River were obtained from the California Data Exchange Center. The data presented in this report relied on the water gage at Bend, California (BND) (RM 260), operated by U.S. Geological Survey (USGS) and California Department of Water Resources (DWR).

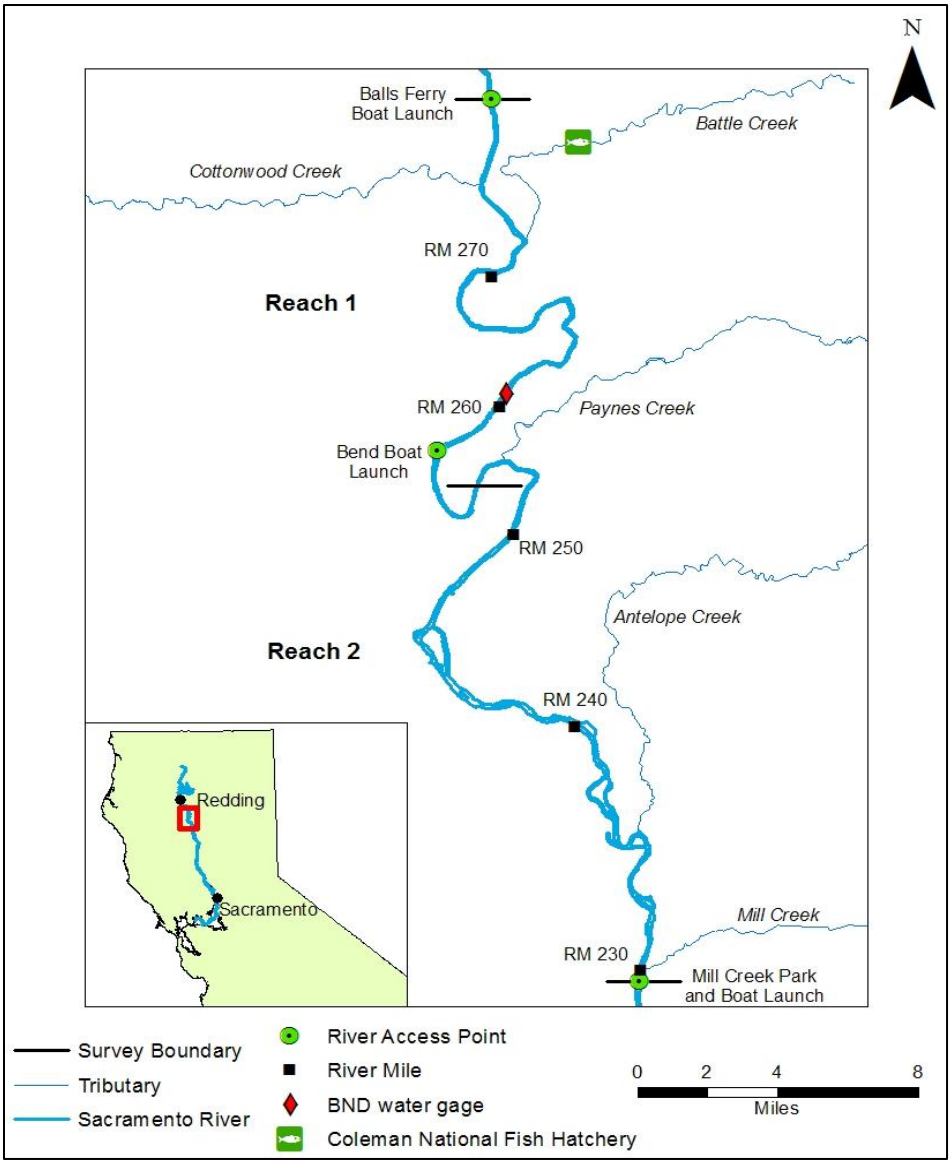


Figure 1. Fall Chinook salmon carcass survey area of the Sacramento River (RM 229- RM 276). Survey area is indicated on the California state map.

*Sampling Protocol*

Weekly carcass surveys were conducted between October 7, 2012 and December 18, 2012, and encompassed the majority of FCS spawning in the Sacramento River. Surveys began prior to the beginning of most FCS spawning and were terminated when the number of carcasses observed was almost zero and most carcasses observed were in an advanced state of decay, indicating that spawning activity had subsided.

Surveys were conducted with one jet boat and two observers. Each reach was surveyed by driving upstream from the launch site on one side of the river to the reach boundary and then reversing course to continue surveying on the opposite bank downstream to the launch site. Sampling gear included a 5-meter gig pole, data sheet, global positioning system (GPS) device, specimen vials, specimen knives, and a machete.

Carcasses were recovered using a 5 meter pole with a five-pronged gig attached. The physical condition of each carcass was estimated as "fresh", "non-fresh", "very non-fresh", or "skeleton". A carcass was considered "fresh" if it had at least one clear eye, relatively firm body texture, or pink gills; "non-fresh" if the eyes were cloudy, the gills were no longer pink or the body texture had softened slightly; "very non-fresh" if it was in a decomposed state and the body was very soft and flaccid; and "skeleton" if it was in an advanced state of decay, and was mostly a bony skeleton with little to no tissue. Data collected from carcasses included: date, location (survey reach, GPS waypoint), sex, spawn status (spawned, un-spawned, and unknown), fork length, and adipose fin status (absent, present, and unknown), with the exception of skeletons, which were only tallied for sex and size (grilse <700 mm and adult ≥ 700 mm) and not sampled for biological specimens. Spawn status for females was defined as spawned (abdomen extremely flaccid and very few eggs remaining), un-spawned (abdomen firm and swollen or many eggs remaining), or unknown (indeterminable spawn status, usually due to predation on the carcass). The spawn status for males was always categorized as unknown. Adipose fin status was categorized as either "absent", indicating the adipose fin was missing from the salmon due to removal prior to being released from a hatchery, "present", indicating the adipose fin was intact on the carcass, or "unknown", which typically resulted when a carcass was either very deteriorated or had been subject to predation. The head and a tissue sample were collected from salmon with an adipose fin status of absent or unknown. Collected heads were transported to the Red Bluff Fish and Wildlife Office (RBFWO) and subsequently processed for CWT recovery. Carcasses of unknown fin status were subsequently reclassified as "absent" if a CWT was recovered from the head or "present" if no CWT was recovered. A small piece of fin tissue and a patch of scales were collected from each fresh carcass. Fin tissues were preserved in 100% ethanol and archived in the USFWS salmonid tissue archive at RBFWO. Scale patches were air dried prior to transferring to the CDFW Central Valley scale ageing project. After data were recorded and samples collected, each carcass was cut in half with a machete to prevent resampling, and returned to the river.

*Data Analysis*

The process for removing and decoding CWTs in recovered salmon is described in U.S. Fish and Wildlife Service (2005). Age, hatchery of origin, release group size, and release location were determined by querying the tag codes in the Regional Mark Information System (RMIS; www.rmpc.org). The age of CWT salmon was determined by identifying brood year relative to return year. Spatial distribution and sex composition were compared between natural-origin and hatchery-origin carcasses.

To estimate the percentage of hatchery-origin salmon in the survey area an expansion factor was calculated for each CWT group using the equation shown below. The expanded number (i.e., total number of observed salmon represented by that CWT code) was estimated by dividing the number of salmon observed with that CWT code by the expansion factor.

$$Expansion\ Factor = \frac{number\ of\ marked\ and\ tagged\ juvenile\ fish\ in\ a\ CWT\ group}{total\ marked\ and\ unmarked\ juvenile\ fish\ represented\ by\ the\ CWT\ group}$$

For example, if a CWT is recovered from a group of salmon that had a 25% mark rate, then the expansion factor for this particular CWT would be 0.25, and the expanded number for each salmon observed would be 4. In this case, each CWT recovery represents four hatchery-origin

salmon, including one marked salmon and three unmarked salmon. We assumed that unmarked hatchery-origin salmon had similar biological characteristics and distribution (e.g. sex, hatchery of origin, and survey reach) as those of the salmon with a CWT observed in our surveys. This assumption was not applied to date, fork length, or spatial distribution (i.e., river mile) due to a small sample size for each of these metrics.

To provide a broader perspective of monitoring results in the context of natural spawning FCS in the upper Sacramento River, some data from this USFWS supplemental survey were combined with the data collected that were by the California Department of Fish and Wildlife (CDFW) in the uppermost 26 miles of the Sacramento River accessible to anadromous fish. Considered together, these two surveys characterize natural spawning FCS across the uppermost 74 miles of the Sacramento River, an area that supports a majority of natural FCS spawning in the mainstem Sacramento River (CDFW 2012).

## Results

*River Conditions*

Average flow on the Sacramento River at Bend, California was 8,443 cubic feet per second (cfs) during the survey period. A minimum flow of 5,890 cfs occurred on November 27, 2012 and a maximum flow of 70,400 cfs occurred on December 2, 2012 (http://cdec.water.ca.gov). Turbidity was generally low prior to storm events beginning on November 16, 2012, but increased after storms and high flows during the first week of December (http://cdec.water.ca.gov). The average temperature was 11.8 degrees Celsius (°C), with a minimum of 7.9 °C on December 17, 2012 and a maximum of 13.8 °C on October 16, 2012 (Figure 2; http://cdec.water.ca.gov). This data is considered provisional and is subject to change (http://cdec.water.ca.gov).

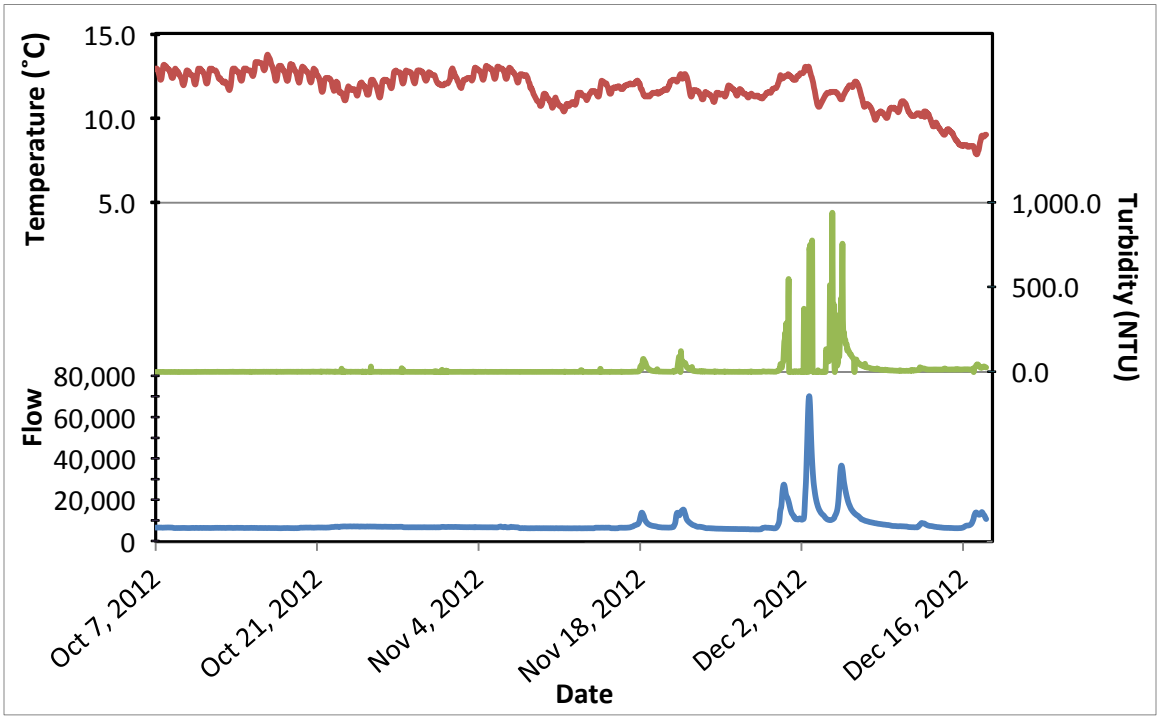


Figure 2. Hourly flow, turbidity, and water temperature of the Sacramento River at Bend, California from October 9, 2012 through December 18, 2012 (BND, www.cdec.water.ca.gov).

*Carcass Recoveries*

We observed 578 carcasses during the survey period, including 202 fresh carcasses, 196 non-fresh carcasses and 76 very non-fresh carcasses, and 104 intact skeletons. Biological data, including fork length, sex, and spawn condition, was recorded for 474 carcasses. A sample of fin tissue was collected from 259 carcasses and 218 scale patches were collected. All data and percentages presented are based on the 474 carcasses with associated biological data, unless otherwise noted.

*Coded-wire Tag Recoveries*

The heads were collected from 83 salmon carcasses, including 73 from salmon with an absent adipose fin and 10 from salmon that had unknown adipose fin status. A CWT was recovered from 69 of the collected heads. Tags were not detected in 12 heads (5 absent adipose fin and 7 unknown adipose fin status) and two tags from heads with an absent adipose fin status were lost during extraction. Three of the 10 heads collected from carcasses with unknown adipose fin status contained a CWT. The 7 carcasses with an unknown adipose fin status from which no CWTs were recovered were reclassified as "present" adipose fin status for subsequent analyses. The two lost tags, along with the 5 absent adipose fin carcasses without a CWT, were categorized as "No CWT" and grouped with hatchery-origin salmon for subsequent analyses.

*Hatchery-origin Returns*

Application of the CWT expansion factors to the 76 hatchery-origin salmon (69 CWT recoveries and 7 "No CWT") to account for unmarked hatchery production yields an estimate that 271 of the 474 salmon observed in the survey area were hatchery-origin, representing 57.2% of observed carcasses. An expansion factor (0.280) was calculated for the seven hatchery-origin carcasses categorized as "No CWT" using the weighted average expansion factors from the CWTs recovered on this survey. Most FCS are marked at Central Valley fish hatcheries at a 25% rate, but some experimental release groups of FCS are marked at a 100% rate.

Coded wire tag recoveries were identified as: Coleman NFH FCS onsite releases ($N$ = 27 recovered, $N$ = 108 expanded), Coleman NFH FCS offsite (San Pablo Bay) releases ($N$ = 15 recovered, $N$ = 60 expanded), Feather River Fish Hatchery FCS offsite (San Pablo Bay and San Francisco Bay) releases ($N$ = 20 recovered, $N$ = 65 expanded), Mokelumne River Fish Hatchery FCS offsite (San Pablo Bay) releases ($N$ = 5 recovered, $N$ = 5 expanded), Nimbus Fish Hatchery FCS offsite (San Pablo Bay) releases ($N$ = 2 recovered, $N$ = 8 expanded), or no CWT ($N$ = 7, expanded $N$ = 25). No spring Chinook salmon or late-fall Chinook salmon were observed. Natural-origin salmon ($N$ = 203) comprised 42.8% of the population (Figure 3). Fifty-three percent of the observed males were of hatchery origin and 63% of the observed females were of hatchery-origin.

