# Juvenile Salmonid Monitoring in Clear Creek, California, from October 2007 through September 2008

USFWS Report
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Grant Number P0685508 Task 2

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December 2009

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The suggested citation for this report is:

Earley, J. T., D. J. Colby, and M. R. Brown. 2009. Juvenile salmonid monitoring in Clear Creek, California, from October 2007 through September 2008. U.S. Fish and Wildlife Service, Red Bluff Fish and Wildlife Office, Red Bluff, California.

**Juvenile Salmonid Monitoring in Clear Creek, California, from October 2007 through September 2008**

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*Abstract.*—The U.S. Fish and Wildlife Service (FWS) have been conducting juvenile salmonid monitoring in Clear Creek, Shasta County, California, using a rotary screw trap (RST) at river mile (RM) 1.7 since December 1998. This monitoring project has three primary objectives: 1) calculate an annual juvenile passage index (JPI) for Chinook salmon (*Oncorhynchus tshawytscha*) and steelhead / rainbow trout (*O. mykiss*), for inter-year comparisons and analyses of effectiveness of stream restoration activities; 2) obtain juvenile salmonid life history information including size, emergence timing, emigration timing, and potential factors limiting survival at various life stages; and 3) collect otolith and genetic samples from juvenile salmonids for analyses and developing baseline markers for the Clear Creek salmonid populations.

Chinook run designations based on length-at-date tables (Greene 1992) suggest that late-fall, winter, spring and fall Chinook salmon are captured in our RST. However, due to overlapping spawn timing of spring and fall Chinook populations, it is problematic to accurately index juvenile passage using only the RST at RM 1.7. When emergent fry are trapped after December 1, they are classified as fall Chinook even though most spring Chinook pass after this date. This underestimates the spring Chinook JPI. Since 2003, we have used a weir to isolate adult spring Chinook upstream of RM 8.1 or in some cases RM 7.4. To better estimate the passage of juvenile spring Chinook, we placed a second RST at RM 8.3. The spring Chinook JPI is now measured using the RST at RM 8.3.

Passage indices with 90% and 95% confidence intervals are generated for late-fall, spring, and fall Chinook salmon from brood year (BY) 2007 and steelhead / rainbow trout from BY 2007 Age 0+ and BY 2008 Age 0. The spring Chinook index for BY 2007 from the Upper Clear Creek (UCC) RST was 110,224. The indices of passage for BY 2007 from the Lower Clear Creek (LCC) RST were 202,011 for late-fall, and 5,545,303 for fall-run Chinook salmon. The steelhead / rainbow trout indices from LCC were as follows; 255 BY 2007 Age 0+, and 36,499 BY 2008. Winter-run sized Chinook from LCC produced an index of 342. It is likely that winter sized Chinook were late spawned late-fall Chinook salmon. Mark and recapture trials were conducted from December 2007 through May 2008 to determine RST efficiency at both locations and ranged from 2.7% to 29.4%. This report presents passage data from all brood years whose emigration ended between October 1, 2007 and September 30, 2008.

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## Introduction

The U.S. Fish and Wildlife Service (USFWS), Red Bluff Fish and Wildlife Office (RBFWO) has been monitoring juvenile salmonids in Clear Creek, Shasta County, California using a rotary screw trap (RST) at river mile (RM) 1.7, since December 1998 and with a second trap at RM 8.3 since 2003. This monitoring project has three primary objectives: 1) calculate an annual juvenile passage index (JPI) for Chinook salmon (*Oncorhynchus tshawytscha*) and steelhead / rainbow trout (*O. mykiss*), for inter-year comparisons and analyses of effectiveness of stream restoration activities; 2) obtain juvenile salmonid life history information including size, emergence timing, emigration timing, and potential factors limiting survival at various life stages; and 3) collect otolith and tissue samples from juvenile salmonids for future analyses and developing baseline markers for the Clear Creek salmonid populations. While RSTs have limitations, they can be an effective monitoring tool, and can provide a reliable estimate of juvenile production when used consistently over a number of years (CAMP 2002, sec. 5-1).

Clear Creek is a west side tributary of the Sacramento River in Shasta County. Four runs of Chinook salmon from the Sacramento River watershed, including late-fall-run (LFC), spring-run (SCS), fall-run (FCS), and winter-run (WCS), are known to inhabit Clear Creek. Spring Chinook salmon are listed as threatened (1999) and winter Chinook salmon are listed as endangered (1994), up listed from a previous 1990 listing of threatened, under the Federal Endangered Species Act (ESA). Winter Chinook may have historically been present or may spawn opportunistically, however a naturally self-sustaining population of does not exist in Clear Creek. The California Central Valley *O. mykiss* (STT) population includes both anadromous (steelhead) and resident forms. The California Central Valley Steelhead population has been listed as threatened by the ESA since March 1998.

Late-fall Chinook salmon migrate into Clear Creek, November through April, with peak migration in December and peak spawning occurring in January. Late fall Chinook primarily utilize the lower reaches of Clear Creek (Reach 6) (Table 1 and Figure **1**) for all life history phases. Spring Chinook salmon generally migrate into Clear Creek before late August, and spawn in the upper reaches (Reaches 1-5a; RM 8.1 - 18.1) in September and October (Table 1 and Figure **1**). Fall Chinook spawning occurs soon after and often overlaps in time with the SCS, with >99% taking place in Reach 6 below the gorge cascade (Giovannetti, 2008). A picket weir is used to prevent FCS from spawning in the upper reaches.

Restoration of anadromous salmonid populations in Clear Creek is an important element of the Central Valley Project Improvement Act (CVPIA). The CVPIA has a specific goal to double populations of anadromous fishes in the Central Valley of California. The Clear Creek Restoration Program authorized by Section 3406 (b) 12 of CVPIA, has funded many anadromous fish restoration actions which were outlined in the CVPIA Anadromous Fisheries Restoration Program (AFRP) Working Paper (USFWS 1995), and Draft Restoration Plan (USFWS 1997; finalized in 2001).

Since 2003, RBFWO has used a second Upper Clear Creek (UCC) RST at RM 8.3 to index passage of SCS. Passage indices of the SCS using the Lower Clear Creek (LCC) RST RM 1.7 were found to be significantly underestimated (Gaines 2003, Greenwald 2003, and Brown 2007). The picket weir was placed instream when the adult snorkel survey determined that the majority of SCS had passed upstream of RM 8.1. The picket weir location was at RM 8.1 (Table **2**) in 2003-2005. In August of 2006 and 2007, the picket weir was placed at RM 7.4 because adult SCS observed during the June snorkel survey had not passed upstream of RM 8.1. The use of the picket weir has greatly minimized the presence of FCS in the upper watershed.

This report presents sampling data from the upper and lower Clear Creek RSTs. All passage data is from brood years whose emigration ended between October 1, 2007 and September 30, 2008.

## Study Area

The Clear Creek watershed below Whiskeytown Dam covers an area of approximately 48.9 miles$^2$, and receives supplemental water from a cross-basin transfer between Lewiston Lake in the Trinity River watershed and Whiskeytown Reservoir in the Sacramento River watershed. Separated at the Clear Creek Road Bridge, the upper and lower reaches of the creek are geomorphically distinct and support different fish communities. The upper reach flows south from Whiskeytown Reservoir almost 10 mi. The lower reach heads in an easterly direction to the Sacramento River for a distance of approximately 8.2 mi (Figure 1). In the upper reach the stream is more constrained by canyon walls and a bedrock channel, has a higher gradient, has less spawning gravel, and has more deep pools. In the lower reach, the stream meanders through a less constrained alluvial flood plain, has a lower gradient, has more spawning gravel, and has fewer deep pools. The lower reach is managed for fall and late-fall Chinook and supports species of the foothills fish community. The upper reach supports coldwater species and is managed for spring Chinook and steelhead / rainbow trout, which require cooler summer water temperatures than the runs downstream.

Acting as a sediment trap, Whiskeytown Reservoir has starved the lower portion of Clear Creek of its sediment. The coarse sediment deficit and concomitant reduction in habitat quality in Clear Creek below Whiskeytown Dam has been well documented by various investigators (Coots as cited in McBain and Trush 2001, GMA 2003). Effects of reduced coarse sediment supply include riffle coarsening, fossilization of alluvial features, loss of fine sediments available for overbank deposition and riparian re-generation, and a reduction in the amount and quality of spawning gravels available for anadromous salmonids (GMA 2006). In some areas of the Clear Creek, stream channel only clay hardpan or bedrock remains, thus the need for gravel supplementation.

Ambient air temperatures range from approximately 32°F in winter to summer highs in excess of 115°F. Most precipitation falls into this watershed as rainfall. The average rainfall in the Clear Creek watershed ranges from approximately 20 inches in the lowest elevations to more than 60 in. in the highest elevations. Most of the watershed's rainfall occurs between November and April, with little or none occurring during the summer months (McBain and Trush et al. 2000).

The upper Clear Creek rotary screw trap is located at RM 8.3 above the confluence with the Sacramento River (latitude 40º 29' 30" north, longitude 122º 29' 46.8" west). The lower Clear Creek rotary screw trap is located at RM 1.7 above the confluence (latitude 40º 30' 22" north, longitude 122º 23' 45" west). The RSTs operate in or near the thalweg of the channel at both locations. The stream gradients at these locations range from approximately 1 - 1.5 degrees. The creek bottom substrate at these locations is primarily composed of gravel and cobble. The creek's riparian zone vegetation in these areas is dominated by willow (*Salix* sp.), cottonwood (*Populus sp.*), Himalayan blackberry (*Rubus discolor*). Canopy cover of the riparian vegetation over the channel in the sampling areas is generally less than 5%.

## Methods

*Sampling protocol*—Sampling for juvenile salmonids in Clear Creek was accomplished by using standardized RST sampling techniques that generally were consistent with the CVPIA's Comprehensive Assessment and Monitoring Program (CAMP) standard protocol (CAMP 1997). The RSTs deployed in Clear Creek, are manufactured by E.G. Solutions®, Corvallis, Oregon. This type of trap consists of a 5 ft (1.5 m) diameter cone covered with 3-mm diameter perforated stainless steel screen. This cone acts as a sieve, which separates fish from the sampled water. The cone is supported between two pontoons and its auger-type action passes water, fish, and debris to the rear of the trap, and directly into a live box. This live box retains fish and debris, and passes water through screens located in its back, sides, and bottom.

We selected two trees with diameter-at-breast height measurements of approximately 12-18 in. on opposite banks of the creek to use as attachment points for the traps for securing the RST in the thalweg of Clear Creek. The trees were approximately 200 ft. apart and far enough above the flood plain to avoid most flood waters. Using these trees as anchors, the RST is attached to a cable high line and positioned in stream with a system of ropes, and pulleys. The UCC RST was fished during the current reporting period from November 26, 2007 through June 30, 2008. The LCC RST was also fished from November 26, 2007 through June 30, 2008. An attempt was made to fish the RST 24-hours per day, seven days each week. Methods for access and data collection were identical for both traps.

Fisheries crews typically accessed the RST by wading from the creek banks. However, for crew access during higher flows, the RST was pulled into shallow water for boarding. After being serviced, the RST was returned back to the thalweg as soon as possible to begin fishing again. The RST was serviced once per day unless high flows, heavy debris loads, or high fish densities required multiple trap checks to avoid mortality of captured fish or damage to equipment. At each trap servicing, crews process the collected fish, clear the RST of debris, provide maintenance, and obtain environmental and RST data. Collected data included dates and times of RST operation, creek depth at the RST, RST cone fishing depth, number of rotations of the RST cone, the amount and type of debris collected, basic weather conditions, water temperature, current velocity, and water turbidity. Water depths were measured using a graduated staff to the nearest 0.1 feet. The RST cone fishing depth was measured with a gauge that was permanently mounted to the RST frame in front of the cone. The number of rotations of the RST cone was measured with a mechanical stroke counter (Global Industrial Products, Battle Ground, WA) that was mounted to the RST railing adjacent to the cone. The amount of debris in the RST was volumetrically measured using a 10-gallon plastic tub. Water temperatures were continuously obtained with an instream Onset HOBO® Water Temp Pro v2 Logger. Water velocity was measured from a grab-sample using an Oceanic® Model 2030 flowmeter (General Oceanics, Inc., Miami, Florida). This velocity was measured in the time when the live box of the RST was being cleared of debris and the fish sorted from this debris. Water turbidity was measured from a grab-sample with a Hach® Model 2100D turbidimeter (Hach Company, Ames, Iowa).

To remove the contents of the RST live well for examination, we used dip nets to scoop debris and fish onto a sorting table. When the number of all fishes collected in the RST was less than approximately 250 individuals, we counted and measured all fishes while on the aft deck of the RST. When catch exceeded approximately 250 individuals, fishes were transported to the shore in 5-gallon buckets and put into 25-gallon buckets until further examination.

*Counting and measurement*—We counted and obtained length measurements (to the nearest 1.0 mm) for all fish taxa that were collected. Counts and measurements were also generated for mortalities for each fish taxa. Fish to be measured were first placed in a 1-gallon plastic tub and anesthetized with Tricaine Methanesulfonate (MS-222; Argent Chemical Laboratories, Inc. Redmond, Washington) solution at a concentration of 60 - 80 mg/l. After being measured on a wet measuring board with wet hands, the fish were placed in a 10-gallon plastic tub that was filled with fresh creek water to allow for recovery from the anesthetic effects before being released back into the creek. Water in the tubs was replaced as necessary with fresh creek water to maintain adequate temperature and oxygen levels. Due to the large numbers of juvenile salmon that were frequently encountered, and project objectives, we used different criteria to count salmon, trout, and non-salmonid species:

*Chinook salmon*—When less than approximately 250 salmon were collected in the RST, all were counted and measured for fork length (FL). The measured juvenile salmon were assigned a life-stage classification of fry, parr, silvery parr, or smolt. For all Chinook salmon that were counted and measured, we also assigned run designations, using length-at-date tables from Greene (1992). These designations included fall-run, late-fall-run, winter-run, or spring-run. At the UCC RST all Chinook captured were considered to be SCS, due to the use of the weir which blocked FCS from passing upstream of the RST, regardless of their designation by the length-at-date tables.

When more than approximately 250 juvenile salmon were captured, subsampling was conducted. To conduct the subsampling, a cylinder-shaped 1/8" mesh "subsampling net" with a split-bottom construction was used. The bottom of the subsampling net was constructed with a metal frame that created two equal halves. Each half of the subsampling net bottom was built with a mesh bag that was capable of being tied shut, however, just one side was tied shut and the other side was left open. This subsampling net was placed in a 25-gallon bucket that was partially filled with creek water. All collected juvenile salmon were poured into this bucket. The net was then lifted, resulting in a halving of the sample. Approximately one-half of the salmon were retained in the side of the net with the closed mesh bag, and approximately one-half of the salmon in the side with the open mesh bag were left in the bucket. We successively subsampled until approximately 150 - 250 individuals remained. The number of successive splits that we used varied with the number of salmon collected, from one split (= ½ split) and occasionally up to seven splits (= 1/128 split).

After subsampling the salmon to the appropriate split, all fish in the subsample of approximately 150 - 250 individuals were counted and measured for FL. These salmon were also assigned a life-stage classification and run designation, using the methods previously described above. We proceeded to successively count all salmon in each split, until all salmon were counted.

*Steelhead / rainbow trout*—We counted and measured the FL of all steelhead / rainbow trout that were collected in the RSTs. Life stages of juveniles were classified similarly as Chinook. Steelhead / rainbow trout were classified as one of the following yolk-sac fry, fry, parr, silvery parr, or smolt. We weighed all collected juvenile steelhead / rainbow trout equal to or larger than 50 mm FL to the nearest 0.01-gram using a battery-operated Ohaus Scout® digital scale (Ohaus Corporation, Florham Park, New Jersey). Steelhead / rainbow trout juveniles were also given a maturation status of unknown.

*Non-salmonid taxa*—All non-salmonid taxa, were counted and up to 20 randomly selected individuals were measured. We measured the total length for lamprey (*Lampetra spp*.), cottids (*Cottus spp*.), and western mosquitofish (*Gambusia affinis*), and measured the FL for all of the other non-salmonid taxa. Catch data for all fish taxa were typically consolidated to represent monthly sums. Our sampling weeks were identified by year and number. Our first sampling week of the current study was during Week # 48 in 2007, and the last sampling week was during Week # 26 in 2008 (Table 2).

*Genetic and otolith sampling*—Genetic samples were taken on selected Chinook salmon for the purpose of run identification. Samples were taken by removing a 1-mm$^2$ tissue sample from the top or base of the caudal fin. The samples were divided into three equal parts and placed in 2-ml triplicate vials of the same record number with 0.5 ml of ethanol as a preservative. The triplicate samples were taken for; 1) USFWS archive, 2) CDFG archive, and 3) analysis by the Oregon State University's Hatfield Marine Lab in Newport, Oregon.

We anticipated sampling up to one hundred otolith samples from LCC steelhead / rainbow trout. Samples that were less than 50 mm FL were euthanized and placed in 60-ml vials with 40 ml of ethanol. Samples that were 50 mm or greater were euthanized and stored frozen.

*Mark and recapture efficiency techniques*—One of the objectives of our monitoring project is to develop a passage index of the number of juvenile salmonids passing downstream in a given unit of time, usually in a given week or year. We call this estimate a juvenile passage index (JPI). Since the RST only captures fish from a small portion of the creek cross section, we needed to implement a method to project the RST catch numbers to parts of the creek outside of the RST capture zone. We needed to determine the efficiency of the RST to catch all juvenile salmonid species moving downstream during a given time period. By determining the RST efficiency, we were able to calculate a JPI from the actual catch. To determine efficiencies of the RST, mark-recapture trials were conducted.

During periods when juvenile Chinook salmon capture was sufficient and weather permitted, mark-recapture trials were attempted twice weekly. We attempted to mark 400 juvenile Chinook salmon for each trial, with a goal to recapture at least seven marked individuals. In an effort to meet our goal of recapturing a minimum of seven individuals, we generally did not conduct mark-recapture studies during periods when numbers of juvenile salmon captured were less than about 200 individuals.

Only naturally-produced (unmarked, unclipped, and untagged) juvenile salmon captured by the RST were used for mark-recapture trials. We used either a single mark or a dual mark, to mark the salmon over the course of the study period. Single marking was used when our releases of marked salmon occurred more than five days apart, and when USFWS was not actively conducting salmon mark-recapture studies at nearby locations. The USFWS conducts mark and recapture trials at the Red Bluff Diversion Dam (RBDD), for estimating trap efficiency while monitoring Sacramento River juvenile salmonid populations. The dual mark allowed RBDD to distinguish Clear Creek marked Chinook from RBDD marked Chinook. The methods used for single-marking and dual-marking are described below:

*Single-marking technique*—Our single-marking technique consisted of immersion staining of salmon with Bismarck brown-Y stain (J.T. Baker Chemical Company, Phillipsburg, New Jersey). The Bismarck brown was applied at a concentration of 1.6 grams / 20 gallons of water and allowed a 45-50 minute contact time.

