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State of California
The Resources Agency
DEPARTMENT OF FISH AND GAME

Chinook Salmon Populations for the Upper Sacramento River Basin In 2008

By
Douglas Killam
Northern Region-Dept. of Fish and Game
Sacramento River Salmon and Steelhead Assessment Project

SRSSAP Technical Report No. 09-1
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Cover photo: Sacramento River "geyser". Photo by D. Killam

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SUMMARY

Population sizes were estimated for Chinook salmon passing upstream of Princeton Ferry in the Upper Sacramento River Basin (Figure 1). Annual population estimates for the Basin were determined through a number of methodologies including: carcass surveys, hatchery counts, aerial and in-stream redd surveys, snorkel counts, angler interviews, video counts, and ladder counts at hatcheries and the Red Bluff Diversion Dam (RBDD). This report does not include salmon information from tributaries that enter into the Sacramento River downstream of the town of Princeton (Butte Creek, Feather and American River(s) and Big Chico Creek). These and other waterways are detailed in reports from other projects. A summary of the entire California Central Valley salmon stocks is available annually in reports titled "Annual Report: Chinook Salmon Spawning Stocks in California's Central Valley"

In 2008, there were an estimated **64,341** Chinook salmon in the Upper Sacramento River Basin (USRB), upstream of Princeton Ferry. This includes an estimate of 11,897 late-fall-run, 2,830 winter-run, 861 spring-run, and 48,752 fall-run Chinook salmon (Table 1). The majority of these salmon migrated above RBDD (96%) to spawn in the tributaries or main-stem of the Sacramento River upstream of Red Bluff.

Readers interested in conducting further analysis of the data provided in this report should be aware that the summaries of data herein may be generalized to fit the limited scope of the report. For analytical data needs, readers should directly contact the author or other project staff for specific requirements or limitations to the data. The author may be reached via e-mail at (dkillam@dfg.ca.gov). This report and others from this project can be found on the Calfish.Org website. Interested readers can go to the Calfish.org website and select "Independent Datasets", then select CDFG Red Bluff. Next, select the category to view (reports, or spreadsheets, presentations, etc.) If interested, readers may request specific tables from this report in spreadsheet formats (most tables in this report are in picture formats), to allow further analysis based on their individual needs or requirements.

This program received financial assistance through the **Federal Aid in Sport Fish Restoration Program**. The U.S. Department of the Interior prohibits discrimination on the basis of race, color, national origin, age, sex, or disability. If you believe you have been discriminated against in any program, activity, or facility, or if you desire further information, please write to:

The Office of Human Resources
U.S. Fish and Wildlife Service
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Arlington, CA 22203

INTRODUCTION

The Upper Sacramento River Basin (USRB) of California's Central Valley is unique because it has four separate runs of Chinook salmon (*Oncorhynchus tshawytscha*) each year. The USRB for purposes of this report refers to the anadromous portions of the Sacramento River watershed upstream of Princeton CA (RM 164). Each run of Chinook, hereafter referred to as salmon or run, (i.e. winter-run) has adopted a different life history (spawning locations, and seasonal timing) that allows it to survive many different environmental conditions found over the course of a year in the USRB (Figure 1).

The historical migration timing of the four adult Chinook salmon runs into the USRB is provided in Appendix Table 1. The naming of the runs can be confusing (e.g. winter-run spawn in mid-June). The run names originate from the time salmon canneries operated in the lower river (i.e. 1860's). The name of each run described when the peak of the run was passing through the San Francisco Bay.

During earlier years the primary purpose for monitoring salmon was to manage for commercial and sport salmon harvest. (Note: the USRB has Chinook and steelhead (O. *mykiss*), but no spawning populations of the other Eastern Pacific salmon species (i.e. chum/dog, coho/silver, humpback/pink, and sockeye/red). In recent years, the focus of monitoring has been augmented to provide feedback for restoration activities (including protection of listed stocks) in the Central Valley, as well as the traditional role of managing stocks for sport and commercial harvest.

This report provides a summary of the 2008 USRB salmon monitoring activities conducted by staff from the California Department of Fish and Game's (CDFG), Sacramento River Salmon and Steelhead Assessment Project (SRSSAP). Funding for the SRSSAP staff in 2008 was provided by the Sport Fish Restoration Program (SFR), and by a CALFED Ecosystem Restoration Program (ERP) grant. The SFR staff included two CDFG Associate Biologists and a Fish and Wildlife Technician. The ERP grant provided funding for six Pacific States Marine Fisheries Commission (PSMFC) field survey crew members.

In 2008 the SRSSAP staff conducted both stand-alone surveys and cooperative surveys with the staff from several organizations: the United States Fish and Wildlife Service: Red Bluff Fish and Wildlife Office (USFWS), the Coleman National Fish Hatchery (CNFH), the Western Shasta Resource Conservation District (WSRCD) and other watershed groups. Details of other specific monitoring surveys in the USRB can be found on the websites of these groups. The data found here is a compilation of the different sources and methodologies used to produce population estimates within the USRB. Annual reports providing data on the USRB salmon populations are available going back to the early 1950's. In these early years, data is often lacking for particular streams due to lack of funding and personnel. Fish ladders, walking surveys, and hatchery counts were the primary methods of data collection until 1967.

Readers of this and earlier reports should be aware that revisions to population estimates may occur at any time. Reader comments received by the author in the past have indicated that readers can be frustrated by population numbers changing from one year to the next or inconsistent reporting between reports. Persons interested in receiving the latest or most up to date numbers should check with the author or the CDFG electronic Grandtab file which is updated once a year. The Grandtab file is now online at the following link:
http://www.calfish.org/Programs/AdditionalPrograms/CDFGRedBluff/tabid/105/Default.aspx
The databases maintained (by this author) that are used to produce the salmon counts in this report each undergo 1-3 individual quality control (QC) checks to ensure that readers are receiving the correct information. Despite this the numbers may still need to be updated based on new information or changes made to data sometimes outside of the SRSSAP control. In addition, administrative requirements may delay or modify the ability to provide accurate and unchanging population estimates. One such requirement in 2008 was a result of the severe state budget crisis facing California. This fiscal emergency resulted in the termination of 5 of the 6 PSMFC crew members working for the SRSSAP in December of 2008, near the end of the fall-run main-stem Sacramento carcass survey. This caused a significant delay in the QC of all fall-run data, a shortage of crew for the late-fall and winter-run 2009 surveys, and a significant delay in QC and reporting of data from 2008.

In late 2008 a significant change was made by the USFWS to the CNFH dataset from earlier years. This change in salmon counts for late-fall, fall and spring-run counts at the CNFH was made to years 2000 to 2008. While seemingly insignificant to some readers these changes cascade into many changes for the overall annual counts and reports since the annual reports provide run summaries for each year. The new numbers were the result of a comprehensive review of coded-wire tag data made by the USFWS staff (USFWS, Laura Mahoney, pers. comm.). Although previous overall numbers of fish remained the same; the outcome of the change was to reallocate some CNFH fish (including non coded-wire tagged fish) to different runs based on the run label of hatchery-origin coded-wire tagged fish. Unfortunately, from a salmon run accounting perspective, re-labeling a previously reported CNFH fall-run fish to a late-fall-run fish has the unintended consequence of moving that fish to the following year. The result is that both the original and the later year reports need to be updated.

Appendix D of this report contains an updated version of Table 1 for years 2000 to 2007. It is the intent of the author to provide the most up to date numbers for each year. These individual tables can be printed out and placed in earlier printed reports. As time permits, the author will revise the earlier reports and post them on the above website. Readers should check the title page of each report to determine if any revisions were made. It is expected that only annual SRSSAP reports from years 2000 to 2007 will be revised in this process. The changes to CNFH data will also be reflected in the most current version of the CDFG Grandtab file (post-April 2009).

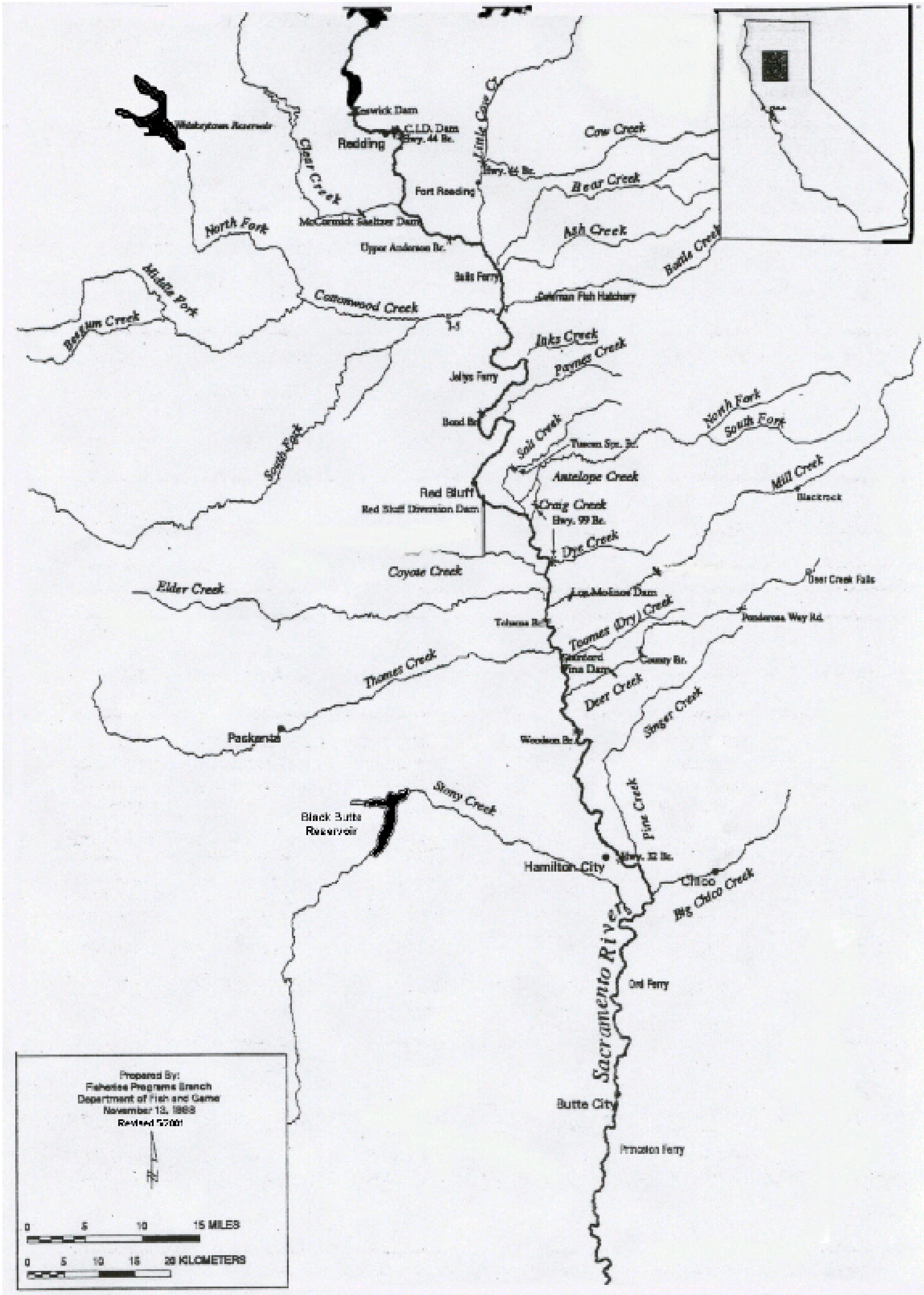

Figure 1. The Upper Sacramento River Basin (from Keswick Dam to Princeton Ferry).

Table 1. Summary of the 2008 Chinook salmon population estimates for the USRB, (Sacramento River and tributaries from Keswick Dam downstream to Princeton Ferry).

LOCATION	Late-Fall-Run	Winter-run	Spring-Run	Fall-Run
Red Bluff to Keswick Dam (upstream of RBDD)				
Sacramento River Main-Stem	3,673	2,725	0	23,134
Livingston Stone Hatchery		105		0
Battle Creek Coleman Hatchery	6,334			10,639
Battle Creek Above hatchery	19		105	
Battle Creek Below Hatchery	n/a ^			4,286
Bear Creek	n/a		n/a	19
Clear Creek	n/a		200	7,677
Cow Creek	n/a		n/a	478
Cottonwood Creek	n/a		0	510
Angler Harvest	588	0	0	0
SUB-TOTAL UPSTREAM OF RBDD	*10,614*	*2,830*	*305*	*46,743*
Red Bluff to Princeton (downstream of RBDD)				
Sacramento River Main-Stem	291	0	52	1,609
Mill Creek	n/a		362	166
Deer Creek	n/a		140	194
Antelope Creek	n/a		2	n/a
Angler Harvest*	993	0	0	40
SUB-TOTAL DOWNSTREAM OF RBDD	*1,284*	*0*	*556*	*2,009*
SYSTEM GRAND TOTAL	**11,897**	**2,830**	**861**	**48,752**
All Upper Sacramento River Basin (Keswick Dam to Princeton) $				
2008 TOTAL SALMON ALL COMBINED:			**64,341**	

NOTE: These values represent minimum numbers, unsurveyed waters have additional smaller salmon populations
^ n/a: Is not available, represents salmon present but no estimate available.
* Angler data from Late fall is from late 2007, Fall is from Angler survey Nov-Dec 2008 based on cwt results of harvest
$ Numerous tributaries not surveyed, also Big Chico creek survey results are available from other DFG project

From 1967 until 1986, the Red Bluff Diversion Dam (RBDD) provided a good method of monitoring all four salmon runs, as well as steelhead trout. During this period, the RBDD was typically operated throughout the year. This allowed for complete accounting of salmon and steelhead escapement. The RBDD is operated by lowering 11 large steel gates (15 feet tall) into the Sacramento River at Red Bluff, see Appendix Figure E1. The resulting pool forms Lake Red Bluff and provides gravity flow water "free" (no pumping necessary) into agricultural diversions. During RBDD operation, adult salmon migrating into the USRB, must find and use one of three fish ladders at the dam. The delay in finding these ladders at the RBDD was thought to be a major reason for the decline of the winter-run populations (NMFS 1996). Beginning in 1987, the time period of operation of the RBDD was limited for portions of each year to facilitate improved passage of winter-run salmon. When not in operation, the RBDD gates are raised completely out of the water. This returns the river to natural flow conditions and eliminates any passage delay. This action was deemed necessary for winter-run salmon, which were at critically low and declining population levels, and had been previously petitioned for listing (October 1985) under state and federal Endangered Species Act (ESA). From 1995 to 2007, the RBDD was operated from approximately 15 May through 15 September. In 2008 the gates were removed on 01 September in response to a Federal District court order issued to better protect salmon and steelhead populations.

Because of the reduced fish counting opportunities at the RBDD, the salmon population estimates in the USRB are now produced through a variety of methods with overhead video counting of live fish and traditional carcass surveys being the primary ones. Although of limited utility, the RBDD was still operated to provide some limited data for the USRB in 2008.

Carcass surveys using mark and recapture methodologies were re-initiated in 1996 on the main-stem Sacramento River above RBDD. The year-round main-stem carcass surveys now provide the only source of natural spawning late-fall-run escapement in the USRB. In addition, the carcass surveys are used to report the fall and winter-run escapements used by the CDFG as official estimates.

The late-fall-run escapement on the main-stem Sacramento River is monitored through a boat mark and recapture carcass survey and aerial redd counts (December-April). Late-fall-run carcass surveys are normally difficult to conduct on USRB tributaries due to typically high flow (or flood) conditions, making consistent weekly mark and recapture surveys not practical. Late-fall-run are known to spawn in most fall-run tributaries and opportunities for future alternative monitoring opportunities exist. Presently, only Clear Creek (USFWS-carcass count) and Battle Creek (CNFH-hatchery count) provide tributary data on late-fall-run salmon.

A main-stem winter-run carcass survey (May-August) has been conducted since 1996. Since 2001, the CALFED-ERP funded survey has provided the “official” annual escapement estimate (replacing the RBDD estimate) for this federally and state-listed endangered species. This species currently spawns only in the main-stem Sacramento River and is the focus of many restoration activities throughout the Central Valley. The winter-run estimate forms the scientific basis for establishing the allowable juvenile winter-run “take” limits at the pumping facilities in the Sacramento-San Joaquin Delta.

Spring-run salmon inventories have been sporadically conducted since the 1940’s on USRB tributary streams. Methodologies from the 1940’s through the 1980’s were incomplete, inconsistent, and not replicable at best. In many years surveys were not conducted. Spawning escapement estimates were derived from incomplete spawning ground surveys, carcass surveys with unknown expansion factors, and partial ladder and weir counts.   Since the early 1990’s, there has been an effort to standardize sampling methods and to develop an annual index of abundance. A single escapement estimator has been selected for each spring-run tributary, recognizing the sampling limitations in each watershed. Unlike fall-run carcasses surveys, there are not enough spring-run carcasses encountered to conduct mark and recapture surveys in the USRB.

Details of specific fall and spring-run surveys conducted for Clear, Antelope, Mill and Deer Creeks are available in separate reports for the 2008 year (Harvey Arrison-in prep, 2008). In past SRSSAP annual reports, these creeks were included within a single report.

Beginning in 2006, the reports were conducted by the individual project biologists/authors. This allowed for greater detail in reporting than previously possible.

Since 1953, fall-run salmon inventories have been routinely conducted on USRB tributary streams. Prior to 1988, Peterson mark and recapture methodologies, ladder counts and aerial redd surveys were used with varying sampling intensity and reliability of estimates. Since 1988, mark and recapture surveys have been standardized into weekly surveys for the duration of the spawning run on each tributary. The mark and recapture estimator used on each creek (seasonal Peterson, Schaefer or Jolly-Seber), is based on the total carcasses encountered and weekly percent recovery of tags. To obtain fall-run escapement estimates in Battle, Cow, Cottonwood and Bear Creek(s) video counting stations were operated.

METHODS and RESULTS

Since 1969, the RBDD estimates were used to generate estimates for all runs of salmonids in the main-stem Sacramento River (steelhead, four runs of Chinook salmon). Only the RBDD data for spring-run salmon was used to provide an estimate in 2008. Data trends and estimates from RBDD were still generated in 2008, but the CDFG has used main-stem carcass survey data and tributary specific results as the official estimates since 2001, (1998 for late-fall-run).

Carcass Mark and Recapture Surveys:

Carcass mark and recapture surveys (carcass surveys) have been used by the CDFG for many years to estimate salmon populations on rivers throughout the state. Since all Chinook salmon die after spawning a population can be counted by estimating how many carcasses were present each year. Because of the current "gates out" schedule at the RBDD (September- May) the carcass surveys have been chosen as the "official" alternative to the RBDD count for the Upper Sacramento River main-stem. Carcass surveys are conducted by boat, see Appendix Figure E2, or walking on foot along a river or stream examining carcasses. Carcasses are tagged with a colored plastic or some other type tag to enable personnel to recognize them on subsequent surveys. Carcasses that were tagged in previous periods and recaptured in new periods form the basic proportion of "carcasses tagged" to "carcasses recaptured" that creates a population estimate. Data is normally collected on sex, length, hatchery-origin salmon (see Appendix B), location, and other categories of interest.

There are a few different methods and/or population models employed to create an estimate. The population models were created for live populations of organisms and each model has a list of sampling assumptions that must be met in order for the model to reflect an accurate portrayal of the population size. The three models used by the CDFG in the USRB are the Peterson, the Schaefer, and the Jolly-Seber. Each has been modified from the original intent of studying live organisms and applied to carcasses. Carcass surveys do not meet the underlying assumptions of any single model so it is often left up to the biologist analyzing the data as to which model best fits the data for a particular survey.

Each model has numerous advantages and disadvantages. The Peterson model is the simplest and is useful in developing an estimate when disruptions to the sampling schedule occur. The Peterson treats the entire schedule as two periods, a tagging period and a recapture period. This is the most simplistic model but is in some surveys the only one that can be used due to low numbers of recaptures, or floods, etc.

The Schaefer and the Jolly-Seber models are more complicated because they depend on repetitive survey periods and recaptured carcasses throughout the survey. Of the two, the Jolly-Seber is the more complicated to analyze but recent software programs have been developed to allow simpler calculation of this method. The Jolly-Seber differs from the Schaefer in that it attempts to account for survival of carcasses between survey periods. The Schaefer is typically utilized for the fall-run on tributaries on Deer, Mill and Clear Creek(s). Beginning in 2001, the Jolly-Seber method was selected by CDFG statisticians and managers as the method to be utilized whenever possible for the main-stem Sacramento River (winter, fall, and late-fall-runs).