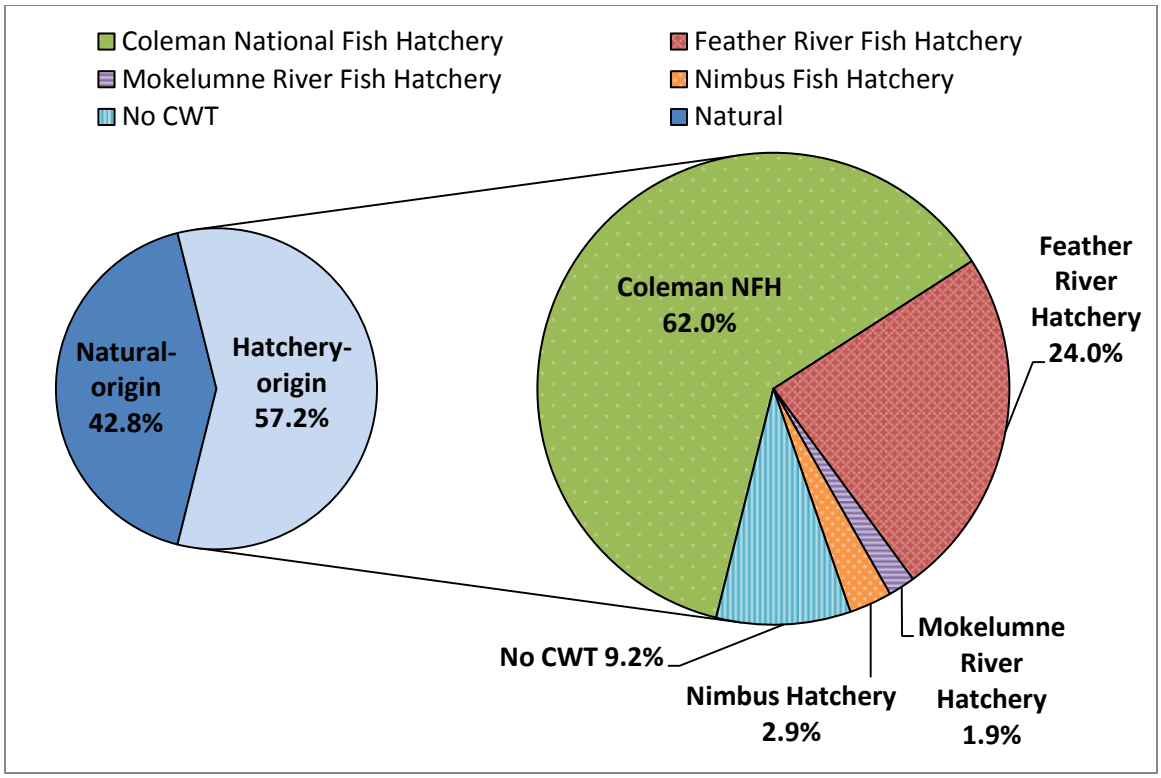


Figure 3. Hatchery contributions to 2012 fall Chinook salmon carcasses observed on the Sacramento River (RM 229- RM 276) based on expanded CWT recoveries.

*Temporal and Spatial Distribution*

The peak of fresh carcasses observed occurred during the week of October 28, 2012 (October 28, 2012 - November 3, 2012) and 51% of fresh females and 59% of fresh males were observed before or during this time (Figure 4). Four fresh carcasses were observed during the week of November 25, 2012 and no additional fresh carcasses were observed after November 27, 2013 through the end of the survey on December 18, 2012.

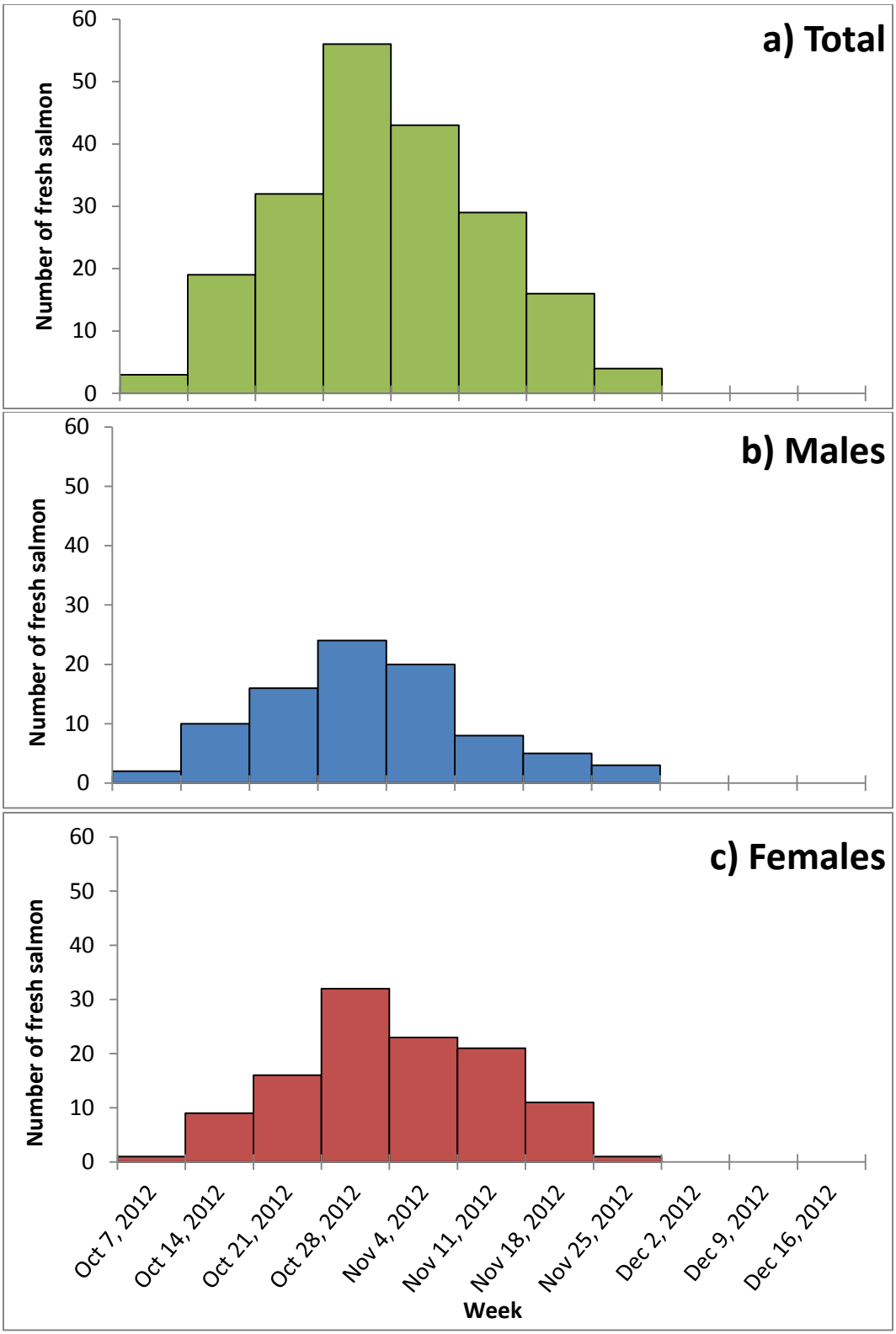


Figure 4. Weekly number of fresh fall Chinook salmon carcasses observed in the Sacramento River (RM 229- RM 276) during USFWS supplemental carcass survey in fall 2012, a) total number of fresh carcasses, b) number of fresh male carcasses, c) number of fresh female carcasses.

Salmon carcasses were observed across the entire survey area but the distribution of carcasses was skewed in a downstream direction. A majority of carcasses (77.6%) were found in a 14 mile stretch from RM 263 through the upstream survey boundary (RM 276). The confluence of Battle Creek (RM 271), where Coleman NFH is located, is within these 14 miles.

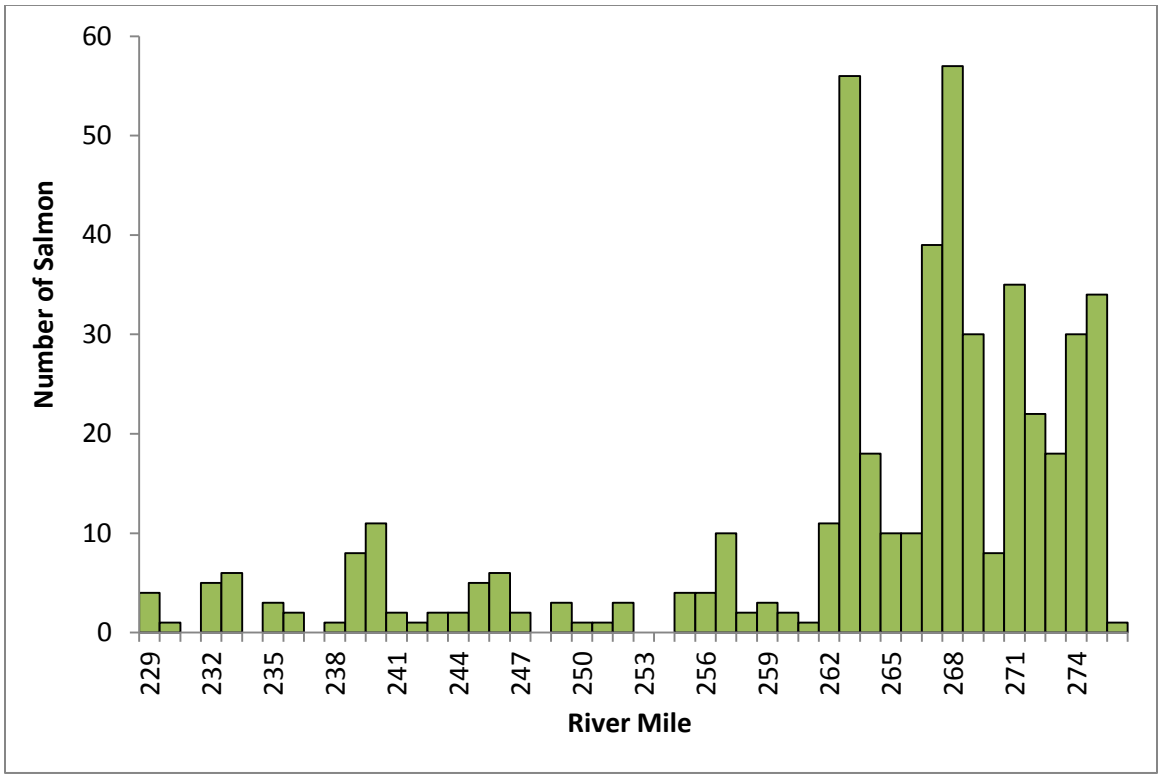


Figure 5. Fall Chinook salmon carcass distribution by river mile on the Sacramento River (RM 229- RM 276) during USFWS supplemental carcass survey in fall 2012.

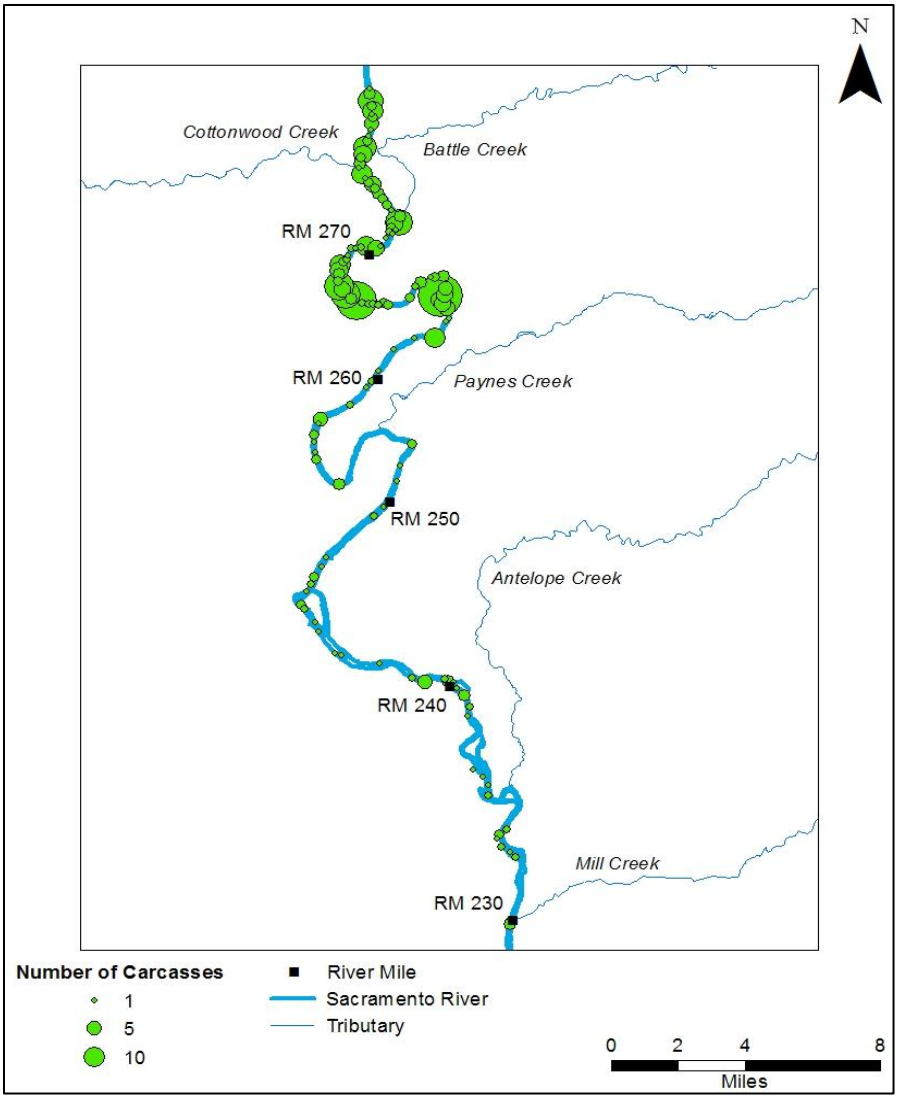


Figure 6. Spatial distribution and abundance of Chinook salmon carcasses observed on the Sacramento River (RM 229- RM 276), California, during USFWS supplemental carcass survey in fall 2012.

Observed carcasses included 255 males and 219 females for a ratio of 1.2 ♂: 1 ♀. The male (*N* = 135) to female (*N* = 137) ratio of hatchery-origin salmon was 1 ♂: 1 ♀, whereas the ratio for natural-origin males (*N* = 120) to females (*N* = 82) was higher at approximately 1.5 ♂: 1 ♀. The proportion of males and females appeared generally consistent across the area covered by the survey (Figure 7).