*Dual-marking techniques*—To conduct our dual-marking procedures, the fish are anesthetized with an MS-222 solution at a concentration of 60-80 mg/l. After the salmon are anaesthetized, we use either an upper or lower caudal fin clipping to attain a primary mark. To perform the fin clips, we use surgical scalpels, to remove an area of approximately 1 mm$^2$ or less from the corners of the caudal fin lobe. Alternate upper and lower clips are used to discern mark groups from trial to trial and trap to trap. After we complete the clipping process, we mark the salmon with Bismarck brown, as described above.

When the single-marking or dual-marking procedures were completed, the marked juvenile salmon were placed in a live car and allowed to recover overnight in the RST live well. This overnight detention allowed us to detect salmon with latent injuries and mortalities resulting from the marking procedure, and removed them from use in the recapture trials. On the following evening, weak, injured, and dead fish were removed. The remaining fish were counted and transported 0.25-0.5 river miles upstream of the RST sampling site to be released. We attempted to release fish in the evening no earlier than 15 minutes before sunset. The nighttime releases of marked fish were designed to 1) reduce the potential for unnaturally high predation on salmon that may be temporarily disorientated by the transportation, and 2) imitate the tendency for natural populations of outmigrating Chinook salmon to move downstream primarily at night (Healey 1998; USFWS, RBFWO, unpublished data). The stained and marked Chinook salmon that were recaptured later by the RST were counted and measured. After being allowed to recover, they were released downstream of the RST to prevent them from being recaptured again. In most cases when flows would most certainly exceed 2,000 cubic feet per second (cfs), fish were released downstream of the trap and efficiency trials are not conducted.

*Trap efficiency*—The trap efficiency was calculated by dividing the number of recaptured juvenile Chinook salmon by the number of released (# recaptured / # released) from the trial group. Efficiencies calculated from the mark-recapture trials were used to generate weekly JPIs (JPI = the sum weekly catch of each salmonid species captured divided by a weekly efficiency) for Chinook salmon and steelhead / rainbow trout using methods described by Thedinga et al. (1994) and Kennen et al. (1994).

Juvenile passage indices for salmonids were generated by summing the daily catch for each salmonid species and run and dividing by the trap efficiency for that week to determine a weekly passage. When instream flow fluctuations occurred or a trial did not recapture 7 recaptures to generate statistically sound estimates, the trial was excluded and a "season" efficiency value was used. Additionally, for the period preceding the first trial and proceeding a week after the last trial of the season we used the season efficiency. Season efficiency values were calculated by dividing the average of fish released from all valid mark and recapture trials and dividing it by the average of all trial recaptures.

1) Weekly trap efficiencies were generated using a stratified weekly estimator, which is a modification of the standard Lincoln-Peterson estimator (Bailey 1951; Steinhorst et al. 2004). The weekly estimator was used as it performs better with small sample sizes and is not undefined when there are zero recaptures (Carlson et al. 1998; Steinhorst et al. 2004). In addition, Steinhorst et al. (2004) found it to be the least inaccurate of three estimators (Whitton et al., USFWS 2006).

   Weekly trap efficiencies were generated by use of the equation:

Equation 1

$$\hat{E}_h = \frac{(r_h + 1)}{(m_h + 1)},$$

Where;
$E$ is the calculated trap efficiency,
$r_h$ is the number of marked fish recaptured in week $h$,
$m_h$ is the number of marked fish released in week $h$.

When more than one mark and recapture trial took place and there was no significant change in environmental factors (i.e., cfs or temperature), the trials were pooled to get a weekly efficiency.

2) Weekly JPIs for Chinook salmon and steelhead trout were calculated using weekly catch totals and either the weekly trap efficiency, pooled trap efficiency, or average season trap efficiency. The season was stratified by week or at times multiple strata per week because as Steinhorst et al. (2004) found, combining the data where there are likely changes in trap efficiency throughout the season leads to inaccurate estimates. Using methods described by Carlson et al. (1998) and Steinhorst et al. (2004), the weekly JPIs were estimated by

Equation 2

$$\hat{N}_h = \frac{U_h}{\hat{E}_h},$$

Where;
$N_h$ is the passage during week $h$,
$U_h$ is the unmarked catch during week $h$,
$E_h$ is the calculated trap efficiency during week $h$.

The variance, 90% and 95% confidence intervals (CI's) for each week ($N_h$) are determined by the percentile bootstrap method with 1,000 iterations (Efron and Tibshirani 1986; Buckland and Garthwaite 1991; Thedinga et al. 1994; Steinhorst et al. 2004). Using data with simulated numbers of migrants, and trap efficiencies, Steinhorst et al. (2004) determined the percentile bootstrap method for developing CI's performed the best as it had the best coverage of a 95% CI. The variance for $N_h$ is simply the sample variance of the 1,000 iterations of $N_h$ produced by bootstrapping $U_h$, $E_h$ and $m_h$ for each week.

As described by Steinhorst et al. (2004), and demonstrated by Whitton et al. (2006), the 90% and 95% CI's for the weekly JPIs were found by producing 1,000 iterations of $N_h$ and locating the 25$^{th}$, 50$^{th}$, 950$^{th}$, and 975$^{th}$ values of the ordered estimates. The 1000 iterations were produced by using a macro in the Systat 10 software program, which used the weekly catch, the calculated efficiency, and the number of marked fish for each trial. The macro produced 1000 variable numbers of recapture from which passage estimates were generated; these latter data were placed in a Microsoft Excel spreadsheet and subsequently ordered from low to high values. A separate spreadsheet was kept for both sets of data, ordered, and unordered. The unordered and ordered data sets were used to determine the final CI and weekly CI, respectively.

This final CI was calculated by summing the stratum of each of the 1000 random unordered iterations horizontally on the spreadsheet. The final column was ordered and the 25$^{th}$, 50$^{th}$, 950$^{th}$, and 975$^{th}$ values were used as the 90% and 95% CI. The final JPI CI uses unordered iterations in calculating values, as summing the ordered iterations produce a CI that is comprised of non-random values. To produce a weekly CI, each weekly stratum is ordered and the 25$^{th}$, 50$^{th}$, 950$^{th}$, and 975$^{th}$ values were used as the 90% and 95% CI.

The standard deviations *(SD)* of the sample means of each stratum are also included with 90% and 95% CI's. Juvenile Chinook salmon and STT JPIs were summarized by brood year.

For dates when sampling was not conducted, or when samples were lost or compromised, we used the mean catch of an equal number of days before, and an equal number of days after, the missing number of sample days to create a surrogate value. For example, if we were missing three days of sampling data, we would calculate the average of the three sampled days before and three sampled days after the missing period. This calculated average of six sampled days would then be used as the surrogate value for each of the three days of missing values. On days where more than half of the day was sampled, a proportionate value was given to the remainder of the day the trap did not fish based on the data that was collected.

*Trap modifications*—During periods of high salmon outmigration, we implemented a modification in the RST to reduce potential negative affects to juvenile salmon created by high fish densities. We implemented this "half-cone modification" to the RST by placing an aluminum plate over one of the two existing cone discharge ports and removing an exterior cone hatch cover. This created a condition where 50% of the collected fish and debris were not collected into the live-box, but were discharged from the cone into the creek. This effectively reduced our catch of both fish and debris by 50%, and reduced crowding of fish in the live-box.

In addition to the half-cone modification described above, we performed several other modifications to the RST equipment and operations to provide for greater protection to collected fishes. Other modifications to RST equipment included enlarging the size of live-box, increasing the size of flotation pontoons. Additionally, a secondary flotation device was added to the rear of the trap to keep it from sinking and getting fish crushed between the live box and cover lids. Inside the live box, we have added a midway fish exclusionary device made of expanded aluminum. This device prevents large predatory fish from harassing smaller salmonids. Modifications to RST operations have included day and night sampling during the peak out migration periods for SCS and FCS. To improve JPI computation, we strived to regularly fish high flows when most juvenile salmonids are thought to outmigrate, marked large numbers of salmon, and increased the frequency of mark-recapture trials from previous years.

## Results

*Sampling Effort*

*Upper Clear Creek*—We operated the UCC RST for 217 days. The UCC RST was installed on November 15, 2007 and set from November 26, 2007 through June 30, 2008. Based upon our experience in sampling previous years, we expected to catch consistently few or zero salmonids in the period from the beginning of August through mid November. Although length-at-date tables suggest we might capture SCS as early as October 16 of each year, we used temperature data from 2003-2006 to calculate SCS emergence time, which showed emergence would not occur until mid to late November. The first eleven days after trap installation were not sampled based on the temperature analysis. Due to high flows, eight days were not sampled.

Due to high juvenile Chinook salmon densities that were anticipated and encountered, we applied the half-cone modification during the entire sampling season with the exception of two weeks in early March. Beginning March 3 and ending March 17, 2008, the full cone was used to evaluate full cone trap efficiencies.

*Lower Clear Creek*—We operated the LCC RST for 217 days. The LCC RST was installed on November 15, 2007 and set from November 26, 2007 through June 30, 2008. Due to high flows, five days were either partially sampled or not sampled at all. Due to high juvenile Chinook salmon densities that were anticipated and encountered, we applied the half-cone modification during the period from November 30, 2007 through May 3, 2008. The full cone was applied from May 4, 2008 through the end of the trapping season.

*Physical Characteristics*

Stream discharge at the study site was approximated by using the U.S. Geological Survey Igo gauging station, located approximately 1.9 river miles above the UCC RST sampling site (Figure 1). Using these data, we determined that mean daily flows ranged from a minimum of 172 cubic feet per second (cfs) on June 30, 2008 to a maximum of 1,310 cfs on February 24, 2008. The maximum hourly measured flow recorded was 1,990 cfs on the evening of February 24, 2007. Flows in Clear Creek were reduced even lower to 72 cfs in the end of July 2008; however, this was not during the trapping season. The minimum flows were from controlled releases out of the reservoir, while maximums were results of natural storm flow accretions.

*Upper Clear Creek*—The channel width of Clear Creek at the UCC RST varied from approximately 30 feet at the lowest flows to more than 130 feet at the highest flows. Water depths in Clear Creek at the base of the RST cone varied from 4.8 feet to 6.0 feet, with an average depth of 5.3 ft. The lowest depths were recorded during early December 2007, and the deepest depths were recorded in late February 2008.

Turbidity levels ranged from 0.44 nephelometric turbidity units (NTU) in June 2008 to 10.7 NTU in February 2008, with a mean turbidity of 1.3 NTU. Turbidity was typically the lowest during the lower flows of summer, and tended to increase during the higher winter flows (Figure 2).

Mean daily water temperatures ranged from a low of 42.4$^{o}$F on January 29, 2008 to 61.6$^{o}$F on June 30, 2008. The warmest water temperatures that occurred while sampling were in June, while the coolest water temperatures were experienced during January and February (Figure 3).

*Lower Clear Creek*—The channel width of Clear Creek at the LCC RST varied from approximately 40 feet at the lowest flows to more than 150 feet at the highest flows. Water depths in Clear Creek at the base of the RST cone varied from 2.7 feet to 3.9 feet, with an average depth of 3.0 ft. The lowest depths were recorded during December 2007, and the deepest depths were recorded in late February 2008.

Turbidity levels ranged from 0.3 NTU in December 2007 to 47.2 NTU in December 2007, with a mean turbidity of 2.0 NTU.

Mean daily water temperatures ranged from a low of 41.8$^{o}$F on January 13, 2007 to 67.6$^{o}$F on June 30, 2008 (Figure 3). Temperatures are measured year round; however, the values above represent temperatures for the days that were actually sampled.

*Fish Assemblage*

*Upper Clear Creek*—A total of 9,935 fish, represented by 13 fish taxa were collected in the UCC RST during the sampling period. The most abundant fish taxa collected were Chinook salmon, steelhead / rainbow trout, riffle sculpin (*Cottus gulosus*), California roach (*Hesperoleucus symmetricus*), cottid fry (*Cottidae spp.*) and Sacramento sucker (*Catostomus occidentalis*). The UCC RST capture data is reported below.

*Chinook salmon*—Length-at-date tables of Greene indicated that we collected SCS, WCS, and FCS. Eight thousand, four hundred-sixty-four, individuals were captured during the study period. This value is the total number of Chinook captured during operations. On November 28, 2007 and January 6, 2008, Chinook salmon of 130 mm and 109 mm respectively were captured. Both Chinook were likely to be LFCS BY 2007 and were not calculated in the SCS BY 2007 passage index because they were clearly not 2007 young of the year. The latter fish was designated as a WCS by length-at-date tables. It was more likely to be a LFCS based on its FL and growth trajectory compared with that of the first LFCS captured on November 28, 2007. The data trends for each run of Chinook salmon are summarized below.

*Spring-run Chinook salmon*—The fork lengths for all BY 2007 spring Chinook salmon captured, ranged from 28 – 100 mm, with a median of 35 mm (Figure 4). Chinook of all life stages were collected (Figure 5). We collect the greatest number of Chinook salmon from the fry size class, with the majority of individuals (98.5%) being 39 mm or less in FL (Figure 6 and Figure 7). The JPI for BY 2007 SCS was 110,224, with upper and lower 95% CI's of 135,069 and 92,728. Peak emigration occurred over a 9-week period from early December 2007 through early February 2008 (Figure 8 and Table 3). The passage indices for SCS at LCC between 1998 and 2007 on average were 20,552. In the five years (2003 – 2007) of using the UCC and the picket weir, the average SCS passage index was 111,402.

*Steelhead / rainbow trout*—A total of 865 STT were captured. The first captures of BY 2008 were on February 9, 2008. The peak emigration for STT was from early April through late May. Indices of passage and confidence intervals were not generated from the upper RST because the distribution of spawning was both above and below the trap site (Giovannetti and Brown 2007).

*Non-salmonids*—We collected 580 non-salmonids in the UCC RST. The most abundant non-salmonids included riffle sculpin, California roach, Cottid fry, and Sacramento sucker. The common and scientific name key for non-salmonids is described in Appendix 1. All other occurrences of non-salmonid species are summarized in Appendix 2.

*Lower Clear Creek*—A total of 216,840 individual fish, represented by 19 fish taxa were collected in the LCC RST during the sampling period. The most abundant fish taxa collected were Chinook salmon, followed by steelhead / rainbow trout, micropterus fry, lamprey ammocoetes (*Lampetra or Entosphenus spp*.) and pacific lamprey (*Lampetra tridentata*. The LCC RST capture data are reported below.

*Chinook salmon*—Data is summarized by the following dates for BY 2007; late-fall April 1 2007 to March 31, 2008, winter Chinook July 1, 2007 to June 30, 2008, spring and fall Chinook October 1, 2007 to September 30, 2008. Length-at-date tables indicated that we collected individuals from all four Chinook salmon runs known from the Sacramento River basin. Two hundred fourteen thousand, one hundred fifty-seven individuals were captured from all runs, during the study period. Fork lengths for all runs of Chinook salmon ranged from 22-107 mm, with a median of 42 mm (Figure 9). Chinook of all life stages were collected (Figure 10). We collected a greater number of Chinook salmon from the fry size class, with the majority of individuals being 39 mm or less in FL. Data trends for each run of Chinook salmon are discussed below.

*Late-fall-run Chinook salmon*—A total of 6,954 LFC were captured. Of the 4,091 LFC that were measured, 67% were in the 30-39 mm FL range (Figure 11). The most common life stage for LFC was fry at 75% (Figure 12). Peak emigration occurred from approximately April 9, 2007 through April 29, 2007, when 84% passed (Table 4). Only one LFC was captured between July 14, 2007 and March 31, 2008. The JPI for BY 2007 LFC was 202,011 with upper and lower 95% CI's of 319,016 and 149,395 (Table 4 and Figure 13).

*Winter-run Chinook salmon*—A total of 18 juvenile Chinook salmon were designated as winter-run Chinook. A passage index of 342 was generated. Seven of the 18 Chinook indexed to have passed were actually captured; the other 11 were derived from proportionate extrapolation of capture data.

*Spring-run Chinook salmon*—Length-at date tables show SCS were collected at LCC. Four hundred thirty-one SCS were captured at the LCC. Peak emigration occurred from late November through December. The JPI for BY 2007 SCS was 10,181 with upper and lower 95% CI's of 13,664 and 8,178. The passage index for SCS is determined by using the UCC RST. The data presented here for LCC RST is underestimated, and provided for comparison purposes.

*Fall-run Chinook salmon*—A total of 211,190 FCS were captured. Fall-run Chinook salmon constituted >98% of all Chinook salmon captured. Approximately 76% of the 29,013 FCS that were measured were in the 30-39 mm FL range, and 15% were in the 40-49 mm FL range (Figure 14). The most common life stage for FCS was fry 83.8% (Figure 15). Peak emigration occurred from January 2008 through February 2008 (Figure 16). The highest weekly passage occurred during the week of February 19, 2008 where 974,147 individuals were estimated to have passed (Figure 16 and Table 5). The JPI for BY 2007 FCS was 5,545,303 with upper and lower 95% CI's of 6,614,700 and 4,816,781 (Table 5).

*Steelhead / rainbow trout*—Passage indices were generated for BY 2008, from January 1 to December 31. During BY 2008 1,892 STT were captured. Steelhead / rainbow trout during 2008 had forklength measurements ranging from 21-140 mm (Figure 17). Steelhead / rainbow trout were captured from the life stage classifications yolk-sac fry, fry, parr, and silvery parr (Figure 18). No STT captured were labeled as smolt based on visual characteristics and protocol criteria. Steelhead / rainbow trout fry made up 73.4% of the total catch while, 72.4% of those measured were in the 20-39 mm size range (Figure 19). The JPI for BY 2008 STT was 36,499 with upper and lower 95% CI's of 40,983 and 33,284 (Table 6). The most common life stage for juvenile STT was fry (Figure 20). Peak emigration of juvenile steelhead fry occurred from mid March through April of 2008 (Figure 21). Ten STT were captured that were considered Age 0+ from BY 2007 or earlier. A passage index of 255 was generated on those captures (Table 7 and Figure 22).

*Non-salmonids*—We collected a total of 788 individual non-salmonids from 16 taxa. The most abundant non-salmonids included Bass fry (*Micropterus spp.),* riffle sculpin and Pacific lamprey. The common and scientific name key for non-salmonids is presented in Appendix 1. These dominant non-salmonid taxa are discussed below; all others are summarized in Appendix 3.

*Bass fry*—A total of 327 *Micropterus spp.* were collected. Captures included Bass family members such as largemouth, spotted and smallmouth. The peak capture month was May 2008

*Riffle sculpin*—A total of 134 riffle sculpin were collected. Riffle sculpin were collected throughout the sampling season.