Red Bluff Diversion Dam (RBDD):

In 2008, for the first time in many years, water temperatures commonly exceeded 59 degrees at the CDFG fish trap. In response, the trapping and handling of salmon was discontinued to minimize stress to the fish as they passed through the dam. The high water temperatures prevented salmon identification by race after around mid-June at RBDD. As a result of this lack of data, only a winter and spring-run estimate was made using the historical methods, since most winter and spring-run had likely passed through the dam's fish ladders by mid-June when warmer water was present. No estimate was made for the fall-run populations as in addition to the warm water; the gates of the RBDD were raised in early September making even ladder counts of fall-run impossible.

During 2008, the limited estimates from the RBDD were based on daily ladder counts made by the USFWS and by the fish-trap sampling conducted by the CDFG at the dam (late-fall-run excluded). Ladder counts were obtained through a combination of closed-circuit camera monitoring and digital video recording of salmon passing through the RBDD fish ladders.

In 2008 and previous years, the total counts of salmon passing each week were adjusted for those periods when the fish ladders remained open but no counts were possible, such as when river turbidity was high, during flood conditions or when the dam gates were temporarily opened. Adjustments to lapses in daytime counts were made by interpolation. The adjusted (if necessary) weekly number of fish was apportioned among the winter, spring, and fall-runs based on their relative proportions seen that week in random samples of salmon taken from the dam's east-bank trapping facility. At the trap, see Appendix Figure E3, each salmon observed was assigned to a run based on phenotypic characteristics including: color, scale condition, and relative degree of sexual maturation (an indication of when it was believed that it would spawn). In 2008, a fin tissue sample from selected trapped salmon was taken for a separate genetic analysis study being conducted by the USFWS.

Estimated numbers of salmon for the periods when the fish ladders were not operated (September to May) were calculated based on historical data. This historical data is presented as weekly averages for each run's migration past RBDD, and is provided in Appendix Table A1. The values presented in Appendix Table A1 are based on the years prior to 1988, when the RBDD was operated throughout the year. During this time the trap and fish ladders were operated continuously. Concern for declining populations of winter-run salmon resulted in the gates being raised for portions of each year. The data that was used to develop historic run timing is different for winter-run than the other salmon runs. Spring, late-fall, and fall-run weekly migration patterns are based on data from 1970 to 1988 (1986 for late-fall). For the winter-run, the years 1982 to 1986 were selected to be used as the historical average framework due to the reduced numbers of winter-run seen at RBDD during these years. It was reasoned that this selected period of time more closely mirrors the current low numbers in winter-run populations.

The majority (average approx. 88%) of winter-run migration currently occurs outside the season of the RBDD operation. Therefore, the accuracy of spawner estimates based on the RBDD fish ladder counts are highly suspect. The methods below demonstrate the traditional methods used for all runs and for the 2008 winter-run.

The total for the 2008 salmon population estimates passing RBDD was calculated as follows:

1) For each Julian week, (Sunday-Saturday), determine estimate of actual salmon counted for period when gates were down (actual fish seen passing ladders + any other adjustments = Estimate). (Other adjustments may include missing day counts, ad-clipped fish, and individual ladder closures.)
2) Determine from the RBDD trap data the percent of that week's passage to be assigned to a particular run (i.e., 29% fall, 14% spring, and 57% winter) (see Appendix table A-2 week 23 for this RBDD data).
3) Determine the total number of salmon for each run during each week that actual counts were made. (Example: estimate multiplied by percentage in #2 for each run.)
4) Sum all of the weekly numbers of salmon counted for each run when counts were made and sum all of the corresponding percentages for those same weeks in Appendix Table A1. This provides the starting point to back calculate for period when the gates were up.
5) Calculate a total estimate for each run for the entire year using the proportion determined in step 4. (Example: winter-run 2008 total fish counted = 482, sum of historical percent during weeks of actual counts = 13.25%, thus total 2008 winter-run estimate is 482 * 100% /13.25% = 3,635 fish), (**note**: actual numbers not rounded until final estimate)

6) The RBDD data for 2008 is presented in Appendix Table A2. If desired, any week or months passage may be estimated by determining total historical passage for that period multiplied by the total in #5 for a given run of salmonids.

7) It is important to note that data from the RBDD does not account for downstream populations. These are determined through aerial redd counts.

The data collected at the RBDD does not determine distribution and numbers into the tributaries and main-stem upstream of RBDD. Instead, the CDFG and the USFWS now conduct combinations of mark and recapture carcass surveys, aerial and in-stream redd surveys, hatchery counts, angler harvest surveys, video counts, weir counts, and snorkel surveys of the main-stem Sacramento River and the major salmon tributaries to determine adult salmon escapements for specific runs and streams.

Sacramento River Main-Stem Aerial Flight Redd Distribution:

In 2008, a CDFG airplane was used to conduct monthly surveys for the late-fall, spring, and fall-run redd distributions. During the winter-run spawning period, helicopter surveys were conducted to enable detailed inspection of winter-run spawning areas.

Aerial redd maps are created (scanned versions available upon request of author: dkillam@dfg.ca.gov) to document the location of spawning areas and distributions in the main-stem and are used to supplement other counting methods to determine the overall population estimate for each run of salmon. Table 2 presents the data from the aerial redd surveys conducted by the CDFG. These surveys provide a historical database on redd distribution in the main-stem Sacramento River from Princeton (river mile (RM) 164) to Keswick Dam (RM 302) (1969-2008), Appendix Table A3. The aerial redd data is also used to estimate spawning escapement in the Sacramento main-stem downstream of both the RBDD and carcass survey areas. The ratio of redds upstream to redds downstream is used in conjunction with the upstream escapement estimate of either the carcass surveys or the RBDD. A simple proportion is used to calculate the downstream estimate. The proportion is constructed as follows: Number of salmon downstream = (salmon upstream after harvest in main-stem / redds upstream) * redds downstream.

Table 2. Summary of redd data collected from aerial flights for year 2008.

2008 Summary of Aerial Redd Survey Data**										
Late-Fall~	% Dist+	Winter	% Dist.	Spring	% Dist.	Fall	% Dist	ALL	% Dist.	RIVER SECTIONS
17	48%	226	51%	0	0%	3	1%	246	27%	Keswick to A.C.I.D. Dam.
0	8%	180	41%	8	35%	25	6%	213	23%	A.C.I.D. Dam to Highway 44 Bridge
0	11%	34	8%	10	43%	86	19%	130	14%	Highway 44 Br. to Airport Rd. Br.
0	14%	1	0%	1	4%	130	29%	132	14%	Airport Rd. Br. to Balls Ferry Br.
0	7%	0	0%	0	0%	50	11%	50	5%	Balls Ferry Br. to Battle Creek.
0	3%	0	0%	0	0%	81	18%	81	9%	Battle Creek to Jellys Ferry Br.
0	1%	0	0%	0	0%	37	8%	37	4%	Jellys Ferry Br. to Bend Bridge
0	1%	0	0%	0	0%	5	1%	5	1%	Bend Bridge to Red Bluff Diversion Dam
0	4%	0	0%	4	17%	22	5%	26	3%	Red Bluff Diversion Dam to Tehama Br.
0	1%	0	0%	0	0%	6	1%	6	1%	Tehama Br. To Woodson Bridge
0	2%	0	0%	0	0%	0	0%	0	0%	Woodson Bridge to Hamilton City Br.
0	1%	0	0%	0	0%	1	0%	1	0%	Hamilton City Bridge to Ord Ferry Br.
0	0%	0	0%	0	0%	0	0%	0	0%	Ord Ferry Br. To Princeton Ferry.
17	100%	441	100%	23	100%	446	100%	927	100%	

** Summary of 1 late-fall run, 14 winter-run, 2 spring-run, and 3 fall-run flights.
+ Late-fall % Distributions are the average Late-fall redd distributions from 2001 to 2007 due to lack of late-fall flights in 2008
~ Late-fall run redd counts do not include survey on 16-Dec-2008.

Aerial redd surveys do not provide complete counts of new redds. Variability in turbidity, river depth, riparian vegetation, weather and wind all effect the ability of the observer to count new redds. Analysis of redd data should be done with caution. The staff of the SRSSAP recommend using aerial redd data only for comparisons of redd distributions by river sections or for specific needs such as use of a specific area as a spawning location. In late 2007 and early 2008 budget and staffing shortages resulted in a lack of flights from December 2007 to late March 2008. The first flight was a late-fall flight in late March that was in poor conditions.

The SRSSAP conducted 20 aerial redd flights for the 2008 escapement surveys (Table 2). **One late-fall**-run survey was conducted. All of late-fall-run redds were from the Anderson Cottonwood Irrigation District Dam (ACID) upstream to Keswick Dam. However conditions on this flight were poor so the redd distributions in Table 2 are the average late-fall redd distributions since 2001. This was done to facilitate a population estimate expansion that was necessary due to the lack of earlier late-fall run flights. **Fourteen winter-run** flights using a helicopter, see Appendix Figure E4, from 24 April through 25 August were conducted. Winter-run redds were observed from Keswick Dam to just downstream of the mouth of Cow Creek. The majority of these redds (91%) were located between Keswick Dam and the Highway 44 Bridge in Redding (Turtle Bay area). **Two spring-run** flights were conducted on 10 and 29 September. A total of 23 redds were observed from the ACID Dam to just below the RBDD**.** **Three fall-run** flights between 07 October and 12 November reported fall-run redds (see Appendix Figure E5) from the Ord Ferry upstream to Keswick Dam. Most of the fall-run redds were fairly evenly distributed from the Highway 44 Bridge downstream to the Jellys Ferry Bridge, that is located above the RBDD.

In summary, during 2008 there were 927 new redds observed in the main-stem from Keswick Dam to Princeton Ferry (RM 164) over a total of 20 flights. The majority of these redds (96%) were upstream of Red Bluff Diversion Dam. Appendix Table A3 presents a summary of historical aerial redd information for years 1969-2008.

The 2008 Salmon Runs in the Upper Sacramento River

Late-fall-run No estimates were made for the late-fall-run at the RBDD. Although some late-fall salmon use tributaries to the USRB (e.g., Clear, Cow and Battle creeks) no spawner population estimates were made in those streams for late-fall salmon. The USFWS conducted a survey to tally carcasses, live fish and redds on Clear Creek late-fall-run salmon, but no population estimate was generated. One should note that late-fall salmon spawn over the calendar year change. For the purposes of reporting late-fall numbers it is customary to report estimates based on when the juveniles emerge. Late-fall salmon spawning in November and December are classified as belonging to the following year, (i.e., December of 2007 spawners are put into 2008 estimate and December of 2008 spawners will be part of the 2009 estimate).

A main-stem carcass survey was conducted from 19 December 2007 through 15 May 2008. The weekly surveys covered a 13.2 mile (21 km) section of the Sacramento River between Keswick Dam, (RM 302), and the power lines just downstream of the mouth of Clear Creek (RM 288.8). In the winter and spring of 2008 the USRB experienced few rain runoff/flood events. As a result survey conditions were ideal for tagging and recapturing carcasses. The spawner population estimate for **the 2008 main-stem late-fall-run was 3,963** including spawners outside the survey area (using average aerial redd proportions).

Appendix Table A4 provides a data summary of the 2008 late-fall-run main-stem population. Crews observed a total of 814 carcasses. Crews tagged 304 of these and recaptured 113 for a recapture rate of 37.2%; which is a somewhat low rate for a main-stem carcass survey under good conditions. Crews measured 188 fresh fish, and a grilse (2 year old) percentage of 1.5% was estimated based on a length cut-off of 610-female and 690-male (millimeters). Males represented 52% of the population. Females were checked for egg retention following spawning. Only 1 of 118 fresh females (0.8%) had not completely spawned. All fish examined were checked for adipose-fin clips representing hatchery-origin from the CNFH on Battle Creek. Fifty-nine salmon of the total 814 examined had an adipose-fin clip (or unknown adipose-fin clip) in 2008. Coded-wire tags (CWT) were recovered from 51 of these carcasses. All 51 were late-fall-run from the Coleman National Fish Hatchery (CNFH), (Appendix table B4). One additional late-fall-run hatchery-origin CWT fish was recovered during the winter-run survey bringing the total late-fall CWT fish to 52 for the year (Appendix Table B2).

The late-fall-run are subject to sport fishing in the main-stem river below Deschutes Road Bridge (RM 280.9). The CDFG's Angler Harvest Survey was revamped in 2007 after being shut down in 2003. The Angler Harvest Survey data was used to calculate an estimate of 1,581 (588 above RBDD and 993 below) late-fall salmon harvested in late 2007, (Table 1). These fish are part of the 2008 late-fall population estimate since the unharvested fish spawn from late 2007 into early 2008. This estimate includes harvest in half of November (other half is fall-run) and all of December and January 2008.

The CNFH spawned and excessed late-fall salmon from 27 December 2007 through 22 February 2008. The hatchery total was **6,334** late-fall fish spawned and excessed, (Laura Mahoney, USFWS, personal communication). In addition, 19 natural-origin (non-adipose-fin clipped) late-fall-run salmon were allowed to pass upstream of the barrier weir at CNFH. The staff at the CNFH allows natural-origin salmon to pass upstream as these fish may be natural-origin late-fall, spring or winter-run salmon.

Based on the carcass survey, angler harvest estimate, CNFH data, and aerial redd data it is estimated that **at least 11,897 late-fall-run** salmon were present above Knights Landing in late 2007 and early 2008 (Table 1), (Note the SRSSAP monitoring begins at Princeton; Angler Survey data above Knights Landing is used since fish caught above Knights Landing were likely destined to spawn in the USRB). This estimate does not include other in-stream tributary estimates that were not conducted due to limited staffing and typically poor weather and turbidity conditions during late autumn and winter.

Winter-run **Carcass Survey:** From 1996 to 2005, an annual CDFG report dedicated to the winter-run main-stem Sacramento River carcass survey was produced in addition to this report. Beginning in 2006, the results of the winter-run carcass survey have been integrated into this report and a separate report is no longer written. Appendix C provides readers with an extensive summary table and notes of the winter-run data collected in 2008 and previous years. This table, and all other data found in this report is available upon request in spreadsheet format. Requests can be directed to author at the e-mail address in the Summary section of this report.

The mark and recapture carcass survey for winter-run salmon was conducted on the main-stem Sacramento River from 1 May through 22 August 2008 (Appendix Table A5). Based on a sample size of 610 tagged large female carcasses and the subsequent recapture of 362 (recovery rate of 59%) of these carcasses, a population estimate of **2,830** winter-run salmon was obtained using the Jolly-Seber model and subsequent adjustments. The carcass survey results were based upon large (>609 mm) female carcasses. The total number of spawning females in the main-stem Sacramento River was 1,515 (including the females retained at Livingston Stone National Fish Hatchery (LSNFH) (n = 53), (Appendix Table A5). Total winter-run salmon collected at the LSNFH in 2008 was 105 fish that were retained for the brood stock collection program.

Run size estimates at the RBDD have been made since 1967. The National Marine Fisheries Service (NMFS, 1996) developed draft winter-run population recovery goals of 10,000 spawning females over 13 consecutive years. This recovery goal was set using the RBDD winter-run population estimates. *Beginning in 2001, the CDFG has chosen for regulatory purposes that the population estimates from the carcass survey will be used in reporting the winter-run salmon estimate.* Data is still presented for the RBDD in order to continue trend data that has been available over the past 35 years.

Red Bluff Diversion Dam: The RBDD estimate for the 2008 winter-run was **3,635,** (Appendix Table A-2). This included and estimated 2,632 natural-origin salmon (all hatchery winter-run have adipose-fin-clipped off) and 1,003 hatchery-origin winter-run. Winter-run fish migrate past the RBDD from December through August. Winter-run passing the RBDD in December of 2007 were part of the 2008 estimate based on traditional run timing (Appendix Table A1). All of these fish were thought to have spawned in the main-stem Sacramento River above Red Bluff (Table 2).

Other Winter-run Data: Fourteen helicopter surveys were conducted to determine winter-run spawning distributions in the main-stem Sacramento River from Woodson Bridge (RM 218) to Keswick Dam (RM 302). This data is presented in Table 2. The proportion of redds above and below the RBDD, and the total estimate of winter-run passing the RBDD, are used to calculate the winter-run estimate for downstream of the RBDD. In 2008, no winter-run redds were observed downstream of the RBDD during aerial flights. Therefore, the winter-run population estimates downstream of the RBDD is zero using the RBDD methodology, and also zero using the “official” carcass survey methods in Table 1.

There was no estimated angler harvest of winter-run above or below the RBDD due to a zero salmon possession limit from 15 January through 31 October 2008 although some angling activities in late December and January in the Delta probably catch winter-run. Also poaching and possibly hooking mortality associated with trout angling probably occurs.

In summary for 2008, the official carcass survey reported an escapement of 2,830 winter-run salmon, (Table 1). In earlier winter-run reporting of the 2008 population, an official estimate of 2,850 was presented. The reduction of 20 fish to 2,830 was the result of a quality control review in early 2009, (reduce 2,850 by 4 adult female and 16 grilse males). In contrast, the historical RBDD winter-run estimate was 3,635 winter-run.

<u>Spring-run</u> Spawning of natural-origin spring-run natal to the main-stem Sacramento River is considered by the CDFG to have largely been eliminated through competition plus hybridization with fall-run salmon (CDFG, 1998). Historically spring-run salmon migrated upstream in the spring and early summer and held over the summer in higher elevations with cooler water temperatures. These fish were then spatially separated from the later arriving fall-run by low flows and warmer temperatures in the lower sections of the waterways. Presently, dams on the Sacramento River, Clear, and Battle creek(s) prevent the spring-run from being spatially isolated from the fall-run. Since fall and spring-run salmon are spawning around the same time each year (late September-October) in the same stream section they may not be genetically isolated.

In 2008 and previous years, attempts to prevent the spatial overlap of spawning fall and spring-run through the use of a temporary picket weir occurred on Clear Creek (USFWS: Jim Early personal comm.). In Battle Creek a fish ladder is operated in a manner to allow spring-run passage upstream of CNFH early in the year. The ladder is closed later in the summer to prevent early arriving fall-run from getting above the CNFH (USFWS: Jess Newton, personal comm.).

The possibility of utilizing the ACID dam on the main-stem Sacramento River to create a spring-run “sanctuary” has been recently discussed. The CDFG does not support this idea because of the temporal overlap between the winter, spring and fall-run populations in this river section during the summer months. In addition, there is a current lack of a reliable means to genetically identify individual spring-run from fall-run that would likely prevent success of isolating spring-run above ACID. Currently, the CDFG cannot make reliable carcass survey estimates of spring-run upstream of RBDD in the main-stem river. This is because of the overlap between the two runs and the lack of a suitable means of distinguishing them.

There is no main-stem Sacramento River spring-run carcass survey, instead results from the RBDD, aerial redd surveys, and the combined totals of Beegum, Battle, and Clear Creek(s) (snorkel surveys of holding areas) are used to provide an index of main-stem spring-run. An estimated 249 salmon showing spring-run characteristics passed RBDD in 2008 (Appendix Table A2). This number is less than the 305 total spring-run cumulatively counted in Clear Creek (200) and Battle Creek (105) (USFWS, Jess

Newton, pers. comm.). Using this traditional RBDD methodology, zero spring-run were "assigned" to the main-stem Sacramento River above RBDD. However, a number of spring-run timed redds were observed downstream of RBDD. Using the RBDD methodology these redds expanded to represent 52 spring-run downstream of RBDD in the main-stem (Table 1). Presently there is no reliable methodology to account for "spring-run" main-stem salmon that may or may not be present on any given year in the main-stem river.

The difficulties encountered in determining a spring-run estimate on the Sacramento River include the spring and fall-run mixing, and also the occurrence of spring-run from the Feather River Hatchery (FRH), that commonly stray into the USRB. Using the data from the traditional methodology indicates a main-stem estimate of 52, (Table 1). There is considerable uncertainty and disagreement amongst biologists as to the exact nature of the spring-run population in the main-stem Sacramento River. Until further research is conducted this uncertainty will continue.

Similar to winter-run fish, in-river angler harvest of the ESA listed "threatened" spring-run is considered to be zero due to fishing closures during migration periods and in primary spawning areas, although some poaching and hook mortality associated with trout angling probably occurs.

Two spring-run flights were conducted on 10 and 29 September 2008 in which 23 redds were observed. Four of these were downstream of RBDD. Historically, the flights in September were titled "Spring-run," although it is likely that they are from a mix of fall and spring-run salmon as previously mentioned.

In summary, **305** spring-run salmon were estimated above RBDD. Data for below RBDD includes the tributaries: Mill (362) (redd survey), Antelope (2), and Deer Creek(s) (140) snorkel surveys (Harvey-Arrison) for a downstream (RBDD to Princeton) spring-run total of 556. In Mill Creek, water clarity prohibits reliable underwater snorkel survey observations, consequently an annual walking redd survey is conducted and expanded into a population estimate.

The total 2008 spring-run escapement to the USRB was at least **861** (Table 1). Note that Butte (10,082) and Big Chico Creek(s) (0) spring-run results are presented in a separate report, since both creeks enter the Sacramento River below Princeton CA, (Tracy McReynolds, CDFG, personal communication).