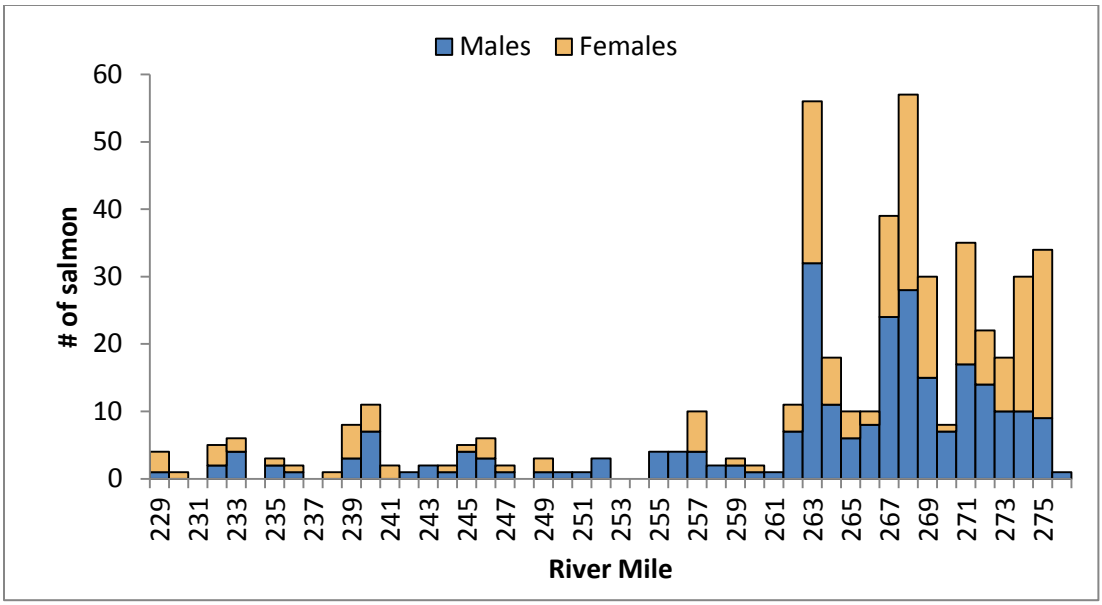

Figure 7. Number of observed fall Chinook salmon carcasses by sex on the upper Sacramento River (RM 229- RM 276) during USFWS supplemental carcass survey in fall 2012.

Spatial distribution of hatchery-origin and natural-origin carcasses varied across the survey area. To illustrate the distribution of male and female carcasses throughout a 74 mile stretch of the upper Sacramento River, data from this survey was combined with data from FCS surveys performed by CDFW. Survey reaches are defined by the CDFW as follows: CDFW 1 (RM 302- RM 298), CDFW 2 (RM 298- RM 296), CDFW 3 (RM 296- RM 289), and CDFW 4 (RM 289- RM 276); (Killam and Johnson 2013.).

For females, the percentage of hatchery-origin salmon observed was over 72% in all survey reaches, except for reach CDFW 3 (60%). For males, the highest percentage of hatchery-origin salmon was observed in the three upstream most reaches surveyed by CDFW, while the lowest percentage of hatchery-origin salmon was observed on reach CDFW 4. Reach CDFW 4, however, only represents 5% of all fish in this analysis and surveys on this reach were terminated after October 30, 2012 and not resumed until December 17, 2012 due to time constraints. It is important to note that CDFW data is based only on fresh salmon observed, whereas FWS data is based on all salmon observed (Figure 8).

a)

b)

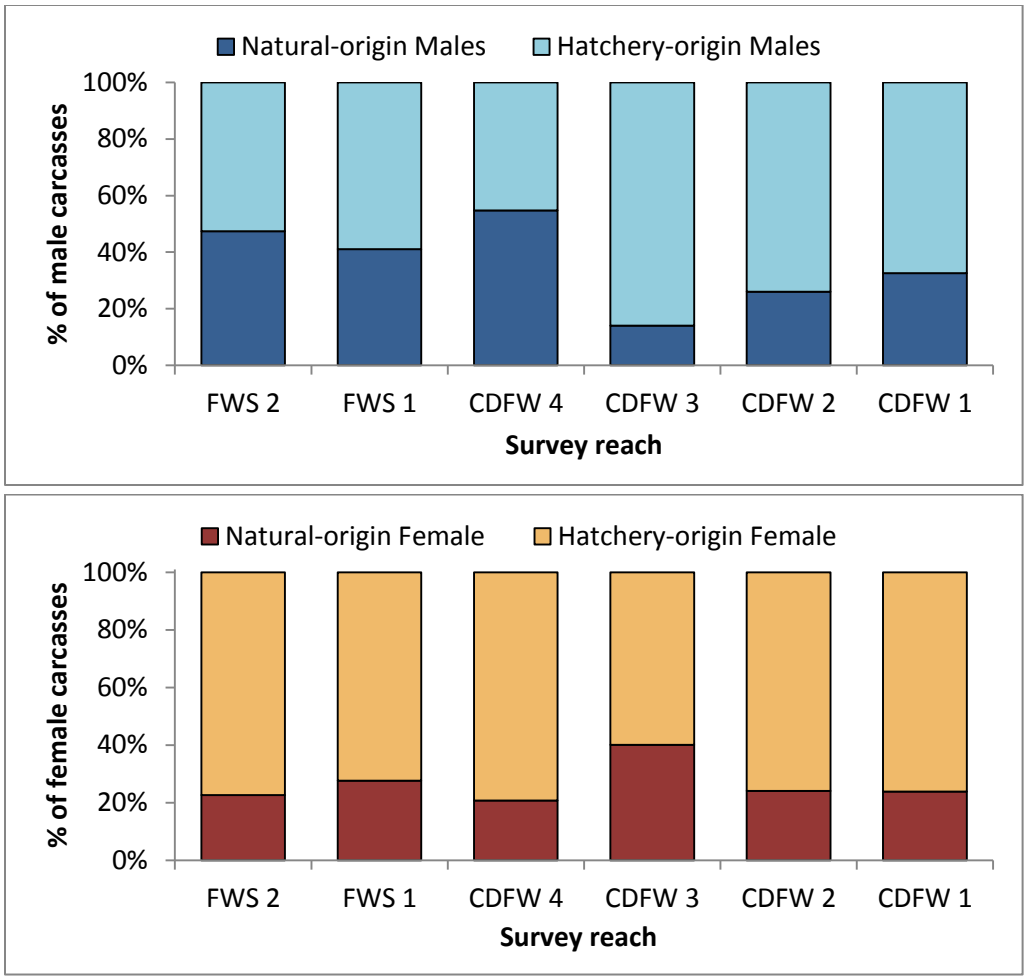


Figure 8. Percent of hatchery-origin and natural-origin fall Chinook salmon carcasses observed on the Sacramento River (RM 229- RM 302) during fall 2012. a) Percent of male carcasses by origin b) Percent of female carcasses by origin. Percentages shown are in relation to the total number of sampled carcasses in each section. CDFW data represents only fresh carcasses. Reaches are defined as follows: CDFW 1 (RM 302- RM 298), CDFW 2 (RM 298- RM 296), CDFW 3 (RM 296- RM 289), and CDFW 4 (RM 289- RM 276), FWS 1 (RM 276- RM 254) and FWS 2 (RM 254- RM 229).

*Age Composition and Length-at-Age*

Lengths of salmon carcasses were bi-modally distributed, with modes at approximately 610mm and 780mm. Length distribution of male carcasses showed a nadir separating the modes at approximately 700 mm (Figure 9). This distribution was used to estimate the proportion of grilse (age-2) and adult (age-3 and age-4) males, with salmon ≥700mm considered to be adults (85.8%; $N = 218$) and salmon <700 mm considered to be grilse (14.2%; $N = 36$). This proportion of grilse males estimated using frequency length distribution was greater than the proportion estimated using CWT data from hatchery-origin males (6.3%). Length distribution for females had a single mode, which likely resulted due to few females returning at age-2. This assumption was supported by the lack of grilse female CWT recoveries (Figure 10). Length was not recorded on one male carcass, which is excluded from this analysis.

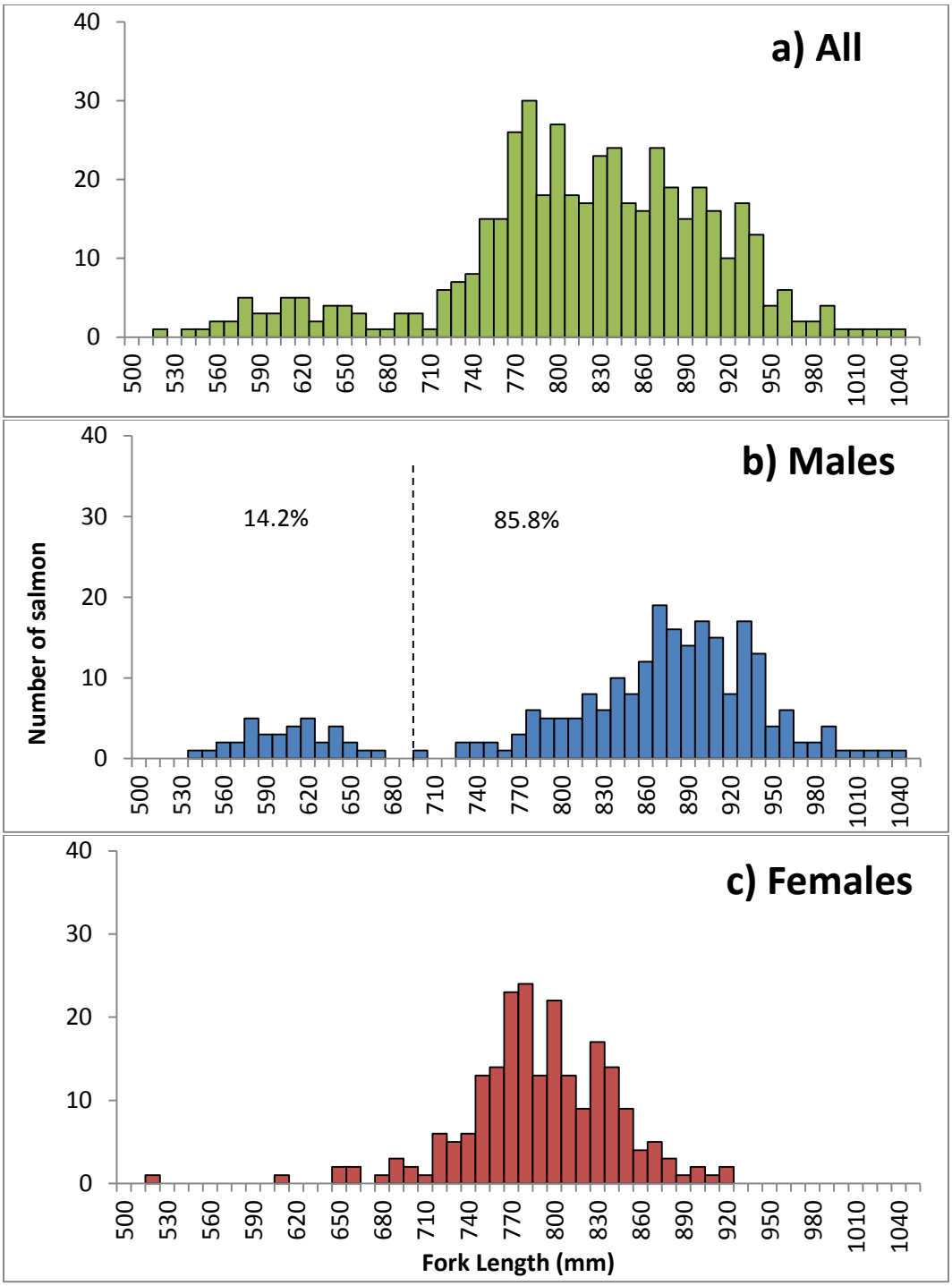


Figure 9. Length frequency distributions of all fall Chinook salmon carcasses observed on Sacramento River (RM 229- RM 276) during USFWS supplemental carcass survey in fall 2012. a) All carcasses (N = 473) b) Male carcasses (*N* = 254) c) Female carcasses (*N* = 219). An estimated grilse cutoff was set at ≥700 mm and is shown as a dotted black line for males. Percentages of salmon above and below this cutoff are shown. A grilse cutoff was not determined for females due to small sample size.

Based on expanded numbers from recovered CWTs, 3.2% of hatchery-origin carcasses were grilse (*N* = 8) and 96.8% were adult (*N* = 239 total, *N* = 227 age-3 and *N* = 12 age-4). One hundred percent of hatchery-origin females were adult (*N* = 119), whereas 6.3% of hatchery-origin male carcasses were grilse (*N* = 8) and 93.7% were adults (*N* = 120; Figure 10).

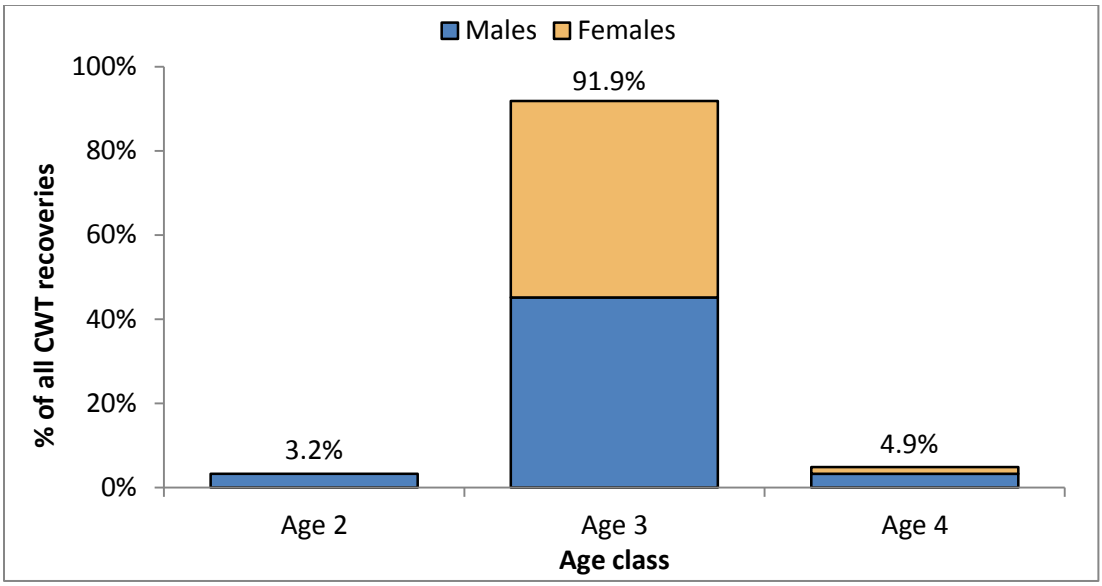


Figure 10. Age of male and female hatchery-origin fall Chinook salmon observed in the Sacramento River (RM 229- RM 276) during USFWS supplemental carcass survey in fall 2012 based on CWT recoveries.