*Lampetra fry*—A total of 121 lamprey fry were collected. Lamprey was collected throughout the sampling season with peak passage in January and February of 2008.

*Genetic and otolith sampling*—We collected 571 genetic samples of Chinook salmon during this sampling season. Two hundred seventy samples were collected from UCC and 301 were collected from LCC. Samples at UCC were taken proportionately throughout the season based on an estimated catch distribution determined by redd observations. The samples collected from LCC were taken at a rate of 10 samples per week, if enough fish were available. During the genetic sampling process, samples of various forklengths were taken when possible to avoid sampling siblings that might potentially bias the genetic analysis. Otoliths of juvenile steelhead / rainbow trout were collected from the LCC RST between February 14, 2008 and June 29, 2008. Ninety-nine samples were taken with forklengths ranging from 25-65 mm.

*Mark and recapture efficiency estimates*

*Upper Clear Creek*—We conducted 27 mark-recapture trials, of which 25 were used to calculate RST efficiency. The release of marked fish began on December 16, 2007 and ended on March 25, 2008. Ten thousand, five hundred thirty-seven Chinook salmon were released, 1,169 were recaptured, and 16 mortalities occurred from marking procedures. Only the 25 trials that were used are shown (Table 8) and the efficiency values are a result of the equation in the methods section (Equation 1). During all 27 trials, Chinook were marked with Bismarck Brown. A secondary mark of an upper or lower caudal fin clip was used to distinguish between multiple weekly release groups and trap locations. Four trials between March 3 and 17, 2008 were conducted with the trap at full-cone to compare the results of trials at half cone.

The number of individual fish released for each trial ranged from 191-496, with an average of 388 during half-cone trials. Recaptured fish numbers per trial ranged from 14-59 with an average of 36. Efficiencies ranged from 3% to 14.9% per trial, with an average of 9.7% (Table 8). Due to low fish collection numbers, we were unable to conduct mark and recapture studies from November 26, 2007 until December 15, 2007 and after March 26, 2008. The trap efficiency value and the week that they are applied to, are shown in Table 9.

*Lower Clear Creek*—We conducted 27 mark-recapture trials to test for RST efficiency. The release of marked fish started on December 22, 2007 and ended on April 8, 2008. Eleven thousand two hundred eighty Chinook salmon were released, 506 were recaptured, and 10 mortalities occurred from marking procedures. Only the 26 trials that were used are shown (Table 10) and the efficiency values are a result of the equation in the methods section (Equation 1). The trap efficiency value and the week that they are applied to, are shown in Table 11. During all 27 trials, Chinook were marked with Bismarck Brown. A secondary mark of an upper or lower caudal fin clip was used to distinguish between multiple weekly release groups and trap locations. One trial conducted on February 2, 2008 was excluded because the trap cone was raised 2 hours after the release due to high flows from rain.

The number of individual fish marked for each trial ranged from 371-418, with an average of 403. Recaptured fish numbers per trial ranged from 10-32 with an average of 19. Efficiencies ranged from 2.7% to 8% per trial, with an average of 5.1%.

Due to low fish collection numbers, we were unable to conduct mark and recapture studies from November 26 until December 16, 2007. As described in the methods, for the period from November 26 through December 16, 2007 (weeks 48-50), April 15- July 30, 2008 (weeks

16-26), we substituted the “season” efficiency. The seasonal efficiency was calculated by dividing the average number of fish released (403) of the 26 trials used, by the average number of recaptures (19). Therefore, the season efficiency was 5% (19+1/403+1).

*Mortality*

*Marking Mortality*—A total of 26 mortalities occurred among the 21,817 marked Chinook salmon, for a total marking mortality ( = total marking mortalities / total number of fish released = 26/21,817) of .12%. Mortalities resulting from our marking procedures for each efficiency trial ranged from 0 – .76%. All mortalities were incidental and no significant marking mortalities occurred (Table 8 and Table 10).

*Trapping Mortality*—A total of 1,899 mortalities for all runs of Chinook salmon and steelhead / rainbow trout occurred as a result of RST sampling for BY 2007.

*Upper Clear Creek spring-run Chinook salmon*—There were 8,462 BY 2007 SCS captured in the upper Clear Creek RST. Of these captures 102 were recorded as mortalities generating a 1.2% mortality rate of fish handled and a 0.09% mortality rate of the total passage index of 110,224 (Table 12).

*Lower Clear Creek late-fall-run Chinook salmon*—There were 6,954 BY 2007 LFC captured in the Clear Creek RST. Of these captures, 37 were recorded as mortalities generating a 0.53% mortality rate of fish handled and a 0.02% mortality rate of the total passage index of 202,011 (Table 13).

*Lower Clear Creek Winter-run Chinook salmon*—There were 6 WCS (according to length-at-date tables) captured in the Clear Creek RST of which the passage index was 314, based on an extrapolated catch of 17. One WCS mortality was recorded. As mentioned previously, no WCS are thought to have spawned in Clear Creek.

*Spring-run Chinook salmon*—There were 239 BY 2007 SCS measured in the lower Clear Creek RST, after the catch data was adjusted for non-measured fish, the capture of SCS was increased to 431. Of these captures 8 were recorded as mortalities generating a 1.9% mortality rate of fish handled and a 0.08% mortality rate of the total passage index of 10,181 (Table 14).

*Lower Clear Creek fall-run Chinook salmon*—There were 211,190 BY 2007 FCS captured in the Clear Creek RST. Of these captures 1,875 were recorded as mortalities generating a 0.89% mortality rate of fish handled and a 0.03% mortality rate of the total passage index of 5,545,303 (Table 15).

*Lower Clear Creek steelhead / rainbow trout*—There were 10 BY 2007 Age 0+ and 1,882 BY 2008 Stt captured in the Clear Creek RSTs. Broodyear 2007Age 0+ had zero mortalities and BY 2008 had seven.

## Discussion and Recommendations

*Sampling Effort*—Flow conditions during the BY 2007 rotary screw trap sampling season were good for trapping due to few high flow events. At the UCC RST 8 days were missed because of high flow events, however the interpolated data only accounts for 4.1% of the SCS catch. The 4.1% interpolated catch resulted in interpolating 10% of the total passage. The LCC RST missed 5 days from sampling due to high flows. The missed sampling days at LCC accounted for 7.5% of the catch data for FCS. Missed sampling days due to high flows can affect the accuracy of the

JPI because the daily passage data has to be interpolated. The interpolated data is the average of the observed catch of three days before and after the high flow event, which may or may not reflect the actual catch and passage.

*Upper Clear Creek spring Chinook abundance*—Over the past 5 years we have been successful in generating a more accurate juvenile passage index of spring Chinook salmon than what can be currently measured by LCC. The use of the UCC RST and the picket weir is essential for determining the SCS JPI. The UCC's location below the SCS and above the FCS and LFC spawning grounds allows us to disregard the length-at date tables and consider all Chinook collected as SCS. The average passage index for SCS as determined by LCC between 2003 and 2007 was 17,846. On the other hand the SCS passage index estimated using the UCC was 111,402 (Table 16). The average index generated with UCC was within the range of expected values based on the average number of redds (55) and the juvenile output per redd (2,145). In 2007, SCS passage at UCC increased 3% from 3 years previous; from 107,054 to 110,224 and the redd productivity decreased from 2,974 to 2,345. An adjustment to passage is also provided to compare what the total SCS passage would be if all redds were above the UCC RST (Table 16 and Figure 23).

Smolt passage from upper Clear Creek appears to be very low (>0.01% of all captures). Juvenile spring Chinook salmon appear to migrate out of Clear Creek as fry or pre smolts, and it may be that Clear Creek SCS use the Sacramento River for rearing and smolting rather than upper Clear Creek. The UCC RST rarely traps "smolts" in the forklength range of 100 -175 mm like those that are trapped in RST's in other SCS streams such as Deer Creek and Mill Creek during fall and spring freshets(Earley, personal observation). This makes it difficult to determine if there is a smolt to adult recruitment relationship that exists in Clear Creek.

**Recommendation 1:** We recommend an analysis of the smolt to adult recruitment relationship. The capture or observation of smolts in upper Clear Creek through other means (i.e. a full creek weir, seines, and electro fishing) might help facilitate this type of analysis. Additionally, a wild stock coded wire tagging experiment might help us better understand what proportion of outmigrants (fry or pre-smol/t-smolts) contribute more to the subsequent adult cohort returns.

*Lower Clear Creek late-fall Chinook abundance*—The late-fall run passage index was the second highest recorded and a 16 fold increase from that of the previous cohort of 2004 (Table 17). Late-fall Chinook are considered stream-type Chinook and historically returned to spawn primarily as 4 or 5 year old fish (Moyle, 2002). Analysis of scale age data from 2003-2007 showed adult LFC to be both 3 and 4 year olds with the 4 year olds ranging from 25% to 100% annually (Giovannetti, 2007). The coded-wire tag (CWT) data showed adult LFC were both 3 and 4 year olds as well, with 4 year olds making up 20% to 100% of tags detected. The CWT and clipped carcass data is from a sample size of 19 for all five years combined (2003-2007).

Overlap in spawn timing makes differentiating FCS and LFC juveniles difficult. The juvenile productivity from redd counts is highly variable and ranged from 595 to 8,080 from 2003-2007. Late-fall Chinook population indices are likely inaccurate because emergence of FCS and LFC overlaps, annual variations in water temperature can shift the distribution of emergence earlier or later in the season and length-at-date tables can mis-assign LFC as FCS or vice-versa. Additionally, increases in fine sediment in the spawning reach (GMA, 2007) may be reducing juvenile production for both LFC and FCS populations and producing inaccurate indices.

**Recommendation 2:** We recommend using an analysis of expected emergence timing for LFC based on 1,850 daily temperature units to emergence to determine the emergence date of LFC fry. Using a temperature-based analysis will allow for more accurate run classification and associated passage indices.

**Recommendation 3:** We recommend trapping 7 days a week in April and May to get all catch data during the peak of fry emergence and emigration and generate a more accurate index of LFC.

**Recommendation 4:** We recommend continued and more collection of scales from carcasses and CWT'ed Chinook for the purpose of age classification and cohort reconstruction to better analyze RST passage results.

*Lower Clear Creek winter Chinook abundance*—Only one juvenile Chinook captured in July was assigned as winter-run. This Chinook was an emergent fry just outside of the length-at-date table's upper limit for LFC. The WCS displayed a similar size and passage timing to that of the LFC, suggesting that most likely they are late spawned LFC. Newly emergent sized Chinook (30-39 mm FL) that were captured by the rotary screw trap in July were consistent with observations and expected emergence from observations of redds in late April during the LFC Kayak survey, suggesting there was not any production from adult WCS during the late winter and spring months. Carcasses recovered in May and June were most likely pre-spawning SCS mortalities, but it is possible that they were winter Chinook salmon. However, snorkel crews did not observe redds on the June survey, indicating that these fish did not spawn (Giovannetti 2008).

*Lower Clear Creek fall Chinook abundance*—The fall Chinook passage index of 5,545,303 is 111% of average for the previous 6 years (4,965,601) (Table 18). The adult escapement of 4,129 is the lowest recorded since increased flows began in 1995. The average escapement for the past 6 years is 11,004. Fall Chinook juvenile productivity is in a declining trend overall in every year with the exception of 2004 and now 2007. The BY2007 passage estimate has the third highest juvenile-per-adult ratio over the past 10 years of record (Table 18). The juvenile productivity tends to be higher in years with lower escapement. Whether this is a function of carrying capacity or other variables such as high concentrations of fine sediment or occurrence of scouring flows is currently being analyzed. The excessive fines can be problematic and contribute to low redd productivity. High sediment could be reduced by providing flushing flows to clear out the accumulation of fine sediments and thereby improving intragravel conditions.

**Recommendations 5:** The productivity of redds throughout the spawning area should be evaluated with a survival-to-emergence (STE) study. Evaluating the STE will be beneficial in understanding the limitations or maximum carrying capacity of the spawning habitat. The knowledge gained from a study of this type might improve our management of flows or justify the need for actions such as those identified in recommendation 6.

**Recommendations 6:** We recommend conducting a flushing flow study of at least 4,000 cfs or greater to mobilize substrate and reduce the amount of fine sediment which may be affecting spawning success.

*Lower Clear Creek steelhead emigration*—steelhead / rainbow trout present in Clear Creek exhibit characteristics of a winter-run steelhead, with adults migrating upstream in the late fall and winter and most fry outmigration beginning in late January or early February and peaking during the months of April and May. Conversely, Moyle 2002 states that "the winter run (steelhead) might better be called the "fall run" because they start entering fresh water in August, with a peak late September-October, after which they hold until flows are high enough in tributaries to enter for spawning." Hallock 1989 also presents data that the adult migration observed at the Red Bluff Diversion Dam from 1969-1982 peaked in September and October. Steelhead / rainbow trout adults use portions of the upper and lower watershed for spawning (i.e., above and below UCC).

Because steelhead spawn upstream and downstream of UCC, passage indices are generated from LCC catch data. The JPI's of STT over the past 5 years, appear to be increasing (Table 19). The BY 2008 passage index was the highest outmigration recorded to date (36,499). The increase in passage may be due to an increase in the STT population size (based on redd counts of 149), or to fewer high flow events occurring during outmigration. Multiple high flow events can force USFWS staff to raise the RST cone or worse sink the RST and not have the ability to catch significant numbers of out migrants. Similarly, both the winters of 2006/2007 and 2007/2008 saw relatively few high flow events and we recorded the two highest passage indices in these years, 33,910 and 36,499 respectively. Alternatively, in the past two years (2007 and 2008) we observed the highest redd counts on record, 165 and 149.

From 2001 to 2008 there was a positive relationship (Figure 24) $R^2 = 0.837$ between redd counts and the JPI. Data from 1999 and 2000 was excluded from this analysis because redd surveys were not conducted. The Steelhead JPI increases as more redds are present suggesting that the rotary screw trap is a highly effective means to estimate outmigration and that redd surveys are an effective method to estimate adult population size. The juvenile productivity (juveniles per redd) calculated for these past eight years averaged 194.

The steelhead passage indices were generated using Chinook trap-efficiency data. We would like to capture enough STT juvenile outmigrants to conduct paired releases with Chinook and compare the results evaluate the use of the Chinook efficiency data. Passage indices are challenging to compare year to year because juvenile STT may rear in freshwater from 1 to 3 years and their migration may be dependent on annual variations in water temperature and stream flow.

There is limited data on steelhead/ rainbow trout fecundity and juvenile productivity in Clear Creek to determine if the measured number of juveniles per redd is high or low. A STT survival-to-emergence or redd capping study may also prove useful in providing information on individual redd contribution to populations. This data could be used to better evaluate the passage indices and redd counts.

**Recommendation 7**: We recommend using STT to conduct RST efficiency trials to validate using CHN efficiency trials for STT passage indices. This may only be feasible in years where STT captures at the RST are sufficient in number to meet the minimum requirements of a mark and recapture study.

*Genetic and otolith sampling*—Genetic samples of juvenile Chinook salmon are analyzed by the Oregon State University's Hatfield Marine Lab in Newport, Oregon, by Dr. Michael Banks. At the time of this report samples collected during the 2007-2008 sampling seasons have not yet been analyzed. We are hoping that advances in the technology used for genetic analysis will continue to improve and assist us in refining our passage indices. Additionally, we hope to develop some baseline genetic data of spawning Chinook in Clear Creek.

We collected steelhead / rainbow trout otolith samples for analysis of Strontium to Calcium ratios to assist in the quantifying of maternal anadromy in the juvenile populations. We currently have no other method for determining the proportion of steelhead / rainbow trout that are anadromous. At the time of this report, the otolith data has not been analyzed.

**Recommendations 8**: We recommend a genetic sampling regime of UCC SCS that is proportionate to the catch distribution instead of equal samples each week throughout the season. A more intensive sampling of smolts will also assist analysis of data in recommendation 1.

**Recommendations 9:** We suggest refinement of the genetic markers and / or baselines to improve the power to distinguish LFC from FCS. Samples from CNFH could also be analyzed to develop baseline.

*Mark and recapture efficiency estimates*—The techniques we are using for mark and recapture trials appear to be adequate to determine trap efficiency. However, our estimates can still be improved by timing trials to coincide more closely with unusual results such as extremely high or low efficiency to help determine if the first trial was valid. Mark and recapture trials should be more strategically centered on or around storm events to better gauge the variability of efficiency associated with variable flows.

The use of threatened SCS for mark and recapture trials at the UCC RST is avoided to the greatest extent by using FCS captured at the LCC RST. Using SCS in December, when FCS are not available, may be necessary for capturing the true efficiency for early emigrating populations, as well as verifying trap efficiency during that part of the season when significant proportions of the entire passage occur.

During March of 2008, four mark-recapture trials at UCC were conducted with the trap at full-cone to compare to half-cone trials (Table 8). The results showed that full-cone trial efficiencies averaged 25% and half-cone efficiencies from the 3 trials before and after averaged 10%. The range of half-cone efficiencies was 3% - 14.3%. The average of all efficiencies was 12.1% with a full-cone high of 27.5%. During periods of equal mean daily flow the half cone efficiencies were half that of the full-cone, which is what we expect to see.

**Recommendations 10:** We recommend in the future when population sizes are much larger, using SCS from the UCC RST for one season to validate efficiencies and assumptions of behaviors between SCS and FCS populations.

**Recommendation 11**: We recommend that the comparisons of the half-cone versus full-cone efficiency be continued to validate that on average, the half cone efficiencies are half of what the full-cone would be.

*Mortality*

*Marking mortality*—Mortality occurring from conducting mark and recapture studies is 0.12% and has been progressively improving from year to year based on refining marking techniques. The main challenge is dealing with Chinook during the springtime where warm weather and physiological changes put fish at a greater risk of mortality due to elevated stress levels. We have been successful in conducting marking activities earlier in the day when ambient temperature is not as much of a stress factor.

*Trapping Mortality*—The UCC RST observed 102 mortalities, some notable incidents were an event where 10 mortalities occurred from an overdose of MS-222 and 47 mortalities from a 2 day storm event in which floating debris and logs stopped the trap. Mortality associated with trapping has decreased from previous years. Mortality was reduced from 900 to 102 or a change in 6.5% to 1.2%. We still would like to have all mortality be less than 1%. We reduced mortality by scheduling multiple daily shifts. However, we have found that during peak emergence, concurrent with rain or high flow events, RST's with threatened SCS need to be monitored 24 hours a day. During the BY 2007, multiple shifts were scheduled, yet mortality still occurred during the time crews were moving between trap sites. Fall-run Chinook mortality from the LCC RST was reduced from 1.28% to .88% from the previous year.

**Recommendation 12:** We recommend when feasible that on days or evenings where significant measureable precipitation and / or debris is anticipated, the RST's are monitored with a dedicated crew for each trap. This would eliminate or minimize the potential for mortality when crews are between traps.