<u>Fall-run</u> **Carcass Survey**: A fall-run carcass survey was conducted to estimate the fall-run spawner population on the main-stem Sacramento River. An estimated **24,743** salmon spawned in the main-stem Sacramento River from Princeton to Keswick Dam based upon expansion of the fall-run carcass survey data, (Appendix Table A6). The carcass survey was conducted from the Clear Creek Power lines (RM 288.8) upstream to the Keswick Dam in Redding (RM 302). The Jolly-Seber method was used to calculate an estimate of 2,703 non-adipose-fin clipped large females for this section. This number is expanded to account for the 74.4% of redds (aerial redd data) located outside of the

carcass survey reach. Further expansions for hatchery fish, small salmon, and large males result in the final estimate of 24,759 for the entire main-stem. This includes and estimated 1,609 downstream of RBDD and the remainder of 23,134 upstream of RBDD in the main-stem river.

Red Bluff Diversion Dam: In 2008 a decision was made to drop the fall-run estimate from the RBDD methodology. This was done for a number of reasons including that the RBDD gates were removed 2 weeks earlier than normal reducing the numbers of fish counted, and also that the RBDD methodology for fall run has consistently under reported the fall run above RBDD for 8 consecutive years.

The CDFG re-initiated an Angler Harvest Survey project in 2007 with CALFED-ERP funding. However in 2008, for the first time ever, the CDFG closed the entire Central Valley river system, (and commercial ocean fisheries targeting fall-run) to fall-run fishing in response to the low numbers of fall-run escapement predicted for 2008. The resulting closure was from July to the end of October. This drastic step was taken to allow all returning fall-run to spawn to prevent even further declines in the already record low number of fall-run in 2008. There was a limited fishery for late-fall salmon in 2008 from 01 November to 31 December only in the main-stem Sacramento River below RBDD.

In previous years, the Angler Harvest Survey did not attempt to distinguish between fall and late-fall-run harvest. During the 2008 limited in river fishery, (November-December from below RBDD to Knights landing), a review of CWT harvested fish resulted in a fall- run estimate of **40** fish (Table 1). This method replaces the method used in previous years which simply used half of November harvest above and below RBDD and assigned to fall run. In 2008, the fall-run estimate using this previous method for the USRB was 521. The remaining harvest in November and December of 2008 will be included in the 2009 late-fall-run harvest estimate (1,732 total – 40 fall-run and 1 winter = 1,691).

An estimated 23,613 fall-run salmon entered the tributaries above Red Bluff. These included estimates for: Battle (4,286 in-stream and 10,639 into the CNFH) and Clear (7,677) creek(s). Video stations reported fall-run estimates for Cow Creek (478), Cottonwood (510) and Bear (19) Creek(s). The overall fall-run estimate upstream of RBDD was 46,743 (Table 1) but this number did not include salmon that used other tributaries to the upper main-stem that were not surveyed (Paynes, Inks, Sulphur and Ash Creek(s) etc.). These systems were traditionally accounted for in the RBDD estimate, but this has not been the case since 2001, when the main-stem carcass survey was reported. Additionally, a combined estimate of 360 was made for fall-run escapement to Mill Creek (166) and Deer Creek (194) (Harvey-Arrison).

In summary, total fall-run escapement to the Upper Sacramento River Basin above Princeton is estimated to be at least **48,752** salmon plus an unknown (thought to be small) additional number of salmon in unsurveyed areas (Table 1).

Appendix Table A7 contains a summary of historical run information from all runs from 1986 to present. Readers should use caution in interpreting this data to meet specific needs. There are numerous categories (total populations, spawner populations, etc) included in this data, and readers should contact the authors of this report (and other reports) directly to ensure that the data required is available. The data for this report is available electronically and can be sent directly to interested readers with appropriate categories and data limitations explained.

Sacramento River Tributaries: Specific Estimates

Clear Creek

Late-Fall-run   No population estimates were conducted for this run in 2008.

Spring-run   The USFWS conducts snorkel surveys in August as an annual index of spring-run abundance. In 2008, during the August survey **200** spring-run were counted. A temporary picket weir was again installed to spatially separate spring-run from fall-run spawners in this creek.

Fall-run   Ten weekly fall-run spawner surveys of lower Clear Creek were made during 2008 in the 6.7 km (4.2 mi) reach downstream of the former McCormick-Saeltzer Dam site. An estimated population of **7,677** fall-run salmon resulted (Harvey-Arrison).

Twenty-one coded-wire tags (CWT's) were recovered from 28 potential adipose-fin clipped fish in Clear Creek. Four of these were tagged as spring-run from the Feather River Hatchery. The remaining 17 hatchery fish were also from the Feather River Hatchery but were tagged as fall-run fish. An additional 6 fish had no tag detected and 1 tag was lost during reading, (Appendix Table B4).

Cow Creek

Late-Fall-run   No surveys for this run in this tributary were made in 2008.

Fall-run   A video monitoring station located in lower Cow Creek reported the passage of **478** fall-run salmon. Daily station information on salmon passage, flow and average water temperature is given in Table 3. The station was set-up less than a mile from the mouth the creek, see Appendix Figure E6. Details of the station and methods are available in an earlier report, (Killam, 08-2, 2008). The station recorded fish passage 24 / 7 using an overhead camera from 13 September to 19 December 2008. This was the third year of this monitoring effort, and was a cooperative effort between local landowners, CDFG, USFWS and the Western Shasta Resource Conservation District (WSRCD). Changes to station methods in 2008 included the use of digital video recorders (DVR's), to replace older VCR's, and the addition of 3 underwater cameras specifically designed and constructed by SRSSAP personnel to identify species. Details of the specifics of the changes in methods are available in a separate report on Bear Creek which used the same (new in 2008) technology (Chichester, 2009).

Table 3. Daily information on salmon passage, flow and average water temperature for the 2008 Cow Creek Video Station.

2008 Cow Creek Video Station Salmon Passage							
Date	Passage	Flow	Water F°	Date	Passage	Flow	Water F°
13-Sep	0	8	n/a	1-Nov	130	89	58
14-Sep	0	5	n/a	2-Nov	60	247	58
15-Sep	0	5	n/a	3-Nov	71	376	55
16-Sep	0	10	n/a	4-Nov	28	371	53
17-Sep	0	10	n/a	5-Nov	7	145	50
18-Sep	0	8	n/a	6-Nov	3	105	52
19-Sep	0	10	n/a	7-Nov	10	88	54
20-Sep	0	13	n/a	8-Nov	5	82	54
21-Sep	0	17	n/a	9-Nov	6	109	54
22-Sep	0	16	n/a	10-Nov	5	91	53
23-Sep	0	19	70	11-Nov	1	83	52
24-Sep	0	17	70	12-Nov	6	79	54
25-Sep	0	12	70	13-Nov	5	74	55
26-Sep	0	14	70	14-Nov	3	70	56
27-Sep	0	13	71	15-Nov	1	65	55
28-Sep	0	14	71	16-Nov	2	65	55
29-Sep	0	11	72	17-Nov	1	66	54
30-Sep	1	13	72	18-Nov	0	65	53
1-Oct	0	12	72	19-Nov	2	64	52
2-Oct	0	16	71	20-Nov	0	63	51
3-Oct	0	19	69	21-Nov	2	65	50
4-Oct	0	41	66	22-Nov	-1	66	49
5-Oct	6	73	65	23-Nov	0	63	48
6-Oct	-1	40	66	24-Nov	1	64	48
7-Oct	0	29	67	25-Nov	0	64	49
8-Oct	0	27	66	26-Nov	1	67	50
9-Oct	0	26	63	27-Nov	1	83	51
10-Oct	2	25	59	28-Nov	0	83	50
11-Oct	0	26	57	29-Nov	0	83	51
12-Oct	0	26	56	30-Nov	1	84	51
13-Oct	8	26	58	1-Dec	0	82	49
14-Oct	6	25	60	2-Dec	1	82	49
15-Oct	5	25	61	3-Dec	-1	83	47
16-Oct	15	25	62	4-Dec	0	83	45
17-Oct	2	26	63	5-Dec	0	81	45
18-Oct	-2	26	62	6-Dec	1	81	44
19-Oct	3	26	62	7-Dec	0	81	44
20-Oct	7	25	62	8-Dec	0	83	45
21-Oct	17	27	60	9-Dec	0	82	44
22-Oct	2	27	59	10-Dec	1	82	44
23-Oct	2	26	59	11-Dec	0	82	43
24-Oct	0	26	60	12-Dec	0	83	42
25-Oct	3	26	59	13-Dec	0	85	42
26-Oct	2	27	60	14-Dec	0	90	41
27-Oct	5	27	60	15-Dec	1	135	40
28-Oct	1	28	59	16-Dec	0	150	39
29-Oct	8	30	58	17-Dec	0	121	37
30-Oct	22	31	57	18-Dec	0	105	36
31-Oct	11	43	58	**Totals**	**478**		

Bear Creek

Fall-run A video monitoring station located in lower Bear Creek was used, along with a lower creek redd survey to estimate that there were **19** fall-run salmon spawning in 2008 for Bear Creek. The station was built 1.5 miles from the confluence of Bear Creek and the Sacramento River, see Appendix Figure E7. Specific details of the station and data are available in a separate report, (Chichester, 2009). The station recorded fish passage 24 / 7 using an overhead camera from 23 September to 06 May 2009. This was the second year a video station was used to produce an estimate and provide a count of fall-run salmon in Bear Creek. In some earlier years, selected sections of the creek were walked, and population counts made were based on live fish and redd counts.

The video station in Bear creek in 2008 was also the first attempt to collect fish passage information throughout the fall, winter, and spring months in a natural stream environment without a fish ladder or dam. The station data collected during the winter months on steelhead passage (available in 2009 reporting) is the first ever recorded for Bear Creek and represents the first steps in utilizing newer technology to monitor salmonids passage in previously unmonitored places and times in the USRB.

Late-fall-run, and Steelhead The video station continued operation until May of 2009 in the expectation of determining steelhead and any late-fall or spring-run salmon passage into Bear creek. No salmon were observed in December (and into January 2009) therefore no late-fall-run salmon were estimated for Bear Creek. Steelhead passage was estimated at 45 adults through 31 December 2008. Results of the 2009 period will be available in the 2009 annual report.

Cottonwood Creek

Late-fall-run   No surveys for this run in this tributary were made in 2008.

Spring-run   **Zero** spring-run Chinook were estimated in Beegum Creek a tributary to the Middle Fork of Cottonwood Creek in 2008. A summer wildfire burned much of the Beegum watershed north of the creek, resulting in severe loss of vegetation. Fires burned in many places right down to the creek along the entire 9 mile section of salmon habitat above the Highway 36 Bridge.

Fall-run   A video monitoring station located in lower Cottonwood Creek reported **510** fall-run salmon. Daily station information on salmon passage, flow and average water temperature is given in Table 4. The station was set-up less than a mile from the mouth the creek, see Appendix Figure E8. Specific details of the station methods are available in a previous report, (Killam, 08-3, 2008). The station recorded fish passage 24 / 7 using an overhead camera from 13 September to 29 December 2008. In 2008, the use of Digital Video Recorders (DVR's), (replacing VCR's), and the addition of underwater cameras were significant changes from methods in earlier years detailed in the 2007 report (Killam, 08-3-2008).

Table 4. Daily information on salmon passage, flow and average water temperature for the 2008 Cottonwood Creek Video Station.

2008 Cottonwood Creek Video Station Salmon Passage							
Date	**Passage**	**Flow**	**Water F°**	**Date**	**Passage**	**Flow**	**Water F°**
13-Sep	0	57	74	7-Nov	-1	181	57
14-Sep	0	67	75	8-Nov	3	168	57
15-Sep	0	59	74	9-Nov	1	164	57
16-Sep	0	57	74	10-Nov	1	157	56
17-Sep	0	58	73	11-Nov	2	146	56
18-Sep	0	54	72	12-Nov	2	135	57
19-Sep	0	52	70	13-Nov	1	131	58
20-Sep	0	56	70	14-Nov	0	136	59
21-Sep	0	60	71	15-Nov	1	130	58
22-Sep	0	69	70	16-Nov	4	127	58
23-Sep	0	68	70	17-Nov	2	123	57
24-Sep	1	62	69	18-Nov	-1	118	57
25-Sep	0	66	70	19-Nov	1	116	56
26-Sep	0	80	69	20-Nov	0	113	55
27-Sep	0	78	70	21-Nov	2	111	54
28-Sep	1	78	70	22-Nov	1	111	53
29-Sep	0	79	71	23-Nov	0	112	53
30-Sep	0	80	71	24-Nov	1	108	52
1-Oct	0	72	71	25-Nov	0	107	53
2-Oct	0	65	70	26-Nov	2	107	54
3-Oct	7	79	68	27-Nov	0	106	54
4-Oct	6	119	66	28-Nov	2	104	53
5-Oct	18	173	67	29-Nov	2	103	54
6-Oct	4	143	67	30-Nov	1	102	54
7-Oct	0	112	67	1-Dec	-1	101	53
8-Oct	1	105	67	2-Dec	1	100	53
9-Oct	0	102	64	3-Dec	0	100	51
10-Oct	13	106	61	4-Dec	0	99	50
11-Oct	7	104	59	5-Dec	0	98	50
12-Oct	26	109	59	6-Dec	0	97	49
13-Oct	20	118	60	7-Dec	1	96	49
14-Oct	21	117	62	8-Dec	0	86	49
15-Oct	41	125	63	9-Dec	-1	91	n/a
16-Oct	19	106	63	10-Dec	0	91	n/a
17-Oct	17	109	64	11-Dec	1	91	n/a
18-Oct	11	111	64	12-Dec	-1	91	n/a
19-Oct	15	121	64	13-Dec	0	91	n/a
20-Oct	9	106	63	14-Dec	0	91	n/a
21-Oct	22	69	62	15-Dec	0	105	n/a
22-Oct	20	58	62	16-Dec	0	104	n/a
23-Oct	9	55	62	17-Dec	0	98	n/a
24-Oct	8	52	62	18-Dec	0	94	n/a
25-Oct	10	50	63	19-Dec	0	94	n/a
26-Oct	5	49	63	20-Dec	0	95	n/a
27-Oct	9	48	62	21-Dec	1	99	n/a
28-Oct	8	48	62	22-Dec	3	103	n/a
29-Oct	15	48	61	23-Dec	0	117	n/a
30-Oct	6	47	60	24-Dec	0	144	n/a
31-Oct	17	54	61	25-Dec	2	171	n/a
1-Nov	23	82	61	26-Dec	0	188	n/a
2-Nov	27	317	59	27-Dec	0	166	n/a
3-Nov	25	296	57	28-Dec	1	142	n/a
4-Nov	18	393	55	29-Dec	0	135	n/a
5-Nov	16	315	53	**TOTAL**	**510**		
6-Nov	2	227	55				

Battle Creek

<u>Late-fall-run</u>   No in-river surveys were made for naturally spawning late-fall-run in Battle Creek in 2008. The CNFH reported that **6,334** fish entered the facility, and 19 were passed above the fish ladder, (Table 1).

<u>Spring-run</u>   The USFWS monitors spring-run passage in Battle Creek using the CNFH fish ladder. If water temperatures are below 60 degrees (Fahrenheit) salmon may be trapped for adipose-fin clip observations and for genetic sample collection. Trapped salmon with an adipose-fin clip representing hatchery-origin are taken into the hatchery. Salmon with no clip are allowed to pass upstream. Normally, if water temperatures are above 60 degrees (F) a video monitoring system is installed in the ladder and salmon are counted as they pass. In 2008 the fish ladder into the CNFH and the barrier weir were totally reconstructed, see Appendix Figure E9. During this time Battle Creek was diverted around the site in a new channel and a SRSSAP/USFWS video station was used to count any spring-run that migrated through the construction site. The station was operated by USFWS personnel from 6 May through 28 August. An estimated **105** Spring-run salmon were counted in Battle Creek in 2008 using the combination of trap and video station (USFWS: Jess Newton, personal com.).

<u>Fall-run</u>   The data from the Battle Creek Video Station was used to estimate the in-stream population, see Appendix Figure E10. Daily station information on salmon passage, flow and average water temperature is given in Table 5. Based on the video station counts of large salmon (24" or >) from Table 5 of 14,489 and expanding for small salmon (< 24") (based on counts from the CNFH and in-stream survey) an estimated 14,925 total fall-run were present in the Battle Creek watershed. The CNFH reported that **10,639** (Table 1) of these entered into the hatchery leaving a remainder of **4,286** as the in-stream spawning population estimate for Battle Creek beneath the hatchery.

To maintain a database of the biological characteristics of the spawning population a limited carcass stream survey was made weekly to observe only fresh carcasses. This survey ran from the CNFH weir downstream to the Jellys Ferry Bridge and observed 317 fresh carcasses from 08 October to 24 November. In the survey 50.2% of the carcasses were adult females, 47.6% adult males, and 1.6% male grilse and 0.6% were female grilse. In contrast, the CNFH reported 44.1% adult females, 51.6% adult males and 4.3% jack grilse. In addition to these findings, it was observed that 1.3% (n = 4) of the 317 in-stream carcasses were adipose-fin clipped compared to 1.9% (n = 207) in the CNFH.

Beginning in 2006 the CNFH began tagging 25% of production fall-run. These "constant fractionally marked" fish would be 2-year old grilse in 2008, but were not evident in the carcass survey. In contrast the CNFH reported 462 total jacks of which 87 were clipped (18.8%). Another finding of the survey was that 12.4% of the females observed were unspawned, (died before spawning). This number, although large for most USRB waters, is typical for Battle Creek.

Table 5. Daily information on salmon passage, flow and average water temperature for the 2008 Battle Creek Video Station.

2008 Battle Creek Creek Video Station Salmon Passage							
Date	**Passage**	**Flow**	**Water F°**	**Date**	**Passage**	**Flow**	**Water F°**
21-Aug	1	196	72	13-Oct	192	206	53
22-Aug	0	196	69	14-Oct	383	208	55
23-Aug	0	194	70	15-Oct	234	203	56
24-Aug	1	193	70	16-Oct	191	206	56
25-Aug	0	191	69	17-Oct	682	205	57
26-Aug	0	190	68	18-Oct	205	204	57
27-Aug	1	193	68	19-Oct	226	205	57
28-Aug	1	190	69	20-Oct	161	204	57
29-Aug	0	189	69	21-Oct	124	203	56
30-Aug	0	190	69	22-Oct	148	201	55
31-Aug	0	189	65	23-Oct	71	207	55
1-Sep	5	190	63	24-Oct	121	200	55
2-Sep	5	191	63	25-Oct	97	200	55
3-Sep	2	190	64	26-Oct	166	200	56
4-Sep	6	189	66	27-Oct	171	201	55
5-Sep	-1	190	67	28-Oct	109	200	55
6-Sep	0	186	67	29-Oct	96	205	55
7-Sep	0	186	68	30-Oct	371	226	54
8-Sep	2	190	67	31-Oct	329	234	55
9-Sep	0	186	66	1-Nov	232	277	56
10-Sep	5	188	65	2-Nov	165	411	55
11-Sep	19	188	65	3-Nov	92	319	54
12-Sep	6	197	65	4-Nov	44	337	52
13-Sep	19	199	65	5-Nov	4	283	50
14-Sep	11	198	65	6-Nov	13	275	51
15-Sep	16	197	65	7-Nov	-2	250	52
16-Sep	106	198	65	8-Nov	3	246	53
17-Sep	19	197	65	9-Nov	2	255	53
18-Sep	52	197	63	10-Nov	2	245	51
19-Sep	87	203	62	11-Nov	8	237	52
20-Sep	32	203	61	12-Nov	5	232	53
21-Sep	466	202	62	13-Nov	4	232	54
22-Sep	118	201	62	14-Nov	11	225	54
23-Sep	110	200	61	15-Nov	14	233	53
24-Sep	203	198	61	16-Nov	10	228	53
25-Sep	515	197	61	17-Nov	5	230	53
26-Sep	567	198	61	18-Nov	11	235	52
27-Sep	35	197	62	19-Nov	5	233	52
28-Sep	37	197	62	20-Nov	2	234	51
29-Sep	220	191	63	21-Nov	3	236	50
30-Sep	1,135	197	63	22-Nov	2	235	49
1-Oct	535	190	63	23-Nov	2	234	49
2-Oct	185	205	63	24-Nov	4	231	49
3-Oct	1,304	209	61	25-Nov	11	229	51
4-Oct	**2,193**	**237**	**60**	26-Nov	195	228	52
5-Oct	781	247	60	27-Nov	24	228	52
6-Oct	127	230	59	28-Nov	3	227	50
7-Oct	89	224	59	29-Nov	2	223	51
8-Oct	204	221	59	30-Nov	7	224	51
9-Oct	83	216	57	1-Dec	8	222	50
10-Oct	69	210	54	2-Dec	2	224	50
11-Oct	64	210	53	**TOTAL**	**14,489**	Large >24" salmon	
12-Oct	82	208	52				

Antelope Creek

Spring-run   A redd survey on 3 October in Antelope Creek reported a single "practice" redd. This resulted in a spring-run Chinook estimate of **2** for Antelope Creek in 2008.