**Discussion**

Hatchery-origin fall Chinook comprised an estimated 57% of salmon carcasses on surveyed areas of the Sacramento River (RM 229- RM 276) in the fall of 2012. FCS from Coleman NFH (62%) comprised the greatest proportion of hatchery-origin salmon observed, followed by FCS from Feather River Fish Hatchery (24%), Nimbus Fish Hatchery (3%) and Mokelumne River Fish Hatchery (2%). We caution the reader against interpreting the origins of hatchery salmon observed as the sole basis for comparing relative rates of straying from each hatchery facility. For example, the relatively higher proportion of Coleman NFH FCS observed on this survey should not be interpreted as indicating a relatively higher rate of straying by salmon originating at Coleman NFH as compared to other Central Valley hatcheries. To compare the relative rates of straying between Central Valley hatchery facilities, it is important to consider the geographic scope of inference, and we recommend that straying for hatchery facilities be evaluated on the scale of the Central Valley Basin as described in Kormos et al. (2012).

The greater proportion of carcasses observed from Coleman NFH onsite releases (40% of all hatchery-origin carcasses observed) as compared to off-site releases (22% of all hatchery-origin carcasses observed) should not be interpreted as indicating a relatively higher rate of straying by FCS released at the hatchery. When comparing stray rates of onsite and offsite release groups, which take into account the total number of fish released at a location, the offsite release groups had a higher stray rate into the surveyed section of the Sacramento River than the onsite release groups. During the 2011 survey, no offsite release FCS from Coleman NFH were observed in the survey area, indicating these fish may have strayed farther or had different survival than

onsite release groups. These findings are supported by previous assessments of Coleman NFH offsite releases, which showed that juvenile salmon transported and released at distant locations were more likely to stray at geographically distant locations, whereas juvenile salmon released offsite but closer to the hatchery strayed at an intermediate level, and were observed in closer proximity to the hatchery (Niemela 1996).

Coleman NFH is located on Battle Creek, and the confluence of Battle Creek with the Sacramento River is located at RM 271. The proximate location of Coleman NFH to the survey area likely influenced the high percentage of observed hatchery-origin carcasses originating from this hatchery relative to other Central Valley hatcheries. FCS returning to Battle Creek are either collected at the hatchery or spawn naturally within the creek. The current operational strategy for managing FCS broodstock at the Coleman NFH is to leave approximately 20,000 salmon to spawn naturally in Battle Creek. In 2012, an estimated 31,554 FCS spawned in Battle Creek (California Department of Fish and Wildlife 2013).

It is also possible that some of the FCS observed on this survey spawned naturally in Battle Creek prior to drifting downstream as kelts or carcasses. This possibility was supported by data in that the much of peak location of carcass recovery (RM 263- RM 276) was downstream of the confluence with Battle Creek (RM 271). If this occurred, we would have incorrectly presumed that carcasses observed on the survey represented straying FCS, instead of salmon that correctly homed to Battle Creek and drifted into the survey area. While some spawned out FCS may have ended up within the survey area, we do not believe this was likely a significant source of error within the present survey. Lower Battle Creek has long sections of slack water that would not readily transport carcasses back into the Sacramento River. Additionally, while the peak location of carcass recovery was downstream of the confluence of Battle Creek, relatively high numbers of FCS from the Coleman NFH were also observed upstream of the mouth of Battle Creek (RM 272- RM 276).

Within the survey area, the sex ratio was approximately equal, regardless of origin. The percent of hatchery-origin carcasses was lower in males than in females (53% and 63% respectively), but both were more than half of carcasses observed. These results are in contrast to findings from the 2011 FCS carcass survey, which had a relatively strong age-2 class that were predominantly males. During 2011, males outnumber females at a 2:1 ratio overall, with the male to female ratio for hatchery-origin carcasses observed equaling 3:1, and a 1:1 sex ratio in natural-origin salmon. Over 80% of male carcasses observed on in 2011 survey were hatchery-origin, whereas females were almost equally hatchery-origin and natural-origin.

The proportion of hatchery-origin carcasses (70%) observed by CDFW surveys in the upper river in 2012 was greater than the proportion observed in that section in 2011 (47% hatchery-origin). A majority of the carcasses observed were Feather River Fish Hatchery FCS offsite releases (33%), followed by Coleman NFH FCS onsite releases (24%). Other recovered CWTs included Coleman NFH FCS offsite releases, Mokelumne River Fish Hatchery FCS offsite releases, and Feather River Fish Hatchery spring Chinook salmon offsite releases, which each represented less than 5% of CWT recoveries. Due to differences in sampling methods used by each survey, the CDFW data presented in this report is based only on fresh carcasses observed while FWS data is

based on all sampled carcasses. These data are comparable, as each best represents the observed salmon population based on the available data.

During carcass surveys, a variety of environmental conditions (wind, glare, turbidity, etc.) can affect the ability of an observer to locate carcasses. During the 2012 survey, there were periods of increased turbidity that may have decreased the ability of observers to detect carcasses. Additionally, surveys were cancelled during the first week of December for safety concerns related to high flows, decreased visibility and increased debris in the river. We do not believe, however, that infrequent increases in turbidity or the missed survey period had an appreciable effect on the results of this survey. The periods of increased turbidity occurred late in the season after the period of peak carcass recovery, and after a high flow event that may have removed carcasses from the survey area. Some of the turbidity data presented in this report may be outliers and the frequency and magnitude of these high values are not corroborated by turbidity data taken daily at the Red Bluff Diversion Dam (U.S. Fish and Wildlife Service 2012). Data retrieved from the California Data Exchange Center (http://cdec.water.ca.gov) is considered provisional and is subject to change.

Information resulting from the 2012 Sacramento River supplemental carcass survey project highlights the importance of surveying across broad geographic areas and across multiple years for a more complete representation of the FCS escapement in the upper Sacramento River. Data from this project capitalizes on the substantial investments made into the Central Valley CFM program and partially fulfill the objectives of the Central Valley In-river Chinook Salmon Escapement Monitoring Plan for the Sacramento River. Additionally, information from this carcass survey works toward achieving recommendations by the California Hatchery Scientific Review Group (HSRG) to monitor escapement of hatchery-origin salmon into natural spawning areas (California HSRG 2012). Collecting future escapement data from the Sacramento River, in addition to tributaries of the upper Sacramento River, would further expand our understanding of how FCS spawn in the Central Valley, and can be used to promote better management of hatchery-origin and natural-origin stocks (California HSRG 2012).

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## Literature Cited


Bergman, J.M., R. Nielson, and A. Low. 2012. Central Valley in-river Chinook salmon escapement monitoring plan. California Department of Fish and Game. Fisheries Branch Administrative Report: 2012-1.

Buttars, B. 2011. Constant fractional marking/ tagging program for Central Valley fall Chinook salmon, 2011 marking season. Pacific States Marine Fisheries Commission.

California Department of Fish and Wildlife (CDFW). 2013. Grandtab dataset for Central Valley Chinook salmon escapement. Available at http://www.calfish.org/tabid/213/Default.aspx.

California Hatchery Scientific Review Group (California HSRG). 2012. California Hatchery Review Report. Prepared for the US Fish and Wildlife Service and Pacific States Marine Fisheries Commission. June 2012. 100 pgs.

Cuenco, M. L., T. W. H. Backman, and P. R. Mundy. 1993. The use of supplementation to aid in natural stock restoration. Pages 269-293 *in* J. G. Cloud and G. H. Thorgaard, eds. Genetic conservation of salmonid fishes. Plenum Press, New York.

Dittman, A. H., and T. P. Quinn. 1996. Homing in Pacific salmon: mechanisms and ecological basis. The Journal of Experimental Biology 199: 83-91.

Hard, J.J., R.P. Jones, Jr., M.R. Delarm, and R.S. Waples. 1992. Pacific salmon and artificial propagation under the Endangered Species Act. NOAA Technical Memorandum, NMFS-NWFSC-25. 25 pp.

Killam, D. 2009. Chinook salmon population for the upper Sacramento River basin in 2008. California Department of Fish and Game, Sacramento River Salmon and Steelhead Assessment Project Technical Report No.09-1.

Killam, D and M. Johnson. 2013. Chinook salmon populations of the upper Sacramento River basin in 2012. California Department of Fish and Wildlife. RBFO Technical Report 02-2013.

Kormos, B., M. Palmer-Zwahlen, and A. Low. 2012. Recovery of coded-wire tags from the Chinook salmon in California's Central Valley escapement and ocean harvest in 2010. California Department of Fish and Game. Fisheries Branch Administrative Report 2012-02.

Niemela, K. S. 1996. Effects of release location on contribution to the ocean fishery, contribution to hatchery, and straying for brood years 1987-1991 fall Chinook salmon propagated at Coleman National Fish Hatchery. U.S. Fish and Wildlife Service. Northern Central Valley Fish and Wildlife Office Project Completion Report.

Quinn, T. P., R. S. Nemeth, and D. O. McIsaac. 1991. Homing and straying patterns of fall Chinook salmon in the lower Columbia River. Transactions of the American Fisheries Society 120: 150-156.

Quinn, T. P. 1993. A review of homing and straying of wild and hatchery-produced salmon. Fisheries Research 18(1-2): 29-44.

U.S. Fish and Wildlife Service. 2005. Summary of biological monitoring and sampling activities conducted at the Coleman National Fish Hatchery (NFH) by the Hatchery Evaluation Program during 2002-2003 spawning season. Red Bluff Fish and Wildlife Office Technical Report.

U.S. Fish and Wildlife Service. 2012. Juvenile salmonid monitoring preliminary bi-weekly report (November, 2012-December, 2012), 4 reports. Red Bluff Fish and Wildlife Office, Red Bluff Diversion Dam- Juvenile Salmonid Monitoring. Available: http://www.fws.gov/redbluff/rbdd_biweekly.aspx (January 2014).

Waples, R. S., M. J. Ford, and D. Schmitt. 2007. Empirical results of salmon supplementation in the Northeast Pacific: A preliminary assessment. pp. 383-403 in T. M. ert, ed. Ecological and Genetic Implications of Aquaculture Activities. Kluwer Academic Publishers.

Williamson, K. S., and May, B. 2005. Homogenization of fall-run Chinook salmon gene pools in the Central Valley of California, USA. North American Journal of Fisheries Management, *25*:3, 993-1009.

## Appendix A

Table A. 1. Release information associated with coded wire tags recovered from Chinook salmon carcasses in Sacramento River (RM 229- RM 276) during fall 2012. Numbers of juvenile salmon released are categorized based on juvenile retention data as follows: Clip/Tag = adipose fin-clipped with coded wire tag; No Clip/Tag = no adipose fin-clip with coded wire tag; Clip/ No Tag = adipose fin-clipped without coded wire tag; No Clip/ No Tag = no adipose fin-clip without coded wire tag.

| CWT Code | Hatchery of Origin | Run | Release Location | Brood Year | Clip/ Tag | No Clip/ Tag | Clip/ No Tag | No Clip/ No Tag | Expansion Factor | Number Recovered | Expanded Number |
|---|---|---|---|---|---|---|---|---|---|---|---|
| 054884 | Coleman NFH | Fall | Coleman NFH | 2008 | 115782 | 0 | 287 | 348496 | 0.249 | 1 | 4.01 |
| 054879 | Coleman NFH | Fall | Conoco Phillips | 2008 | 107725 | 0 | 267 | 324493 | 0.249 | 1 | 4.01 |
| 055180 | Coleman NFH | Fall | Coleman NFH | 2009 | 88137 | 0 | 0 | 265541 | 0.249 | 1 | 4.01 |
| 055181 | Coleman NFH | Fall | Coleman NFH | 2009 | 95007 | 0 | 244 | 286921 | 0.249 | 3 | 12.07 |
| 055183 | Coleman NFH | Fall | Coleman NFH | 2009 | 116291 | 282 | 0 | 349904 | 0.249 | 1 | 4.01 |
| 055185 | Coleman NFH | Fall | Coleman NFH | 2009 | 108389 | 0 | 0 | 325252 | 0.250 | 3 | 12.00 |
| 055188 | Coleman NFH | Fall | Coleman NFH | 2009 | 117670 | 0 | 311 | 355427 | 0.249 | 4 | 16.09 |
| 055189 | Coleman NFH | Fall | Coleman NFH | 2009 | 112440 | 0 | 0 | 337542 | 0.250 | 1 | 4.00 |
| 055190 | Coleman NFH | Fall | Coleman NFH | 2009 | 99672 | 0 | 0 | 304467 | 0.247 | 1 | 4.05 |
| 055191 | Coleman NFH | Fall | Coleman NFH | 2009 | 104281 | 0 | 0 | 313051 | 0.250 | 1 | 4.00 |
| 055195 | Coleman NFH | Fall | Coleman NFH | 2009 | 112693 | 788 | 1182 | 347451 | 0.244 | 1 | 4.10 |
| 055197 | Coleman NFH | Fall | Coleman NFH | 2009 | 107617 | 0 | 0 | 323139 | 0.250 | 1 | 4.00 |
| 055199 | Coleman NFH | Fall | Coleman NFH | 2009 | 99659 | 0 | 0 | 300079 | 0.249 | 2 | 8.02 |
| 055221 | Coleman NFH | Fall | Coleman NFH | 2009 | 109482 | 0 | 550 | 330261 | 0.249 | 3 | 12.06 |
| 055225 | Coleman NFH | Fall | Coleman NFH | 2009 | 90698 | 0 | 0 | 272183 | 0.250 | 2 | 8.00 |
| 055184 | Coleman NFH | Fall | Mare Island Net pen | 2009 | 114091 | 0 | 0 | 347008 | 0.247 | 2 | 8.08 |
| 055187 | Coleman NFH | Fall | Mare Island Net pen | 2009 | 118588 | 0 | 309 | 356835 | 0.249 | 9 | 36.10 |
| 055196 | Coleman NFH | Fall | Mare Island Net pen | 2009 | 105240 | 0 | 0 | 316941 | 0.249 | 3 | 12.03 |
| 055376 | Coleman NFH | Fall | Coleman NFH | 2010 | 112097 | 0 | 0 | 336585 | 0.250 | 1 | 4.00 |
| 055379 | Coleman NFH | Fall | Coleman NFH | 2010 | 106750 | 0 | 0 | 320379 | 0.250 | 1 | 4.00 |
| 068670 | Feather River Hatchery | Fall | San Pablo Bay Net Pens | 2009 | 398016 | 494 | 494 | 1201929 | 0.249 | 1 | 4.02 |
| 068671 | Feather River Hatchery | Fall | San Pablo Bay Net Pens | 2009 | 392330 | 0 | 987 | 1181282 | 0.249 | 4 | 16.05 |
| 068672 | Feather River Hatchery | Fall | San Pablo Bay Net Pens | 2009 | 400675 | 0 | 981 | 1206374 | 0.249 | 9 | 36.12 |
| 068624 | Feather River Hatchery | Fall | Tiburon | 2009 | 41238 | 212 | 211 | 212 | 0.985 | 2 | 2.03 |