*Trap Modifications*—We used one trap modification (expanded aluminum excluders) to reduce juvenile mortality in the trap live-box. Excluders were designed to create refugia in the live box between large (>250 mm) and small (<250mm) fishes. These appeared to work well, although salmonids of all sizes would prey on recently emergent Chinook and STT fry. The excluders can be further covered in smaller mesh, however, other RST projects found the mesh screen to gill >75mm Chinook and cause mortality (W. Poytress, USFWS, RBFWO, Personal Communication). In the future, we plan to use a video camera to evaluate fish behavior within the trap live-box with high debris and higher flows. Additionally, we are pursuing the concept of electronic data recording in the field and eliminating the use of paper hardcopy data for the 2008-2009 trapping season.

## Acknowledgments

Funding for this project was provided by the CALFED Bay-Delta Program. We would also like to thank the following people for their contributions: Tara Anderson, RJ Bottaro, Tim Blubaugh, Felipe Carrillo, Jacob Cunha, Jessica Fischer, Sierra Franks, Sarah Giovannetti, Eric Grosvenor, Jacie Knight, Dave LaPlante, Randal Loges, Jess Newton, Erich Parizek, Chad Praetorius, Hayley Potter, Bill Poytress, Marie Schrecengost, James Smith, Laurie Stafford, Andy Trent, Keenan True, and Kellie Whitton. We thank the Coleman National Fish Hatchery staff, especially Scott Hamelberg and Mike Keeler, for accommodating our program at the Coleman National Fish Hatchery. The CALFED Ecosystem Restoration Program provided California Department of Water Resources funding for this project, through Proposition 50, Grant Number P0685508, which was administered by the California Department of Fish and Game and GCAP Services, Costa Mesa, California (Sacramento Office).

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**Tables**

Table 1. The 2007 Clear Creek snorkel survey reach number and location and river miles. In August 2007, the Clear Creek picket weir was placed instream at river mile 7.4. The weir was placed at the Shooting Gallery site due to the observation of 22 adult Chinook in June 2007, below the upstream weir site at RM 8.1.

| Reach | River Mile | Location |
|---|---|---|
| 1 | 18.1 - 15.9 | Whiskeytown Dam to Need Camp Bridge |
| 2 | 15.9 - 13.0 | Need Camp Bridge to Kanaka Creek |
| 3 | 13.0 - 10.9 | Kanaka Creek to Igo Gauge |
| 4 | 10.8 - 8.5 | Igo Gauge to Clear Creek Road Bridge |
| 5a1 | 8.5 - 8.1 | Clear Creek Road Bridge to Reading Bar Picket Weir Site |
| 5a2 | 8.1 - 7.4 | Reading Bar Picket Weir Site to Shooting Gallery Picket Weir Site |
| 5b | 7.4 - 6.5 | Shooting Gallery Picket Weir Site to Old McCormick-Saeltzer Dam Site |
| 6 | 6.5 - 1.7 | Old McCormick-Saeltzer Dam Site to USFWS Lower Rotary Screw Trap |

Table 2. Dates with corresponding week numbers for rotary screw trap operations at river mile 1.7 and 8.3 in Clear Creek, Shasta County, California, by the U.S. Fish and Wildlife Service from October 1, 2007 through June 30, 2008.

| Dates | Corresponding Week | Dates | Corresponding Week |
|---|---|---|---|
| 10/01-10/07 | 40 | 04/02-04/08 | 14 |
| 10/08-10/14 | 41 | 04/09-04/15 | 15 |
| 10/15-10/21 | 42 | 04/16-04/22 | 16 |
| 10/22-10/28 | 43 | 04/23-04/29 | 17 |
| 10/29-11/04 | 44 | 04/30-05/06 | 18 |
| 11/05-11/11 | 45 | 05/07-05/13 | 19 |
| 11/12-11/18 | 46 | 05/14-05/20 | 20 |
| 11/19-11/25 | 47 | 05/21-05/27 | 21 |
| 11/26-12/02 | 48 | 05/28-06/03 | 22 |
| 12/03-12/09 | 49 | 06/04-06/10 | 23 |
| 12/10-12/16 | 50 | 06/11-06/17 | 24 |
| 12/17-12/23 | 51 | 06/18-06/24 | 25 |
| 12/24-12/31 | 52 | 06/25-07/01 | 26 |
| 01/01-01/07 | 1 | 07/02-07/08 | 27 |
| 01/08-01/14 | 2 | 07/09-07/15 | 28 |
| 01/15-01/21 | 3 | 07/16-07/22 | 29 |
| 01/22-01/28 | 4 | 07/23-07/29 | 30 |
| 01/29-02/04 | 5 | 07/30-08/05 | 31 |
| 02/05-02/11 | 6 | 08/06-08/12 | 32 |
| 02/12-02/18 | 7 | 08/13-08/19 | 33 |
| 02/19-02/25 | 8 | 08/20-08/26 | 34 |
| 02/26-03/04 | 9 | 08/27-09/02 | 35 |
| 03/05-03/11 | 10 | 09/03-09/09 | 36 |
| 03/12-03/18 | 11 | 09/10-09/16 | 37 |
| 03/19-03/25 | 12 | 09/17-09/23 | 38 |
| 03/26-04/01 | 13 | 09/24-09/30 | 39 |

Table 3. Weekly summaries of passage indices with 90% and 95% confidence intervals and standard deviation (SD) of the weekly strata of Broodyear 2007 spring-run Chinook salmon captured at the upper rotary screw trap at river mile 8.3 in Clear Creek, Shasta County, California, by the U.S. Fish and Wildlife Service from November 26, 2007 through June 30, 2008.

| Days Sampled | Week | Date | 95% CI Lower | 90% CI Lower | Weekly Passage | 90% CI Upper | 95% CI Upper | S.D. |
|---|---|---|---|---|---|---|---|---|
| 0 of 7 | Week 40 | 10/01/07 | 0 | 0 | 0 | 0 | 0 | 0 |
| 0 of 7 | Week 41 | 10/08/07 | 0 | 0 | 0 | 0 | 0 | 0 |
| 0 of 7 | Week 42 | 10/15/07 | 0 | 0 | 0 | 0 | 0 | 0 |
| 0 of 7 | Week 43 | 10/22/07 | 0 | 0 | 0 | 0 | 0 | 0 |
| 0 of 7 | Week 44 | 10/29/07 | 0 | 0 | 0 | 0 | 0 | 0 |
| 0 of 7 | Week 45 | 11/05/07 | 0 | 0 | 0 | 0 | 0 | 0 |
| 0 of 7 | Week 46 | 11/12/07 | 0 | 0 | 0 | 0 | 0 | 0 |
| 0 of 7 | Week 47 | 11/19/07 | 0 | 0 | 0 | 0 | 0 | 0 |
| 6 of 7 | Week 48 | 11/26/07 | 2,284 | 2,366 | 3,312 | 4,731 | 5,095 | 765 |
| 7 of 7 | Week 49 | 12/03/07 | 10,221 | 10,951 | 15,331 | 20,442 | 23,586 | 3,383 |
| 7 of 7 | Week 50 | 12/10/07 | 5,939 | 6,363 | 8,909 | 11,878 | 13,706 | 1,930 |
| 5 of 7 | Week 51 | 12/17/07 | 20,670 | 21,408 | 29,971 | 39,962 | 42,816 | 6,354 |
| 2 of 7 | Week 51 Pt:II | | 1,617 | 1,643 | 2,046 | 2,506 | 2,709 | 277 |
| 5 of 7 | Week 52* | 12/24/07 | 2,331 | 2,445 | 3,044 | 3,825 | 4,032 | 423 |
| 3 of 7 | Week 52* Pt:II | | 625 | 646 | 795 | 978 | 1,031 | 106 |
| 2 of 7 | Week 1 | 01/01/08 | 1,136 | 1,193 | 1,467 | 1,853 | 1,956 | 202 |
| 5 of 7 | Week 1 Pt:II | | 17,568 | 18,366 | 26,937 | 40,406 | 44,896 | 7,383 |
| 4 of 7 | Week 2 | 01/08/08 | 8,452 | 9,186 | 13,206 | 19,208 | 21,129 | 3,192 |
| 3 of 7 | Week 2 Pt:II | | 1,489 | 1,585 | 2,233 | 3,275 | 3,275 | 490 |
| 4 of 7 | Week 3 | 01/15/08 | 289 | 299 | 377 | 468 | 495 | 52 |
| 3 of 7 | Week 3 Pt:II | | 233 | 242 | 295 | 354 | 361 | 35 |
| 1 of 7 | Week 4 | 01/22/08 | 214 | 223 | 268 | 328 | 342 | 33 |
| 6 of 7 | Week 4 Pt:II | | 813 | 838 | 1,024 | 1,257 | 1,349 | 138 |
| 7 of 7 | Week 5 | 01/29/08 | 194 | 199 | 267 | 356 | 389 | 50 |
| 4 of 7 | Week 6 | 02/05/08 | 131 | 141 | 203 | 305 | 332 | 50 |

| Days Sampled | Week | Date | 95% CI Lower | 90% CI Lower | Weekly Passage | 90% CI Upper | 95% CI Upper | S.D. |
|---|---|---|---|---|---|---|---|---|
| 3 of 7 | Week 6 Pt:II | | 16 | 17 | 22 | 28 | 30 | 4 |
| 4 of 7 | Week 7 | 02/12/08 | 20 | 20 | 25 | 31 | 33 | 3 |
| 3 of 7 | Week 7 Pt:II | | 19 | 19 | 24 | 29 | 31 | 3 |
| 1 of 7 | Week 8 | 02/19/08 | 0 | 0 | 0 | 0 | 0 | 0 |
| 2 of 7 | Week 8 Pt:II | | 0 | 0 | 0 | 0 | 0 | 0 |
| 2 of 7 | Week 8 Pt:III | | 9 | 9 | 12 | 16 | 17 | 2 |
| 4 of 7 | Week 9 | 02/26/08 | 65 | 68 | 87 | 116 | 121 | 16 |
| 3 of 7 | Week 9 Pt:II | | 22 | 23 | 28 | 34 | 35 | 3 |
| 4 of 7 | Week 10 | 03/05/08 | 26 | 27 | 32 | 37 | 38 | 3 |
| 3 of 7 | Week 10 Pt:II | | 0 | 0 | 0 | 0 | 0 | 0 |
| 4 of 7 | Week 11 | 03/12/08 | 19 | 20 | 23 | 26 | 27 | 2 |
| 3 of 7 | Week 11 Pt:II | | 0 | 0 | 0 | 0 | 0 | 0 |
| 4 of 7 | Week 12 | 03/19/08 | 7 | 7 | 9 | 12 | 12 | 1 |
| 3 of 7 | Week 12 Pt:II | | 0 | 0 | 0 | 0 | 0 | 0 |
| 7 of 7 | Week 13 | 03/26/08 | 16 | 16 | 21 | 28 | 29 | 4 |
| 7 of 7 | Week 14 | 04/02/08 | 47 | 49 | 64 | 85 | 88 | 10 |
| 7 of 7 | Week 15 | 04/09/08 | 24 | 25 | 32 | 41 | 44 | 5 |
| 7 of 7 | Week 16 | 04/16/08 | 0 | 0 | 0 | 0 | 0 | 0 |
| 7 of 7 | Week 17 | 04/23/08 | 16 | 16 | 21 | 27 | 29 | 3 |
| 7 of 7 | Week 18 | 04/30/08 | 32 | 33 | 43 | 56 | 59 | 7 |
| 7 of 7 | Week 19 | 05/07/08 | 8 | 8 | 11 | 14 | 15 | 2 |
| 7 of 7 | Week 20 | 05/14/08 | 48 | 49 | 64 | 85 | 91 | 11 |
| 7 of 7 | Week 21 | 05/21/08 | 16 | 16 | 21 | 27 | 29 | 3 |
| 7 of 7 | Week 22 | 05/28/08 | 0 | 0 | 0 | 0 | 0 | 0 |
| 7 of 7 | Week 23 | 06/04/08 | 0 | 0 | 0 | 0 | 0 | 0 |
| 7 of 7 | Week 24 | 06/11/08 | 0 | 0 | 0 | 0 | 0 | 0 |
| 7 of 7 | Week 25 | 06/18/08 | 0 | 0 | 0 | 0 | 0 | 0 |
| 7 of 7 | Week 26 | 06/25/08 | 0 | 0 | 0 | 0 | 0 | 0 |

| Days Sampled | Week | Date | 95% CI Lower | 90% CI Lower | Weekly Passage | 90% CI Upper | 95% CI Upper | S.D. |
|---|---|---|---|---|---|---|---|---|
| 0 of 7 | Week 27 | 07/02/08 | 0 | 0 | 0 | 0 | 0 | 0 |
| 0 of 7 | Week 28 | 07/09/08 | 0 | 0 | 0 | 0 | 0 | 0 |
| 0 of 7 | Week 29 | 07/16/08 | 0 | 0 | 0 | 0 | 0 | 0 |
| 0 of 7 | Week 30 | 07/23/08 | 0 | 0 | 0 | 0 | 0 | 0 |
| 0 of 7 | Week 31 | 07/30/08 | 0 | 0 | 0 | 0 | 0 | 0 |
| 0 of 7 | Week 32 | 08/06/08 | 0 | 0 | 0 | 0 | 0 | 0 |
| 0 of 7 | Week 33 | 08/13/08 | 0 | 0 | 0 | 0 | 0 | 0 |
| 0 of 7 | Week 34 | 08/20/08 | 0 | 0 | 0 | 0 | 0 | 0 |
| 0 of 7 | Week 35 | 08/27/08 | 0 | 0 | 0 | 0 | 0 | 0 |
| 0 of 7 | Week 36 | 09/03/08 | 0 | 0 | 0 | 0 | 0 | 0 |
| 0 of 7 | Week 37 | 09/10/08 | 0 | 0 | 0 | 0 | 0 | 0 |
| 0 of 7 | Week 38 | 09/17/08 | 0 | 0 | 0 | 0 | 0 | 0 |
| 0 of 7 | Week 39 | 09/24/08 | 0 | 0 | 0 | 0 | 0 | 0 |
| | | Total | 92,728 | 94,472 | 110,224 | 130,585 | 135,069 | |

*Week 52 (12/24/07-12/31/07) contains 8 days for keeping Jan. 1 as Julian calendar day 1.

Table 4. Weekly summaries of passage indices with 90% and 95% confidence intervals and standard deviation (SD) of the weekly strata of Broodyear 2007 late-fall-run Chinook salmon captured at the lower rotary screw at river mile 1.7 in Clear Creek, Shasta County, California, by the U.S. Fish and Wildlife Service from April 1, 2007 through March 31, 2008.

| Days Sampled | Week | Date | 95% CI Lower | 90% CI Lower | Weekly Passage | 90% CI Upper | 95% CI Upper | S.D. |
|---|---|---|---|---|---|---|---|---|
| 7 of 7 | Week 14 | 04/02/07 | 2,201 | 2,317 | 3,675 | 5,503 | 6,289 | 1,096 |
| 7 of 7 | Week 15 | 04/09/07 | 13,707 | 15,320 | 23,682 | 37,205 | 43,405 | 8,645 |
| 7 of 7 | Week 16 | 04/16/07 | 59,426 | 63,388 | 105,634 | 190,164 | 237,706 | 56,145 |
| 7 of 7 | Week 17 | 04/23/07 | 17,442 | 18,784 | 27,140 | 40,699 | 44,399 | 6,605 |
| 7 of 7 | Week 18 | 04/30/07 | 8,014 | 8,435 | 13,356 | 20,034 | 22,896 | 4,119 |
| 1 of 7 | Week 19 | 05/07/07 | 775 | 816 | 1,292 | 1,938 | 2,214 | 372 |
| 6 of 7 | Week 19 Pt:II | | 3,692 | 3,807 | 5,293 | 7,166 | 8,122 | 1,095 |
| 7 of 7 | Week 20 | 05/14/07 | 1,874 | 1,978 | 2,635 | 3,560 | 3,748 | 509 |
| 7 of 7 | Week 21 | 05/21/07 | 3,592 | 3,817 | 5,310 | 7,634 | 8,143 | 1,133 |
| 7 of 7 | Week 22 | 05/28/07 | 2,621 | 2,790 | 3,760 | 5,406 | 5,766 | 818 |
| 7 of 7 | Week 23 | 06/04/07 | 3,015 | 3,210 | 4,327 | 6,219 | 6,634 | 945 |
| 7 of 7 | Week 24 | 06/11/07 | 2,106 | 2,238 | 3,113 | 4,212 | 4,476 | 649 |
| 7 of 7 | Week 25 | 06/18/07 | 739 | 785 | 1,092 | 1,477 | 1,569 | 235 |
| 7 of 7 | Week 26 | 06/25/07 | 337 | 358 | 499 | 675 | 765 | 107 |
| 7 of 7 | Week 27 | 07/02/07 | 423 | 436 | 607 | 821 | 872 | 123 |
| 7 of 7 | Week 28 | 07/09/07 | 291 | 300 | 418 | 565 | 641 | 86 |
| 0 of 7 | Week 29 | 07/16/07 | 0 | 0 | 0 | 0 | 0 | 0 |
| 0 of 7 | Week 30 | 07/23/07 | 0 | 0 | 0 | 0 | 0 | 0 |
| 0 of 7 | Week 31 | 07/30/07 | 0 | 0 | 0 | 0 | 0 | 0 |
| 0 of 7 | Week 32 | 08/06/07 | 0 | 0 | 0 | 0 | 0 | 0 |
| 0 of 7 | Week 33 | 08/13/07 | 0 | 0 | 0 | 0 | 0 | 0 |
| 0 of 7 | Week 34 | 08/20/07 | 0 | 0 | 0 | 0 | 0 | 0 |
| 0 of 7 | Week 35 | 08/27/07 | 0 | 0 | 0 | 0 | 0 | 0 |
| 0 of 7 | Week 36 | 09/03/07 | 0 | 0 | 0 | 0 | 0 | 0 |
| 0 of 7 | Week 37 | 09/10/07 | 0 | 0 | 0 | 0 | 0 | 0 |
| 0 of 7 | Week 38 | 09/17/07 | 0 | 0 | 0 | 0 | 0 | 0 |
| 0 of 7 | Week 39 | 09/24/07 | 0 | 0 | 0 | 0 | 0 | 0 |
| 0 of 7 | Week 40 | 10/01/07 | 0 | 0 | 0 | 0 | 0 | 0 |

| Days Sampled | Week | Date | 95% CI Lower | 90% CI Lower | Weekly Passage | 90% CI Upper | 95% CI Upper | S.D. |
|---|---|---|---|---|---|---|---|---|
| 0 of 7 | Week 41 | 10/08/07 | 0 | 0 | 0 | 0 | 0 | 0 |
| 0 of 7 | Week 42 | 10/15/07 | 0 | 0 | 0 | 0 | 0 | 0 |
| 0 of 7 | Week 43 | 10/22/07 | 0 | 0 | 0 | 0 | 0 | 0 |
| 0 of 7 | Week 44 | 10/29/07 | 0 | 0 | 0 | 0 | 0 | 0 |
| 0 of 7 | Week 45 | 11/05/07 | 0 | 0 | 0 | 0 | 0 | 0 |
| 0 of 7 | Week 46 | 11/12/07 | 0 | 0 | 0 | 0 | 0 | 0 |
| 0 of 7 | Week 47 | 11/19/07 | 0 | 0 | 0 | 0 | 0 | 0 |
| 7 of 7 | Week 48 | 11/26/07 | 0 | 0 | 0 | 0 | 0 | 0 |
| 7 of 7 | Week 49 | 12/03/07 | 0 | 0 | 0 | 0 | 0 | 0 |
| 7 of 7 | Week 50 | 12/10/07 | 0 | 0 | 0 | 0 | 0 | 0 |
| 7 of 7 | Week 51 | 12/17/07 | 115 | 121 | 178 | 269 | 302 | 54 |
| 8 of 8 | Week 52* | 12/24/07 | 0 | 0 | 0 | 0 | 0 | 0 |
| 6 of 7 | Week 1 | 01/01/08 | 0 | 0 | 0 | 0 | 0 | 0 |
| 7 of 7 | Week 2 | 01/08/08 | 0 | 0 | 0 | 0 | 0 | 0 |
| 7 of 7 | Week 3 | 01/15/08 | 0 | 0 | 0 | 0 | 0 | 0 |
| 7 of 7 | Week 4 | 01/22/08 | 0 | 0 | 0 | 0 | 0 | 0 |
| 7 of 7 | Week 5 | 01/29/08 | 0 | 0 | 0 | 0 | 0 | 0 |
| 7 of 7 | Week 6 | 02/05/08 | 0 | 0 | 0 | 0 | 0 | 0 |
| 7 of 7 | Week 7 | 02/12/08 | 0 | 0 | 0 | 0 | 0 | 0 |
| 6 of 7 | Week 8 | 02/19/08 | 0 | 0 | 0 | 0 | 0 | 0 |
| 7 of 7 | Week 9 | 02/26/08 | 0 | 0 | 0 | 0 | 0 | 0 |
| 7 of 7 | Week 10 | 03/05/08 | 0 | 0 | 0 | 0 | 0 | 0 |
| 7 of 7 | Week 11 | 03/12/08 | 0 | 0 | 0 | 0 | 0 | 0 |
| 7 of 7 | Week 12 | 03/19/08 | 0 | 0 | 0 | 0 | 0 | 0 |
| 7 of 7 | Week 13 | 03/26/08 | 0 | 0 | 0 | 0 | 0 | 0 |
| | | Total | 149,395 | 155,897 | 202,011 | 279,553 | 319,016 | |