A video station was installed on the upstream end of the fish ladder of the Edwards Irrigation Dam located approximately 9.4 miles upstream from the mouth of Antelope Creek on the Sacramento River; see Appendix Figures E11 and E12. The station was operated from 21 December 2007 until 5 June 2008. Data from the station indicated that 3 salmon and 125 adult steelhead passed upstream of the dam. Daily results of the 2007-2008 Antelope Creek Video Station are presented in Table 6.

Fall-run   No surveys for this run in this tributary were made in 2008, although fall-run are typically observed in Antelope Creek during October and November in an area near Highway 99 East (Cone Grove Park).

Mill Creek

Spring-run   An estimated **362** spring-run Chinook spawned in Mill Creek in 2008. This was based on redd surveys of 41 miles of the creek made in October 2008, (Harvey-Arrison).

Starting in March of 2008, a video station was used for the second time to count incoming and outgoing steelhead and spring-run Chinook salmon on lower Mill Creek. In addition a DIDSON (Dual Frequency Identification Sonar camera) that is capable of "seeing" into muddy water was used in conjunction with the video station. Results of that study are detailed in Johnson, 2008. The station was located about 1.8 miles from the mouth of Mill Creek, see Appendix Figure E13. It was operated from 07 March to 27 June 2008. During this period **381** spring-run salmon were counted and an estimated 4 upstream moving steelhead and 36 downstream or "kelt" steelhead were observed.

The combination of video and DIDSON technology provided a superior method of counting salmonids on a tributary stream than either method alone. The strengths of the video system (cost, species identification) combined with the strength of the DIDSON (turbid water abilities) provide a powerful new method for monitoring fish passage in USRB and Central Valley streams subject to periodic turbid water conditions.

Fall-run   Three surveys were made by walking an 8-mile reach between the canyon mouth and the confluence with the Sacramento River in November 2008. There were 83 redds observed, this was expanded to develop a fall-run Chinook estimate of **166** spawners present in Mill Creek in 2008 (Harvey-Arrison).

Video station technology was again used in Mill Creek beginning on 24 October 2008 to count upstream migrating salmon and steelhead. This new station was placed at the top end of the fish ladder of Ward Dam-an irrigation diversion dam located approximately 3.1 miles upstream from the mouth of Mill Creek at the Sacramento River.

Table 6. Daily information on salmon and steelhead passage and average water temperature for the 2007- 2008 Antelope Creek Video Station.

2007-2008 Antelope Creek Creek Video Station Salmonid Passage											
Date	**Salmon**	**Steelhead**	**Water F°**	**Date**	**Salmon**	**Steelhead**	**Water F°**	**Date**	**Salmon**	**Steelhead**	**Water F°**
21-Dec	0	0	42	15-Feb	0	0	43	11-Apr	0	0	58
22-Dec	0	0	40	16-Feb	0	0	44	12-Apr	0	0	60
23-Dec	0	2	42	17-Feb	0	0	45	13-Apr	0	0	62
24-Dec	0	0	43	18-Feb	0	0	46	14-Apr	0	0	62
25-Dec	0	0	41	19-Feb	0	1	46	15-Apr	0	0	58
26-Dec	0	0	40	20-Feb	0	2	48	16-Apr	0	0	56
27-Dec	0	1	38	21-Feb	0	1	47	17-Apr	0	0	58
28-Dec	0	0	39	22-Feb	0	0	47	18-Apr	0	1	60
29-Dec	-1	0	40	23-Feb	0	4	46	19-Apr	0	0	59
30-Dec	0	0	41	24-Feb	0	8	46	20-Apr	0	1	55
31-Dec	0	0	39	25-Feb	0	4	47	21-Apr	0	0	54
1-Jan	0	0	38	26-Feb	0	0	47	22-Apr	0	-2	53
2-Jan	0	0	39	27-Feb	0	1	48	23-Apr	0	2	52
3-Jan	0	0	40	28-Feb	0	5	49	24-Apr	0	0	54
4-Jan	0	0	45	29-Feb	2	3	50	25-Apr	0	0	57
5-Jan	0	0	44	1-Mar	0	2	51	26-Apr	0	0	61
6-Jan	0	0	43	2-Mar	0	1	48	27-Apr	0	0	64
7-Jan	0	1	43	3-Mar	1	0	48	28-Apr	0	0	62
8-Jan	0	0	43	4-Mar	0	1	48	29-Apr	0	0	n/a
9-Jan	0	10	44	5-Mar	0	0	48	30-Apr	0	0	n/a
10-Jan	0	7	45	6-Mar	0	0	47	1-May	0	0	n/a
11-Jan	0	9	47	7-Mar	0	0	47	2-May	0	0	n/a
12-Jan	0	6	47	8-Mar	0	0	49	3-May	0	0	n/a
13-Jan	0	2	46	9-Mar	0	2	51	4-May	0	0	n/a
14-Jan	0	1	44	10-Mar	0	1	52	5-May	0	0	n/a
15-Jan	0	0	43	11-Mar	0	2	54	6-May	0	0	n/a
16-Jan	0	0	41	12-Mar	0	0	55	7-May	0	0	n/a
17-Jan	0	0	40	13-Mar	0	4	55	8-May	0	0	n/a
18-Jan	0	0	40	14-Mar	0	4	53	9-May	0	0	n/a
19-Jan	0	2	40	15-Mar	0	0	51	10-May	0	0	n/a
20-Jan	0	0	40	16-Mar	0	0	49	11-May	0	0	n/a
21-Jan	0	0	41	17-Mar	0	0	50	12-May	0	0	n/a
22-Jan	0	0	40	18-Mar	0	0	53	13-May	0	0	n/a
23-Jan	0	0	40	19-Mar	0	0	53	14-May	0	0	n/a
24-Jan	0	0	41	20-Mar	1	0	52	15-May	0	0	n/a
25-Jan	0	2	42	21-Mar	0	0	52	16-May	0	0	n/a
26-Jan	0	2	45	22-Mar	0	0	52	17-May	0	0	n/a
27-Jan	0	3	46	23-Mar	0	0	54	18-May	0	0	n/a
28-Jan	0	0	42	24-Mar	0	0	55	19-May	0	0	71
29-Jan	0	1	42	25-Mar	0	5	57	20-May	0	0	67
30-Jan	0	1	42	26-Mar	0	1	55	21-May	0	0	63
31-Jan	0	3	42	27-Mar	0	0	52	22-May	0	0	62
1-Feb	0	2	42	28-Mar	0	0	51	23-May	0	0	60
2-Feb	0	3	43	29-Mar	0	1	51	24-May	0	0	60
3-Feb	0	1	**43**	30-Mar	0	0	51	25-May	0	0	60
4-Feb	0	1	42	31-Mar	0	0	51	26-May	0	0	61
5-Feb	0	0	41	1-Apr	0	0	52	27-May	0	0	62
6-Feb	0	0	43	2-Apr	0	0	53	28-May	0	0	64
7-Feb	0	2	44	3-Apr	0	0	55	29-May	0	0	66
8-Feb	0	2	44	4-Apr	0	0	55	30-May	0	0	67
9-Feb	0	0	44	5-Apr	0	2	55	31-May	0	0	68
10-Feb	0	0	45	6-Apr	0	0	56	1-Jun	0	0	69
11-Feb	0	3	47	7-Apr	0	0	55	2-Jun	0	0	69
12-Feb	0	0	47	8-Apr	0	0	55	3-Jun	0	0	70
13-Feb	0	1	47	9-Apr	0	0	54	4-Jun	0	0	68
14-Feb	0	0	44	10-Apr	0	0	55	**TOTALS**	**3**	**125**	

This station operated from 24 October through 29 June 2009, see Appendix Figure E14. This station was not able to be operated in conjunction with a DIDSON camera due to the high cost of acquiring a DIDSON for the Project. An estimated 188 fall-run passed the fish ladder with an additional 30 estimated downstream (redd count of 15 x 2) resulting in a video estimate of 218 fall-run. Daily results of the Fall 2008 Mill Creek Video Station are presented in Table 7. An estimated 89 adult steelhead were also observed passing the ladder from 24 October through 31 December 2008. Results of the 2009 counts will be available in the 2009 Annual report.

Table 7. Daily information on salmon and steelhead passage, flows, and average water temperature for the 2008-2009 Mill Creek Video Station.

2008-2009 Mill Creek Creek Video Station Salmonid Passage									
Date	**Salmon**	**Steelhead**	**Flow**	**Water F°**	**Date**	**Salmon**	**Steelhead**	**Flow**	**Water F°**
24-Oct	-1	0	43	56	28-Nov	1	0	98	49
25-Oct	3	2	42	56	29-Nov	0	0	97	49
26-Oct	6	1	42	56	30-Nov	0	0	97	49
27-Oct	2	0	43	55	1-Dec	0	0	97	49
28-Oct	13	0	44	56	2-Dec	0	0	97	50
29-Oct	7	3	44	55	3-Dec	0	0	97	48
30-Oct	1	0	47	54	4-Dec	0	0	96	46
31-Oct	20	3	72	56	5-Dec	0	0	96	45
1-Nov	53	24	144	56	6-Dec	0	0	96	45
2-Nov	36	13	286	55	7-Dec	0	0	96	45
3-Nov	26	14	176	54	8-Dec	0	0	91	45
4-Nov	1	8	232	52	9-Dec	-1	0	85	43
5-Nov	-2	5	148	49	10-Dec	0	0	84	43
6-Nov	2	3	128	50	11-Dec	0	0	85	43
7-Nov	-3	1	125	51	12-Dec	0	0	86	43
8-Nov	1	0	124	53	13-Dec	0	0	87	44
9-Nov	3	2	130	53	14-Dec	0	0	89	43
10-Nov	2	1	121	51	15-Dec	0	0	97	43
11-Nov	2	0	114	50	16-Dec	0	0	96	41
12-Nov	4	0	112	52	17-Dec	0	0	90	38
13-Nov	4	0	115	53	18-Dec	0	0	86	37
14-Nov	1	0	116	54	19-Dec	0	0	99	40
15-Nov	1	2	115	53	20-Dec	0	0	97	40
16-Nov	0	0	112	53	21-Dec	0	0	99	41
17-Nov	-1	1	109	53	22-Dec	0	0	141	42
18-Nov	2	0	107	52	23-Dec	0	0	114	42
19-Nov	0	1	106	51	24-Dec	0	0	122	42
20-Nov	1	1	105	50	25-Dec	0	0	400	44
21-Nov	0	0	105	49	26-Dec	0	0	154	41
22-Nov	1	0	104	48	27-Dec	0	2	117	41
23-Nov	0	0	103	48	28-Dec	0	0	110	42
24-Nov	1	0	102	48	29-Dec	0	0	113	44
25-Nov	2	0	100	49	30-Dec	0	0	119	44
26-Nov	0	1	98	50	31-Dec	0	1	110	43
27-Nov	0	1	98	50	**TOTALS**	**188**	**90**		

Deer Creek

Spring-run On 05 August, 2008, Deer Creek, Tehama County, was snorkel surveyed to count holding adult spring-run. There were **140** spring-run observed**.** Twenty-four miles of stream was surveyed, (Harvey-Arrison).

Fall-run Three redd surveys were made in November covering the reach between the USGS stream flow gauge and the Highway 99 East Bridge. These surveys reported a total of 97 redds which was expanded (redds x 2= salmon) to provide an estimate of 194 fall-run Chinook present in 2008 in Deer Creek (Harvey-Arrison).

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APPENDIX A - Data Tables

Appendix Table A1. Average migration timing for the various salmonid runs passing the Red Bluff Diversion Dam 1970-1988.

Percentage and cumulative percentages

		Based on years--82-86 Winter Run		1970-1988 Spring Run		1970-1988 Fall Run		1970-1986 Late-Fall		1970-1988 Steelhead	
	Week	%	cum.%	%	cum.%	%	cum.%	%	cum.%	%	cum.%
	1	1.70	3.45					6.50	55.39	0.97	91.84
JAN	2	1.78	5.23					6.32	61.71	0.80	92.64
	3	0.35	5.57					3.07	64.77	0.61	93.25
	4	1.28	6.85					2.91	67.69	0.50	93.75
	5	2.38	9.23					3.58	71.26	0.29	94.05
FEB	6	3.12	12.35					4.08	75.34	0.45	94.50
	7	3.08	15.44					4.19	79.54	0.56	95.06
	8	0.97	16.41					4.38	83.91	0.53	95.59
	9	6.35	22.76					3.29	87.20	0.49	96.09
MAR	10	7.72	30.48					2.14	89.34	0.46	96.54
	11	9.23	39.70	start				1.74	91.08	0.38	96.92
	12	7.79	47.49	0.10	0.10			3.39	94.47	0.30	97.22
	13	4.91	52.40	0.25	0.35			2.08	96.55	0.28	97.50
	14	7.64	60.04	0.59	0.93			1.82	98.37	0.35	97.85
APR	15	8.26	68.29	0.96	1.89			1.39	99.76	0.26	98.12
	16	9.19	77.48	1.38	3.27			0.24	100.00	0.19	98.31
	17	3.47	80.95	1.63	4.90			end		0.17	98.48
	18	2.02	82.98	1.60	6.50					0.16	98.63
MAY	19	1.60	84.58	1.71	8.21					0.17	98.80
	20	2.17	86.75	2.16	10.37					0.23	99.03
	21	3.09	89.84	2.63	13.00	start				0.18	99.20
	22	2.03	91.87	2.86	15.86	0.01	0.01			0.20	99.40
JUN	23	1.63	93.50	2.61	18.47	0.00	0.02			0.13	99.54
	24	1.84	95.34	2.93	21.40	0.01	0.03			0.14	99.68
	25	0.51	95.85	3.50	24.89	0.03	0.06			0.15	99.82
	26	0.76	96.61	3.10	27.99	0.08	0.14			0.18	100.00
	27	1.60	98.20	3.67	31.66	0.10	0.24			0.13	0.13
JUL	28	0.31	98.52	6.02	37.68	0.29	0.53			0.18	0.31
	29	1.04	99.55	4.75	42.44	0.49	1.02			0.18	0.49
	30	0.44	99.99	3.21	45.65	0.70	1.72			0.22	0.72
	31	0.01	100.00	4.12	49.77	0.96	2.68			0.26	0.98
AUG	32	end		6.97	56.74	1.68	4.36			0.39	1.36
	33			6.07	62.81	2.95	7.31			0.68	2.04
	34			6.75	69.55	3.53	10.84			1.12	3.16
	35			5.74	75.29	3.91	14.75			2.36	5.52
	36			7.22	82.51	4.54	19.29			3.82	9.34
SEP	37			6.68	89.19	5.59	24.88			5.80	15.14
	38			5.23	94.42	8.58	33.46			7.54	22.67
	39			3.70	98.12	9.24	42.70			8.95	31.63
	40			1.19	99.31	10.49	53.19	start		11.75	43.37
OCT	41			0.69	100.00	10.59	63.78	0.26	0.26	11.27	54.65
	42			end		8.97	72.75	2.06	2.32	9.79	64.44
	43					6.99	79.74	2.33	4.65	6.51	70.95
	44					6.70	86.44	3.27	7.92	5.17	76.12
NOV	45					4.68	91.12	4.24	12.16	4.04	80.17
	46					2.71	93.83	3.42	15.58	2.44	82.61
	47					2.23	96.06	3.65	19.23	2.21	84.82
	48	start				1.68	97.74	5.37	24.60	2.05	86.87
DEC	49	0.17	0.17			0.90	98.64	5.27	29.87	1.44	88.31
	50	0.38	0.55			0.66	99.30	5.27	35.14	1.04	89.35
	51	0.49	1.04			0.51	99.81	6.94	42.08	0.69	90.04
	52	0.71	1.75			0.19	100.00	6.81	48.89	0.83	90.87

Appendix Table A2. Summary of 2008 Red Bluff Diversion Dam fish passage information. *Readers note: to better access this and following data tables use the zoom function of your software.*

Trapped at Dam				Percentages by Race			Adjusted	Calculated Number of Fish			Historical Percentages of Runs				Steelhead
Week	F	S	W	%F	%S	%W	Counts	# F	#S	#W	F	S	W	Steelhead	Counts
21	0	2	10	0.0%	16.7%	83.3%	255	0	43	213	0.00%	2.63%	3.09%	0.18%	0
22	0	5	8	0.0%	38.5%	61.5%	108	0	42	66	0.01%	2.86%	2.03%	0.20%	0
23	2	1	4	28.6%	14.3%	57.1%	135	39	19	77	0.00%	2.61%	1.63%	0.13%	0
24	2	5	7	14.3%	35.7%	50.0%	142	20	51	71	0.01%	2.93%	1.84%	0.14%	0
25	n/a	n/a	n/a	60.7%	12.5%	26.8%	204	124	26	55	0.03%	3.50%	0.51%	0.15%	0
26	2	0	0	100.0%	0.0%	0.0%	133	133	0	0	0.08%	3.10%	0.76%	0.18%	0
27	n/a	n/a	n/a	n/a	n/a	n/a	139	139	0	0	0.10%	3.67%	1.60%	0.13%	0
28	n/a	n/a	n/a	n/a	n/a	n/a	152	152	0	0	0.29%	6.02%	0.31%	0.18%	0
29	n/a	n/a	n/a	n/a	n/a	n/a	77	77	0	0	0.49%	4.75%	1.04%	0.18%	0
30	12	0	0	100.0%	0.0%	0.0%	103	103	0	0	0.70%	3.21%	0.44%	0.22%	0
31	2	0	0	100.0%	0.0%	0.0%	258	258	0	0	0.96%	4.12%	0.01%	0.26%	0
32	16	0	0	100.0%	0.0%	0.0%	400	400	0	0	1.68%	6.97%	0.00%	0.39%	5
33	n/a	n/a	n/a	n/a	n/a	n/a	390	390	0	0	2.95%	6.07%	0.00%	0.68%	7
34	n/a	n/a	n/a	n/a	n/a	n/a	1037	1037	0	0	3.53%	6.75%	0.00%	1.12%	13
35	n/a	n/a	n/a	n/a	n/a	n/a	1113	1113	0	0	3.91%	5.74%	0.00%	2.36%	21
36	n/a	n/a	n/a	n/a	n/a	n/a	370	370	0	0	4.54%	7.22%	0.00%	3.82%	5
Totals	36	13	29				5,016	4,355	180	482	19.29%	72.14%	13.25%	10.31%	51
Note: F = Fall, S= Spring, and W = Winter-run							Total 2008	n/a	249	3,635					

Expanded Red Bluff Diversion Dam Trap and Upstream of RBDD System Information-2008

RBDD Actual Trap				Estimate for System above RBDD				
F	S	W	Total	Fall	Spring	Winter	Total	SUMMARY OF MAJOR CATEGORIES
36	13	29	78	22,578	249	3,635	26,463	ALL SALMON (both Ad-clipped and Natural).
32	13	21	66	20,070	249	2,632	22,951	NATURAL (non-ad-clipped) fish.
89%	100%	72%	85%	89%	100%	72%	87%	% Natural Fish.
4	0	8	12	2,509	0	1,003	3,512	AD-CLIPPED fish.
11%	0%	28%	15%	11%	0%	28%	13%	% Ad-Clipped Fish
32	10	12	54	20,070	191	1,504	21,765	ADULTS (all fish greater than 609 mm).
89%	77%	41%	69%	89%	77%	41%	82%	% Adults.
4	3	17	24	2,509	57	2,131	4,697	GRILSE (all fish less than 610mm).
11%	23%	59%	31%	11%	23%	59%	18%	% Grilse.
23	11	23	57	14,837	211	2,883	17,931	MALES (all fish). *Note River estimate #'s for unknowns added here.
64%	85%	79%	73%	66%	85%	79%	68%	% Males (of all fish).
12	2	6	20	7,741	38	752	8,532	FEMALES (all fish). *Note River estimate #'s for unknowns added here
33%	15%	21%	26%	34%	15%	21%	32%	% Females (of all fish).
1	0	0	1	627	0	0	627	UNKNOWN SEX (all fish). These fish already added to above categories.
3%	0%	0%	1%	3%	0%	0%	2%	% Unknown (of all fish). Unknowns proportioned by ratio of known male:female
F	S	W	Total	Fall	Spring	Winter	Total	SUMMARY OF MISCELLANEOUS CATEGORIES
29	10	7	46	18,188	191	877	19,257	Natural Adults
3	3	14	20	1,882	57	1,755	3,694	Natural Grilse
3	0	5	8	1,882	0	627	2,508	Ad-Clipped Adults
1	0	3	4	627	0	376	1,003	Ad-Clipped Grilse
20	11	16	47	12,948	211	2,006	15,164	male natural
11	2	5	18	7,122	38	627	7,787	female natural
1	0	0	1	627	0	0	627	unknown sex natural
3	0	7	10	1,882	0	877	2,759	male ad-clipped
1	0	1	2	627	0	125	753	female ad-clipped
0	0	0	0	0	0	0	0	unknown ad-clipped
19	8	8	35	12,301	153	1,003	13,457	male adults
12	2	4	18	7,769	38	501	8,309	female adults
1	0	0	1	627	0	0	627	unknown adults
4	3	15	22	2,509	57	1,880	4,446	male grilse
0	0	2	2	0	0	251	251	female grilse
0	0	0	0	0	0	0	0	unknown grilse
17	8	4	29	11,043	153	501	11,697	male natural adults
11	2	3	16	7,145	38	376	7,560	female natural adults
1	0	0	1	627	0	0	627	unknown natural adults
3	3	12	18	1,882	57	1,504	3,443	male natural grilse
0	0	2	2	0	0	251	251	female natural grilse
0	0	0	0	0	0	0	0	unknown natural grilse
2	0	4	6	1,254	0	501	1,756	male ad-clipped adults
1	0	1	2	627	0	125	753	female ad-clipped adults
0	0	0	0	0	0	0	0	unknown ad-clipped adults
1	0	3	4	627	0	376	1,003	male ad-clipped grilse
0	0	0	0	0	0	0	0	female ad-clipped grilse
0	0	0	0	0	0	0	0	unknown ad-clipped grilse

Note-Unknown fish for the System estimate have been added proportionally into the male and female categories

Appendix Table A3. Summary of aerial redd counts for Sacramento River System from Keswick Dam downstream to Princeton Ferry from 1969-2008.