| CWT Code | Hatchery of Origin | Run | Release Location | Brood Year | Clip/ Tag | No Clip/ Tag | Clip/ No Tag | No Clip/ No Tag | Expansion Factor | Number Recovered | Expanded Number |
|---|---|---|---|---|---|---|---|---|---|---|---|
| 068654 | Feather River Hatchery | Fall | Wickland Oil Net Pens | 2009 | 108744 | 0 | 3809 | 254 | 0.964 | 3 | 3.11 |
| 068660 | Feather River Hatchery | Fall | Wickland Oil Net Pens | 2009 | 53306 | 302 | 129 | 161647 | 0.247 | 1 | 4.04 |
| 068641 | Mokelumne River Hatchery | Fall | Sherman Island Net Pens | 2009 | 285045 | 0 | 0 | 944 | 0.997 | 2 | 2.01 |
| 068688 | Mokelumne River Hatchery | Fall | Sherman Island Net Pens | 2009 | 102476 | 0 | 226 | 0 | 0.998 | 1 | 1.00 |
| 068708 | Mokelumne River Hatchery | Fall | Sherman Island Net Pens | 2009 | 395978 | 0 | 873 |  | 0.998 | 2 | 2.00 |
| 068638 | Nimbus Fish Hatchery | Fall | Mare Island Net pen | 2008 | 400048 | 0 | 0 | 1201089 | 0.250 | 1 | 4.00 |
| 068680 | Nimbus Fish Hatchery | Fall | Mare Island Net pen | 2009 | 279383 | 0 | 0 | 838649 | 0.250 | 1 | 4.00 |
| Lost |  |  |  |  |  |  |  |  | *0.280* | 2 | *7.14* |
| NTD |  |  |  |  |  |  |  |  | *0.280* | 5 | *17.86* |
| Total |  |  |  |  |  |  |  |  |  | 76 | 271 |

Table A. 2. Biological data from Chinook salmon carcasses with a coded wire tag in the Sacramento River (RM 229- RM 276) during fall 2012. "NTD" indicates there was no coded wire tag detected in the head, and "No Head" designates an adipose fin-clipped carcass for which no head was recovered, due to predation or deteriorated physical condition. One coded wire tag was lost prior to decoding. A sample number "0" indicates a tissue was not collected for the carcass.

| Date | Sample | Sex | Fork length | Adipose Fin Status | Spawn Condition | Carcass Condition | Reach | CWT Code |
|---|---|---|---|---|---|---|---|---|
| 07-Oct-12 | 1502 | Female | 830 | Present | Unspawned | Fresh | 1 | |
| 07-Oct-12 | 1501 | Male | 820 | Absent | Unknown | Non-Fresh | 1 | 055181 |
| 07-Oct-12 | 1503 | Male | 910 | Present | Unknown | Fresh | 1 | |
| 11-Oct-12 | 0 | Male | 880 | Present | Unknown | Very Non-Fresh | 2 | |
| 11-Oct-12 | 1504 | Male | 950 | Present | Unknown | Fresh | 2 | |
| 15-Oct-12 | 1685 | Male | 950 | Absent | Unknown | Fresh | 1 | 055180 |
| 15-Oct-12 | 1696 | Female | 760 | Absent | Spawned | Fresh | 1 | 055181 |
| 15-Oct-12 | 1689 | Male | 830 | Absent | Unknown | Fresh | 1 | 055183 |
| 15-Oct-12 | 1683 | Female | 800 | Present | Spawned | Fresh | 1 | |
| 15-Oct-12 | 1686 | Female | 760 | Present | Spawned | Fresh | 1 | |
| 15-Oct-12 | 1687 | Female | 760 | Present | Spawned | Non-Fresh | 1 | |
| 15-Oct-12 | 1688 | Female | 830 | Present | Spawned | Fresh | 1 | |
| 15-Oct-12 | 1700 | Female | 820 | Absent | Spawned | Fresh | 1 | 055187 |
| 15-Oct-12 | 0 | Female | 830 | Present | Spawned | Non-Fresh | 1 | |
| 15-Oct-12 | 1692 | Female | 760 | Present | Spawned | Fresh | 1 | |
| 15-Oct-12 | 1693 | Female | 770 | Present | Spawned | Fresh | 1 | |
| 15-Oct-12 | 0 | Female | 800 | Present | Unspawned | Non-Fresh | 1 | |
| 15-Oct-12 | 1694 | Female | 750 | Present | Spawned | Fresh | 1 | |
| 15-Oct-12 | 1697 | Female | 810 | Present | Unspawned | Fresh | 1 | |
| 15-Oct-12 | 0 | Male | 830 | Present | Unknown | Very Non-Fresh | 1 | |
| 15-Oct-12 | 1681 | Male | 910 | Present | Unknown | Fresh | 1 | |
| 15-Oct-12 | 1682 | Male | 910 | Present | Unknown | Fresh | 1 | |
| 15-Oct-12 | 1684 | Male | 650 | Present | Unknown | Fresh | 1 | |
| 15-Oct-12 | 0 | Male | 960 | Present | Unknown | Non-Fresh | 1 | |
| 15-Oct-12 | 1690 | Male | 840 | Present | Unknown | Fresh | 1 | |
| 15-Oct-12 | 1691 | Male | 880 | Present | Unknown | Fresh | 1 | |
| 15-Oct-12 | 1695 | Male | 810 | Present | Unknown | Fresh | 1 | |
| 15-Oct-12 | 1698 | Male | 550 | Present | Unknown | Fresh | 1 | |
| 15-Oct-12 | 1699 | Male | 890 | Present | Unknown | Fresh | 1 | |
| 15-Oct-12 | 0 | Male | 800 | Present | Unknown | Non-Fresh | 1 | |
| 15-Oct-12 | 0 | Male | 870 | Present | Unknown | Non-Fresh | 1 | |
| 21-Oct-12 | 1723 | Female | 850 | Present | Spawned | fresh | 1 | |
| 21-Oct-12 | 1722 | Male | 910 | Present | Unknown | fresh | 1 | |
| 21-Oct-12 | 0 | Male | 580 | Present | Unknown | non-fresh | 1 | |
| 21-Oct-12 | 1724 | Female | 800 | Present | Unspawned | non-fresh | 1 | |
| 21-Oct-12 | 1725 | Male | 880 | Present | Unknown | fresh | 1 | |
| 21-Oct-12 | 0 | Male | 870 | Present | Unknown | non-fresh | 1 | |
| 21-Oct-12 | 1726 | Female | 765 | Present | Unspawned | fresh | 1 | |
| 21-Oct-12 | 1728 | Male | 920 | Present | Unknown | non-fresh | 1 | |
| 21-Oct-12 | 1729 | Female | 780 | Present | Spawned | fresh | 1 | |
| 21-Oct-12 | 1730 | Female | 810 | Present | Spawned | non-fresh | 1 | |
| 21-Oct-12 | 1731 | Male | 880 | Present | Unknown | fresh | 1 | |
| 21-Oct-12 | 1732 | Male | 905 | Present | Unknown | fresh | 1 | |
| 21-Oct-12 | 0 | Male | 770 | Present | Unknown | non-fresh | 1 | |
| 21-Oct-12 | 0 | Male | | Present | Unknown | non-fresh | 1 | |
| 21-Oct-12 | 1719 | Male | 850 | Absent | Unknown | non-fresh | 1 | 055185 |
| 21-Oct-12 | 0 | Male | 990 | Present | Unknown | non-fresh | 1 | |
| 21-Oct-12 | 1733 | Female | 840 | Present | Spawned | fresh | 1 | |
| 21-Oct-12 | 1735 | Female | 760 | Present | Spawned | fresh | 1 | |
| 21-Oct-12 | 1737 | Female | 750 | Present | Spawned | fresh | 1 | |
| 21-Oct-12 | 1734 | Female | 870 | Absent | Unspawned | fresh | 1 | 055188 |
| 21-Oct-12 | 1721 | Female | 750 | Absent | Spawned | non-fresh | 1 | 055191 |
| 21-Oct-12 | 1718 | Male | 920 | Absent | Unknown | non-fresh | 1 | 055197 |
| 21-Oct-12 | 1736 | Male | 880 | Present | Unknown | fresh | 1 | |

| Date | Sample | Sex | Fork length | Adipose Fin Status | Spawn Condition | Carcass Condition | Reach | CWT Code |
|---|---|---|---|---|---|---|---|---|
| 21-Oct-12 | 1738 | Female | 770 | Present | Unknown | fresh | 1 | |
| 21-Oct-12 | 0 | Male | 790 | Present | Unknown | non-fresh | 1 | |
| 21-Oct-12 | 0 | Male | 920 | Present | Unknown | non-fresh | 1 | |
| 21-Oct-12 | 1727 | Male | 750 | Absent | Unknown | fresh | 1 | 068624 |
| 21-Oct-12 | 1739 | Female | 800 | Present | Unspawned | fresh | 1 | |
| 21-Oct-12 | 1740 | Female | 750 | Present | Spawned | fresh | 1 | |
| 21-Oct-12 | 0 | Male | 580 | Present | Unknown | non-fresh | 1 | |
| 21-Oct-12 | 1741 | Female | 780 | Present | Spawned | fresh | 1 | |
| 21-Oct-12 | 1742 | Female | 770 | Present | Spawned | fresh | 1 | |
| 21-Oct-12 | 1743 | Male | 870 | Present | Unknown | non-fresh | 1 | |
| 21-Oct-12 | 1744 | Female | 880 | Present | Unspawned | fresh | 1 | |
| 21-Oct-12 | 0 | Male | 700 | Present | Unknown | non-fresh | 1 | |
| 21-Oct-12 | 1745 | Male | 870 | Present | Unknown | fresh | 1 | |
| 21-Oct-12 | 1717 | Female | 770 | Present | Spawned | fresh | 1 | |
| 21-Oct-12 | 1711 | Male | 940 | Present | Unknown | fresh | 1 | |
| 21-Oct-12 | 1712 | Male | 930 | Present | Unknown | fresh | 1 | |
| 21-Oct-12 | 1713 | Female | 760 | Present | Spawned | fresh | 1 | |
| 21-Oct-12 | 1714 | Female | 920 | Present | Unspawned | fresh | 1 | |
| 21-Oct-12 | 1715 | Female | 820 | Present | Spawned | non-fresh | 1 | |
| 21-Oct-12 | 1716 | Male | 900 | Present | Unknown | fresh | 1 | |
| 21-Oct-12 | 0 | Male | 830 | Present | Unknown | non-fresh | 1 | |
| 21-Oct-12 | 0 | Male | 790 | Present | Unknown | non-fresh | 1 | |
| 21-Oct-12 | 1720 | Male | 820 | Present | Unknown | fresh | 1 | |
| 22-Oct-12 | 0 | Male | 880 | Present | Unknown | non-fresh | 2 | |
| 22-Oct-12 | 1505 | Male | 880 | Present | Unknown | Fresh | 2 | |
| 22-Oct-12 | 1506 | Male | 870 | Present | Unknown | Fresh | 2 | |
| 22-Oct-12 | 0 | Male | 800 | Present | Unknown | non-fresh | 2 | |
| 22-Oct-12 | 1508 | Male | 570 | Present | Unknown | Fresh | 2 | |
| 22-Oct-12 | 1509 | Male | 590 | Present | Unknown | Fresh | 2 | |
| 22-Oct-12 | 1510 | Male | 890 | Present | Unknown | Fresh | 2 | |
| 22-Oct-12 | 1507 | Male | 620 | Absent | Unknown | very non-fresh | 2 | 055379 |
| 27-Oct-12 | 1549 | Male | 890 | Absent | Unknown | Fresh | 1 | 054879 |
| 27-Oct-12 | 1521 | Male | 970 | Absent | Unknown | very non-fresh | 1 | 054884 |
| 27-Oct-12 | 1531 | Male | 940 | Absent | Unknown | Non-fresh | 1 | 055185 |
| 27-Oct-12 | 1513 | Female | 880 | Present | Spawned | Fresh | 1 | |
| 27-Oct-12 | 0 | Female | 830 | Present | Spawned | very non-fresh | 1 | |
| 27-Oct-12 | 0 | Female | 780 | Present | Spawned | Non-fresh | 1 | |
| 27-Oct-12 | 0 | Female | 730 | Present | Spawned | Non-fresh | 1 | |
| 27-Oct-12 | 0 | Female | 780 | Present | Spawned | Non-fresh | 1 | |
| 27-Oct-12 | 0 | Female | 860 | Present | Spawned | Non-fresh | 1 | |
| 27-Oct-12 | 1542 | Female | 780 | Present | Spawned | Fresh | 1 | |
| 27-Oct-12 | 1525 | Female | 780 | Absent | Spawned | Non-fresh | 1 | 055187 |
| 27-Oct-12 | 1544 | Female | 770 | Present | Spawned | Fresh | 1 | |
| 27-Oct-12 | 0 | Female | 750 | Present | Spawned | Non-fresh | 1 | |
| 27-Oct-12 | 1551 | Female | 760 | Present | Spawned | Fresh | 1 | |
| 27-Oct-12 | 1557 | Female | 870 | Absent | Spawned | Fresh | 1 | 055187 |
| 27-Oct-12 | 0 | Female | 850 | Present | Spawned | very non-fresh | 1 | |
| 27-Oct-12 | 0 | Female | 860 | Present | Spawned | very non-fresh | 1 | |
| 27-Oct-12 | 1520 | Female | 840 | Present | Spawned | Fresh | 1 | |
| 27-Oct-12 | 1517 | Female | 830 | Present | Spawned | Fresh | 1 | |
| 27-Oct-12 | 0 | Female | 840 | Present | Unspawned | Non-fresh | 1 | |
| 27-Oct-12 | 1528 | Female | 750 | Present | Spawned | Fresh | 1 | |
| 27-Oct-12 | 0 | Female | 800 | Present | Spawned | Non-fresh | 1 | |
| 27-Oct-12 | 0 | Female | 850 | Present | Spawned | Non-fresh | 1 | |
| 27-Oct-12 | 1532 | Female | 920 | Present | Spawned | Fresh | 1 | |
| 27-Oct-12 | 1533 | Female | 840 | Present | Spawned | Fresh | 1 | |
| 27-Oct-12 | 0 | Female | 830 | Present | Spawned | Non-fresh | 1 | |
| 27-Oct-12 | 1534 | Female | 770 | Present | Spawned | Fresh | 1 | |
| 27-Oct-12 | 1535 | Female | 810 | Present | Spawned | Fresh | 1 | |
| 27-Oct-12 | 0 | Female | 840 | Present | Spawned | Non-fresh | 1 | |