*Week 52 (12/24/07-12/31/07) contains 8 days for keeping Jan. 1 as Julian calendar day 1.

Table 5. Weekly summaries of passage indices with 90% and 95% confidence intervals and standard deviation (SD) of the weekly strata of Broodyear 2007 fall-run Chinook salmon captured at the lower rotary screw at river mile 1.7 in Clear Creek, Shasta County, California, by the U.S. Fish and Wildlife Service from November 26, 2007 through June 30, 2008.

| Days Sampled | Week | Date | 95% CI Lower | 90% CI Lower | Weekly Passage | 90% CI Upper | 95% CI Upper | S.D. |
|---|---|---|---|---|---|---|---|---|
| 0 of 7 | Week 40 | 10/01/07 | 0 | 0 | 0 | 0 | 0 | 0 |
| 0 of 7 | Week 41 | 10/08/07 | 0 | 0 | 0 | 0 | 0 | 0 |
| 0 of 7 | Week 42 | 10/15/07 | 0 | 0 | 0 | 0 | 0 | 0 |
| 0 of 7 | Week 43 | 10/22/07 | 0 | 0 | 0 | 0 | 0 | 0 |
| 0 of 7 | Week 44 | 10/29/07 | 0 | 0 | 0 | 0 | 0 | 0 |
| 0 of 7 | Week 45 | 11/05/07 | 0 | 0 | 0 | 0 | 0 | 0 |
| 0 of 7 | Week 46 | 11/12/07 | 0 | 0 | 0 | 0 | 0 | 0 |
| 0 of 7 | Week 47 | 11/19/07 | 0 | 0 | 0 | 0 | 0 | 0 |
| 7 of 7 | Week 48 | 11/26/07 | 135 | 144 | 202 | 289 | 311 | 46 |
| 7 of 7 | Week 49 | 12/03/07 | 4,757 | 5,085 | 7,367 | 10,533 | 11,343 | 1,738 |
| 7 of 7 | Week 50 | 12/10/07 | 3,792 | 4,054 | 5,878 | 8,397 | 9,797 | 1,431 |
| 7 of 7 | Week 51 | 12/17/07 | 66,678 | 73,346 | 112,846 | 183,365 | 209,560 | 35,679 |
| 8 of 8 | Week 52* | 12/24/07 | 14,858 | 15,601 | 20,807 | 27,132 | 28,365 | 3,866 |
| 3 of 7 | Week 1 | 01/01/08 | 5,858 | 6,159 | 8,004 | 10,443 | 11,438 | 1,410 |
| 3 of 7 | Week 1 Pt:II | | 182,609 | 189,372 | 269,099 | 393,311 | 426,087 | 66,361 |
| 7 of 7 | Week 2 | 01/08/08 | 192,428 | 198,843 | 284,063 | 397,685 | 426,091 | 63,571 |
| 7 of 7 | Week 3 | 01/15/08 | 119,022 | 123,126 | 155,246 | 193,008 | 210,038 | 22,503 |
| 5 of 7 | Week 4 | 01/22/08 | 278,878 | 288,838 | 404,373 | 539,164 | 577,676 | 89,599 |
| 2 of 7 | Week 4 Pt.II | | 196,123 | 202,251 | 281,393 | 380,709 | 431,470 | 59,625 |
| 1 of 7 | Week 5 | 01/29/08 | 31,596 | 33,571 | 46,708 | 67,142 | 71,618 | 10,053 |
| 6 of 7 | Week 5 Pt:II | | 362,058 | 375,468 | 533,554 | 779,818 | 844,803 | 124,347 |
| 5 of 7 | Week 6 | 02/05/08 | 562,741 | 594,004 | 972,007 | 1,527,440 | 1,782,013 | 313,574 |
| 2 of 7 | Week 6 Pt:II | | 69,008 | 71,165 | 99,012 | 133,957 | 142,329 | 19,647 |
| 7 of 7 | Week 7 | 02/12/08 | 270,006 | 285,435 | 384,240 | 555,013 | 587,661 | 77,065 |
| 4 of 7 | Week 8 | 02/19/08 | 157,466 | 167,308 | 232,774 | 334,616 | 356,924 | 50,161 |
| 2 of 7 | Week 8 Pt:II | | 453,062 | 479,712 | 741,373 | 1,165,015 | 1,359,185 | 233,743 |
| 1 of 7 | Week 9 | 02/26/08 | 69,677 | 73,548 | 120,350 | 189,122 | 220,643 | 38,153 |
| 6 of 7 | Week 9 Pt:II | | 242,352 | 253,123 | 335,016 | 421,872 | 455,622 | 56,807 |

| Days Sampled | Week | Date | 95% CI Lower | 90% CI Lower | Weekly Passage | 90% CI Upper | 95% CI Upper | S.D. |
|---|---|---|---|---|---|---|---|---|
| 7 of 7 | Week 10 | 03/05/08 | 69,415 | 72,774 | 90,240 | 112,800 | 118,737 | 12,916 |
| 7 of 7 | Week 11 | 03/12/08 | 107,200 | 111,488 | 142,934 | 185,814 | 199,086 | 24,415 |
| 7 of 7 | Week 12 | 03/19/08 | 43,567 | 45,461 | 69,707 | 104,560 | 116,178 | 20,748 |
| 7 of 7 | Week 13 | 03/26/08 | 60,070 | 62,254 | 79,628 | 103,757 | 107,000 | 12,020 |
| 7 of 7 | Week 14 | 04/02/08 | 41,018 | 42,566 | 55,021 | 70,500 | 72,774 | 8,629 |
| 7 of 7 | Week 15 | 04/09/08 | 10,160 | 10,396 | 13,552 | 17,193 | 18,626 | 2,213 |
| 7 of 7 | Week 16 | 04/16/08 | 2,626 | 2,814 | 3,943 | 5,627 | 6,060 | 926 |
| 1 of 7 | Week 17 | 04/23/08 | 1,546 | 1,602 | 2,238 | 3,203 | 3,450 | 500 |
| 6 of 7 | Week 18 | 04/30/08 | 3,057 | 3,162 | 4,585 | 6,551 | 7,054 | 1,082 |
| 7 of 7 | Week 19 | 05/07/08 | 10,221 | 10,951 | 15,333 | 21,903 | 23,587 | 3,484 |
| 7 of 7 | Week 20 | 05/14/08 | 12,982 | 13,909 | 19,477 | 27,818 | 29,958 | 4,375 |
| 7 of 7 | Week 21 | 05/21/08 | 10,393 | 10,764 | 15,069 | 20,092 | 21,527 | 3,335 |
| 7 of 7 | Week 22 | 05/28/08 | 2,478 | 2,563 | 3,709 | 5,310 | 5,718 | 873 |
| 7 of 7 | Week 23 | 06/04/08 | 7,110 | 7,618 | 10,666 | 15,237 | 16,409 | 2,414 |
| 7 of 7 | Week 24 | 06/11/08 | 2,195 | 2,352 | 3,293 | 4,704 | 5,066 | 766 |
| 7 of 7 | Week 25 | 06/18/08 | 795 | 851 | 1,192 | 1,703 | 1,834 | 256 |
| 7 of 7 | Week 26 | 06/25/08 | 279 | 289 | 404 | 577 | 622 | 93 |
| 0 of 7 | Week 27 | 07/02/08 | 0 | 0 | 0 | 0 | 0 | 0 |
| 0 of 7 | Week 28 | 07/09/08 | 0 | 0 | 0 | 0 | 0 | 0 |
| 0 of 7 | Week 29 | 07/16/08 | 0 | 0 | 0 | 0 | 0 | 0 |
| 0 of 7 | Week 30 | 07/23/08 | 0 | 0 | 0 | 0 | 0 | 0 |
| 0 of 7 | Week 31 | 07/30/08 | 0 | 0 | 0 | 0 | 0 | 0 |
| 0 of 7 | Week 32 | 08/06/08 | 0 | 0 | 0 | 0 | 0 | 0 |
| 0 of 7 | Week 33 | 08/13/08 | 0 | 0 | 0 | 0 | 0 | 0 |
| 0 of 7 | Week 34 | 08/20/08 | 0 | 0 | 0 | 0 | 0 | 0 |
| 0 of 7 | Week 35 | 08/27/08 | 0 | 0 | 0 | 0 | 0 | 0 |
| 0 of 7 | Week 36 | 09/03/08 | 0 | 0 | 0 | 0 | 0 | 0 |
| 0 of 7 | Week 37 | 09/10/08 | 0 | 0 | 0 | 0 | 0 | 0 |
| 0 of 7 | Week 38 | 09/17/08 | 0 | 0 | 0 | 0 | 0 | 0 |
| 0 of 7 | Week 39 | 09/24/08 | 0 | 0 | 0 | 0 | 0 | 0 |
| | | Total | 4,816,781 | 4,906,462 | 5,545,303 | 6,359,077 | 6,614,700 | |

*Week 52 (12/24/07-12/31/07) contains 8 days for keeping Jan. 1 as Julian calendar day 1.

Table 6. Weekly summaries of passage indices with 90% and 95% confidence intervals, standard deviation (SD) of the weekly strata for BY 2008, steelhead / rainbow trout captured by the lower rotary screw trap at river mile 1.7 in Clear Creek, Shasta County, California, by the U.S. Fish and Wildlife Service from January 1, 2008 through December 31, 2008.

| Days Sampled | Week | BY2008 | 95% CI Lower | 90% CI Lower | Weekly Passage | 90% CI Upper | 95% CI Upper | S.D. |
|---|---|---|---|---|---|---|---|---|
| 6 of 7 | Week 1 | 01/01/08 | 0 | 0 | 0 | 0 | 0 | 0 |
| 7 of 7 | Week 2 | 01/08/08 | 0 | 0 | 0 | 0 | 0 | 0 |
| 7 of 7 | Week 3 | 01/15/08 | 0 | 0 | 0 | 0 | 0 | 0 |
| 7 of 7 | Week 4 | 01/22/08 | 0 | 0 | 0 | 0 | 0 | 0 |
| 1 of 7 | Week 5 | 01/29/08 | 25 | 26 | 35 | 51 | 54 | 7 |
| 6 of 7 | Week 5 Pt:II | | 14 | 14 | 21 | 31 | 34 | 5 |
| 5 of 7 | Week 6 | 02/05/08 | 86 | 89 | 223 | 186 | 201 | 30 |
| 2 of 7 | Week 6 Pt:II | | 62 | 65 | 91 | 123 | 131 | 19 |
| 7 of 7 | Week 7 | 02/12/08 | 387 | 421 | 566 | 736 | 775 | 112 |
| 3 of 7 | Week 8 | 02/19/08 | 154 | 164 | 228 | 327 | 349 | 51 |
| 3 of 7 | Week 8 Pt:II | | 191 | 202 | 330 | 518 | 605 | 162 |
| 1 of 7 | Week 9 | 02/26/08 | 42 | 45 | 73 | 115 | 134 | 27 |
| 6 of 7 | Week 9 Pt:II | | 442 | 462 | 611 | 799 | 866 | 105 |
| 7 of 7 | Week 10 | 03/05/08 | 547 | 564 | 711 | 889 | 936 | 100 |
| 7 of 7 | Week 11 | 03/12/08 | 1,153 | 1,199 | 1,537 | 1,934 | 2,067 | 234 |
| 7 of 7 | Week 12 | 03/19/08 | 787 | 821 | 1,260 | 1,889 | 2,099 | 343 |
| 7 of 7 | Week 13 | 03/26/08 | 2,782 | 2,832 | 3,623 | 4,582 | 4,868 | 550 |
| 7 of 7 | Week 14 | 04/02/08 | 4,616 | 4,883 | 6,192 | 7,934 | 8,463 | 982 |
| 7 of 7 | Week 15 | 04/09/08 | 1,987 | 2,079 | 2,709 | 3,725 | 3,887 | 485 |
| 7 of 7 | Week 16 | 04/16/08 | 646 | 693 | 970 | 1,385 | 1,492 | 221 |
| 1 of 7 | Week 17 | 04/23/08 | 1,407 | 1,505 | 2,182 | 3,117 | 3,356 | 514 |
| 6 of 7 | Week 18 | 04/30/08 | 1,158 | 1,198 | 1,737 | 2,482 | 2,673 | 409 |
| 7 of 7 | Week 19 | 05/07/08 | 1,538 | 1,644 | 2,384 | 3,405 | 3,973 | 579 |
| 7 of 7 | Week 20 | 05/14/08 | 929 | 996 | 1,394 | 1,991 | 2,144 | 327 |
| 7 of 7 | Week 21 | 05/21/08 | 1,393 | 1,443 | 2,020 | 2,886 | 3,108 | 450 |
| 7 of 7 | Week 22 | 05/28/08 | 1,023 | 1,059 | 1,535 | 2,193 | 2,362 | 362 |
| 7 of 7 | Week 23 | 06/04/08 | 2,060 | 2,208 | 3,091 | 4,415 | 4,755 | 701 |
| 7 of 7 | Week 24 | 06/11/08 | 875 | 938 | 1,313 | 1,876 | 2,020 | 295 |

| Days Sampled | Week | BY2008 | 95% CI Lower | 90% CI Lower | Weekly Passage | 90% CI Upper | 95% CI Upper | S.D. |
|---|---|---|---|---|---|---|---|---|
| 7 of 7 | Week 25 | 06/18/08 | 446 | 462 | 646 | 862 | 923 | 143 |
| 7 of 7 | Week 26 | 06/25/08 | 633 | 655 | 949 | 1,356 | 1,461 | 223 |
| 0 of 7 | Week 27 | 07/02/08 | 0 | 0 | 0 | 0 | 0 | 0 |
| 0 of 7 | Week 28 | 07/09/08 | 0 | 0 | 0 | 0 | 0 | 0 |
| 0 of 7 | Week 29 | 07/16/08 | 0 | 0 | 0 | 0 | 0 | 0 |
| 0 of 7 | Week 30 | 07/23/08 | 0 | 0 | 0 | 0 | 0 | 0 |
| 0 of 7 | Week 31 | 07/30/08 | 0 | 0 | 0 | 0 | 0 | 0 |
| 0 of 7 | Week 32 | 08/06/08 | 0 | 0 | 0 | 0 | 0 | 0 |
| 0 of 7 | Week 33 | 08/13/08 | 0 | 0 | 0 | 0 | 0 | 0 |
| 0 of 7 | Week 34 | 08/20/08 | 0 | 0 | 0 | 0 | 0 | 0 |
| 0 of 7 | Week 35 | 08/27/08 | 0 | 0 | 0 | 0 | 0 | 0 |
| 0 of 7 | Week 36 | 09/03/08 | 0 | 0 | 0 | 0 | 0 | 0 |
| 0 of 7 | Week 37 | 09/10/08 | 0 | 0 | 0 | 0 | 0 | 0 |
| 0 of 7 | Week 38 | 09/17/08 | 0 | 0 | 0 | 0 | 0 | 0 |
| 0 of 7 | Week 39 | 09/24/08 | 0 | 0 | 0 | 0 | 0 | 0 |
| 0 of 7 | Week 40 | 10/01/08 | 0 | 0 | 0 | 0 | 0 | 0 |
| 0 of 7 | Week 41 | 10/08/08 | 0 | 0 | 0 | 0 | 0 | 0 |
| 0 of 7 | Week 42 | 10/15/08 | 0 | 0 | 0 | 0 | 0 | 0 |
| 0 of 7 | Week 43 | 10/22/08 | 0 | 0 | 0 | 0 | 0 | 0 |
| 0 of 7 | Week 44 | 10/29/08 | 0 | 0 | 0 | 0 | 0 | 0 |
| 0 of 7 | Week 45 | 11/05/08 | 0 | 0 | 0 | 0 | 0 | 0 |
| 0 of 7 | Week 46 | 11/12/08 | 13 | 14 | 20 | 29 | 31 | 13 |
| 7 of 7 | Week 47 | 11/19/08 | 13 | 14 | 20 | 29 | 31 | 13 |
| 7 of 7 | Week 48 | 11/26/08 | 0 | 0 | 0 | 0 | 0 | 0 |
| 7 of 7 | Week 49 | 12/03/08 | 13 | 14 | 20 | 29 | 31 | 13 |
| 7 of 7 | Week 50 | 12/10/08 | 0 | 0 | 0 | 0 | 0 | 0 |
| 7 of 7 | Week 51 | 12/17/08 | 0 | 0 | 0 | 0 | 0 | 0 |
| 8 of 8 | Week 52* | 12/24/08 | 6 | 6 | 8 | 10 | 10 | 6 |
| | | Total | 33,284 | 33,677 | 36,499 | 40,025 | 40,983 | |

*Week 52 (12/24/07-12/31/07) contains 8 days for keeping Jan. 1 as Julian calendar day 1.