Percentages of redds in main-stem Sacramento from aerial flights (up and downstream of RBDD)										
YEAR	Late-Fall		Winter-Run		Spring-Run		Fall-Run		ALL COMBINED	
	% Up	% Down	% Up	% Down	% Up	% Down	% Up	% Down	% Up	% Down
1969	n/a	n/a	n/a	n/a	n/a	n/a	74.4%	25.6%	74.4%	25.6%
1970	n/a	n/a	n/a	n/a	n/a	n/a	85.6%	14.4%	85.6%	14.4%
1971	n/a	n/a	n/a	n/a	n/a	n/a	68.5%	31.5%	68.5%	31.5%
1972	67.2%	32.8%	n/a	n/a	n/a	n/a	63.5%	36.5%	64.8%	35.2%
1973	75.9%	24.1%	n/a	n/a	n/a	n/a	69.9%	30.1%	74.7%	25.3%
1974	n/a	n/a	n/a	n/a	n/a	n/a	60.9%	39.1%	60.9%	39.1%
1975	n/a	n/a	n/a	n/a	n/a	n/a	56.4%	43.6%	56.4%	43.6%
1976	64.7%	35.3%	n/a	n/a	n/a	n/a	72.9%	27.1%	71.9%	28.1%
1977	n/a	n/a	n/a	n/a	n/a	n/a	45.1%	54.9%	45.1%	54.9%
1978	25.6%	74.4%	n/a	n/a	n/a	n/a	46.0%	54.0%	43.2%	56.8%
1979	42.7%	57.3%	n/a	n/a	n/a	n/a	53.9%	46.1%	52.0%	48.0%
1980	n/a	n/a	n/a	n/a	n/a	n/a	48.7%	51.3%	48.7%	51.3%
1981	63.5%	36.5%	87.8%	12.2%	n/a	n/a	63.0%	37.0%	63.5%	36.5%
1982	n/a	n/a	97.0%	3.0%	n/a	n/a	67.1%	32.9%	67.5%	32.5%
1983	71.2%	28.8%	n/a	n/a	81.1%	18.9%	47.6%	52.4%	59.3%	40.7%
1984	78.9%	21.1%	n/a	n/a	93.3%	6.7%	66.6%	33.4%	67.2%	32.8%
1985	81.5%	18.5%	71.8%	28.2%	78.6%	21.4%	55.5%	44.5%	56.3%	43.7%
1986	72.8%	27.2%	n/a	n/a	100.0%	0.0%	64.5%	35.5%	64.9%	35.1%
1987	64.1%	35.9%	95.5%	4.5%	n/a	n/a	71.4%	28.6%	71.0%	29.0%
1988	98.9%	1.1%	74.5%	25.5%	97.4%	2.6%	77.9%	22.1%	78.3%	21.7%
1989	41.9%	56.4%	97.9%	2.1%	100.0%	0.0%	83.3%	16.7%	82.6%	17.4%
1990	87.4%	12.6%	93.3%	6.7%	100.0%	0.0%	66.8%	33.2%	67.8%	32.2%
1991	81.6%	18.4%	100.0%	0.0%	100.0%	0.0%	66.9%	33.1%	67.8%	32.2%
1992	85.8%	14.2%	96.4%	3.6%	100.0%	0.0%	73.8%	26.2%	75.1%	24.9%
1993	100.0%	0.0%	97.7%	2.3%	100.0%	0.0%	72.5%	27.5%	72.7%	27.3%
1994	77.0%	23.0%	100.0%	0.0%	85.1%	14.9%	77.8%	22.2%	77.8%	22.2%
1995	61.9%	38.1%	99.4%	0.6%	90.9%	9.1%	83.5%	16.5%	83.5%	16.5%
1996	n/a	n/a	100.0%	0.0%	100.0%	0.0%	85.5%	14.5%	86.0%	14.0%
1997	n/a	n/a	100.0%	0.0%	99.0%	1.0%	82.8%	17.2%	83.6%	16.4%
1998	97.2%	2.8%	97.9%	2.1%	100.0%	0.0%	90.6%	9.4%	92.5%	7.5%
1999	n/a	n/a	100.0%	0.0%	100.0%	0.0%	78.8%	21.2%	99.0%	1.0%
2000	98.6%	1.4%	100.0%	0.0%	100.0%	0.0%	90.8%	9.2%	94.7%	5.3%
2001	95.2%	4.8%	99.6%	0.4%	96.6%	3.4%	76.9%	23.1%	86.2%	13.8%
2002	100.0%	0.0%	99.8%	0.2%	100.0%	0.0%	69.3%	30.7%	80.5%	19.5%
2003	97.3%	2.7%	99.7%	0.3%	100.0%	0.0%	74.5%	25.5%	79.8%	20.2%
2004	100.0%	0.0%	100.0%	0.0%	100.0%	0.0%	78.1%	21.9%	87.1%	12.9%
2005	90.2%	9.8%	100.0%	0.0%	84.8%	15.2%	78.8%	21.2%	90.9%	9.1%
2006	75.5%	24.5%	99.7%	0.3%	100.0%	0.0%	84.0%	16.0%	86.5%	13.5%
2007	90.4%	9.6%	100.0%	0.0%	100.0%	0.0%	82.6%	17.4%	88.1%	11.9%
2008	92.7%	7.3%	100.0%	0.0%	82.6%	17.4%	93.5%	6.5%	96.4%	3.6%
AVERAGE	79%	21%	96%	4%	96%	4%	71%	29%	74%	26%
n/a = not available										

Appendix Table A4. Summary of the 2008 Late-fall-run Chinook carcass survey results for the main-stem Sacramento River.

2008 Mainstem Sacramento River Late-Fall-Run Chinook Salmon

Survey conducted from 19 Dec 2007 through 15 May 2008. Total of 22 weekly survey periods

Category	Fresh Large Female	Fresh Large Male	Non-Fresh+ Large Female	Non-Fresh+ Large Male	Fresh Small Female	Fresh Small Male	Non-Fresh+ Small Female	Non-Fresh+ Small Male	TOTAL
Tagged	99	28	133	43	0	0	0	1	304
Chopped+	24	12	270	141	0	1	2	1	451
Hatchery	21	5	26	3	0	1	0	3	59
TOTAL	144	45	429	187	0	2	2	5	814
Recaptured	33	9	56	15	0	0	0	0	113

Note: On mainstem carcass survey a large fish is greater than 609 mm in forklength; a fresh fish is clear eyed.

Notes: Weather, and flow conditions combined with full staffing resulted in the 2008 Late-Fall survey being conducted under ideal conditions.

POPULATION ESTIMATE CALCULATIONS: Late-Fall-Run 2008 Mainstem

POPULATION ESTIMATE CATEGORIES	ESTIMATE	Adjustments	
Calculation for large female (Jolly Seber)	975	975	Jolly Seber mark-recapture calculation result
Large Female Ad-Clipped Fish In-River Adjustment	1,133	1.1626	* Based on Large Female Fresh Carcasses with final Ad-clips (20 of 143).
Large Female Fresh Chop (scavenger expansion)	1,157	24	Total number of fresh large female chopped carcasses observed
Number of All Large Females Downstream Redd Factor	1,897	1.6393	2008 Redds below carcass survey (39%) from avg since 2004
Number Large Males (> 649 mm) from CNFH Data	2,005	1.0570	^ Based on the ratio of male large (>649) to female large at the CNFH: 3002-male to 2840-female
Total Females	1,897	1.0000	Based on total females to large females from carcass survey fresh fish sample 0 small to 143 large
Total Males	2,066	1.0303	Based on total males to large males from carcass survey fresh fish sample 2 small to 45 large
	0	0	Number of LF fish transferred to CNFH from Keswick for Spawning
Final Estimate is 3,963 =	3,963		

In-River age composition				
Adult Females >2 yrs	1,897	Jills	0	Adults and Jills based on 610 mm cut-off (0 female <610mm vs 119 >609mm) of 119 total measured females)
Adult Males >2 yrs	2,005	Jacks	61	Adults and Jacks based on 690 mm cut-off (1 males <690mm vs 33 >689mm) of 34 total measured males)

* Adipose clipped carcasses are not part of the Jolly Seber Estimate since they are dissected to remove coded wire tags.

+ Note: Chopped non-fresh carcass categories include skeleton chops that were unknown ad-clip status, and some of these had unknown sex.

^ The carcass survey sex ratio of large fresh fish was 76% female, to account for males leaving the system while alive, the CNFH Late-fall data is instead used (49%).

Appendix Table A5. Summary of the 2008 Winter-run Chinook carcass survey results for the main-stem Sacramento River.

2008 Mainstem Sacramento River Winter-Run Chinook Salmon

Survey conducted from 1 May 2007 through 22 August 2008 Total of 38 survey periods

Category	Fresh Large Female	Fresh Large Male	Non-Fresh Large Female	Non-Fresh Large Male	Fresh Small Female	Fresh Small Male	Non-Fresh Small Female	Non-Fresh Small Male	TOTAL
Tagged	351	99	259	109	0	14	1	8	**841**
Chopped+	27	20	314	128	0	1	1	11	**502**
Hatchery	26	3	21	8	0	5	0	3	**66**
TOTAL	**404**	**122**	**594**	**245**	**0**	**20**	**2**	**22**	**1,409**
Recaptured	207	47	155	58	0	6	1	1	**475**

Note: On mainstem carcass survey a large fish is greater than 609 mm in forklength; a fresh fish is clear eyed.

Notes: The 2008 winter-run carcass survey for the second year in a row reported a low population estimate. Water visibility was fair and the low number was not related to changing survey conditions. Many biologists focused on poor ocean conditions as the primary reason for the decline.

POPULATION ESTIMATE CALCULATIONS: Winter-Run 2008 Mainstem

Jolly-Seber Calculation for large Female	**1368**	**Adjustments**	
Large Female Ad-Clipped Fish In-River Adjustment	**1,462**	1.0688	*Based on large female fresh:(>609mm) with Ad-clips (final) (26 of 404) = 6.4%
Number of All Large Females (>609 mm) Downstream Redds	**1,462**	1.0000	Zero redds below carcass survey location: 441 new redds were observed during WR surveys,
Number Large Males (> 609 mm) from Keswick Trap Data	**1,086**	0.7426	^ Based on large males (>609) (n = 75) to large females (>609) (n = 101) at Keswick Trap
Total Females	**1,462**	1.0000	Based on total females to large females (>609mm) from fresh fish (387 total fresh: 0 small).
Total Males	**1,262**	1.1626	Based on total males to large males (>609mm) from fresh fish (128 total fresh: 19 small)
Number of Fish Removed from Population by LSNFH	**105**	105	USFWS Data from LSNFH Collections 2008.
Final Estimate is	**2,830**	This number includes all Winter run in the Sacramento River: 6 additional estimated to have entered Battle Creek	

In-River age composition

Adult Females >2 yrs	1,462	Jills	0	Adults and Jills based on 600 mm cut-off (0 females <600 mm vs 387 >599mm) of 387 total females)
Adult Males >2 yrs	1,059	Jacks	203	Adults and Jacks based on 670 mm cut-off (22 males <670mm vs 106 >669mm) of 128 total males)

Carcass Population Component Breakdowns:

#'s From top	% of totals clipped	Total clipped	@ LSNFH %unclipped	CATEGORY	HATCHERY FISH In -River	HATCHERY FISH In-LSNFH	HATCHERY FISH Total	NATURAL FISH In - River	NATURAL FISH In-LSNFH	NATURAL FISH Total	OVERALL Total	OVERALL %	
1,462	0.0644	94	0.00226	Number of Adult Females (>599mm)	97	2	99	1,365	51	1,416	**1,515**	**53.5%**	Number of Adult Females
1,059	0.0167	18	0.00226	Number of Adult Males (>669mm)	20	2	22	1,039	46	1,085	**1,107**	**39.1%**	Number of Adult Males
0	0.0000	0	0.00842	Number of Grilse Females (Jills)	0	0	0	0	0	0	**0**	**0.0%**	Number of Grilse Females (Jills)
203	0.2174	44	0.00842	Number of Grilse Males (Jacks)	45	4	49	158	0	158	**207**	**7.3%**	Number of Grilse Males (Jacks)
2,725	Total in-river			TOTALS	163	8	171	2,562	97	2,659	**2,830**	**100.0%**	
105	Total in hatchery												

* Adipose clipped carcasses are not part of the Jolly Seber Estimate since they are dissected to remove coded wire tags.

^ The carcass survey sex ratio of fresh fish was 77% female, to account for males leaving the system while alive, the Keswick Dam Trap data is instead used.

+ Note: Chopped non-fresh carcass categories include skeleton chops that were unknown ad-clip status, and some of these had unknown sex.

@This number is the number of LSNFH hatchery fish which did not receive ad-clips for the year 2003 (.032%) -5 year; 2004(.588%) -4 year ; 2005 (.057%) - 3 year old "adult" fish, 2006 (.842%) -2 yea

@ 5 year old clips, 4 year old clips and 3 year old clips (adults) were averaged in for 2008 since all showed up in the CWT data base (.032 + .588 + .057) / 3 = 0.226.

Appendix Table A6. Summary of the 2008 Fall-run Chinook carcass survey results for the main-stem Sacramento River.

2008 Mainstem Sacramento River Fall-Run Chinook Salmon

Survey conducted from 11 Sept 2008 through 23 Dec 2008. Total of 16 weekly survey periods

Category	Fresh Large Female	Fresh Large Male	Non-Fresh+ Large Female	Non-Fresh+ Large Male	Fresh Small Female	Fresh Small Male	Non-Fresh+ Small Female	Non-Fresh+ Small Male	TOTAL
Tagged	168	78	300	126	0	6	2	4	**684**
Chopped+	18	11	485	287	0	0	1	6	**808**
Hatchery	5	0	12	2	0	1	1	0	**21**
TOTAL	**191**	**89**	**797**	**415**	**0**	**7**	**4**	**10**	**1,513**
Recaptured	35	13	69	19	0	0	0	0	**136**

Note: On mainstem carcass survey a large fish is greater than 609 mm in forklength; a fresh fish is clear eyed.

Notes: Fall run 2008 went well. Low flows due to continued dry water conditions. Problems were encountered in late December when CA budget crisis resulted in survey crew being layed off permanently. This resulted in data management problems for quality control procedures and data entry

POPULATION ESTIMATE CALCULATIONS: Fall-Run 2008 Mainstem

POPULATION ESTIMATE CATEGORIES	ESTIMATE	Adjustments	
Calculation for large female (Jolly Seber)	2,703	2,703	Jolly Seber mark-recapture calculation result
Large Female Ad-Clipped Fish In-River Adjustment	2,776	1.0269	* Based on Large Female Fresh Carcasses with final Ad-clips (5 of 191).
Large Female Fresh Chop (scavenger expansion)	2,794	18	Total number of fresh large female chopped carcasses observed that were never able to be tagged
Number of All Large Females Downstream Redd Factor	10,931	3.9123	Redds within carcass survey location (114) of total of 446 redds
Number Large Males (> 649 mm) from CNFH Data	12,805	1.1714	^ Based on the ratio of male large (>649) to female large at the CBNFH: 5488-male to 4685-female
Total Females	10,931	1.0000	Based on total females to large females from carcass survey fresh fish sample 0 small to 191 large
Total Males	13,812	1.0787	Based on total males to large males from carcass survey fresh fish sample 7 small to 89 large
Final Estimate is 24,743 =	**24,743**		

In-River age composition				
Adult Females >2 yrs	10,931	Jills	0	Adults and Jills based on 610 mm cut-off (0 female <610mm vs 173 >609mm) of 173 total females) from length frequency analysis
Adult Males >2 yrs	12,187	Jacks	1,625	Adults and Jacks based on 670 mm cut-off (10 males <670mm vs 75 >669mm) of 85 total males) from length frequency analysis

* Adipose clipped carcasses are not part of the Jolly Seber Estimate since they are dissected to remove coded wire tags.
+ Note: Chopped non-fresh carcass categories include skeleton chops that were unknown ad-clip status, and some of these had unknown sex.
^ The carcass survey sex ratio of large fresh fish was 68% female, to account for males leaving the system while alive, the CNFH fall data is instead used (46%).

Appendix Table A7. Summary of the Chinook salmon population estimates by run in the Upper Sacramento River Basin, upstream of Princeton (RM164) for the years 1986-2008.

YEAR **	Salmon Totals for Sacramento System above Princeton ^				
	Late-Fall	Winter	Spring	Fall	TOTALS
1986	11,398	2,596	17,657	144,377	176,029
1987	26,438	2,186	11,435	134,686	174,746
1988	12,937	2,886	11,003	159,448	186,273
1989	31,261	696	5,895	96,271	134,123
1990	8,150	430	5,305	71,799	85,683
1991	8,591	211	1,607	56,277	66,686
1992	11,944	1,241	876	51,588	65,650
1993	n/a	387	716	71,314	72,416
1994	n/a	186	2,221	112,923	115,330
1995	n/a	1,297	2,082	169,556	172,935
1996	n/a	1,337	1,520	172,058	174,915
1997	n/a	880	793	249,118	250,791
1998	46,454*	2,992	4,096	119,114	172,666
1999	32,368*	3,288	2,660	308,745	347,061
2000	16,085*	1,352	1,442	195,134	214,013
2001	25,153*	5,523 / **8,224***	3,710	235,222*	272,309
2002	42,420*	9,172 / **7,441***	4,445	570,946*	625,252
2003	9,897*	9,757 / **8,218***	4,550	287,045*	309,710
2004	16,771*	7192 / **7,869***	2,380	163,211*	190,231
2005	18,927*	5,299 / **15,839***	3,690	269,281*	307,737
2006	17,789*	7,415 / **17,304***	3,889	167,907*	206,889
2007	21,515*	6,144/ **2,541***	2,357	52,494*	78,906
2008	11,897*	3,635/ **2830***	861	48,752*	64,341
AVERAGE	20,555	4,010	4,139	169,881	194,117

^ Data from RBDD counts + aerial redd flights + tributary surveys beneath RBDD + other methods when noted

** Totals reflect available data, many streams not surveyed have populations of salmon

* These estimates calculated using carcass survey results, hatchery counts, video counts, angler and redd surveys

Note: Winter run average is calculated using RBDD numbers from 1986 till 2000 and carcass numbers after 2000

QC review of aerial redds revised Winter run year 92 by +1 fish, and year 98 by -10 fish from previous reports

Revisions to numbers at CNFH resulted in updated table numbers from previous years 2000 to 2007 reports

APPENDIX B - Coded-Wire Tag Results Tables

Appendix Table B1. Summary of the Coded-wire tag (CWT) results, **by brood year,** for adipose-fin clipped (hatchery) Chinook salmon, in the Upper Sacramento River Basin in 2008 collected during Sacramento River Salmon and Steelhead Assessment Project escapement surveys.

Brood Year	Clear	Sac. Riv.	Totals	Age	Percent
2006	10	13	23	2 year old	17.0%
2005	9	89	98	3 year old	72.6%
2004	2	9	11	4 year old	8.1%
2003	0	3	3	5 year old	2.2%
No tag data	7	24	31	unknown	
Totals	28	138	166		100.0%

Appendix Table B2. Summary of the 2008 CWT results, **by run,** for adipose-fin clipped (hatchery) Chinook salmon, in the Upper Sacramento River Basin, collected during Sacramento River Salmon and Steelhead Assessment Project escapement surveys.