| Date | Sample | Sex | Fork length | Adipose Fin Status | Spawn Condition | Carcass Condition | Reach | CWT Code |
|---|---|---|---|---|---|---|---|---|
| 27-Oct-12 | 1537 | Female | 800 | Present | Spawned | Fresh | 1 | |
| 27-Oct-12 | 1538 | Female | 800 | Present | Spawned | Fresh | 1 | |
| 27-Oct-12 | 1559 | Male | 910 | Absent | Unknown | Non-fresh | 1 | 055188 |
| 27-Oct-12 | 0 | Female | 790 | Present | Spawned | Non-fresh | 1 | |
| 27-Oct-12 | 1539 | Female | 850 | Present | Spawned | Fresh | 1 | |
| 27-Oct-12 | 0 | Female | 890 | Present | Spawned | Non-fresh | 1 | |
| 27-Oct-12 | 0 | Female | 850 | Present | Spawned | Non-fresh | 1 | |
| 27-Oct-12 | 0 | Female | 740 | Present | Spawned | Non-fresh | 1 | |
| 27-Oct-12 | 1540 | Female | 810 | Present | Spawned | Fresh | 1 | |
| 27-Oct-12 | 1541 | Female | 840 | Present | Spawned | Fresh | 1 | |
| 27-Oct-12 | 0 | Female | 730 | Present | Spawned | Non-fresh | 1 | |
| 27-Oct-12 | 1545 | Female | 760 | Present | Spawned | Fresh | 1 | |
| 27-Oct-12 | 1546 | Female | 770 | Present | Spawned | Fresh | 1 | |
| 27-Oct-12 | 1547 | Female | 790 | Present | Spawned | Fresh | 1 | |
| 27-Oct-12 | 1548 | Female | 790 | Present | Spawned | Fresh | 1 | |
| 27-Oct-12 | 0 | Female | 910 | Present | Unspawned | Non-fresh | 1 | |
| 27-Oct-12 | 1550 | Female | 800 | Present | Spawned | Fresh | 1 | |
| 27-Oct-12 | 1553 | Female | 750 | Present | Spawned | Fresh | 1 | |
| 27-Oct-12 | 1554 | Female | 790 | Present | Spawned | Fresh | 1 | |
| 27-Oct-12 | 1555 | Female | 700 | Present | Spawned | Fresh | 1 | |
| 27-Oct-12 | 1552 | Male | 840 | Absent | Unknown | Fresh | 1 | 055190 |
| 27-Oct-12 | 1518 | Male | 930 | Absent | Unknown | Fresh | 1 | 055225 |
| 27-Oct-12 | 1530 | Male | 960 | Absent | Unknown | Fresh | 1 | 055225 |
| 27-Oct-12 | 1514 | Male | 590 | Absent | Unknown | Fresh | 1 | 055376 |
| 27-Oct-12 | 1543 | Female | 780 | Absent | Spawned | Fresh | 1 | 068660 |
| 27-Oct-12 | 1529 | Female | 770 | Absent | Spawned | Fresh | 1 | 068671 |
| 27-Oct-12 | 1519 | Female | 790 | Absent | Spawned | Fresh | 1 | 068672 |
| 27-Oct-12 | 0 | Male | 940 | Present | Unknown | Non-fresh | 1 | |
| 27-Oct-12 | 1512 | Male | 850 | Present | Unknown | Fresh | 1 | |
| 27-Oct-12 | 0 | Male | 890 | Present | Unknown | Non-Fresh | 1 | |
| 27-Oct-12 | 0 | Male | 900 | Present | Unknown | very non-fresh | 1 | |
| 27-Oct-12 | 1515 | Male | 580 | Present | Unknown | Fresh | 1 | |
| 27-Oct-12 | 1516 | Male | 850 | Present | Unknown | Fresh | 1 | |
| 27-Oct-12 | 0 | Male | 860 | Present | Unknown | Non-fresh | 1 | |
| 27-Oct-12 | 0 | Male | 840 | Present | Unknown | Non-fresh | 1 | |
| 27-Oct-12 | 0 | Male | 860 | Present | Unknown | Non-fresh | 1 | |
| 27-Oct-12 | 0 | Male | 910 | Present | Unknown | Non-fresh | 1 | |
| 27-Oct-12 | 0 | Male | 740 | Present | Unknown | Non-fresh | 1 | |
| 27-Oct-12 | 1560 | Male | 780 | Present | Unknown | Fresh | 1 | |
| 27-Oct-12 | 1561 | Male | 860 | Present | Unknown | Fresh | 1 | |
| 27-Oct-12 | 0 | Male | 620 | Present | Unknown | Non-fresh | 1 | |
| 27-Oct-12 | 1523 | Male | 610 | Present | Unknown | Fresh | 1 | |
| 27-Oct-12 | 1511 | Male | 610 | Present | Unknown | Fresh | 1 | |
| 27-Oct-12 | 0 | Male | 910 | Present | Unknown | Non-fresh | 1 | |
| 27-Oct-12 | 1522 | Male | 900 | Present | Unknown | Fresh | 1 | |
| 27-Oct-12 | 0 | Male | 820 | Present | Unknown | very non-fresh | 1 | |
| 27-Oct-12 | 0 | Male | 910 | Present | Unknown | Non-fresh | 1 | |
| 27-Oct-12 | 0 | Male | 870 | Present | Unknown | Non-fresh | 1 | |
| 27-Oct-12 | 0 | Male | 870 | Present | Unknown | Non-fresh | 1 | |
| 27-Oct-12 | 0 | Male | 870 | Present | Unknown | Non-fresh | 1 | |
| 27-Oct-12 | 0 | Male | 770 | Present | Unknown | very non-fresh | 1 | |
| 27-Oct-12 | 1524 | Male | 870 | Present | Unknown | Fresh | 1 | |
| 27-Oct-12 | 1526 | Male | 860 | Present | Unknown | Fresh | 1 | |
| 27-Oct-12 | 1527 | Male | 970 | Present | Unknown | Fresh | 1 | |
| 27-Oct-12 | 0 | Male | 930 | Present | Unknown | very non-fresh | 1 | |
| 27-Oct-12 | 0 | Male | 890 | Present | Unknown | Non-fresh | 1 | |
| 27-Oct-12 | 0 | Male | 930 | Present | Unknown | Non-fresh | 1 | |
| 27-Oct-12 | 1536 | Male | 960 | Present | Unknown | Fresh | 1 | |
| 27-Oct-12 | 0 | Male | 870 | Present | Unknown | Very Non-Fresh | 1 | |
| 27-Oct-12 | 0 | Male | 900 | Present | Unknown | very non-fresh | 1 | |

| Date | Sample | Sex | Fork length | Adipose Fin Status | Spawn Condition | Carcass Condition | Reach | CWT Code |
|---|---|---|---|---|---|---|---|---|
| 27-Oct-12 | 1558 | Female | 650 | Unknown | Spawned | Fresh | 1 | NTD |
| 27-Oct-12 | 1556 | Male | 940 | Present | Unknown | Fresh | 1 | |
| 27-Oct-12 | 0 | Male | 910 | Present | Unknown | Non-fresh | 1 | |
| 29-Oct-12 | 0 | Female | 800 | Present | Spawned | Non-fresh | 2 | |
| 29-Oct-12 | 1567 | Female | 770 | Present | Spawned | Fresh | 2 | |
| 29-Oct-12 | 1570 | Female | 830 | Present | Spawned | Fresh | 2 | |
| 29-Oct-12 | 1562 | Female | 800 | Absent | Spawned | Non-fresh | 2 | 055187 |
| 29-Oct-12 | 1571 | Female | 790 | Absent | Spawned | Fresh | 2 | 055187 |
| 29-Oct-12 | 1564 | Male | 920 | Absent | Unknown | Non-fresh | 2 | 055199 |
| 29-Oct-12 | 1563 | Male | 870 | Present | Unknown | Fresh | 2 | |
| 29-Oct-12 | 1565 | Male | 920 | Present | Unknown | Fresh | 2 | |
| 29-Oct-12 | 1566 | Male | 580 | Present | Unknown | Fresh | 2 | |
| 29-Oct-12 | 1568 | Male | 870 | Present | Unknown | Fresh | 2 | |
| 29-Oct-12 | 1569 | Male | 890 | Present | Unknown | Fresh | 2 | |
| 29-Oct-12 | 0 | Male | 820 | Present | Unknown | Non-fresh | 2 | |
| 29-Oct-12 | 1572 | Male | 600 | Present | Unknown | Fresh | 2 | |
| 02-Nov-12 | 1574 | Female | 780 | Present | Spawned | Fresh | 1 | |
| 02-Nov-12 | 0 | Female | 760 | Present | Spawned | Non-fresh | 1 | |
| 02-Nov-12 | 0 | Female | 830 | Present | Spawned | very non-fresh | 1 | |
| 02-Nov-12 | 0 | Female | 860 | Present | Spawned | very non-fresh | 1 | |
| 02-Nov-12 | 0 | Female | 760 | Present | Spawned | very non-fresh | 1 | |
| 02-Nov-12 | 0 | Female | 810 | Present | Spawned | Non-fresh | 1 | |
| 02-Nov-12 | 0 | Female | 790 | Present | Spawned | very non-fresh | 1 | |
| 02-Nov-12 | 0 | Female | 860 | Present | Spawned | Very Non-Fresh | 1 | |
| 02-Nov-12 | 0 | Female | 810 | Present | Spawned | Non-fresh | 1 | |
| 02-Nov-12 | 1579 | Female | 720 | Present | Spawned | Fresh | 1 | |
| 02-Nov-12 | 0 | Female | 770 | Present | Spawned | very non-fresh | 1 | |
| 02-Nov-12 | 1573 | Female | 810 | Present | Spawned | Fresh | 1 | |
| 02-Nov-12 | 0 | Female | 880 | Present | Spawned | Non-fresh | 1 | |
| 02-Nov-12 | 1577 | Female | 780 | Present | Spawned | Fresh | 1 | |
| 02-Nov-12 | 0 | Female | 760 | Present | Spawned | Non-fresh | 1 | |
| 02-Nov-12 | 0 | Female | 850 | Present | Spawned | Non-fresh | 1 | |
| 02-Nov-12 | 1578 | Female | 810 | Present | Spawned | Fresh | 1 | |
| 02-Nov-12 | 0 | Female | 780 | Present | Spawned | Non-fresh | 1 | |
| 02-Nov-12 | 0 | Female | 800 | Present | Spawned | Non-fresh | 1 | |
| 02-Nov-12 | 1586 | Female | 770 | Absent | Spawned | very non-fresh | 1 | 055184 |
| 02-Nov-12 | 1580 | Female | 810 | Present | Spawned | Fresh | 1 | |
| 02-Nov-12 | 0 | Female | 800 | Present | Spawned | Very Non-Fresh | 1 | |
| 02-Nov-12 | 0 | Female | 810 | Present | Spawned | very non-fresh | 1 | |
| 02-Nov-12 | 0 | Female | 800 | Present | Spawned | very non-fresh | 1 | |
| 02-Nov-12 | 0 | Female | 840 | Present | Spawned | Non-fresh | 1 | |
| 02-Nov-12 | 0 | Female | 830 | Present | Spawned | Non-fresh | 1 | |
| 02-Nov-12 | 0 | Female | 720 | Present | Spawned | Non-fresh | 1 | |
| 02-Nov-12 | 1590 | Female | 850 | Present | Spawned | Fresh | 1 | |
| 02-Nov-12 | 0 | Female | 690 | Present | Spawned | very non-fresh | 1 | |
| 02-Nov-12 | 1752 | Female | 820 | Present | Spawned | Fresh | 1 | |
| 02-Nov-12 | 1575 | Female | 850 | Absent | Spawned | Non-fresh | 1 | 055187 |
| 02-Nov-12 | 1588 | Female | 850 | Absent | Spawned | Non-fresh | 1 | 055188 |
| 02-Nov-12 | 1583 | Male | 960 | Absent | Unknown | very non-fresh | 1 | 055189 |
| 02-Nov-12 | 1581 | Male | 840 | Absent | Unknown | very non-fresh | 1 | 055199 |
| 02-Nov-12 | 1756 | Male | 620 | Absent | Unknown | Fresh | 1 | 055221 |
| 02-Nov-12 | 1750 | Male | 810 | Absent | Unknown | Non-fresh | 1 | 055221 |
| 02-Nov-12 | 1748 | Female | 770 | Absent | Spawned | very non-fresh | 1 | 068624 |
| 02-Nov-12 | 0 | Male | 870 | Present | Unknown | very non-fresh | 1 | |
| 02-Nov-12 | 0 | Male | 920 | Present | Unknown | Very Non-Fresh | 1 | |
| 02-Nov-12 | 0 | Male | 980 | Present | Unknown | very non-fresh | 1 | |
| 02-Nov-12 | 0 | Male | 860 | Present | Unknown | very non-fresh | 1 | |
| 02-Nov-12 | 0 | Male | 650 | Present | Unknown | very non-fresh | 1 | |
| 02-Nov-12 | 0 | Male | 860 | Present | Unknown | very non-fresh | 1 | |
| 02-Nov-12 | 0 | Male | 880 | Present | Unknown | Non-Fresh | 1 | |