Table 7. Weekly summaries of passage indices with 90% and 95% confidence intervals, standard deviation (SD) of the weekly strata for BY 2007, Age 0+, steelhead / rainbow trout captured by the lower rotary screw trap at river mile 1.7 in Clear Creek, Shasta County, California, by the U.S. Fish and Wildlife Service from January 1, 2008 through December 31, 2008.

| Days Sampled | Week | BY2007 0+ | 95% CI Lower | 90% CI Lower | Weekly Passage | 90% CI Upper | 95% CI Upper | S.D. |
|---|---|---|---|---|---|---|---|---|
| 3 of 7 | Week 1 | 01/01/08 | 0 | 0 | 0 | 0 | 0 | 0 |
| 3 of 7 | Week1 Pt:II | | 28 | 30 | 42 | 62 | 67 | 10 |
| 7 of 7 | Week 2 | 01/08/08 | 0 | 0 | 0 | 0 | 0 | 0 |
| 7 of 7 | Week 3 | 01/15/08 | 0 | 0 | 0 | 0 | 0 | 0 |
| 5 of 7 | Week 4 | 01/22/08 | 0 | 0 | 0 | 0 | 0 | 0 |
| 2 of 7 | Week 4 Pt:II | | 12 | 13 | 18 | 24 | 27 | 4 |
| 7 of 7 | Week 5 | 01/29/08 | 0 | 0 | 0 | 0 | 0 | 0 |
| 7 of 7 | Week 6 | 02/05/08 | 0 | 0 | 0 | 0 | 0 | 0 |
| 7 of 7 | Week 7 | 02/12/08 | 0 | 0 | 0 | 0 | 0 | 0 |
| 4 of 7 | Week 8 | 02/19/08 | 12 | 13 | 18 | 25 | 27 | 4 |
| 2 of 7 | Week 8 Pt:II | | 0 | 0 | 0 | 0 | 0 | 0 |
| 1 of 7 | Week 9 | 02/26/08 | 42 | 45 | 73 | 115 | 134 | 26 |
| 6 of 7 | Week 9 Pt:II | | 17 | 18 | 24 | 31 | 33 | 4 |
| 7 of 7 | Week 10 | 03/05/08 | 0 | 0 | 0 | 0 | 0 | 0 |
| 7 of 7 | Week 11 | 03/12/08 | 16 | 16 | 21 | 27 | 29 | 3 |
| 7 of 7 | Week 12 | 03/19/08 | 0 | 0 | 0 | 0 | 0 | 0 |
| 7 of 7 | Week 13 | 03/26/08 | 14 | 15 | 19 | 24 | 26 | 3 |
| 7 of 7 | Week 14 | 04/02/08 | 15 | 15 | 20 | 25 | 27 | 3 |
| 7 of 7 | Week 15 | 04/09/08 | 0 | 0 | 0 | 0 | 0 | 0 |
| 7 of 7 | Week 16 | 04/16/08 | 13 | 14 | 20 | 29 | 31 | 5 |
| 1 of 7 | Week 17 | 04/23/08 | 0 | 0 | 0 | 0 | 0 | 0 |
| 6 of 7 | Week 18 | 04/30/08 | 0 | 0 | 0 | 0 | 0 | 0 |
| 7 of 7 | Week 19 | 05/07/08 | 0 | 0 | 0 | 0 | 0 | 0 |
| 7 of 7 | Week 20 | 05/14/08 | 0 | 0 | 0 | 0 | 0 | 0 |
| 7 of 7 | Week 21 | 05/21/08 | 0 | 0 | 0 | 0 | 0 | 0 |
| 7 of 7 | Week 22 | 05/28/08 | 0 | 0 | 0 | 0 | 0 | 0 |
| 7 of 7 | Week 23 | 06/04/08 | 0 | 0 | 0 | 0 | 0 | 0 |

| Days Sampled | Week | BY2007 0+ | 95% CI Lower | 90% CI Lower | Weekly Passage | 90% CI Upper | 95% CI Upper | S.D. |
|---|---|---|---|---|---|---|---|---|
| 7 of 7 | Week 24 | 06/11/08 | 0 | 0 | 0 | 0 | 0 | 0 |
| 7 of 7 | Week 25 | 06/18/08 | 0 | 0 | 0 | 0 | 0 | 0 |
| 7 of 7 | Week 26 | 06/25/08 | 0 | 0 | 0 | 0 | 0 | 0 |
| 0 of 7 | Week 27 | 07/02/08 | 0 | 0 | 0 | 0 | 0 | 0 |
| 0 of 7 | Week 28 | 07/09/08 | 0 | 0 | 0 | 0 | 0 | 0 |
| 0 of 7 | Week 29 | 07/16/08 | 0 | 0 | 0 | 0 | 0 | 0 |
| 0 of 7 | Week 30 | 07/23/08 | 0 | 0 | 0 | 0 | 0 | 0 |
| 0 of 7 | Week 31 | 07/30/08 | 0 | 0 | 0 | 0 | 0 | 0 |
| 0 of 7 | Week 32 | 08/06/08 | 0 | 0 | 0 | 0 | 0 | 0 |
| 0 of 7 | Week 33 | 08/13/08 | 0 | 0 | 0 | 0 | 0 | 0 |
| 0 of 7 | Week 34 | 08/20/08 | 0 | 0 | 0 | 0 | 0 | 0 |
| 0 of 7 | Week 35 | 08/27/08 | 0 | 0 | 0 | 0 | 0 | 0 |
| 0 of 7 | Week 36 | 09/03/08 | 0 | 0 | 0 | 0 | 0 | 0 |
| 0 of 7 | Week 37 | 09/10/08 | 0 | 0 | 0 | 0 | 0 | 0 |
| 0 of 7 | Week 38 | 09/17/08 | 0 | 0 | 0 | 0 | 0 | 0 |
| 0 of 7 | Week 39 | 09/24/08 | 0 | 0 | 0 | 0 | 0 | 0 |
| 0 of 7 | Week 40 | 10/01/08 | 0 | 0 | 0 | 0 | 0 | 0 |
| 0 of 7 | Week 41 | 10/08/08 | 0 | 0 | 0 | 0 | 0 | 0 |
| 0 of 7 | Week 42 | 10/15/08 | 0 | 0 | 0 | 0 | 0 | 0 |
| 0 of 7 | Week 43 | 10/22/08 | 0 | 0 | 0 | 0 | 0 | 0 |
| 0 of 7 | Week 44 | 10/29/08 | 0 | 0 | 0 | 0 | 0 | 0 |
| 0 of 7 | Week 45 | 11/05/08 | 0 | 0 | 0 | 0 | 0 | 0 |
| 0 of 7 | Week 46 | 11/12/08 | 0 | 0 | 0 | 0 | 0 | 0 |
| 7 of 7 | Week 47 | 11/19/08 | 0 | 0 | 0 | 0 | 0 | 0 |
| 7 of 7 | Week 48 | 11/26/08 | 0 | 0 | 0 | 0 | 0 | 0 |
| 7 of 7 | Week 49 | 12/03/08 | 0 | 0 | 0 | 0 | 0 | 0 |
| 7 of 7 | Week 50 | 12/10/08 | 0 | 0 | 0 | 0 | 0 | 0 |
| 7 of 7 | Week 51 | 12/17/08 | 0 | 0 | 0 | 0 | 0 | 0 |
| 8 of 8 | Week 52* | 12/24/08 | 0 | 0 | 0 | 0 | 0 | 0 |
| | | Total | 209 | 214 | 255 | 307 | 329 | |

*Week 52 (12/24/07-12/31/07) contains 8 days for keeping Jan. 1 as Julian calendar day 1.

Table 8. Trap efficiency data gathered by using mark-recapture trials with juvenile Chinook salmon at the upper rotary screw trap at river mile 8.3 in Clear Creek, Shasta County, California, by the U.S. Fish and Wildlife Service from December 16, 2007 through March 28, 2008. The shaded rows indicate trials that were excluded from calculating passage indices.

| Trial | Mark Date | Release Date | Fish Released | Mortality | % Mortality | Trap Catch | Efficiency |
|---|---|---|---|---|---|---|---|
| 1 | 15-Dec-07 | 16-Dec-07 | 191 | 0 | 0.00% | 19 | 0.1042 |
| 2 | 21-Dec-07 | 22-Dec-07 | 400 | 0 | 0.00% | 48 | 0.1222 |
| 3 | 28-Dec-07 | 29-Dec-07 | 325 | 2 | 0.62% | 47 | 0.1472 |
| 4 | 3-Jan-08 | 3-Jan-08 | 496 | 2 | 0.40% | 14 | 0.0302 |
| 5 | 7-Jan-08 | 8-Jan-08 | 391 | 1 | 0.26% | 15 | 0.0408 |
| 6 | 11-Jan-08 | 12-Jan-08 | 318 | 0 | 0.00% | 21 | 0.0690 |
| 7 | 14-Jan-08 | 15-Jan-08 | 402 | 0 | 0.00% | 45 | 0.1141 |
| 8 | 18-Jan-08 | 19-Jan-08 | 401 | 0 | 0.00% | 59 | 0.1493 |
| 9 | 22-Jan-08 | 23-Jan-08 | 394 | 2 | 0.51% | 53 | 0.1367 |
| | 25-Jan-08 | 26-Jan-08 | 399 | | | 14 | |
| 10 | 28-Jan-08 | 29-Jan-08 | 406 | 0 | 0.00% | 31 | 0.0786 |
| | 1-Feb-08 | | 400 | 1 | | | |
| 11 | 4-Feb-08 | 5-Feb-08 | 405 | 0 | 0.00% | 17 | 0.0443 |
| 12 | 8-Feb-08 | 9-Feb-08 | 410 | 1 | 0.24% | 36 | 0.0900 |
| 13 | 11-Feb-08 | 12-Feb-08 | 401 | 3 | 0.75% | 47 | 0.1194 |
| 14 | 15-Feb-08 | 16-Feb-08 | 402 | 0 | 0.00% | 50 | 0.1266 |
| 15 | 19-Feb-08 | 20-Feb-08 | 399 | 1 | 0.25% | 19 | 0.0500 |
| 16 | 22-Feb-08 | 22-Feb-08 | 402 | 0 | 0.00% | 33 | 0.0844 |
| 17 | 26-Feb-08 | 26-Feb-08 | 397 | 2 | 0.50% | 31 | 0.0804 |
| 18 | 29-Feb-08 | 1-Mar-08 | 405 | 0 | 0.00% | 57 | 0.1429 |
| 19 | 3-Mar-08 | 4-Mar-08 | 374 | 0 | 0.00% | 82 | 0.2213 |
| 20 | 7-Mar-08 | 8-Mar-08 | 402 | 0 | 0.00% | 110 | 0.2754 |
| 21 | 10-Mar-08 | 11-Mar-08 | 405 | 0 | 0.00% | 105 | 0.2611 |
| 22 | 14-Mar-08 | 15-Mar-08 | 406 | 0 | 0.00% | 103 | 0.2555 |
| 23 | 17-Mar-08 | 18-Mar-08 | 402 | 0 | 0.00% | 43 | 0.1092 |
| 24 | 21-Mar-08 | 22-Mar-08 | 410 | 0 | 0.00% | 34 | 0.0852 |
| 25 | 24-Mar-08 | 25-Mar-08 | 394 | 1 | 0.25% | 36 | 0.0937 |

Table 9. Summary of trap efficiency values used for weekly passage indices of Chinook salmon and steelhead / rainbow trout captured in the upper rotary screw trap at river mile 8.3 by the U.S. Fish and Wildlife Service from November 26, 2007 to June 30, 2008.

| Dates | Week | Releases | Recaptures | Efficiency |
|---|---|---|---|---|
| 11/26-12/21 | 48-51 | 191 | 19 | 0.1042 |
| 12/22-12/23 | 51 | 400 | 48 | 0.1222 |
| 12/24-12/28 | 52 | 400 | 48 | 0.1222 |
| 12/29-12/31 | 52 | 325 | 47 | 0.1472 |
| 01/01-01/02 | 1 | 325 | 47 | 0.1472 |
| 01/03-01/07 | 1 | 496 | 14 | 0.0302 |
| 01/08-01/11 | 2 | 391 | 15 | 0.0408 |
| 01/12-01/14 | 2 | 318 | 21 | 0.0690 |
| 01/15-01/18 | 3 | 402 | 45 | 0.1141 |
| 01/19-01/21 | 3 | 401 | 59 | 0.1493 |
| 01/22-01/22 | 4 | 401 | 59 | 0.1493 |
| 01/23-01/28 | 4 | 394 | 53 | 0.1367 |
| 01/29-02/04 | 5 | 406 | 31 | 0.0786 |
| 02/05-02/08 | 6 | 405 | 17 | 0.0443 |
| 02/09-02/11 | 6 | 410 | 36 | 0.0900 |
| 02/12-02/15 | 7 | 401 | 47 | 0.1194 |
| 02/16-02/18 | 7 | 402 | 50 | 0.1266 |
| 02/19-02/19 | 8 | 401 | 47 | 0.1194 |
| 02/20-02/21 | 8 | 399 | 19 | 0.0500 |
| 02/22-02/25 | 8 | 402 | 33 | 0.0844 |
| 02/26-02/29 | 9 | 397 | 31 | 0.0804 |
| 03/01-03/03 | 9 | 405 | 57 | 0.1429 |
| 03/04-03/07 | 10 | 374 | 82 | 0.2213 |
| 03/08-03/10 | 10 | 402 | 110 | 0.2754 |
| 03/11-03/14 | 11 | 405 | 105 | 0.2611 |
| 03/15-03/17 | 11 | 406 | 103 | 0.2555 |
| 03/18-03/21 | 12 | 402 | 43 | 0.1092 |
| 03/22-03/24 | 12 | 410 | 34 | 0.0852 |
| 03/25-06/30 | 13-26 | 394 | 36 | 0.0937 |

Table 10. Trap efficiency test data gathered by using mark-recapture trials with juvenile Chinook salmon at the lower rotary screw trap at river mile 1.7 in Clear Creek, Shasta County, California, by the U.S. Fish and Wildlife Service from December 22, 2007 through April 11, 2008. The shaded row indicates a trial that was not used to calculate passage indices.

| Trial | Mark Date | Release Date | Fish Released | Mortality | % Mortality | Trap Catch | Efficiency |
|---|---|---|---|---|---|---|---|
| 1 | 21-Dec-07 | 22-Dec-07 | 402 | 0 | 0.00% | 12 | 0.0323 |
| 2 | 31-Dec-07 | 31-Dec-07 | 398 | 0 | 0.00% | 29 | 0.0752 |
| 3 | 11-Jan-08 | 12-Jan-08 | 401 | 0 | 0.00% | 20 | 0.0522 |
| 4 | 14-Jan-08 | 15-Jan-08 | 399 | 0 | 0.00% | 24 | 0.0625 |
| 5 | 18-Jan-08 | 19-Jan-08 | 398 | 0 | 0.00% | 21 | 0.0551 |
| 6 | 22-Jan-08 | 23-Jan-08 | 417 | 0 | 0.00% | 19 | 0.0478 |
| 7 | 25-Jan-08 | 26-Jan-08 | 405 | 0 | 0.00% | 22 | 0.0567 |
| 8 | 28-Jan-08 | 29-Jan-08 | 401 | 1 | 0.25% | 18 | 0.0473 |
| | 1-Feb-08 | 2-Feb-08 | 417 | 1 | 0.24% | | |
| 9 | 4-Feb-08 | 5-Feb-08 | 408 | 0 | 0.00% | 10 | 0.0269 |
| 10 | 8-Feb-08 | 9-Feb-08 | 418 | 0 | 0.00% | 22 | 0.0549 |
| 11 | 11-Feb-08 | 12-Feb-08 | 407 | 0 | 0.00% | 14 | 0.0368 |
| 12 | 15-Feb-08 | 16-Feb-08 | 410 | 0 | 0.00% | 11 | 0.0292 |
| 13 | 19-Feb-08 | 20-Feb-08 | 402 | 0 | 0.00% | 22 | 0.0571 |
| 14 | 22-Feb-08 | 22-Feb-08 | 402 | 0 | 0.00% | 10 | 0.0273 |
| 15 | 26-Feb-08 | 26-Feb-08 | 396 | 3 | 0.76% | 20 | 0.0529 |
| 16 | 29-Feb-08 | 1-Mar-08 | 402 | 0 | 0.00% | 13 | 0.0347 |
| 17 | 3-Mar-08 | 4-Mar-08 | 371 | 0 | 0.00% | 24 | 0.0672 |
| 18 | 7-Mar-08 | 8-Mar-08 | 401 | 1 | 0.25% | 25 | 0.0647 |
| 19 | 10-Mar-08 | 11-Mar-08 | 404 | 0 | 0.00% | 18 | 0.0469 |
| 20 | 14-Mar-08 | 15-Mar-08 | 405 | 0 | 0.00% | 20 | 0.0517 |
| 21 | 17-Mar-08 | 18-Mar-08 | 401 | 1 | 0.25% | 14 | 0.0373 |
| 22 | 24-Mar-08 | 25-Mar-08 | 397 | 0 | 0.00% | 27 | 0.0704 |
| 23 | 28-Mar-08 | 29-Mar-08 | 405 | 0 | 0.00% | 15 | 0.0394 |
| 24 | 31-Mar-08 | 1-Apr-08 | 404 | 2 | 0.50% | 20 | 0.0519 |
| 25 | 4-Apr-08 | 5-Apr-08 | 401 | 0 | 0.00% | 20 | 0.0522 |
| 26 | 7-Apr-08 | 8-Apr-08 | 411 | 1 | 0.24% | 32 | 0.0801 |

Table 11. Summary of trap efficiency values used for weekly passage indices of Chinook salmon and steelhead / rainbow trout captured in the lower rotary screw trap at river mile 1.7 by the U.S. Fish and Wildlife Service from November 26, 2007 through June 30, 2008. Darkly shaded rows indicate pooled values where more than one trial was used to determine efficiency. Lightly shaded rows indicate weeks where season efficiency was used.