Location	Spring ^	Fall	Winter	Late-Fall	Totals
Clear Creek	4	17	0	0	21
Sacramento	5	12	45	52	114
Totals	9	29	45	52	135

^ Spring-run CWT data are salmon from the Feather River Hatchery (Clear Creek n = 4), (Sacramento main-stem n = 5).

Appendix Table B3. Summary of the 2008 CWT results, **by hatchery,** for adipose-fin clipped (hatchery) Chinook salmon, in the Upper Sacramento River Basin collected during Sacramento River Salmon and Steelhead Assessment Project escapement surveys.

HATCHERY SOURCE	Total	Percentage
Yuba River Screw Trap	1	0.7%
Coleman National Fish Hatchery	52	38.5%
Feather River Hatchery	37	27.4%
Livingston Stone Hatchery	45	33.3%
CWT's with good reads: Total	135	100.0%
TAG NOT DETECTED (100000)	29	
TAG LOST (200000)	1	
HEAD LOST (300000)	1	
Total Problem CWT's	31	18.7%
Overall CWT (found) Totals	135	percent Tag
Total heads thought to be hatchery	**166**	not detected

Appendix Table B4. Summary of the 2008 CWT results, **by tag code,** for adipose-fin clipped (hatchery) Chinook salmon, in the Upper Sacramento River Basin collected during Sacramento River Salmon and Steelhead Assessment Project escapement surveys.

CWT Code	Hatchery*	Release Location	Brood Year	Run	Survey	**Clear**	**Sac Riv.**
51680	LSNFH	LAKE REDDING	2006	winter	winter		1
51693	LSNFH	LAKE REDDING	2004	winter	winter		1
51766	CNFH	CNFH	2003	late-fall	late-fall		1
51979	LSNFH	LAKE REDDING	2003	winter	winter		1
52273	CNFH	CNFH	2004	late-fall	late-fall		2
52274	CNFH	CNFH	2004	late-fall	late-fall		1
52368	LSNFH	LAKE REDDING	2006	winter	winter		3
52478	LSNFH	LAKE REDDING	2005	winter	winter		2
52479	LSNFH	LAKE REDDING	2005	winter	winter		2
52480	LSNFH	LAKE REDDING	2005	winter	winter		3
52481	LSNFH	LAKE REDDING	2005	winter	winter		4
52482	LSNFH	LAKE REDDING	2005	winter	winter		3
52483	LSNFH	LAKE REDDING	2005	winter	winter		3
52484	LSNFH	LAKE REDDING	2005	winter	winter		1
52485	LSNFH	LAKE REDDING	2005	winter	winter		1
52487	LSNFH	LAKE REDDING	2005	winter	winter		2
52488	LSNFH	LAKE REDDING	2005	winter	winter		1
52774	LSNFH	LAKE REDDING	2005	winter	winter		2
52775	LSNFH	LAKE REDDING	2005	winter	winter		2
52776	LSNFH	LAKE REDDING	2005	winter	winter		2

CWT Code	Hatchery*	Release Location	Brood Year	Run	Survey	**Clear**	**Sac Riv.**
52777	LSNFH	LAKE REDDING	2005	winter	winter		1
52782	CNFH	CNFH	2005	late-fall	late-fall		6
52783	CNFH	CNFH	2005	late-fall	late-fall		3
52789	CNFH	RYDE-KOKET	2005	late-fall	late-fall		1
52790	CNFH	RYDE-KOKET	2005	late-fall	late-fall		1
52791	CNFH	RYDE-KOKET	2005	late-fall	late-fall		3
52794	CNFH	PORT CHICAGO	2005	late-fall	late-fall		1
52864	CNFH	CNFH	2005	late-fall	winter		1
52865	CNFH	CNFH	2005	late-fall	late-fall		2
52866	CNFH	CNFH	2005	late-fall	late-fall		2
52867	CNFH	CNFH	2005	late-fall	late-fall		10
52868	CNFH	CNFH	2005	late-fall	late-fall		5
52869	CNFH	CNFH	2005	late-fall	late-fall		2
52870	CNFH	CNFH	2005	late-fall	late-fall		7
53072	LSNFH	LAKE REDDING	2005	winter	winter		1
53074	LSNFH	LAKE REDDING	2005	winter	winter		6
53374	CNFH	BENICIA	2006	late-fall	late-fall		2
53380	CNFH	DISCOV. PARK	2006	late-fall	late-fall		1
53385	CNFH	CNFH	2006	late-fall	late-fall		1
53399	LSNFH	LAKE REDDING	2006	winter	winter		1
53468	LSNFH	LAKE REDDING	2006	winter	winter		1
53473	LSNFH	LAKE REDDING	2006	winter	winter		1
601010503	FRH	YOLO BYPASS	2005	fall	fall		1
601010601	FRH	YOLO BYPASS	2005	fall	fall		1
601010602	FRH	YOLO BYPASS	2005	fall	fall		1
601010603	FRH	YOLO BYPASS	2005	fall	fall	1	
601010604	FRH	YOLO BYPASS	2005	fall	fall	1	
601010700	FRH	YOLO ELKHORN	2005	fall	fall		1
601030601	Yuba-RST	YUBA RIVER	2004	fall	fall		1
601090209	FRH	ELKHORN RAMP	2006	fall	fall	1	
62313	FRH	SELBY	2005	fall	fall		1
62336	FRH	WICKLAND OIL	2006	spring	fall	1	
62401	FRH	SAN PABLO BAY	2003	spring	fall		1
62410	FRH	WICKLAND PEN	2004	spring	fall	1	1
62414	FRH	WICKLAND PEN	2004	fall	fall	1	
62444	FRH	WICKLAND PEN	2004	spring	fall		1
62447	FRH	WICKLAND PEN	2004	spring	fall		2
62450	FRH	SELBY	2005	fall	fall	2	
62452	FRH	SELBY	2005	fall	fall		1
62454	FRH	SELBY	2005	fall	fall	3	1
62455	FRH	SELBY	2005	fall	fall		1
62457	FRH	SELBY	2005	spring	fall	1	
62460	FRH	NA	2005	spring	fall	1	
62479	FRH	SELBY	2005	fall	fall		1
67000	FRH	SAN PABLO BAY	2006	fall	fall	6	1
67002	FRH	SAN PABLO BAY	2006	fall	fall		1

CWT Code	Hatchery*	Release Location	Brood Year	Run	Survey	**Clear**	**Sac Riv.**
67017	FRH	SAN PABLO BAY	2006	fall	fall	1	
67018	FRH	SAN PABLO BAY	2006	fall	fall	1	
				total		21	114
100000	No Tag	No Tag Detected			fall	6	3
100000	No Tag	No Tag Detected			late-fall		6
100000	No Tag	No Tag Detected			winter		14
200000	CWT lost	CWT Lost			fall	1	
300000	Head lost	Head Unrecovered			late-fall		1
				total		7	24
					2008 TOTALS	28	138
Carcasses examined for ad-clips: These numbers are for general categories; for specific analysis purposes please contact Project biologists						3,105	3,736
Chinook Population estimates (Clear creek- fall-run only)						7,677	31,552

* Hatchery Abbreviations as follows:
CNFH = Coleman National Fish Hatchery
LSNFH = Livingston Stone National Fish Hatchery
FRH = Feather River Hatchery

Appendix Table B5. Summary of the 2008 Sacramento River main-stem carcass survey results comparing adipose-fin-clipped carcasses to non-clipped carcasses for all three runs of Chinook salmon (late-fall, winter and fall).

2008 Annual Summary of CWT and Population Estimates Report for the Upper Sacramento River

Notes for readers analyzing this data:

1. Carcass survey results need attention to prevent errors when comparing cwt proportions to total encountered. It is suggested to use only fresh fish to conduct most analysis because some non-fresh fish, that are chopped, crews are unable to know if that fish had an ad-clip (skeletons) Using fresh fish eliminates this potential error.
2. Crews only collect measurements and data on non-fresh fish if it has an ad-clip. See below for summary of information on this run
3. Original data stored in Access databases by the survey the data was collected on and are available for analysis if requested: dkillam@dfg.ca.gov
4. Skeletons are carcasses without ad-clip determination; crews do not collect heads on these but determine proportion of clips from fresh fish proportions
5. Skeletons are not checked for CWTs and are chopped. If creating ratios (i.e. total fish vs cwts) do not include skeletons these could never produce a cwt even if they had one.
6. 100% of Winter and Late-fall hatchery fish are clipped (though in reality some small % are not clipped) at hatchery,
7. Fall run hatchery fish are not 100% so analysis should be done with extreme caution to details for this run.
8. The late fall spawn over the calender year break. It is standard to report fish from late in 2007 and early in 2008 as 2008 fish. Fish late in 2008 will be included in the 2009 reporting

LATE FALL Upper Sacramento River Carcass Survey Results December 19th, 2007 through May 15th, 2008

2007-2008 LATE_FALL_RUN Mainstem Sacramento River Carcass Survey		**SUMMARY OF SURVEY RESULTS**
Total Fresh Fish encountered (clear eye)	**191**	sum of total fresh fish from survey (includes fresh clips)
Total Potential ad-clips CWT's collected from fresh fish	**27**	this number includes 1 unknown clipped fish that was determined to be natural origin after no tag was found
Total fish encountered-(see note 5)	**814**	sum of all carcassesfrom survey (includes all clips)
Total Potential ad-clips CWT's encountered	**59**	this number includes 1 unknown clipped fish that was determined to be natural origin after no tag was found
Total Population estimate from Carcass Survey	**3,963**	

WINTER-RUN Upper Sacramento River Carcass Survey Results May 1st through August 22nd 2008

2008 WINTER-RUN Mainstem Sacramento River Carcass Survey		**SUMMARY OF SURVEY RESULTS**
Total Fresh Fish encountered (clear eye)	**546**	sum of total fresh fish from survey (includes fresh clips)
Total Potential ad-clips CWT's collected from fresh fish	**34**	this number includes 1 unknown clipped fish that were determined to be natural origin after no tag was found
Total fish encountered- (see note 5)	**1,409**	sum of all carcassesfrom survey (includes all clips)
Total Potential ad-clips CWT's encountered (within the total)	**66**	this number includes 6 unknown clipped fish that were determined to be natural origin after no tag was found
Total Population estimate from Carcass Survey	**2,830**	note 105 of these fish were collected by LSNFH use caution on calculations

FALL-RUN Upper Sacramento River Carcass Survey Results September 11th 2008 through December 23rd, 2008

2008 FALL-RUN Mainstem Sacramento River Carcass Survey		**SUMMARY OF SURVEY RESULTS**
Total Fresh Fish encountered (clear eye)	**281**	sum of total fresh fish from survey (includes fresh clips)
Total Potential ad-clips CWT's collected from fresh fish	**6**	this number includes 0 unknown clipped fish that were determined to be natural origin after no tag was found
Total fish encountered- (see note 5)	**1,513**	sum of all carcassesfrom survey (includes all clips)
Total Potential ad-clips CWT's encountered (within the total)	**21**	this number includes 1 unknown clipped fish that was determined to be natural origin after no tag was found
Total Population estimate from Carcass Survey	**24,743**	
All Sacramento river mainstem ad clipped fish encountered	3,736	
Total Population estimates for three runs combined	31,536	

APPENDIX C - Winter-Run Carcass Survey Summary Notes and Table

The following notes refer to the Table of Winter-run carcass survey results listed in the table immediately following the end of these notes.

1 - Official total System estimate: This is the official number used by the Department and other agencies when reporting winter-run spawning populations (both hatchery and in-river). This data is also available in the Department's "GrandTab", an electronic summary of Central Valley salmon escapements. This number may include winter-run observed in Battle Creek (i.e. the six seen in Battle Creek in 2006). The RBDD number was used from 1996 to 2000. From 2001 to present, the Jolly-Seber estimate from the carcass survey was used. It is important to note that this number includes some winter-run that were estimated to have entered Battle Creek (1996 = 325, 1997 = 44, 2006 = 6).

2 – In river spawner estimate: This number is the number of winter-run salmon thought to have spawned naturally in the Sacramento River. It includes both natural-origin and hatchery fish which spawned in the river. It also includes adults and grilse and fish assumed to have spawned downstream determined by aerial redds.

3a – Removed for hatchery use: This number is the number of fish removed for hatchery brood stock including fish which died before being spawned. It includes mostly natural - origin fish as well as some hatchery-origin fish used for brood stock or sacrificed to determine hatchery-origin. In 1996 and 1997 this number represents the number of fish that were observed in Battle Creek at Coleman National Fish Hatchery. In 2006, five coded-wire tagged winter-run were sacrificed at the Coleman Barrier Weir to determine hatchery-origin. These five fish (along with a one natural winter-run) are not listed here, but are included in the total System estimate row above.

3b - In years 96, 97 and 06 winter-run salmon were surveyed in Battle Creek based on timing and passage dates. In 2006 5 of the six were sacrificed at CNFH and the other passed upstream.

4 – Peterson Standardized estimate: This number represents an expanded and corrected Peterson estimate from earlier carcass surveys that allows for comparison of numbers for all years using identical data parameters to generate an estimate. In this estimate both fresh and non-fresh adult carcasses are used in calculations. In addition grilse numbers and salmon spawning outside of carcass survey area (determined by aerial redd counts) are included. A correction to the Peterson estimate was applied to the 1996-2002 survey results. The correction eliminated the inclusion of tagged fish in the "examined fish" variable of the Peterson formula. A discussion of the details surrounding this correction is available in the 2004 CDFG Winter-run carcass survey report: Appendix 6.

5 - Reported Peterson estimate: This number represents the Peterson estimate reported in the Department reports from 1996-2002. In years 1998-2000 it does not include spawners outside of the carcass area (in 1996-1997 this number was zero, and in 2001-2002 aerial redd data was included). It also includes (except 1996-1997) the data from only fresh adult carcasses. Estimates produced using only fresh carcasses must account for the non-fresh tagged carcasses as fish examined or the Peterson estimate will be incorrect (WR carcass

survey annual report, 2004: Appendix 6). This problem is corrected for by using both fresh and non-fresh data in the Peterson Standardized estimate in the row above.

6 – Jolly-Seber in-river + expansions: This number represents the number of in-river spawners estimated through the use of the Jolly-Seber model and other expansions (including hatchery in-river spawners, downstream spawners, adult males, and grilse). The Jolly-Seber number has been the official Department estimate since 2001. Due to insufficient recaptures in earlier years the Jolly-Seber model was unable to be used, because during the calculations in the Jolly-Seber model if recaptures are zero for any recovery period an error is generated as a result of dividing by zero. This problem was prevalent in earlier years when populations were low and sometimes currently in the beginning and end of the survey or at other times when carcass numbers are low.

7 – RBDD estimate: This number results from calculations at the Red Bluff Diversion Dam fish trap and fish ladders. The RBDD numbers go back to 1967 and represent a long term database for winter-run populations. Since 1986 the RBDD number has been calculated using an average number which recently has resulted in significantly different numbers from the carcass survey. Beginning in 2001 the Department recognized that the carcass survey provided an improved method of counting winter-run salmon. The RBDD number is still developed to provide a continuation of data trends since 1967 but is no longer recognized as the most accurate number but it's use continues to provide some information to determine trends and to different groups analyzing data.

8 – Estimated adult females in-river: This number (from carcass survey) provides an estimate of the number of adult females that can be useful in comparing the number of juveniles produced by the winter-run spawners. The calculation of this number has been "standardized" for the survey years. The numbers in Table 1 years 1996-2000 are based on the standardized Peterson estimates for those years, but these numbers are not the official ones (RBDD was official). From 2001 to Present the number is based on the Jolly-Seber estimates (official). The adult female numbers for years 1996 to 2000 from the RBDD "official" reporting are as follows: 1996 = 421, 1997 = 308, 1998 = 1,183, 1999 = 427, and 2000 = 394. This number is useful in calculating the JPE number used by NMFS to determine the number of juveniles produced each year and the subsequent expectations of "take" numbers to be set for the pumping plants in the South Delta

9a – Total carcasses encountered: This number is the total number of individual carcasses encountered during the survey. It does not include the fish recaptured after they were initially tagged. It can be compared to the total population to determine what proportion of the population was sampled.

9b- Date of peak carcasses encountered: This is the date, during each yearly survey, that the most carcasses were found. It does not include recaptured carcasses. It includes all sizes, sexes and hatchery fish. This date can be used to estimate the timing of peak spawning activity. It can be assumed that the peak carcass date precedes peak spawning by a two-week (14 day) period. Thus if peak carcasses occurs on 15 July then peak spawning likely occurred on 01 July. Caution in interpreting this data should be used, as often there are two or more peaks or many days of similar but slightly lower counts either earlier or later in survey.

10 – Carcasses tagged (all): This number is the total of all carcasses tagged during the surveys. It includes males and females, hatchery fish and grilse. In all surveys the grilse and adults were recorded as separate categories. Starting in 2003 hatchery fish were not survey tagged (because head removed) so they were not part of the tagged numbers. Population estimates were based on adult (large fish (defined as greater than 609mm for years 2003-present, similar-years 96-2002) and expanded for grilse after a large (adult) estimate was made. Subsequent expansions utilize other data to calculate the final population estimate.

11 – Carcasses chopped (all): In Table 1 this number includes the carcasses (including grilse) that were not tagged and did not have a survey jaw tag in them (recaptures). A chopped carcass is typically non-fresh; meaning it is not suitable for tagging or collecting biological data from. They are checked for survey tags placed in prior periods and then chopped in half to avoid re-counting. In some cases, fresh carcasses were chopped if they had been partially eaten by scavengers. It is also important to note that a recaptured previously tagged carcass is also chopped after the tag color and location is recorded, but these are not labeled as Chopped in the database. For purposes of the Peterson estimate calculation the category labeled "Examined" includes both recaptured and chopped carcasses, but not tagged fish.

12 – Carcasses recaptured (all): This number represents the number of previously tagged carcasses (including grilse) that are recaptured in the subsequent survey periods. It does not include hatchery tags or other types of tags applied when the fish was alive. The survey protocols dictate that all recaptures be chopped upon recapture. This was done to ensure that the surveys were conducted as "sampling without replacement" surveys. Starting in 2004, individually numbered "disc" tags were also applied to fresh carcasses to determine carcass decay times and movements over time. These carcasses were not chopped upon recapture but their first recapture date was used as if they were chopped for purposes of the population estimate protocols, (all subsequent recaptures were ignored for mark-recapture purposes). This type of sampling was still "sampling without replacement" but the data on these disc tagged fish can be used in the future as "sampling with replacement" if desired.

13 – Carcasses with a fin-clip (CWT (Hatchery): This number represents the number of adipose-fin clipped or coded-wire tagged (CWT) hatchery fish that were collected during the surveys. A carcass is identified as a hatchery fish by the absence of the adipose-fin that is clipped off during hatchery tagging when the fish was a juvenile. In some cases the carcass is too decayed (or eaten) to tell if the fin has rotted off or was clipped off. In these "unknown clipped" cases the carcass head was removed and the fish was classified as a hatchery fish if a tag was found or as a natural-origin fish if no tag was found. Because some adipose-fin clip fish shed their CWT there are often fish that are obviously clipped, but when dissected have no tag detected. If crews were positive that it was an adipose-fin clip, the fish (with no tag detected) was labeled as a hatchery fish even if no CWT was found. Not all hatchery fish found on the surveys were winter-run as some late-fall-run and spring-run fish were encountered. In recent years (2001-present) the vast majority of hatchery fish were winter-run salmon raised at the Livingston Stone National Fish Hatchery. More specific details of hatchery evaluation are located in the Service's Annual winter-run carcass survey reports.

14 – Number of CWT's found: This number represents the total number of coded-wire tags actually recovered by crews dissecting heads. The tag codes 200000 and 400000 are included here (lost and illegible) as these were actual tags present in the fish. The number given is the total number of cwt(s). The number in the parentheses is the number of cwt's (included in the total) that were from other runs (i.e. CNFH late fall, or Feather River spring-run).

15 – Percent of hatchery fish in population: This value is the percent of hatchery fish present in the overall total population. It is calculated by survey data and the fresh fish ratios of clipped to natural-origin carcasses. The value given here is based upon the database used by the CDFG in generating the population estimate. Values in the USFWS final reports are different but generally similar. The differences occur in the methodologies used by the two agencies. From 2003 to present the value given is based on the "final ad-clip" status in the CDFG database. The final ad-clip data attempts to account for all fish sampled in the survey. Fish are listed as natural if they had no fin clip or had an unknown fin clip that no CWT was detected. Fish that were listed as ad-fin clipped by crews receive a hatchery label. Unknown and partial clipped fish are listed according to the dissection results. Unknowns with CWT are hatchery, those without are natural, this is similar for partials. Another category during dissection is "head lost" or 300000 tag code. In the rare cases of unknown clip and head lost carcasses the final database status is proportioned to the ratio of the rest of the population. In short all sampled carcasses are assigned one origin or the other (natural or hatchery).