| Date | Sample | Sex | Fork length | Adipose Fin Status | Spawn Condition | Carcass Condition | Reach | CWT Code |
|---|---|---|---|---|---|---|---|---|
| 02-Nov-12 | 0 | Male | 940 | Present | Unknown | Non-fresh | 1 | |
| 02-Nov-12 | 1751 | Male | 850 | Present | Unknown | Fresh | 1 | |
| 02-Nov-12 | 0 | Male | 950 | Present | Unknown | very non-fresh | 1 | |
| 02-Nov-12 | 0 | Male | 930 | Present | Unknown | very non-fresh | 1 | |
| 02-Nov-12 | 0 | Male | 930 | Present | Unknown | very non-fresh | 1 | |
| 02-Nov-12 | 0 | Male | 880 | Present | Unknown | Non-fresh | 1 | |
| 02-Nov-12 | 0 | Male | 940 | Present | Unknown | very non-fresh | 1 | |
| 02-Nov-12 | 0 | Male | 910 | Present | Unknown | very non-fresh | 1 | |
| 02-Nov-12 | 0 | Male | 880 | Present | Unknown | very non-fresh | 1 | |
| 02-Nov-12 | 1585 | Female | 730 | Unknown | Spawned | Non-fresh | 1 | 068670 |
| 02-Nov-12 | 0 | Male | 600 | Present | Unknown | very non-fresh | 1 | |
| 02-Nov-12 | 0 | Male | 930 | Present | Unknown | very non-fresh | 1 | |
| 02-Nov-12 | 1584 | Male | 560 | Present | Unknown | Fresh | 1 | |
| 02-Nov-12 | 1587 | Male | 900 | Present | Unknown | Fresh | 1 | |
| 02-Nov-12 | 0 | Male | 780 | Present | Unknown | very non-fresh | 1 | |
| 02-Nov-12 | 0 | Male | 760 | Present | Unknown | Non-fresh | 1 | |
| 02-Nov-12 | 0 | Male | 930 | Present | Unknown | very non-fresh | 1 | |
| 02-Nov-12 | 0 | Male | 910 | Present | Unknown | Very Non-Fresh | 1 | |
| 02-Nov-12 | 0 | Male | 880 | Present | Unknown | very non-fresh | 1 | |
| 02-Nov-12 | 1757 | Male | 830 | Present | Unknown | Fresh | 1 | |
| 02-Nov-12 | 0 | Male | 900 | Present | Unknown | very non-fresh | 1 | |
| 02-Nov-12 | 0 | Male | 840 | Present | Unknown | Non-fresh | 1 | |
| 02-Nov-12 | 1758 | Male | 570 | Present | Unknown | Fresh | 1 | |
| 02-Nov-12 | 0 | Male | 980 | Present | Unknown | Non-fresh | 1 | |
| 02-Nov-12 | 1746 | Male | 620 | Present | Unknown | Fresh | 1 | |
| 02-Nov-12 | 0 | Male | 930 | Present | Unknown | very non-fresh | 1 | |
| 02-Nov-12 | 0 | Male | 830 | Present | Unknown | Non-fresh | 1 | |
| 02-Nov-12 | 0 | Male | 890 | Present | Unknown | very non-fresh | 1 | |
| 02-Nov-12 | 1747 | Male | 870 | Present | Unknown | Fresh | 1 | |
| 02-Nov-12 | 0 | Male | 870 | Present | Unknown | Very Non-Fresh | 1 | |
| 02-Nov-12 | 1749 | Male | 820 | Present | Unknown | Fresh | 1 | |
| 02-Nov-12 | 0 | Male | 860 | Present | Unknown | Non-fresh | 1 | |
| 02-Nov-12 | 0 | Male | 850 | Present | Unknown | Non-fresh | 1 | |
| 02-Nov-12 | 0 | Male | 800 | Present | Unknown | Non-fresh | 1 | |
| 02-Nov-12 | 0 | Male | 600 | Present | Unknown | Non-fresh | 1 | |
| 02-Nov-12 | 1582 | Male | 790 | Absent | Unknown | very non-fresh | 1 | 068671 |
| 02-Nov-12 | 0 | Male | 930 | Present | Unknown | very non-fresh | 1 | |
| 02-Nov-12 | 1576 | Female | 840 | Absent | Spawned | Fresh | 1 | 068672 |
| 02-Nov-12 | 1589 | Male | 820 | Unknown | Unknown | very non-fresh | 1 | NTD |
| 03-Nov-12 | 1951 | Male | 890 | Absent | Unknown | Non-fresh | 1 | 055181 |
| 03-Nov-12 | 1761 | Female | 730 | Present | Spawned | Fresh | 1 | |
| 03-Nov-12 | 0 | Female | 680 | Present | Spawned | Non-fresh | 1 | |
| 03-Nov-12 | 0 | Female | 780 | Present | Spawned | Non-fresh | 1 | |
| 03-Nov-12 | 0 | Female | 790 | Present | Spawned | Non-fresh | 1 | |
| 03-Nov-12 | 0 | Female | 830 | Present | Unspawned | Non-fresh | 1 | |
| 03-Nov-12 | 1956 | Female | 820 | Present | Unspawned | Fresh | 1 | |
| 03-Nov-12 | 1953 | Female | 760 | Absent | Spawned | Fresh | 1 | 055187 |
| 03-Nov-12 | 1955 | Male | 900 | Absent | Unknown | Non-fresh | 1 | 055188 |
| 03-Nov-12 | 1764 | Male | 920 | Absent | Unknown | Non-fresh | 1 | 055195 |
| 03-Nov-12 | 1767 | Female | 770 | Absent | Spawned | Non-fresh | 1 | 055196 |
| 03-Nov-12 | 0 | Male | 730 | Present | Unknown | Non-fresh | 1 | |
| 03-Nov-12 | 0 | Male | 850 | Present | Unknown | Non-fresh | 1 | |
| 03-Nov-12 | 1760 | Male | 910 | Absent | Unknown | Non-fresh | 1 | 068654 |
| 03-Nov-12 | 0 | Male | 640 | Present | Unknown | Non-fresh | 1 | |
| 03-Nov-12 | 1753 | Male | 870 | Present | Unknown | Fresh | 1 | |
| 03-Nov-12 | 1754 | Male | 850 | Present | Unknown | Fresh | 1 | |
| 03-Nov-12 | 1755 | Male | 590 | Present | Unknown | Fresh | 1 | |
| 03-Nov-12 | 1759 | Male | 940 | Present | Unknown | Fresh | 1 | |
| 03-Nov-12 | 0 | Male | 640 | Present | Unknown | Non-fresh | 1 | |
| 03-Nov-12 | 0 | Male | 940 | Present | Unknown | Non-Fresh | 1 | |

| Date | Sample | Sex | Fork length | Adipose Fin Status | Spawn Condition | Carcass Condition | Reach | CWT Code |
|---|---|---|---|---|---|---|---|---|
| 03-Nov-12 | 1762 | Male | 870 | Present | Unknown | Fresh | 1 | |
| 03-Nov-12 | 1763 | Male | 930 | Present | Unknown | Fresh | 1 | |
| 03-Nov-12 | 0 | Male | 840 | Present | Unknown | Non-fresh | 1 | |
| 03-Nov-12 | 1954 | Female | 750 | Absent | Spawned | Non-fresh | 1 | 068672 |
| 03-Nov-12 | 1765 | Male | 950 | Present | Unknown | Fresh | 1 | |
| 03-Nov-12 | 0 | Male | 900 | Present | Unknown | Non-fresh | 1 | |
| 03-Nov-12 | 1958 | Female | 770 | Absent | Spawned | Fresh | 1 | 068672 |
| 03-Nov-12 | 0 | Male | 730 | Present | Unknown | Non-fresh | 1 | |
| 03-Nov-12 | 0 | Male | 940 | Present | Unknown | Non-fresh | 1 | |
| 03-Nov-12 | 0 | Male | 630 | Present | Unknown | Non-fresh | 1 | |
| 03-Nov-12 | 0 | Male | 830 | Present | Unknown | very non-fresh | 1 | |
| 03-Nov-12 | 0 | Male | 810 | Present | Unknown | Non-fresh | 1 | |
| 03-Nov-12 | 1770 | Male | 900 | Absent | Unknown | Non-fresh | 1 | 068672 |
| 03-Nov-12 | 0 | Male | 990 | Present | Unknown | Non-Fresh | 1 | |
| 03-Nov-12 | 0 | Male | 890 | Present | Unknown | Non-fresh | 1 | |
| 03-Nov-12 | 1957 | Male | 900 | Present | Unknown | Fresh | 1 | |
| 03-Nov-12 | 0 | Male | 880 | Present | Unknown | Non-fresh | 1 | |
| 03-Nov-12 | 0 | Male | 930 | Present | Unknown | Non-fresh | 1 | |
| 03-Nov-12 | 1766 | Male | 860 | Absent | Unknown | Non-fresh | 1 | Lost |
| 03-Nov-12 | 1768 | Male | 800 | Absent | Unknown | Non-fresh | 1 | Lost |
| 03-Nov-12 | 1769 | Female | 870 | Absent | Spawned | Non-fresh | 1 | NTD |
| 03-Nov-12 | 1952 | Female | 520 | Absent | Spawned | Fresh | 1 | NTD |
| 05-Nov-12 | 1969 | Female | 810 | Present | Spawned | Fresh | 2 | |
| 05-Nov-12 | 1974 | Female | 730 | Present | Spawned | Fresh | 2 | |
| 05-Nov-12 | 0 | Female | 840 | Present | Spawned | Non-fresh | 2 | |
| 05-Nov-12 | 1975 | Female | 760 | Present | Spawned | Fresh | 2 | |
| 05-Nov-12 | 1970 | Male | 960 | Unknown | Unknown | very non-fresh | 2 | 055185 |
| 05-Nov-12 | 1959 | Female | 870 | Present | Spawned | Fresh | 2 | |
| 05-Nov-12 | 0 | Female | 840 | Present | Spawned | Non-fresh | 2 | |
| 05-Nov-12 | 1961 | Female | 840 | Present | Spawned | Fresh | 2 | |
| 05-Nov-12 | 1963 | Female | 820 | Present | Spawned | Fresh | 2 | |
| 05-Nov-12 | 1964 | Female | 770 | Present | Spawned | Fresh | 2 | |
| 05-Nov-12 | 1973 | Female | 750 | Present | Spawned | Fresh | 2 | |
| 05-Nov-12 | 1965 | Male | 880 | Absent | Unknown | Non-fresh | 2 | 055196 |
| 05-Nov-12 | 0 | Male | 660 | Present | Unknown | Non-fresh | 2 | |
| 05-Nov-12 | 0 | Male | 900 | Present | Unknown | Non-fresh | 2 | |
| 05-Nov-12 | 1960 | Male | 940 | Present | Unknown | Fresh | 2 | |
| 05-Nov-12 | 0 | Male | 780 | Present | Unknown | Non-fresh | 2 | |
| 05-Nov-12 | 0 | Male | 620 | Present | Unknown | Non-fresh | 2 | |
| 05-Nov-12 | 1967 | Male | 900 | Absent | Unknown | Non-fresh | 2 | 068672 |
| 05-Nov-12 | 1966 | Male | 890 | Present | Unknown | Fresh | 2 | |
| 05-Nov-12 | 1968 | Female | 750 | Absent | Spawned | Non-fresh | 2 | NTD |
| 05-Nov-12 | 1971 | Female | 840 | Absent | Spawned | Non-fresh | 2 | NTD |
| 05-Nov-12 | 1972 | Female | 780 | Absent | Spawned | Fresh | 2 | NTD |
| 05-Nov-12 | 1962 | Male | 870 | Unknown | Unknown | Fresh | 2 | NTD |
| 09-Nov-12 | 0 | Female | 810 | Present | Spawned | Non-fresh | 1 | |
| 09-Nov-12 | 1992 | Male | 840 | Absent | Unknown | very non-fresh | 1 | 055187 |
| 09-Nov-12 | 1976 | Female | 770 | Present | Spawned | Fresh | 1 | |
| 09-Nov-12 | 1978 | Female | 840 | Present | Spawned | Fresh | 1 | |
| 09-Nov-12 | 1980 | Female | 800 | Present | Spawned | Fresh | 1 | |
| 09-Nov-12 | 0 | Female | 770 | Present | Spawned | Very Non-Fresh | 1 | |
| 09-Nov-12 | 0 | Female | 780 | Present | Spawned | very non-fresh | 1 | |
| 09-Nov-12 | 1983 | Female | 820 | Present | Spawned | Fresh | 1 | |
| 09-Nov-12 | 0 | Female | 820 | Present | Spawned | very non-fresh | 1 | |
| 09-Nov-12 | 0 | Female | 800 | Present | Spawned | Non-fresh | 1 | |
| 09-Nov-12 | 1988 | Female | 780 | Present | Spawned | Fresh | 1 | |
| 09-Nov-12 | 0 | Female | 750 | Present | Spawned | Non-fresh | 1 | |
| 09-Nov-12 | 1991 | Female | 780 | Present | Spawned | Fresh | 1 | |
| 09-Nov-12 | 0 | Female | 720 | Present | Spawned | Very Non-Fresh | 1 | |
| 09-Nov-12 | 1998 | Female | 820 | Absent | Spawned | Non-fresh | 1 | 055196 |