| Dates | Week | Marks | Recaptures | Efficiency |
|---|---|---|---|---|
| 11/26-12/16 | 48-50 | 402 | 20 | 0.0521 |
| 12/17-12/23 | 51 | 402 | 12 | 0.0323 |
| 12/24-12/31 | 52 | 398 | 29 | 0.0752 |
| 01/01-01/03 | 1 | 398 | 29 | 0.0752 |
| 01/04-01/07 | 1 | 401 | 18 | 0.0473 |
| 01/08-01/14 | 2 | 401 | 18 | 0.0473 |
| 01/15-01/21 | 3 | 797 | 45 | 0.0576 |
| 01/22-01/26 | 4 | 417 | 19 | 0.0478 |
| 01/27-01/28 | 4 | 405 | 22 | 0.0567 |
| 01/29-01/29 | 5 | 405 | 22 | 0.0567 |
| 01/30-02/04 | 5 | 401 | 18 | 0.0473 |
| 02/05-02/09 | 6 | 408 | 10 | 0.0269 |
| 02/10-02/11 | 6 | 418 | 22 | 0.0549 |
| 02/12-02/18 | 7 | 817 | 25 | 0.0318 |
| 02/19-02/22 | 8 | 402 | 22 | 0.0571 |
| 02/23-02/25 | 8 | 402 | 10 | 0.0273 |
| 02/26-02/26 | 9 | 402 | 10 | 0.0273 |
| 02/27-03/03 | 9 | 798 | 33 | 0.0426 |
| 03/04-03/10 | 10 | 772 | 49 | 0.0647 |
| 03/11-03/17 | 11 | 809 | 38 | 0.0481 |
| 03/18-03/24 | 12 | 401 | 14 | 0.0373 |
| 03/25-03/31 | 13 | 802 | 42 | 0.0535 |
| 04/01-04/07 | 14 | 805 | 40 | 0.0509 |
| 04/08-04/14 | 15 | 411 | 32 | 0.0801 |
| 04/15-06/30 | 16-26 | 402 | 20 | 0.0521 |

Table 12. Annual mortality of spring-run Chinook salmon captured by the upper rotary screw trap at river mile 8.3 in Clear Creek, Shasta County, California, by the U.S. Fish and Wildlife Service from November 26, 2007 through June 30, 2008.

| Week | Date | Weekly Passage | Catch | Mortality | % Passage | % Catch |
|---|---|---|---|---|---|---|
| Week 40 | 10/1/2007 | 0 | 0 | 0 | 0.00% | 0.00% |
| Week 41 | 10/8/2007 | 0 | 0 | 0 | 0.00% | 0.00% |
| Week 42 | 10/15/2007 | 0 | 0 | 0 | 0.00% | 0.00% |
| Week 43 | 10/22/2007 | 0 | 0 | 0 | 0.00% | 0.00% |
| Week 44 | 10/29/2007 | 0 | 0 | 0 | 0.00% | 0.00% |
| Week 45 | 11/5/2007 | 0 | 0 | 0 | 0.00% | 0.00% |
| Week 46 | 11/12/2007 | 0 | 0 | 0 | 0.00% | 0.00% |
| Week 47 | 11/19/2007 | 0 | 0 | 0 | 0.00% | 0.00% |
| Week 48 | 11/26/2007 | 3,312 | 333 | 12 | 0.36% | 3.60% |
| Week 49 | 12/3/2007 | 15,331 | 1,586 | 11 | 0.07% | 0.69% |
| Week 50 | 12/10/2007 | 8,909 | 924 | 4 | 0.04% | 0.43% |
| Week 51 | 12/17/2007 | 32,017 | 3,349 | 23 | 0.07% | 0.69% |
| Week 52 | 12/24/2007 | 3,839 | 487 | 2 | 0.05% | 0.41% |
| Week 1 | 1/1/2008 | 28,404 | 677 | 39 | 0.14% | 5.76% |
| Week 2 | 1/8/2008 | 15,439 | 684 | 9 | 0.06% | 1.32% |
| Week 3 | 1/15/2008 | 672 | 87 | 0 | 0.00% | 0.00% |
| Week 4 | 1/22/2008 | 1,292 | 144 | 1 | 0.08% | 0.69% |
| Week 5 | 1/29/2008 | 267 | 21 | 0 | 0.00% | 0.00% |
| Week 6 | 2/5/2008 | 225 | 11 | 0 | 0.00% | 0.00% |
| Week 7 | 2/12/2008 | 49 | 6 | 0 | 0.00% | 0.00% |
| Week 8 | 2/19/2008 | 12 | 1 | 0 | 0.00% | 0.00% |
| Week 9 | 2/26/2008 | 115 | 11 | 0 | 0.00% | 0.00% |
| Week 10 | 3/5/2008 | 32 | 6 | 1 | 3.16% | 16.67% |
| Week 11 | 3/12/2008 | 23 | 6 | 0 | 0.00% | 0.00% |
| Week 12 | 3/19/2008 | 9 | 1 | 0 | 0.00% | 0.00% |
| Week 13 | 3/26/2008 | 21 | 2 | 0 | 0.00% | 0.00% |
| Week 14 | 4/2/2008 | 64 | 6 | 0 | 0.00% | 0.00% |
| Week 15 | 4/9/2008 | 32 | 3 | 0 | 0.00% | 0.00% |
| Week 16 | 4/16/2008 | 0 | 0 | 0 | 0.00% | 0.00% |
| Week 17 | 4/23/2008 | 21 | 2 | 0 | 0.00% | 0.00% |
| Week 18 | 4/30/2008 | 43 | 4 | 0 | 0.00% | 0.00% |
| Week 19 | 5/7/2008 | 11 | 1 | 0 | 0.00% | 0.00% |
| Week 20 | 5/14/2008 | 64 | 6 | 0 | 0.00% | 0.00% |
| Week 21 | 5/21/2008 | 21 | 2 | 0 | 0.00% | 0.00% |
| Week 22 | 5/28/2008 | 0 | 0 | 0 | 0.00% | 0.00% |
| Week 23 | 6/4/2008 | 0 | 0 | 0 | 0.00% | 0.00% |
| Week 24 | 6/11/2008 | 0 | 0 | 0 | 0.00% | 0.00% |
| Week 25 | 6/18/2008 | 0 | 0 | 0 | 0.00% | 0.00% |
| Week 26 | 6/25/2008 | 0 | 0 | 0 | 0.00% | 0.00% |
| Week 27 | 7/2/2008 | 0 | 0 | 0 | 0.00% | 0.00% |
| Week 28 | 7/9/2008 | 0 | 0 | 0 | 0.00% | 0.00% |
| Week 29 | 7/16/2008 | 0 | 0 | 0 | 0.00% | 0.00% |
| Week 30 | 7/23/2008 | 0 | 0 | 0 | 0.00% | 0.00% |

| Week | Date | Weekly Passage | Catch | Mortality | % Passage | % Catch |
|---|---|---|---|---|---|---|
| Week 31 | 7/30/2008 | 0 | 0 | 0 | 0.00% | 0.00% |
| Week 32 | 8/6/2008 | 0 | 0 | 0 | 0.00% | 0.00% |
| Week 33 | 8/13/2008 | 0 | 0 | 0 | 0.00% | 0.00% |
| Week 34 | 8/20/2008 | 0 | 0 | 0 | 0.00% | 0.00% |
| Week 35 | 8/27/2008 | 0 | 0 | 0 | 0.00% | 0.00% |
| Week 36 | 9/3/2008 | 0 | 0 | 0 | 0.00% | 0.00% |
| Week 37 | 9/10/2008 | 0 | 0 | 0 | 0.00% | 0.00% |
| Week 38 | 9/17/2008 | 0 | 0 | 0 | 0.00% | 0.00% |
| Week 39 | 9/24/2008 | 0 | 0 | 0 | 0.00% | 0.00% |

Table 13. Annual mortality of late-fall-run Chinook salmon captured by the lower rotary screw trap at river mile 1.7 in Clear Creek, Shasta County, California, by the U.S. Fish and Wildlife Service from April 1, 2007 through March 31, 2008.

| Week | Date | Weekly Passage | Catch | Mortality | % Passage | % Catch |
|---|---|---|---|---|---|---|
| Week 14 | 4/2/2007 | 3,675 | 163 | 0 | 0.00% | 0.00% |
| Week 15 | 4/9/2007 | 23,682 | 640 | 0 | 0.00% | 0.00% |
| Week 16 | 4/16/2007 | 105,634 | 2,095 | 101 | 0.10% | 4.81% |
| Week 17 | 4/23/2007 | 27,140 | 1,110 | 15 | 0.05% | 1.32% |
| Week 18 | 4/30/2007 | 13,356 | 517 | 3 | 0.02% | 0.58% |
| Week 19 | 5/7/2007 | 6,585 | 443 | 5 | 0.08% | 1.13% |
| Week 20 | 5/14/2007 | 2,635 | 235 | 4 | 0.15% | 1.70% |
| Week 21 | 5/21/2007 | 5,310 | 394 | 9 | 0.17% | 2.28% |
| Week 22 | 5/28/2007 | 3,760 | 279 | 0 | 0.00% | 0.00% |
| Week 23 | 6/4/2007 | 4,327 | 321 | 1 | 0.02% | 0.31% |
| Week 24 | 6/11/2007 | 3,113 | 231 | 2 | 0.06% | 0.87% |
| Week 25 | 6/18/2007 | 1,092 | 81 | 2 | 0.18% | 2.47% |
| Week 26 | 6/25/2007 | 499 | 37 | 0 | 0.00% | 0.00% |
| Week 27 | 7/2/2007 | 607 | 23 | 0 | 0.00% | 0.00% |
| Week 28 | 7/9/2007 | 418 | 31 | 1 | 0.24% | 3.23% |
| Week 29 | 7/16/2007 | 0 | 0 | 0 | 0.00% | 0.00% |
| Week 30 | 7/23/2007 | 0 | 0 | 0 | 0.00% | 0.00% |
| Week 31 | 7/30/2007 | 0 | 0 | 0 | 0.00% | 0.00% |
| Week 32 | 8/6/2007 | 0 | 0 | 0 | 0.00% | 0.00% |
| Week 33 | 8/13/2007 | 0 | 0 | 0 | 0.00% | 0.00% |
| Week 34 | 8/20/2007 | 0 | 0 | 0 | 0.00% | 0.00% |
| Week 35 | 8/27/2007 | 0 | 0 | 0 | 0.00% | 0.00% |
| Week 36 | 9/3/2007 | 0 | 0 | 0 | 0.00% | 0.00% |
| Week 37 | 9/10/2007 | 0 | 0 | 0 | 0.00% | 0.00% |
| Week 38 | 9/17/2007 | 0 | 0 | 0 | 0.00% | 0.00% |
| Week 39 | 9/24/2007 | 0 | 0 | 0 | 0.00% | 0.00% |
| Week 40 | 10/1/2007 | 0 | 0 | 0 | 0.00% | 0.00% |
| Week 41 | 10/8/2007 | 0 | 0 | 0 | 0.00% | 0.00% |
| Week 42 | 10/15/2007 | 0 | 0 | 0 | 0.00% | 0.00% |
| Week 43 | 10/22/2007 | 0 | 0 | 0 | 0.00% | 0.00% |
| Week 44 | 10/29/2007 | 0 | 0 | 0 | 0.00% | 0.00% |
| Week 45 | 11/5/2007 | 0 | 0 | 0 | 0.00% | 0.00% |
| Week 46 | 11/12/2007 | 0 | 0 | 0 | 0.00% | 0.00% |
| Week 47 | 11/19/2007 | 0 | 0 | 0 | 0.00% | 0.00% |
| Week 48 | 11/26/2007 | 0 | 0 | 0 | 0.00% | 0.00% |
| Week 49 | 12/3/2007 | 0 | 0 | 0 | 0.00% | 0.00% |
| Week 50 | 12/10/2007 | 0 | 0 | 0 | 0.00% | 0.00% |

| | | | | | | |
|---|---|---|---|---|---|---|
| Week 51 | 12/17/2007 | 178 | 4 | 0 | 0.00% | 0.00% |
| Week 52 | 12/24/2007 | 0 | 0 | 0 | 0.00% | 0.00% |
| Week 1 | 1/1/2008 | 0 | 0 | 0 | 0.00% | 0.00% |
| Week 2 | 1/8/2008 | 0 | 0 | 0 | 0.00% | 0.00% |
| Week 3 | 1/15/2008 | 0 | 0 | 0 | 0.00% | 0.00% |
| Week 4 | 1/22/2008 | 0 | 0 | 0 | 0.00% | 0.00% |
| Week 5 | 1/29/2008 | 0 | 0 | 0 | 0.00% | 0.00% |
| Week 6 | 2/5/2008 | 0 | 0 | 0 | 0.00% | 0.00% |
| Week 7 | 2/12/2008 | 0 | 0 | 0 | 0.00% | 0.00% |
| Week 8 | 2/19/2008 | 0 | 0 | 0 | 0.00% | 0.00% |
| Week 9 | 2/26/2008 | 0 | 0 | 0 | 0.00% | 0.00% |
| Week 10 | 3/5/2008 | 0 | 0 | 0 | 0.00% | 0.00% |
| Week 11 | 3/12/2008 | 0 | 0 | 0 | 0.00% | 0.00% |
| Week 12 | 3/19/2008 | 0 | 0 | 0 | 0.00% | 0.00% |
| Week 13 | 3/26/2008 | 0 | 0 | 0 | 0.00% | 0.00% |

Table 14. Annual mortality of spring-run Chinook salmon captured by the lower rotary screw trap at river mile 1.7 in Clear Creek, Shasta County, California, by the U.S. Fish and Wildlife Service from October 1, 2007 through September 30, 2008.

| Week | Date | Weekly Passage | Catch | Mortality | % Passage | % Catch |
|---|---|---|---|---|---|---|
| Week 40 | 10/1/2007 | 0 | 0 | 0 | 0.00% | 0.00% |
| Week 41 | 10/8/2007 | 0 | 0 | 0 | 0.00% | 0.00% |
| Week 42 | 10/15/2007 | 0 | 0 | 0 | 0.00% | 0.00% |
| Week 43 | 10/22/2007 | 0 | 0 | 0 | 0.00% | 0.00% |
| Week 44 | 10/29/2007 | 0 | 0 | 0 | 0.00% | 0.00% |
| Week 45 | 11/5/2007 | 0 | 0 | 0 | 0.00% | 0.00% |
| Week 46 | 11/12/2007 | 0 | 0 | 0 | 0.00% | 0.00% |
| Week 47 | 11/19/2007 | 0 | 0 | 0 | 0.00% | 0.00% |
| Week 48 | 11/26/2007 | 1,075 | 56 | 0 | 0.00% | 0.00% |
| Week 49 | 12/3/2007 | 994 | 65 | 0 | 0.00% | 0.00% |
| Week 50 | 12/10/2007 | 1,363 | 71 | 0 | 0.00% | 0.00% |
| Week 51 | 12/17/2007 | 3,846 | 203 | 8 | 0.21% | 3.94% |
| Week 52 | 12/24/2007 | 398 | 29 | 0 | 0.00% | 0.00% |
| Week 1 | 1/1/2008 | 1,217 | 43 | 0 | 0.00% | 0.00% |
| Week 2 | 1/8/2008 | 266 | 18 | 0 | 0.00% | 0.00% |
| Week 3 | 1/15/2008 | 0 | 0 | 0 | 0.00% | 0.00% |
| Week 4 | 1/22/2008 | 0 | 0 | 0 | 0.00% | 0.00% |
| Week 5 | 1/29/2008 | 641 | 16 | 0 | 0.00% | 0.00% |
| Week 6 | 2/5/2008 | 0 | 0 | 0 | 0.00% | 0.00% |
| Week 7 | 2/12/2008 | 126 | 8 | 0 | 0.00% | 0.00% |
| Week 8 | 2/19/2008 | 55 | 24 | 0 | 0.00% | 0.00% |
| Week 9 | 2/26/2008 | 0 | 0 | 0 | 0.00% | 0.00% |
| Week 10 | 3/5/2008 | 0 | 0 | 0 | 0.00% | 0.00% |
| Week 11 | 3/12/2008 | 0 | 0 | 0 | 0.00% | 0.00% |
| Week 12 | 3/19/2008 | 0 | 0 | 0 | 0.00% | 0.00% |
| Week 13 | 3/26/2008 | 0 | 0 | 0 | 0.00% | 0.00% |
| Week 14 | 4/2/2008 | 0 | 0 | 0 | 0.00% | 0.00% |
| Week 15 | 4/9/2008 | 0 | 0 | 0 | 0.00% | 0.00% |
| Week 16 | 4/16/2008 | 0 | 0 | 0 | 0.00% | 0.00% |
| Week 17 | 4/23/2008 | 0 | 0 | 0 | 0.00% | 0.00% |
| Week 18 | 4/30/2008 | 0 | 0 | 0 | 0.00% | 0.00% |
| Week 19 | 5/7/2008 | 0 | 0 | 0 | 0.00% | 0.00% |
| Week 20 | 5/14/2008 | 19 | 1 | 0 | 0.00% | 0.00% |
| Week 21 | 5/21/2008 | 0 | 0 | 0 | 0.00% | 0.00% |
| Week 22 | 5/28/2008 | 0 | 0 | 0 | 0.00% | 0.00% |
| Week 23 | 6/4/2008 | 0 | 0 | 0 | 0.00% | 0.00% |
| Week 24 | 6/11/2008 | 0 | 0 | 0 | 0.00% | 0.00% |

| Week | Date | Weekly Passage | Catch | Mortality | % Passage | % Catch |
|---|---|---|---|---|---|---|
| Week 25 | 6/18/2008 | 0 | 0 | 0 | 0.00% | 0.00% |
| Week 26 | 6/25/2008 | 0 | 0 | 0 | 0.00% | 0.00% |
| Week 27 | 7/2/2008 | 0 | 0 | 0 | 0.00% | 0.00% |
| Week 28 | 7/9/2008 | 0 | 0 | 0 | 0.00% | 0.00% |
| Week 29 | 7/16/2008 | 0 | 0 | 0 | 0.00% | 0.00% |
| Week 30 | 7/23/2008 | 0 | 0 | 0 | 0.00% | 0.00% |
| Week 31 | 7/30/2008 | 0 | 0 | 0 | 0.00% | 0.00% |
| Week 32 | 8/6/2008 | 0 | 0 | 0 | 0.00% | 0.00% |
| Week 33 | 8/13/2008 | 0 | 0 | 0 | 0.00% | 0.00% |
| Week 34 | 8/20/2008 | 0 | 0 | 0 | 0.00% | 0.00% |
| Week 35 | 8/27/2008 | 0 | 0 | 0 | 0.00% | 0.00% |
| Week 36 | 9/3/2008 | 0 | 0 | 0 | 0.00% | 0.00% |
| Week 37 | 9/10/2008 | 0 | 0 | 0 | 0.00% | 0.00% |
| Week 38 | 9/17/2008 | 0 | 0 | 0 | 0.00% | 0.00% |
| Week 39 | 9/24/2008 | 0 | 0 | 0 | 0.00% | 0.00% |