16 – Number of hatchery fish in population: This number is the percent of hatchery fish multiplied by the overall population. It is useful in a general sense in comparing year to year numbers. This number may differ from the numbers calculated by the USFWS in their annual reports, but are generally similar (differences due to methodology and category values). For in-depth analysis of hatchery fish populations the USFWS reports provide a more detailed evaluation of hatchery-origin fish.

17 – Percent recapture of tagged (all): This number is the total recaptured divided by the total tagged. It is a useful way to see if there was consistency over the yearly surveys. A high percent recapture indicates that many of the tagged fish released are recovered in future survey periods. A high recapture rate generally means that the survey periods were spaced close in time and that a lot of effort by crews was applied to the survey. Water visibility and number of fish both can lead to varying recapture rates. Turbid water makes the decaying tagged fish harder to see and lowers recapture percentages. Fewer fish makes finding any fish difficult and increases the likelihood of scavengers eating the released tagged fish (often observed at the start and end of the surveys). Recapture rates can vary widely throughout the winter-run survey (more common in fall and late-fall surveys) due to flooding and muddy water for brief periods. This can have a large effect on the final population estimate, especially if such an episode occurs in the busy part of the survey. A flood immediately following the tagging of many new fish will make recapture of these fish difficult and effectively increase the overall population artificially by making it seem as if many fish were tagged but few recaptured. This is one of many possible bias of carcass surveys, but rarely occurs during the winter-run survey.

18- Percent males in carcass survey: This value is the percent (of both jacks and adults and hatchery fish) calculated from the fresh fish ratios determined by the survey for years 96-02.

Beginning in year 2003 and continuing to the present this percentage is calculated using the number of males determined in the population methodology. This methodology attempts to correct for a known bias that some proportion of male fish leave the carcass survey area after spawning and are not available to crews sampling fresh carcasses. This is "corrected" for by using the ratios of winter-run male adults to female adults observed (alive) at the Keswick Dam Fish Trap (Keswick). This ratio is incorporated into the methodology and generates a large male (>609mm) population estimate. This large male number is used to generate a small male number (<610mm) based on the ratio of these categories in the fresh carcasses sampled database of the survey. Additionally all fresh survey males are plotted by length and frequency to visually determine a fork length cut-off (see categories below for this value each year). After plotting, a cut-off length is selected and the jacks vs. adult male numbers are generated. The percent males from years 2003 to present include all fish including those taken into LSNFH.   Years 1996 to 2002 include estimates for in-river fish only.

19 - Percent adult males to all adults in survey: This number compares male to female adults (greater than 2 year old fish). It incorporates fresh fish survey data for years 96-02 and for years 03-present is based on data from Keswick and survey results (includes LSNFH fish).

20 - Percent adult males to all fish in survey: This number is similar to above only it compares the percentage of the adult male category to all the other categories (jacks, jills and adult females). It is useful in comparing year to year trends and gives some indication of the proportions of other categories (includes LSNFH fish).

21 – Percent jacks to all fish in survey: This number compares 2-year old males (jacks) (based on length frequency analysis) to all other fish in the survey (includes adult males and adult females and jills (includes LSNFH fish)).

22 – Number of jacks from survey that were in-river: This number is the estimated number of jacks present in the river during the year (includes LSNFH fish).

23 – Percent jacks to all fish from RBDD: This number compares the number of jacks (based on fork length cut-off of <610 mm) to all other winter-run encountered at annually at the RBDD.

24 – Number of jacks from the RBDD expanded for the entire system: This number is the estimated number of jacks present in the river for each year based on RBDD data. It would include jacks entering into LSNFH. It does not include the few jacks downstream of RBDD winter-run fish.

25 – Fork length cut-off for jacks (mm) from survey: This number is the fork length cut-off determined by biologists after viewing a length frequency graph of male fish lengths. For years 96-02 it was chosen post-survey but may have conflicted with the mark-recapture efforts since mark-recapture requires a pre-season cut-off to determine adult size during data collection efforts. For years 03 to present a 610 mm cut-off is used to collect mark-recapture data on **small** and **large** carcasses. This eliminates the conflict between mark-recapture data and biological grilse vs. adult data, because the mark recapture generates an estimate, and the number of jacks is derived from within the confines of this estimate after it is complete. Afterwards, the length frequency histogram of all males is observed by biologists and a fork

length cut-off is chosen specific to biological data of fresh carcasses independent of mark-recapture data.

26 – Fork length cut-off for jacks from RBDD data: The traditional cut-off for jacks and jills has been 610 mm. Of note is that Coleman National Fish Hatchery (CNFH) uses 650 as their cut-off for jacks. These two numbers may not be that different since fish at RBDD are not typically mature. As the male reaches maturity it's upper snout lengthens and fork lengths may increase on some jacks to be comparable with either site's cut-off.

27 – Percent females in carcass survey: Similar to footnote 18- for females. Exception is that females are calculated for years 03 to present by the mark recapture estimate. The assumption made is that large females are truly represented by the mark-recapture survey alone and that no bias is associated with this data. (Unlike males which use Keswick fish trap data).

28 – Percent adult females to all adults from survey: Similar to footnote 19 except for females.

29 - Percent adult females to all fish from survey: Similar to footnote 20 except for females.

30 – Percent jills to all fish from survey: Similar to footnote 21 except for females.

31 – Fork length cut-off for jills from survey: Similar to footnote 25 except for females.

32- Number of jills from survey that were in-river: Similar to footnote 22 except for females.

33 – Percent adults vs. percent grilse from survey: This number summarizes the proportion of adults and grilse for all winter-run from each year. It includes all adults vs. all grilse (jack and jills). For years 96 to 00 it is based on the standardized Peterson estimate (footnote 4) for 01-02 it was based on Jolly-Seber in-river estimate (footnote 6). For years 03 to present it is based on all fish, including LSNFH fish.

34 – Number of adults vs. number of grilse from survey: These numbers added together equal the standardized Peterson (footnote 4) for years 96-00. For years 01-02 they equal the Jolly-Seber estimate in river estimate (footnote 6) and for years 2003-to-present equals the overall official estimate including the LSNFH fish.

35 – Percent female spawn success: This number is the ratio of completely spawned to unspawned fresh female fish primarily based on crew's judgment of carcass appearance, (e.g. shrunken abdomen, worn tail). Unsuccessful spawners are those with without tail damage or those with more than a small (handful) of eggs remaining in their body cavity. Unspawned winter-run female fish are uncommon. Otters and incidental hooking by trout anglers are thought to be primary causes. Habitat or water quality limitations have not affected winter-run in recent years.

36 - Percent of redds within the survey area: This number represents the percentage of new redds observed within the boundaries of the carcass survey by the Department's aerial redd flights. These flights are to count new redds and determine the spawning distributions of all

salmon runs on the main-stem Sacramento River. The winter-run flights are typically done in helicopters (planes if no helicopter available) and begin downstream of RBDD in Corning, California. If winter-run redds are observed outside of the survey area the population estimate is expanded by the percent of redds noted outside the boundaries.

37 – Total number of winter-run redds observed: This is the total number of new redds counted by observer on helicopter or fixed wing plane. Typically the flights are flown from mid-April to late-August. Only new redds are counted and counting starts at Woodson Bridge in Corning and goes up to Keswick Dam.

38 – Survey start date: The date in which new fresh fish are tallied as winter-run salmon. Typically carcass surveys are ongoing year round on the Sacramento River. After the winter-run survey commences any older recaptures from the late-fall survey (few) are removed from winter-run databases. After two weeks from the start date all fish (decayed, skeletons, etc) encountered are tallied as winter-run.

39 – Survey end date: The end of the intensive seven days per week sampling for winter-run carcasses.

40 – Number of survey periods: This is the number of survey periods typically characterized by a single pass through the entire survey area marking fish with a single color tag. A new period starts the next day (2003 to present; periods are 3 days long). A survey period starts at the downstream end of the river distance being surveyed and continues until the crews reach the Keswick Dam.

41 – Survey river mile range: This category lists the range of river miles surveyed by crews from 1996 to present. Surveys have shortened or lengthened based on opinions of biologists to ensure that the majority of winter-run spawning is encompassed by the carcass survey.

42 – Flow range in cfs: This number is determined post season by analysis of Keswick outflow data on the CDEC website.

43 – Water temperature: This number is determined by crews taking a single water temperature using a low-cost thermometer at the end of each day in the section just completed. It should not be used for rigorous in depth analysis of temperature relationships for winter-run.

44 - Visibility range: This number is the visibility in feet observed by the crews after finishing a section each day. It is usually taken with the water temperature measurement above. Due to the large variability in techniques and crews over the years it should not be used for in-depth analysis of data. It is designed to provide a general sense of the daily visibility conditions (e.g. wind, glare, turbidity) that crews encounter on the river. For years 96-02 a Secchi disc was lowered on a flexible measuring tape into a deep hole on the river and the resulting depth at which it was no longer visible recorded. For years 03 to present a Secchi disc was attached to a rigid measuring pole and the depth at which the disc was no longer visible was recorded. A (+) after a number in this category represents that the Secchi was visible past the depth available for crews to reach (i.e. either to the river bottom or the length of the pole).

Appendix Table C1. Summary of the 1996 to 2008 winter-run carcass survey data categories. Use zoom function of software for details

Winter-run Carcass Summary Survey		Year												
Category	Note	**1996**	**1997**	**1998**	**1999**	**2000**	**2001**	**2002**	**2003**	**2004**	**2005**	**2006**	**2007**	**2008**
Official total System estimate	1	**1337**	**880**	**2992**	**3288**	**1352**	**8,224**	**7,464**	**8,218**	**7,869**	**15,839**	**17,304**	**2,541**	**2,830**
In-river spawner estimate	2	1,012	836	2,893	3,264	1,263	8,120	7,360	8,133	7,784	15,730	17,205	2,487	2,725
Into Hatchery (CNFH or LSNFH)	3a	325	44	99	24	89	104	104	85	85	109	93	54	105
Winter-run surveyed in Battle Creek	3b	237	226	0	0	0	0	0	0	0	0	6	0	0
Peterson Standardized estimate	4	273	564	2,162	1,136	4,290	6,760	6,106	6,602	6,205	13,549	13,924	2,161	2,466
Reported Peterson estimate	5	820	2,053	5,501	2,262	6,670	11,502	10,541	n/a	n/a	n/a	n/a	n/a	n/a
Jolly-Seber in-river + expansions	6	n/a	n/a	n/a	n/a	6,023	8,120	7,360	8,133	7,784	15,730	17,205	2,487	2,725
RBDD estimate	7	1,337	880	2,992	3,288	1,352	5,523	9,169	9,757	7,192	5,299	7,436	6,144	3,635
Estimated Adult Females in-river-survey	8	193	395	1908	817	3,483	5,262	5,682	5,179	3,252	9,005	8,811	1,542	1,462
Carcasses Encountered on survey	9a	118	239	785	475	2,482	5,145	4,959	4,549	3,280	8,771	7,698	1,581	1,409
Date of peak carcasses encountered	9b	15-July	11-July	01-July	22-June	02-July	08-July	15-July	20-July	13-July	15-July	14-July	14-July	5-July
Carcasses Tagged (all)	10	86	191	575	313	1,954	4,364	3,770	3,457	2,072	4,758	4,121	1,063	841
Carcasses Chopped (all)	11	32	48	208	162	482	781	1,189	882	958	2,448	2,656	427	502
Carcasses Recaptured (all)	12	13	22	75	57	829	2,200	2,159	2,175	1,128	3,001	2,206	716	475
Carcasses with fin clip (CWT / Hatchery)	13	0	5	4	4	4	155	208	179	250	1,565	885	83	60
Number of CWT's found	14	0	5 (0)	2 (0)	2 (1)	1 (1)	124 (0)	148 (8)	134 (0)	168 (1)	1269 (1)	776 (0)	66 (1)	46 (1)
Percent Hatchery Fish in Population	15	0	2.1%	0.5%	0.8%	0.2%	5.2%	5.3%	5.3%	10.2%	20.0%	13.3%	5.7%	6.0%
Number of Hatchery Fish in Population	16	0	12	11	10	7	428	396	434	804	3,165	2,307	144	171
Percent Recapture of Tagged (all)	17	15%	12%	13%	18%	42%	50%	57%	63%	54%	63%	54%	67%	56%
Percent males in carcass survey	18	29%	25%	12%	25%	18%	35%	22%	36%	58%	43%	48%	38%	46%
Percent adult males to all adults: survey	19	13%	24%	10%	11%	17%	29%	18%	32%	43%	38%	48%	35%	42%
Percent adult males to all fish: survey	20	11%	22%	10%	9%	16%	26.20%	17%	30%	32%	35%	47%	33%	39%
Percent jacks to all fish: survey	21	18%	4%	2%	17%	2%	9%	5%	6.1%	25.9%	7.3%	1.9%	5.2%	7.3%
Number of Jacks: survey: in-river	22	50	21	40	189	90	738	360	504	2041	1156	327	131	207
Percent jacks to all fish: RBDD	23	42%	37%	18%	58%	46%	65%	13%	34%	64%	30%	35%	51%	58.6%
Number of jacks from RBDD-system	24	564	328	522	1,907	620	3,566	1,152	3,282	4,570	1,604	2,630	3,140	2,131
Forklength cutoff for jacks (mm): survey	25	< 645	< 645	< 595	< 635	< 605	< 665	< 685	< 610	< 710	< 670	< 660	< 670	< 670
Forklength cutoff for jacks (mm): RBDD	26	< 610	< 610	< 610	< 610	< 610	< 610	< 610	< 610	< 610	< 610	< 610	< 610	< 610
Percent females in carcass survey	27	71%	75%	88%	75%	82%	65%	78%	64%	42%	57%	52%	62%	53.5%
Percent adult females to all adults: survey	28	87%	76%	90%	89%	83%	71%	82%	68%	57%	62%	52%	65%	57.8%
Percent adult females to all fish: survey	29	71%	70%	88%	72%	81%	64.30%	77%	64%	42%	57%	51%	62%	53.5%
Percent jills to all fish: survey	30	0%	4.7%	0%	2.9%	0.6%	0.4%	0.7%	0.5%	0.5%	0.3%	0.3%	0.3%	0.0%
Forklength cutoff for jills (mm): survey	31	< 645	< 645	none	< 595	< 585	< 605	< 545	< 610	< 610	< 600	< 590	< 600	< 600
Number of Jills: survey: in-river	32	0	27	0	32	25	33	51	39	41	42	51	8	0
Percent Adults vs Percent Grilse- survey	33	82%-18%	92%-8%	98%-2%	80%-20%	97%-3%	90%-10%	94%-6%	93%-7%	74%-26%	93%-7%	98%- 2%	95%-5%	92%-8%
Number Adults vs Number Grilse (survey)	34	223 - 50	516 - 48	2122 - 40	915 - 221	4175- 115	7349- 771	6949- 411	7675- 543	5786- 2083	14683-1156	16926-378	2402- 139	2622-207
Percent female spawn success	35	95%	96%	95%	97%	100%	99%	99%	99%	99%	98%	98%	98%	98%
Percent of redds within survey	36	100%	100%	94%	92.5%	72.1%	89.5%	95.9%	99.3%	100%	100%	99.7%	96.2%	100.0%
Total number of winter redds observed	37	70	30	141	1,144	588	1,396	610	878	621	1,968	717	288	441
Survey Date Start	38	4-Apr	30-Apr	5-May	5-May	3-May	2-May	1-May	30-Apr	30-Apr	28-Apr	1-May	1-May	1-May
Survey Date End	39	5-Sep	29-Aug	28-Aug	27-Aug	29-Aug	29-Aug	27-Aug	4-Sep	3-Sep	2-Sep	25-Aug	24-Aug	22-Aug
Number of Survey Periods	40	19	41	39	38	40	40	40	41	43	43	39	39	38
Survey River Mile Range	41	271 -301	288 -301	288 -301	288 -301	288 -301	288 -301	288 -301	286.5 -301	273.5-301	273.5-301	276 -301	276 -301	276 -301
Flow range (cfs x 1000)	42	7 - 16	8 - 15	10 - 23	9 - 13	8 - 16	8 - 15	7 - 15	8 - 29	8 - 16	4 - 37	6 - 15	8 - 15	8 - 13
Water temp (°F) range	43	52 - 59	49 - 52	50 - 54	50 - 54	51 - 54	50 - 55	50 - 56	50 - 54	50 - 57	51 - 59	50 - 56	50 - 58	50 - 58
Visibility range (ft)	44	n/a	3 - 10	4.5 - 11	6 - 11	9 - 21	14 - 21	17 - 22	8 - 15+	8.5 - 16	2 - 16+	5 - 13	2.5 - 20+	10.5 - 16+

Gray numbers are updated numbers from previous publication.

APPENDIX D - Previous Annual Report Salmon Population Revisions

The following Tables are meant to replace the existing tables located in previous SRSSAP annual reports for years 2000 to 2007. The revised numbers are primarily the result of a reallocation to different runs of Coleman National Fish Hatchery salmon based on a review of coded-wire tag databases conducted in 2008 by USFWS staff. Readers are advised to print them out and replace the existing tables in any hardcopies of former reports they may have. Revised annual reports will be made available electronically on the web on the CALFISH.org site select CDFG Red Bluff and select the desired report. Revised reports should be available sometime before September of 2010.

Appendix Table D1. Year 2000 Revision: Chinook Salmon Spawner Populations for the Upper Sacramento River System, 2000 Annual Report-page18

Appendix Table 1. Summary of Chinook salmon populations estimates for Sacramento River System from Keswick Dam downstream to Princeton Ferry in 2000.

LOCATION	Late-Fall-Run	Winter-run	Spring-Run	Fall-Run
Red Bluff to Keswick Dam (upstream of RBDD)				
Sacramento River Main-Stem	8,580	1,261	43	87,793
Livingston Stone Hatchery	0	89		
Battle Creek Coleman Hatchery	4,181			21,659
Battle Creek Above hatchery	0	2	78	
Battle Creek Below Hatchery	n/a ^			53,447
Bear Creek	n/a			n/a
Clear Creek	n/a		9	6,687
Cow Creek	n/a			n/a
Cottonwood Creek	n/a		122	n/a
Angler Harvest	1,793	0	0	6,455
SUB-TOTAL UPSTREAM OF RBDD	*14,554*	*1,352*	*252*	*176,041*
Red Bluff to Princeton (downstream of RBDD)				
Sacramento River Main-Stem	122		0	8,895
Mill Creek	n/a		544	n/a
Deer Creek	n/a		637	n/a
Antelope Creek	n/a		9	n/a
Angler Harvest	1,409	0	0	10,198
SUB-TOTAL DOWNSTREAM OF RBDD	*1,531*	*0*	*1,190*	*19,093*
SYSTEM GRAND TOTAL	**16,085**	**1,352**	**1,442**	**195,134**
All Upper Sacramento River Basin (Keswick Dam to Princeton) $				
2000 TOTAL SALMON ALL COMBINED:			**214,013**	
DATA Revised 8-2009 from previous based on USFWS revison of CNFH databases				
NOTE: These values represent minimum numbers, unsurveyed waters have additional smaller salmon populations				
^ n/a: Is not available, represents salmon present but no estimate available.				
$ Numerous tributaries not surveyed, also Big Chico creek survey results are available from other DFG project				

Appendix Table D2. Year 2001 Revision: Chinook Salmon Spawner Populations for the Upper Sacramento River System, 2001 Annual Report-page19

Appendix Table 1. Summary of Chinook salmon populations estimates for Sacramento River System from Keswick Dam downstream to Princeton Ferry in 2001.