| Date | Sample | Sex | Fork length | Adipose Fin Status | Spawn Condition | Carcass Condition | Reach | CWT Code |
|---|---|---|---|---|---|---|---|---|
| 09-Nov-12 | 1999 | Female | 820 | Present | Spawned | Fresh | 1 | |
| 09-Nov-12 | 0 | Female | 800 | Present | Spawned | very non-fresh | 1 | |
| 09-Nov-12 | 2000 | Female | 790 | Present | Spawned | Fresh | 1 | |
| 09-Nov-12 | 0 | Male | 900 | Present | Unknown | very non-fresh | 1 | |
| 09-Nov-12 | 0 | Male | 900 | Present | Unknown | Non-fresh | 1 | |
| 09-Nov-12 | 1994 | Female | 780 | Absent | Spawned | Non-fresh | 1 | 068641 |
| 09-Nov-12 | 1982 | Female | 790 | Absent | Spawned | Fresh | 1 | 068654 |
| 09-Nov-12 | 1996 | Male | 780 | Absent | Unknown | Non-fresh | 1 | 068654 |
| 09-Nov-12 | 1985 | Male | 840 | Present | Unknown | Fresh | 1 | |
| 09-Nov-12 | 1987 | Female | 780 | Absent | Spawned | very non-fresh | 1 | 068671 |
| 09-Nov-12 | 2001 | Female | 800 | Absent | Spawned | Non-fresh | 1 | 068671 |
| 09-Nov-12 | 1984 | Female | 830 | Absent | Spawned | Fresh | 1 | 068672 |
| 09-Nov-12 | 2002 | Female | 760 | Absent | Spawned | very non-fresh | 1 | 068672 |
| 09-Nov-12 | 1993 | Female | 770 | Absent | Spawned | Fresh | 1 | 068680 |
| 09-Nov-12 | 1977 | Male | 780 | Present | Unknown | Fresh | 1 | |
| 09-Nov-12 | 1979 | Male | 810 | Present | Unknown | Fresh | 1 | |
| 09-Nov-12 | 1981 | Male | 990 | Present | Unknown | Fresh | 1 | |
| 09-Nov-12 | 0 | Male | 880 | Present | Unknown | Very Non-Fresh | 1 | |
| 09-Nov-12 | 1986 | Male | 880 | Present | Unknown | Fresh | 1 | |
| 09-Nov-12 | 0 | Male | 1040 | Present | Unknown | Non-fresh | 1 | |
| 09-Nov-12 | 0 | Male | 930 | Present | Unknown | Non-fresh | 1 | |
| 09-Nov-12 | 0 | Male | 770 | Present | Unknown | Non-fresh | 1 | |
| 09-Nov-12 | 1989 | Male | 580 | Present | Unknown | Fresh | 1 | |
| 09-Nov-12 | 1990 | Male | 820 | Present | Unknown | Fresh | 1 | |
| 09-Nov-12 | 0 | Male | 750 | Present | Unknown | Non-fresh | 1 | |
| 09-Nov-12 | 0 | Male | 850 | Present | Unknown | very non-fresh | 1 | |
| 09-Nov-12 | 0 | Male | 860 | Present | Unknown | Non-fresh | 1 | |
| 09-Nov-12 | 0 | Male | 800 | Present | Unknown | Non-fresh | 1 | |
| 09-Nov-12 | 1997 | Male | 860 | Present | Unknown | Fresh | 1 | |
| 09-Nov-12 | 0 | Male | 890 | Present | Unknown | Non-fresh | 1 | |
| 09-Nov-12 | 0 | Male | 860 | Present | Unknown | Non-fresh | 1 | |
| 09-Nov-12 | 0 | Male | 640 | Present | Unknown | Non-fresh | 1 | |
| 09-Nov-12 | 1995 | Male | 840 | Unknown | Unknown | very non-fresh | 1 | NTD |
| 11-Nov-12 | 2005 | Male | 910 | Absent | Unknown | Non-fresh | 1 | 055184 |
| 11-Nov-12 | 0 | Female | 830 | Present | Spawned | Non-fresh | 1 | |
| 11-Nov-12 | 0 | Female | 650 | Present | Spawned | Non-fresh | 1 | |
| 11-Nov-12 | 0 | Female | 780 | Present | Spawned | Non-fresh | 1 | |
| 11-Nov-12 | 0 | Female | 770 | Present | Spawned | Non-fresh | 1 | |
| 11-Nov-12 | 0 | Female | 780 | Present | Spawned | Non-fresh | 1 | |
| 11-Nov-12 | 0 | Female | 900 | Present | Spawned | Non-fresh | 1 | |
| 11-Nov-12 | 0 | Female | 770 | Present | Spawned | Non-fresh | 1 | |
| 11-Nov-12 | 2003 | Female | 830 | Present | Spawned | Fresh | 1 | |
| 11-Nov-12 | 2004 | Female | 750 | Present | Spawned | Fresh | 1 | |
| 11-Nov-12 | 0 | Female | 700 | Present | Spawned | Non-fresh | 1 | |
| 11-Nov-12 | 0 | Female | 660 | Present | Spawned | Non-fresh | 1 | |
| 11-Nov-12 | 2006 | Female | 790 | Present | Spawned | Fresh | 1 | |
| 11-Nov-12 | 0 | Male | 900 | Present | Unknown | Non-fresh | 1 | |
| 11-Nov-12 | 0 | Male | 630 | Present | Unknown | Non-fresh | 1 | |
| 11-Nov-12 | 0 | Male | 940 | Present | Unknown | Non-fresh | 1 | |
| 11-Nov-12 | 0 | Male | 920 | Present | Unknown | Non-fresh | 1 | |
| 11-Nov-12 | 0 | Male | 890 | Present | Unknown | Non-fresh | 1 | |
| 11-Nov-12 | 0 | Male | 610 | Present | Unknown | Non-fresh | 1 | |
| 13-Nov-12 | 0 | Female | 800 | Present | Spawned | Non-fresh | 2 | |
| 13-Nov-12 | 0 | Female | 720 | Present | Spawned | Non-fresh | 2 | |
| 13-Nov-12 | 2011 | Female | 690 | Present | Spawned | Fresh | 2 | |
| 13-Nov-12 | 2007 | Female | 830 | Present | Spawned | Fresh | 2 | |
| 13-Nov-12 | 2008 | Female | 740 | Present | Spawned | Fresh | 2 | |
| 13-Nov-12 | 2009 | Female | 830 | Present | Spawned | Fresh | 2 | |
| 13-Nov-12 | 2012 | Female | 750 | Present | Spawned | Fresh | 2 | |
| 13-Nov-12 | 0 | Female | 800 | Present | Spawned | Non-fresh | 2 | |

| Date | Sample | Sex | Fork length | Adipose Fin Status | Spawn Condition | Carcass Condition | Reach | CWT Code |
|---|---|---|---|---|---|---|---|---|
| 13-Nov-12 | 0 | Female | 610 | Present | Spawned | Non-fresh | 2 | |
| 13-Nov-12 | 0 | Female | 830 | Present | Spawned | Non-fresh | 2 | |
| 13-Nov-12 | 2015 | Female | 840 | Present | Spawned | Fresh | 2 | |
| 13-Nov-12 | 2010 | Female | 870 | Absent | Spawned | Fresh | 2 | 068638 |
| 13-Nov-12 | 0 | Male | 1020 | Present | Unknown | Non-fresh | 2 | |
| 13-Nov-12 | 2014 | Female | 660 | Unknown | Spawned | Non-fresh | 2 | NTD |
| 13-Nov-12 | 0 | Male | 820 | Present | Unknown | Non-fresh | 2 | |
| 13-Nov-12 | 0 | Male | 990 | Present | Unknown | Non-fresh | 2 | |
| 13-Nov-12 | 0 | Male | 900 | Present | Unknown | Non-fresh | 2 | |
| 13-Nov-12 | 0 | Male | 940 | Present | Unknown | Non-fresh | 2 | |
| 13-Nov-12 | 0 | Male | 1030 | Present | Unknown | Non-fresh | 2 | |
| 13-Nov-12 | 0 | Male | 810 | Present | Unknown | Non-fresh | 2 | |
| 13-Nov-12 | 2013 | Male | 930 | Unknown | Unknown | Non-fresh | 2 | NTD |
| 13-Nov-12 | 0 | Male | 640 | Present | Unknown | Non-fresh | 2 | |
| 13-Nov-12 | 0 | Male | 900 | Present | Unknown | Non-fresh | 2 | |
| 16-Nov-12 | 0 | Female | 830 | Present | Spawned | very non-fresh | 1 | |
| 16-Nov-12 | 0 | Female | 770 | Present | Spawned | very non-fresh | 1 | |
| 16-Nov-12 | 2023 | Female | 740 | Present | Spawned | Fresh | 1 | |
| 16-Nov-12 | 0 | Female | 780 | Present | Spawned | very non-fresh | 1 | |
| 16-Nov-12 | 0 | Female | 720 | Present | Spawned | Non-fresh | 1 | |
| 16-Nov-12 | 2025 | Female | 740 | Absent | Spawned | Very Non-Fresh | 1 | 055187 |
| 16-Nov-12 | 0 | Female | 710 | Present | Spawned | Very Non-Fresh | 1 | |
| 16-Nov-12 | 2021 | Female | 800 | Present | Spawned | Fresh | 1 | |
| 16-Nov-12 | 0 | Female | 740 | Present | Spawned | very non-fresh | 1 | |
| 16-Nov-12 | 2026 | Female | 720 | Present | Spawned | Fresh | 1 | |
| 16-Nov-12 | 2027 | Female | 800 | Present | Spawned | Fresh | 1 | |
| 16-Nov-12 | 2024 | Male | 930 | Absent | Unknown | very non-fresh | 1 | 055221 |
| 16-Nov-12 | 0 | Male | 940 | Present | Unknown | Non-fresh | 1 | |
| 16-Nov-12 | 0 | Male | 560 | Present | Unknown | very non-fresh | 1 | |
| 16-Nov-12 | 2017 | Female | 780 | Absent | Spawned | Fresh | 1 | 068641 |
| 16-Nov-12 | 2016 | Male | 540 | Present | Unknown | Fresh | 1 | |
| 16-Nov-12 | 0 | Male | 880 | Present | Unknown | very non-fresh | 1 | |
| 16-Nov-12 | 2020 | Male | 890 | Absent | Unknown | Non-fresh | 1 | 068672 |
| 16-Nov-12 | 2019 | Female | 790 | Absent | Spawned | Fresh | 1 | 068708 |
| 16-Nov-12 | 2018 | Female | 780 | Unknown | Spawned | Fresh | 1 | 068708 |
| 16-Nov-12 | 0 | Male | 930 | Present | Unknown | Non-fresh | 1 | |
| 16-Nov-12 | 2022 | Male | 840 | Present | Unknown | Fresh | 1 | |
| 16-Nov-12 | 0 | Male | 870 | Present | Unknown | Non-fresh | 1 | |
| 16-Nov-12 | 2028 | Male | 960 | Present | Unknown | Fresh | 1 | |
| 17-Nov-12 | 2030 | Female | 780 | Present | Spawned | Fresh | 1 | |
| 17-Nov-12 | 0 | Female | 810 | Present | Spawned | Non-fresh | 1 | |
| 17-Nov-12 | 2035 | Female | 780 | Present | Spawned | Fresh | 1 | |
| 17-Nov-12 | 2031 | Female | 790 | Present | Spawned | Fresh | 1 | |
| 17-Nov-12 | 0 | Female | 800 | Present | Spawned | Non-fresh | 1 | |
| 17-Nov-12 | 2033 | Male | 890 | Present | Unknown | Fresh | 1 | |
| 17-Nov-12 | 2034 | Female | 690 | Absent | Spawned | Fresh | 1 | 068688 |
| 17-Nov-12 | 2029 | Female | 740 | Unknown | Spawned | very non-fresh | 1 | NTD |
| 17-Nov-12 | 2032 | Male | 610 | Present | Unknown | Fresh | 1 | |
| 17-Nov-12 | 0 | Male | 740 | Present | Unknown | Non-fresh | 1 | |
| 17-Nov-12 | 0 | Male | 790 | Present | Unknown | Non-fresh | 1 | |
| 27-Nov-12 | 0 | Female | 770 | Present | Spawned | Non-fresh | 1 | |
| 27-Nov-12 | 2038 | Female | 900 | Present | Spawned | Fresh | 1 | |
| 27-Nov-12 | 2036 | Male | 930 | Present | Unknown | Fresh | 1 | |
| 27-Nov-12 | 0 | Male | 1000 | Present | Unknown | Non-fresh | 1 | |
| 27-Nov-12 | 0 | Male | 1010 | Present | Unknown | Non-fresh | 1 | |
| 27-Nov-12 | 2037 | Male | 670 | Present | Unknown | Fresh | 1 | |
| 27-Nov-12 | 0 | Male | 790 | Present | Unknown | Non-fresh | 1 | |
| 27-Nov-12 | 2039 | Male | 910 | Present | Unknown | Fresh | 1 | |
| 27-Nov-12 | 0 | Male | 860 | Present | Unknown | Non-fresh | 1 | |
| 27-Nov-12 | 0 | Male | 780 | Present | Unknown | Non-fresh | 1 | |

Table A. 3. Hatchery releases of fall Chinook salmon in the Central Valley for brood years 2008, 2009, and 2010. These are release summaries age-2, age-3 and age-4 salmon in 2012 from hatcheries in California's Central Valley (Coleman National Fish Hatchery (NFH), Feather River Fish Hatchery and the Feather River Hatchery Annex, Nimbus Fish Hatchery, Mokelumne River Fish Hatchery, and Merced River Fish Hatchery). This is a summary of likely fish that may have been observed during the survey. Data was obtained from the Regional Mark Information System (RMIS) database (www.rmpc.org).

| Hatchery | Run | Release Location | Brood Year | Total Released | Number Observed | Expanded Number |
|---|---|---|---|---|---|---|
| Coleman National Fish Hatchery | Fall | Coleman NFH | 2008 | 12,529,458 | 1 | 4 |
| | | | 2009 | 10,210,147 | 24 | 96 |
| | | | 2010 | 11,369,732 | 2 | 8 |
| | | Sacramento River Colusa To Red Bluff Diversion Dam | 2008 | 368,609 | - | - |
| | | | 2009 | 484,432 | - | - |
| | | Mare Island Net Pen | 2010 | 1,339,659 | - | - |
| | | Mare Island at Minor Point | 2008 | 1,059,183 | 1 | 4 |
| | | | 2009 | 874,800 | 14 | 56 |
| Feather River Fish Hatchery | Fall | San Pablo Bay Net Pens | 2008 | 7,013,128 | - | - |
| | | | 2009 | 7,411,675 | 14 | 56 |
| | | | 2010 | 6,440,475 | - | - |
| | | Wickland Oil Net Pen | 2008 | 180,004 | - | - |
| | | | 2009 | 2,124,375 | 4 | 7 |
| | | | 2010 | 3,868,247 | - | - |
| | | Mare Island Net Pen | 2008 | 373,241 | - | - |
| | | Tiburon Net Pens | 2008 | 78,123 | - | - |
| | | | 2009 | 41,873 | 2 | 2 |
| | | | 2010 | 41,952 | - | - |
| | | Santa Cruz Harbor Net Pens | 2009 | 122,334 | - | - |
| | | | 2010 | 187,022 | - | - |
| Mokelumne River Fish Hatchery | Fall | San Joaquin River Sherman Island Opposite Jersey Point | 2008 | 250,969 | - | - |
| | | | 2010 | 1,898,828 | - | - |
| | | Mokelumne River Fish Installation Weir | 2009 | 99,157 | - | - |
| | | | 2010 | 100,467 | - | - |
| | | San Joaquin Sherman Island Net Pen | 2009 | 2,023,958 | 5 | 5 |
| | | | 2010 | 4,548,348 | - | - |
| Merced River Fish Hatchery | Fall | San Joaquin River at Jersey Point | 2008 | 34,532 | - | - |
| | | | 2009 | 165,213 | - | - |
| | | San Joaquin River at Mossdale | 2010 | 6,762 | - | - |
| | | Hatfield State Area | 2010 | 51,404 | - | - |
| | | Merced River Fish Facility | 2010 | 76,971 | - | - |
| Nimbus Fish Hatchery | Fall | Mare Island Net Pens | 2008 | 3,924,887 | 1 | 4 |
| | | | 2009 | 1,391,632 | 1 | 4 |
| | | American River | 2008 | 270,000 | - | - |
| | | Sacramento River At Discovery Park | 2009 | 2,946,623 | - | - |
| | | | 2010 | 2,988,697 | - | - |
| | | American River At Sunrise | 2009 | 274,514 | - | - |
| | | | 2010 | 271,171 | - | - |
| | | Wickland Oil Net Pen | 2010 | 1,595,731 | - | - |
| **Total** | | | | **89,038,333** | **69** | **246** |