LOCATION	Late-Fall-Run	Winter-run	Spring-Run	Fall-Run
Red Bluff to Keswick Dam (upstream of RBDD)				
Sacramento River Main-Stem	18,351	8,085	600	57,920
Livingston Stone Hatchery		104		
Battle Creek Coleman Hatchery	2,439			24,698
Battle Creek Above hatchery	98		111	
Battle Creek Below Hatchery	n/a ^		0	100,604
Bear Creek	n/a		n/a	n/a
Clear Creek	n/a		0	10,865
Cow Creek	n/a		n/a	n/a
Cottonwood Creek	n/a		244	n/a
Angler Harvest	1,515	0	0	4,822
SUB-TOTAL UPSTREAM OF RBDD	*22,403*	*8,189*	*955*	*198,909*
Red Bluff to Princeton (downstream of RBDD)				
Sacramento River Main-Stem	925	35	21	17,376
Mill Creek	n/a		1,104	n/a
Deer Creek	n/a		1,622	n/a
Antelope Creek	n/a		8	n/a
Angler Harvest	1,825	0	0	18,937
SUB-TOTAL DOWNSTREAM OF RBDD	*2,750*	*35*	*2,755*	*36,313*
SYSTEM GRAND TOTAL	**25,153**	**8,224**	**3,710**	**235,222**
All Upper Sacramento River Basin (Keswick Dam to Princeton) $				
2001 TOTAL SALMON ALL COMBINED:			**272,309**	
DATA Revised 8-2009 from previous based on USFWS revison of CNFH databases				
NOTE: These values represent minimum numbers, unsurveyed waters have additional smaller salmon populations				
^ n/a: Is not available, represents salmon present but no estimate available.				
$ Numerous tributaries not surveyed, also Big Chico creek survey results are available from other DFG project				

Appendix Table D3. Year 2002 Revision: Chinook Salmon Spawner Populations for the Upper Sacramento River System, 2002 Annual Report-page24

Appendix Table 1. Summary of Chinook salmon populations estimates for Sacramento River System from Keswick Dam downstream to Princeton Ferry in 2002.

LOCATION	Late-Fall-Run	Winter-run	Spring-Run	Fall-Run
Red Bluff to Keswick Dam (upstream of RBDD)				
Sacramento River Main-Stem	36,004	7,325	195	45,552
Livingston Stone Hatchery	0	104		
Battle Creek Coleman Hatchery	4,186			65,924
Battle Creek Above hatchery	216		222	0
Battle Creek Below Hatchery	n/a ^			397,149
Bear Creek	n/a		n/a	n/a
Clear Creek	n/a		66	16,071
Cow Creek	n/a		n/a	n/a
Cottonwood Creek	n/a		125	n/a
Angler Harvest	745	0	0	7,149
SUB-TOTAL UPSTREAM OF RBDD	*41,151*	*7,429*	*608*	*531,845*
Red Bluff to Princeton (downstream of RBDD)				
Sacramento River Main-Stem	0	12	0	20,138
Mill Creek	n/a		1,594	2,611
Deer Creek	n/a		2,195	n/a
Thomes Creek	n/a		2	n/a
Antelope Creek	n/a		46	n/a
Angler Harvest	1,296	0	0	16,352
SUB-TOTAL DOWNSTREAM OF RBDD	*1,269*	*12*	*3,837*	*39,101*
SYSTEM GRAND TOTAL	**42,420**	**7,441**	**4,445**	**570,946**
All Upper Sacramento River Basin (Keswick Dam to Princeton) [$]				
2002 TOTAL SALMON ALL COMBINED:	**625,252**			
DATA Revised 8-2009 from previous based on USFWS revison of CNFH databases				
NOTE: These values represent minimum numbers, unsurveyed waters have additional smaller salmon populations				
^ n/a: Is not available, represents salmon present but no estimate available.				
$ Numerous tributaries not surveyed, also Big Chico creek survey results are available from other DFG project				

Appendix Table D4. Year 2003 Revision: Chinook Salmon Spawner Populations for the Upper Sacramento River Basin 2003 Annual Report-page 25

Appendix Table 1. Summary of Chinook salmon populations estimates for Sacramento River Basin from Keswick Dam downstream to Princeton Ferry in 2003.

LOCATION	Late-Fall-Run	Winter-run	Spring-Run	Fall-Run
Red Bluff to Keswick Dam (upstream of RBDD)				
Sacramento River Main-Stem	**5,346**	**8,105**	**0**	**66,485**
Livingston Stone Hatchery	**0**	**85**		**0**
Battle Creek Coleman Hatchery	**3,183**			**88,234**
Battle Creek Above hatchery	**57**		**221**	
Battle Creek Below Hatchery	**n/a ^**			**64,764**
Bear Creek	**n/a**		**n/a**	**n/a**
Clear Creek	**n/a**		**25**	**9,475**
Cow Creek	**n/a**		**n/a**	**n/a**
Cottonwood Creek	**n/a**		**73**	**n/a**
Angler Harvest (fall based on avg harvest)	**414**	**0**	**0**	**11,883**
SUB-TOTAL UPSTREAM OF RBDD	***9,000***	***8,190***	***319***	***240,841***
Red Bluff to Princeton (downstream of RBDD)				
Sacramento River Main-Stem	**148**	**28**	**0**	**22,744**
Mill Creek	**n/a**		**1,426**	**2,426**
Deer Creek	**n/a**		**2,759**	**n/a**
Antelope Creek	**n/a**		**46**	**n/a**
Angler Harvest (fall based on avg harvest)	**749**	**0**	**0**	**21,034**
SUB-TOTAL DOWNSTREAM OF RBDD	***897***	***28***	***4,231***	***46,204***
SYSTEM GRAND TOTAL	**9,897**	**8,218**	**4,550**	**287,045**
All Upper Sacramento River Basin (Keswick Dam to Princeton) [$]				
2003 TOTAL SALMON ALL COMBINED:			**309,710**	
DATA Revised 8-2009 from previous based on USFWS revison of CNFH databases				
NOTE: These values represent minimum numbers, unsurveyed waters have additional smaller salmon populations				
^ n/a: Is not available, represents salmon present but no estimate available.				
$ Numerous tributaries not surveyed, also Big Chico creek survey results are available from other DFG project				

Appendix Table D5. Year 2004 Revision: Chinook Salmon Spawner Populations for the Upper Sacramento River Basin 2004 Annual Report-page 3

Table 1. Summary of Chinook salmon population estimates for the USRB (Sacramento River Basin from Keswick Dam downstream to Princeton Ferry) in 2004.

LOCATION	Late-Fall-Run	Winter-run	Spring-Run	Fall-Run
Red Bluff to Keswick Dam (upstream of RBDD)				
Sacramento River Main-Stem	8,824	7,784	370	34,050
Livingston Stone Hatchery		85		
Battle Creek Coleman Hatchery	5,166			69,172
Battle Creek Above hatchery	40		90	
Battle Creek Below Hatchery	n/a ^			23,861
Bear Creek	n/a		n/a	n/a
Clear Creek	n/a		98	6,365
Cow Creek	n/a		n/a	n/a
Cottonwood Creek	n/a		17	n/a
Angler Harvest (based on average harvests)	1,373	0	0	6,757
SUB-TOTAL UPSTREAM OF RBDD	*15,403*	*7,869*	*575*	*140,205*
Red Bluff to Princeton (downstream of RBDD)				
Sacramento River Main-Stem	0	0	0	9,554
Mill Creek	n/a		998	1,192
Deer Creek	n/a		804	300
Antelope Creek	n/a		3	n/a
Angler Harvest (based on average harvests)	1,368	0	0	11,960
SUB-TOTAL DOWNSTREAM OF RBDD	*1,368*	*0*	*1,805*	*23,006*
SYSTEM GRAND TOTAL	**16,771**	**7,869**	**2,380**	**163,211**
All Upper Sacramento River Basin (Keswick Dam to Princeton) $				
2004 TOTAL SALMON ALL COMBINED:			**190,231**	

DATA Revised 8-2009 from previous based on USFWS revison of CNFH databases
NOTE: These values represent minimum numbers, unsurveyed waters have additional smaller salmon populations
^ n/a: Is not available, represents salmon present but no estimate available.
$ Numerous tributaries not surveyed, also Big Chico creek survey results are available from other DFG project

Appendix Table D6. Year 2005 Revision: Chinook Salmon Spawner Populations for the Upper Sacramento River Basin 2005 Annual Report-page 3

Table 1. Summary of Chinook salmon population estimates for the USRB (Sacramento River Basin from Keswick Dam downstream to Princeton Ferry) in 2005.

LOCATION	Late-Fall-Run	Winter-run	Spring-Run	Fall-Run
Red Bluff to Keswick Dam (upstream of RBDD)				
Sacramento River Main-Stem	9,565	15,730	0	44,950
Livingston Stone Hatchery		109		0
Battle Creek Coleman Hatchery	5,562			142,673
Battle Creek Above hatchery	23		73	
Battle Creek Below Hatchery	n/a ^			20,520
Bear Creek	n/a		n/a	n/a
Clear Creek	n/a		69	14,824
Cow Creek	n/a		n/a	n/a
Cottonwood Creek	n/a		47	n/a
Angler Harvest (based on average harvests)	1,373	0	0	11,148
SUB-TOTAL UPSTREAM OF RBDD	*16,523*	*15,839*	*189*	*234,115*
Red Bluff to Princeton (downstream of RBDD)				
Sacramento River Main-Stem	1,035	0	30	12,062
Mill Creek	n/a		1,150	2,426
Deer Creek	n/a		2,239	946
Antelope Creek	n/a		82	n/a
Angler Harvest (based on average harvests)	1,368	0	0	19,732
SUB-TOTAL DOWNSTREAM OF RBDD	*2,403*	*0*	*3,501*	*35,166*
SYSTEM GRAND TOTAL	**18,927**	**15,839**	**3,690**	**269,281**
All Upper Sacramento River Basin (Keswick Dam to Princeton) $				
2005 TOTAL SALMON ALL COMBINED:			**307,737**	

DATA Revised 8-2009 from previous based on USFWS revison of CNFH databases
NOTE: These values represent minimum numbers, unsurveyed waters have additional smaller salmon populations
^ n/a: Is not available, represents salmon present but no estimate available.
$ Numerous tributaries not surveyed, also Big Chico creek survey results are available from other DFG project

Appendix Table D7. Year 2006 Revision: Chinook Salmon Spawner Populations for the Upper Sacramento River Basin 2006 Annual Report-page 3

Table 1. Summary of Chinook salmon population estimates for the USRB (Sacramento River Basin from Keswick Dam downstream to Princeton Ferry) in 2006.

LOCATION	Late-Fall-Run	Winter-run	Spring-Run	Fall-Run
Red Bluff to Keswick Dam (upstream of RBDD)				
Sacramento River Main-Stem	7,684	17,157	0	46,568
Livingston Stone Hatchery		93		0
Battle Creek Coleman Hatchery	4,827	5		57,832
Battle Creek Above hatchery	50	1	221	
Battle Creek Below Hatchery	n/a ^			19,493
Bear Creek	n/a		n/a	n/a
Clear Creek	n/a		77	8,422
Cow Creek	n/a		n/a	4,130
Cottonwood Creek	n/a		55	n/a
Angler Harvest (based on average harvests)	1,373	0	0	6,951
SUB-TOTAL UPSTREAM OF RBDD	*13,934*	*17,256*	*353*	*143,395*
Red Bluff to Princeton (downstream of RBDD)				
Sacramento River Main-Stem	2,487	48	0	8,900
Mill Creek	n/a		1,002	1,403
Deer Creek	n/a		2,432	1,905
Antelope Creek	n/a		102	n/a
Angler Harvest (based on average harvests)	1,368	0	0	12,304
SUB-TOTAL DOWNSTREAM OF RBDD	*3,855*	*48*	*3,536*	*24,512*
SYSTEM GRAND TOTAL	**17,789**	**17,304**	**3,889**	**167,907**
All Upper Sacramento River Basin (Keswick Dam to Princeton) $				
2006 TOTAL SALMON ALL COMBINED:	**206,889**			

DATA Revised 8-2009 from previous based on USFWS revison of CNFH databases
NOTE: These values represent minimum numbers, unsurveyed waters have additional smaller salmon populations
^ n/a: Is not available, represents salmon present but no estimate available.
$ Numerous tributaries not surveyed, also Big Chico creek survey results are available from other DFG project

Appendix Table D8. Year 2007 Revision: Chinook Salmon Spawner Populations for the Upper Sacramento River Basin 2007 Annual Report-page 3

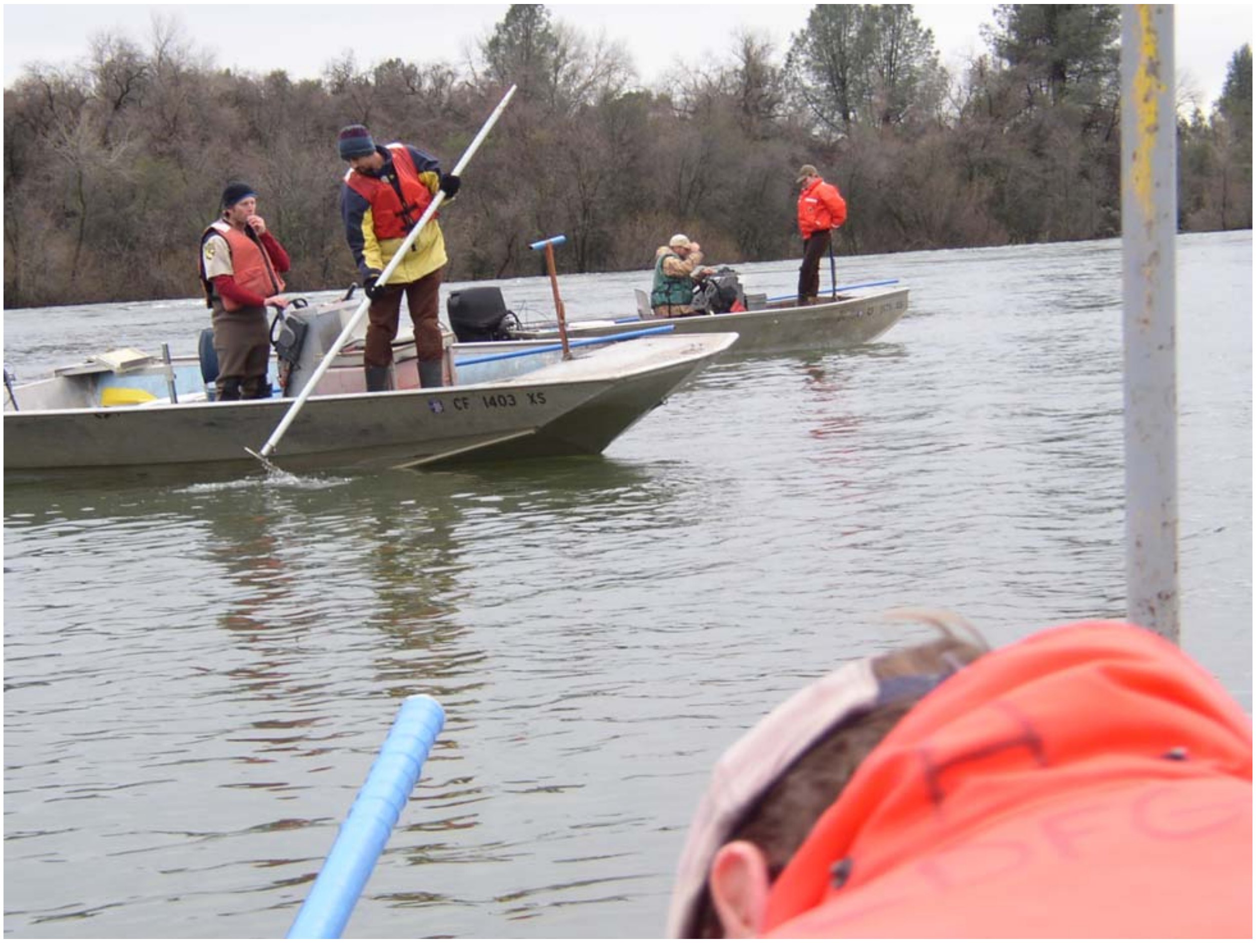
Table 1. Summary of Chinook salmon population estimates for the USRB (Sacramento River Basin from Keswick Dam downstream to Princeton Ferry) in 2007.

LOCATION	Late-Fall-Run	Winter-run	Spring-Run	Fall-Run
Red Bluff to Keswick Dam (upstream of RBDD)				
Sacramento River Main-Stem	13,864	2,487	248	14,097
Livingston Stone Hatchery		54		0
Battle Creek Coleman Hatchery	3,361			11,744
Battle Creek Above hatchery	72		291	
Battle Creek Below Hatchery	n/a ^			9,904
Bear Creek	n/a		n/a	140
Clear Creek	n/a		194	4,129
Cow Creek	n/a		n/a	2,044
Cottonwood Creek	n/a		34	1,250
Angler Harvest (based on average harvests)	1,373	0	0	1,676
SUB-TOTAL UPSTREAM OF RBDD	*18,670*	*2,541*	*767*	*44,984*
Red Bluff to Princeton (downstream of RBDD)				
Sacramento River Main-Stem	1,477	0	0	2,964
Mill Creek	n/a		920	796
Deer Creek	n/a		644	508
Antelope Creek	n/a		26	n/a
Angler Harvest (based on average harvests)	1,368	0	0	3,242
SUB-TOTAL DOWNSTREAM OF RBDD	*2,845*	*0*	*1,590*	*7,510*
SYSTEM GRAND TOTAL	**21,515**	**2,541**	**2,357**	**52,494**
All Upper Sacramento River Basin (Keswick Dam to Princeton) [$]				
2007 TOTAL SALMON ALL COMBINED:			**78,906**	

DATA Revised 8-2009 from previous based on USFWS revison of CNFH databases
NOTE: These values represent minimum numbers, unsurveyed waters have additional smaller salmon populations
^ n/a: Is not available, represents salmon present but no estimate available.
$ Numerous tributaries not surveyed, also Big Chico creek survey results are available from other DFG project

APPENDIX E - Photos of 2008 Activities Discussed in Report Text

Appendix Figure E1. Aerial view of the Red Bluff Diversion Dam.



Appendix Figure E2. Carcass survey boats on the main-stem Sacramento River.

Appendix Figure E3. Fish trapping activities at the Red Bluff Diversion Dam.

Appendix Figure E4. Aerial redd survey helicopter searching for new spawning redds.

Appendix Figure E5. New aerial redds as seen from CDFG plane.

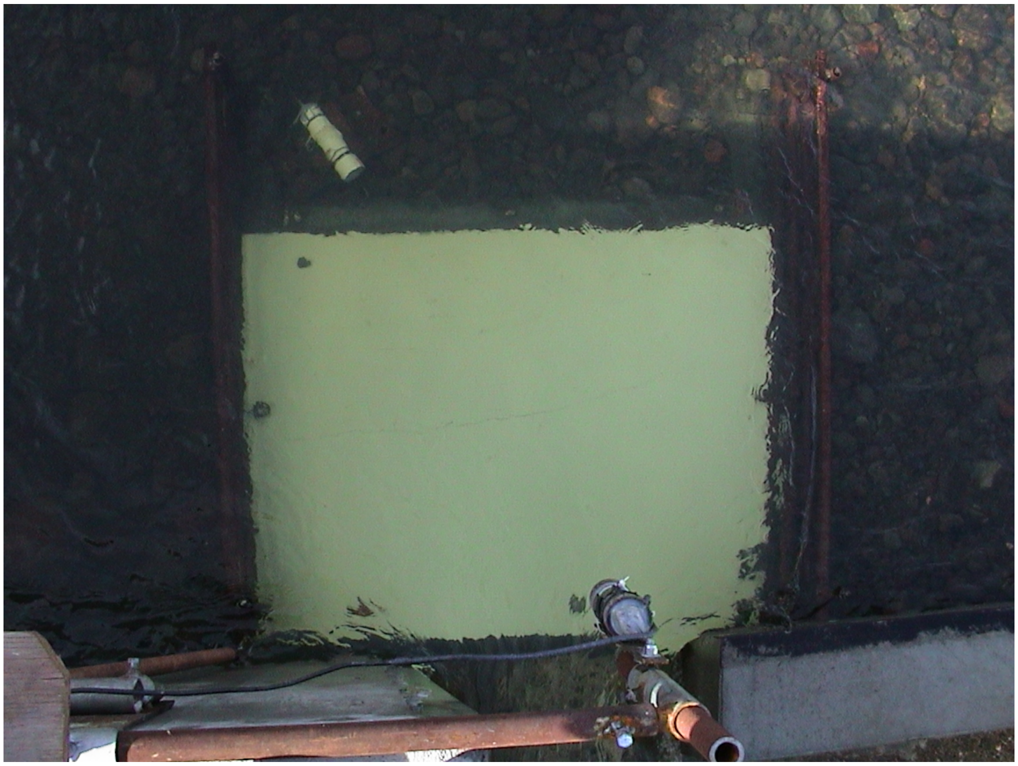
Appendix Figure E6. The Cow Creek Video Station during the 2008 construction.

Appendix Figure E7. View of the Bear Creek Video Station during the 2008 season.

Appendix Figure E8. View of the Cottonwood Creek Video Station during the 2008 setup.

Appendix Figure E9. Aerial view of construction of new fish ladder at CNFH in 2008.

Appendix Figure E10. The Battle Creek Video Station in 2008.



Appendix Figure E11. The Antelope Creek Video Station in 2008 on fish ladder.

Appendix Figure E12. The Antelope Creek Video Station with steelhead in 2008.

Appendix Figure E13. The Mill Creek Video Station and DIDSON camera combination in 2008.

Appendix Figure E14. The Mill Creek Video Station at top of Ward Dam fish ladder in 2008-2009.