Table 15. Annual mortality of fall-run Chinook salmon captured by the lower rotary screw trap at river mile 1.7 in Clear Creek, Shasta County, California, by the U.S. Fish and Wildlife Service from October 1, 2007 through September 30, 2008.

| Week | Date | Weekly Passage | Catch | Mortality | % Passage | % Catch |
|---|---|---|---|---|---|---|
| Week 40 | 10/1/2007 | 0 | 0 | 0 | 0.00% | 0.00% |
| Week 41 | 10/8/2007 | 0 | 0 | 0 | 0.00% | 0.00% |
| Week 42 | 10/15/2007 | 0 | 0 | 0 | 0.00% | 0.00% |
| Week 43 | 10/22/2007 | 0 | 0 | 0 | 0.00% | 0.00% |
| Week 44 | 10/29/2007 | 0 | 0 | 0 | 0.00% | 0.00% |
| Week 45 | 11/5/2007 | 0 | 0 | 0 | 0.00% | 0.00% |
| Week 46 | 11/12/2007 | 0 | 0 | 0 | 0.00% | 0.00% |
| Week 47 | 11/19/2007 | 0 | 0 | 0 | 0.00% | 0.00% |
| Week 48 | 11/26/2007 | 192 | 10 | 0 | 0.00% | 0.00% |
| Week 49 | 12/3/2007 | 6,998 | 361 | 2 | 0.03% | 0.55% |
| Week 50 | 12/10/2007 | 5,584 | 291 | 3 | 0.05% | 1.03% |
| Week 51 | 12/17/2007 | 112,846 | 2,747 | 24 | 0.03% | 0.87% |
| Week 52 | 12/24/2007 | 20,807 | 1,564 | 5 | 0.02% | 0.32% |
| Week 1 | 1/1/2008 | 277,103 | 9,893 | 42 | 0.02% | 0.42% |
| Week 2 | 1/8/2008 | 284,063 | 14,835 | 227 | 0.08% | 1.53% |
| Week 3 | 1/15/2008 | 155,246 | 8,949 | 85 | 0.05% | 0.95% |
| Week 4 | 1/22/2008 | 685,766 | 35,289 | 528 | 0.08% | 1.50% |
| Week 5 | 1/29/2008 | 580,262 | 24,034 | 307 | 0.05% | 1.28% |
| Week 6 | 2/5/2008 | 652,122 | 31,577 | 343 | 0.05% | 1.09% |
| Week 7 | 2/12/2008 | 384,240 | 12,209 | 67 | 0.02% | 0.55% |
| Week 8 | 2/19/2008 | 974,147 | 24,372 | 147 | 0.02% | 0.60% |
| Week 9 | 2/26/2008 | 455,366 | 17,541 | 36 | 0.01% | 0.21% |
| Week 10 | 3/5/2008 | 90,240 | 5,837 | 11 | 0.01% | 0.19% |
| Week 11 | 3/12/2008 | 142,934 | 6,882 | 12 | 0.01% | 0.17% |
| Week 12 | 3/19/2008 | 69,707 | 2,598 | 0 | 0.00% | 0.00% |
| Week 13 | 3/26/2008 | 79,628 | 4,264 | 16 | 0.02% | 0.38% |
| Week 14 | 4/2/2008 | 55,021 | 2,793 | 3 | 0.01% | 0.11% |
| Week 15 | 4/9/2008 | 13,552 | 1,086 | 2 | 0.01% | 0.18% |
| Week 16 | 4/16/2008 | 3,746 | 192 | 0 | 0.00% | 0.00% |
| Week 17 | 4/23/2008 | 2,126 | 111 | 2 | 0.09% | 1.81% |
| Week 18 | 4/30/2008 | 4,356 | 227 | 0 | 0.00% | 0.00% |
| Week 19 | 5/7/2008 | 14,567 | 759 | 4 | 0.03% | 0.53% |
| Week 20 | 5/14/2008 | 18,504 | 964 | 3 | 0.02% | 0.31% |
| Week 21 | 5/21/2008 | 14,316 | 746 | 0 | 0.00% | 0.00% |
| Week 22 | 5/28/2008 | 3,524 | 184 | 0 | 0.00% | 0.00% |
| Week 23 | 6/4/2008 | 10,133 | 528 | 1 | 0.01% | 0.19% |
| Week 24 | 6/11/2008 | 3,128 | 163 | 0 | 0.00% | 0.00% |

| Week | Date | Weekly Passage | Catch | Mortality | % Passage | % Catch |
|---|---|---|---|---|---|---|
| Week 25 | 6/18/2008 | 1,132 | 59 | 0 | 0.00% | 0.00% |
| Week 26 | 6/25/2008 | 384 | 20 | 0 | 0.00% | 0.00% |
| Week 27 | 7/2/2008 | 0 | 0 | 0 | 0.00% | 0.00% |
| Week 28 | 7/9/2008 | 0 | 0 | 0 | 0.00% | 0.00% |
| Week 29 | 7/16/2008 | 0 | 0 | 0 | 0.00% | 0.00% |
| Week 30 | 7/23/2008 | 0 | 0 | 0 | 0.00% | 0.00% |
| Week 31 | 7/30/2008 | 0 | 0 | 0 | 0.00% | 0.00% |
| Week 32 | 8/6/2008 | 0 | 0 | 0 | 0.00% | 0.00% |
| Week 33 | 8/13/2008 | 0 | 0 | 0 | 0.00% | 0.00% |
| Week 34 | 8/20/2008 | 0 | 0 | 0 | 0.00% | 0.00% |
| Week 35 | 8/27/2008 | 0 | 0 | 0 | 0.00% | 0.00% |
| Week 36 | 9/3/2008 | 0 | 0 | 0 | 0.00% | 0.00% |
| Week 37 | 9/10/2008 | 0 | 0 | 0 | 0.00% | 0.00% |
| Week 38 | 9/17/2008 | 0 | 0 | 0 | 0.00% | 0.00% |
| Week 39 | 9/24/2008 | 0 | 0 | 0 | 0.00% | 0.00% |

Table 16. Passage indices of spring-run Chinook salmon with 90% and 95% confidence intervals for Broodyear 2003-2007 captured by the upper rotary screw trap at river mile 8.3 in Clear Creek, Shasta County, California, by the U.S. Fish and Wildlife Service.

| Broodyear | 2003 | 2004 | 2005 | 2006 | 2007 |
|---|---|---|---|---|---|
| 95% Lower CI | 88,817 | 87,439 | 87,516 | 111,749 | 92,728 |
| 90% Lower CI | 90,113 | 90,417 | 89,516 | 113,659 | 94,472 |
| Passage Index | 108,338 | 107,054 | 104,197 | 127,197 | 110,224 |
| 90% Upper CI | 130,960 | 131,700 | 122,580 | 144,692 | 130,585 |
| 95% Upper CI | 137,672 | 136,701 | 128,418 | 148,539 | 135,069 |
| Adjusted passage for all redds above and below RST | 110,422 | 110,028 | 106,201 | 149,318 | 114,914 |
| Number of Redds above RST | 52 | 36 | 52 | 69 | 47 |
| Number of Redds including below RST above reach 6 | 53 | 37 | 53 | 81 | 49 |
| Juveniles per Redd | 2,083 | 2,974 | 2,004 | 1,843 | 2,345 |

Table 17. Passage indices of late-fall run Chinook salmon with 90% and 95% confidence intervals for Broodyear 1999-2007 captured by the lower rotary screw trap at river mile 1.7 in Clear Creek, Shasta County, California, by the U.S. Fish and Wildlife Service.

| Broodyear | 1999 | 2000 | 2001 | 2002 | 2003 | 2004 | 2005 | 2006 | 2007 |
|---|---|---|---|---|---|---|---|---|---|
| 95% Lower CI | 272,930 | 90,576 | 68,446 | 156,297 | 29,432 | 9,570 | 17,808 | 70,716 | 149,395 |
| 90% Lower CI | 275,736 | 92,331 | 70,733 | 158,835 | 30,130 | 9,915 | 18,163 | 72,560 | 155,897 |
| Passage Index | 292,323 | 101,347 | 86,836 | 172,708 | 33,902 | 11,906 | 20,401 | 86,918 | 202,011 |
| 90% Upper CI | 310,697 | 113,299 | 107,359 | 189,998 | 38,705 | 14,701 | 22,733 | 105,130 | 279,553 |
| 95% Upper CI | 314,778 | 116,274 | 112,386 | 192,685 | 39,638 | 15,644 | 23,384 | 113,960 | 319,016 |

Table 18. Passage indices of fall-run Chinook salmon with 90% and 95% confidence intervals for Broodyear 1998-2007 captured by the lower rotary screw trap at river mile 1.7 in Clear Creek, Shasta County, California, by the U.S. Fish and Wildlife Service.

| **Broodyear** | **1998** | **1999** | **2000** | **2001** | **2002** | **2003** | **2004** | **2005** | **2006** | **2007** |
|---|---|---|---|---|---|---|---|---|---|---|
| 95% Lower CI | 5,656,571 | 5,951,440 | 13,535,844 | 5,577,387 | 3,560,468 | 5,311,235 | 5,361,896 | 2,570,162 | 4,275,282 | 4,816,781 |
| 90% Lower CI | 5,760,186 | 6,009,301 | 13,681,994 | 5,602,563 | 3,609,632 | 5,406,501 | 5,465,198 | 2,609,782 | 4,359,617 | 4,906,462 |
| Passage Index | 6,395,638 | 6,405,765 | 14,955,182 | 5,788,701 | 3,858,446 | 6,056,834 | 6,190,757 | 2,969,321 | 4,929,544 | 5,545,303 |
| 90% Upper CI | 7,150,348 | 6,956,968 | 16,222,612 | 6,007,409 | 4,102,132 | 6,797,575 | 6,987,786 | 3,444,467 | 5,667,355 | 6,359,077 |
| 95% Upper CI | 7,303,438 | 7,121,563 | 16,483,244 | 6,042,987 | 4,174,685 | 7,003,322 | 7,216,897 | 3,566,470 | 5,832,272 | 6,614,700 |
| Passage per adult female | 2,573 | 1,567 | 4,466 | 1,031 | 472 | 1,114 | 1,663 | 309 | 947 | 2,105 |

Table 19. Passage indices of steelhead / rainbow trout with 90% and 95% confidence intervals for Broodyear 1999-2008 captured by the lower rotary screw trap at river mile 1.7 in Clear Creek, Shasta County, California, by the U.S. Fish and Wildlife Service.

| **Broodyear** | **1999** | **2000** | **2001** | **2002** | **2003** | **2004** | **2005** | **2006** | **2007** | **2008** |
|---|---|---|---|---|---|---|---|---|---|---|
| 95% Lower CI | 3,986 | 7,951 | 8,120 | 11,731 | 8,758 | 24,137 | 22,247 | 9,362 | 27,515 | 33,284 |
| 90% Lower CI | 4,025 | 8,074 | 8,226 | 11,926 | 8,910 | 24,697 | 22,670 | 9,547 | 28,349 | 33,677 |
| Passage Index | 4,229 | 8,507 | 8,742 | 12,803 | 9,772 | 28,989 | 24,791 | 10,762 | 33,910 | 36,499 |
| 90% Upper CI | 4,446 | 9,004 | 9,311 | 13,860 | 10,761 | 34,454 | 28,211 | 12,313 | 41,428 | 40,025 |
| 95% Upper CI | 4,506 | 9,162 | 9,424 | 14,193 | 10,954 | 36,746 | 29,454 | 12,632 | 43,292 | 40,983 |

**Figures**

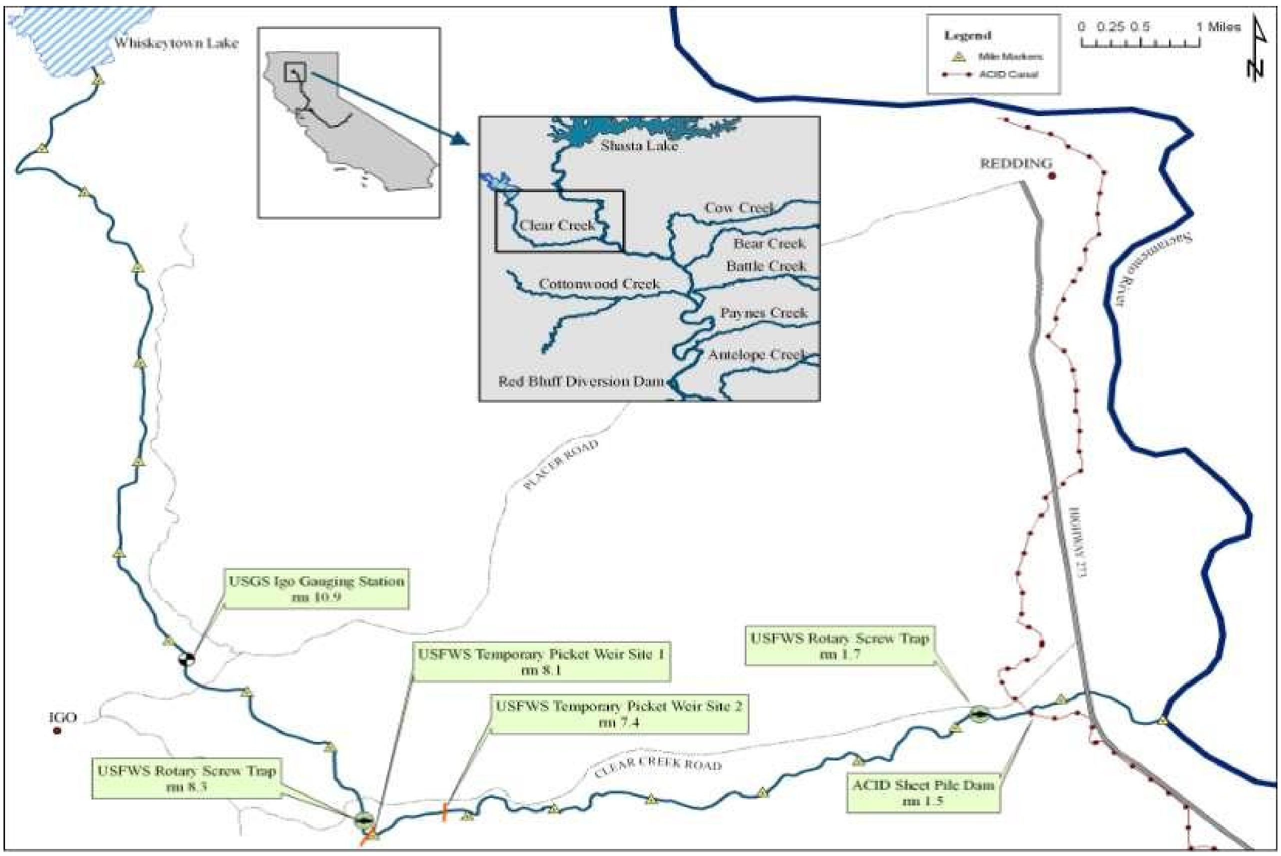


Figure 1. Locations of the upper (UCC) and lower (LCC) rotary screw trap sampling stations used for juvenile salmonid monitoring at river mile 8.3 and 1.7 in Clear Creek, Shasta County, California by the U.S. Fish and Wildlife Service from November 26, 2007 through June 30, 2008.

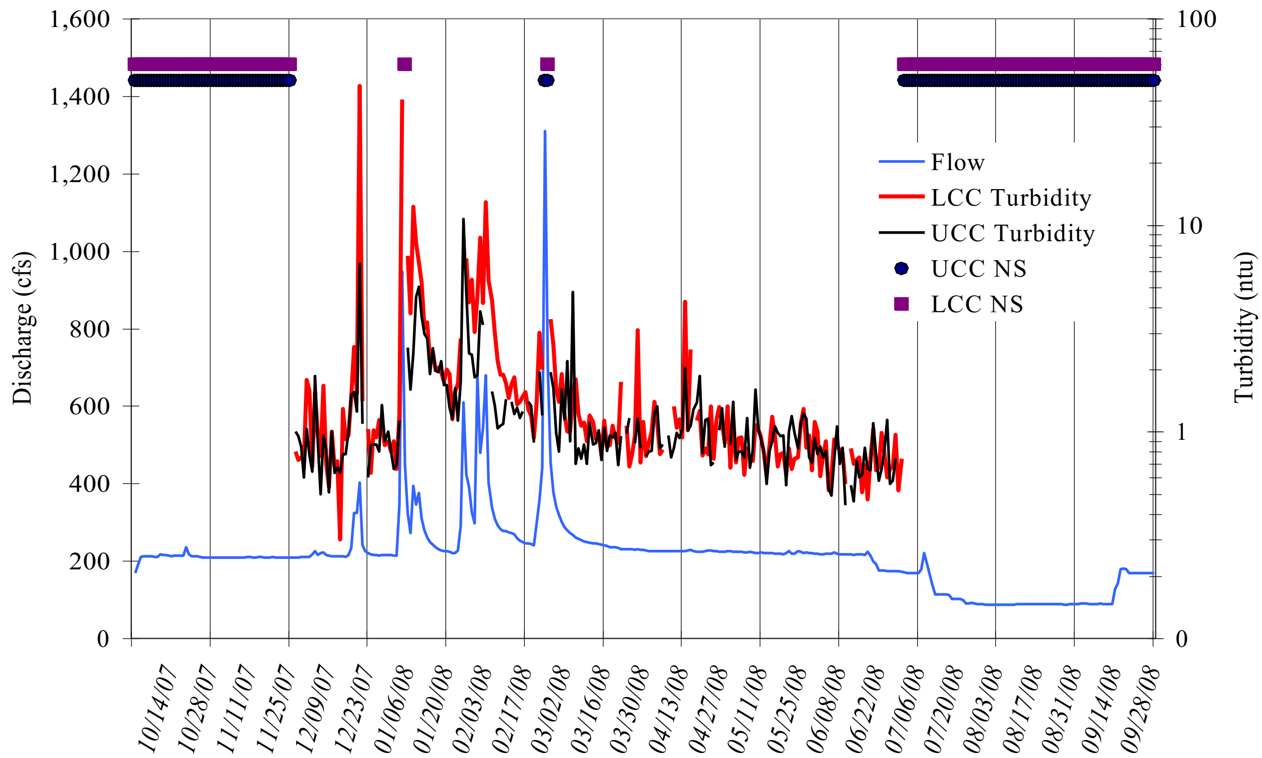


Figure 2. Mean daily flow in cubic feet per second (cfs) measured at the USGS IGO station, non sampling days (NS), and momentary turbidity in nephelometric turbidity units (NTU's) recorded at the upper and lower rotary screw trap sampling stations at river mile 8.3 and 1.7 in Clear Creek, Shasta County, California by the U S. Fish and Wildlife Service from October 1, 2007 through September 30, 2008.

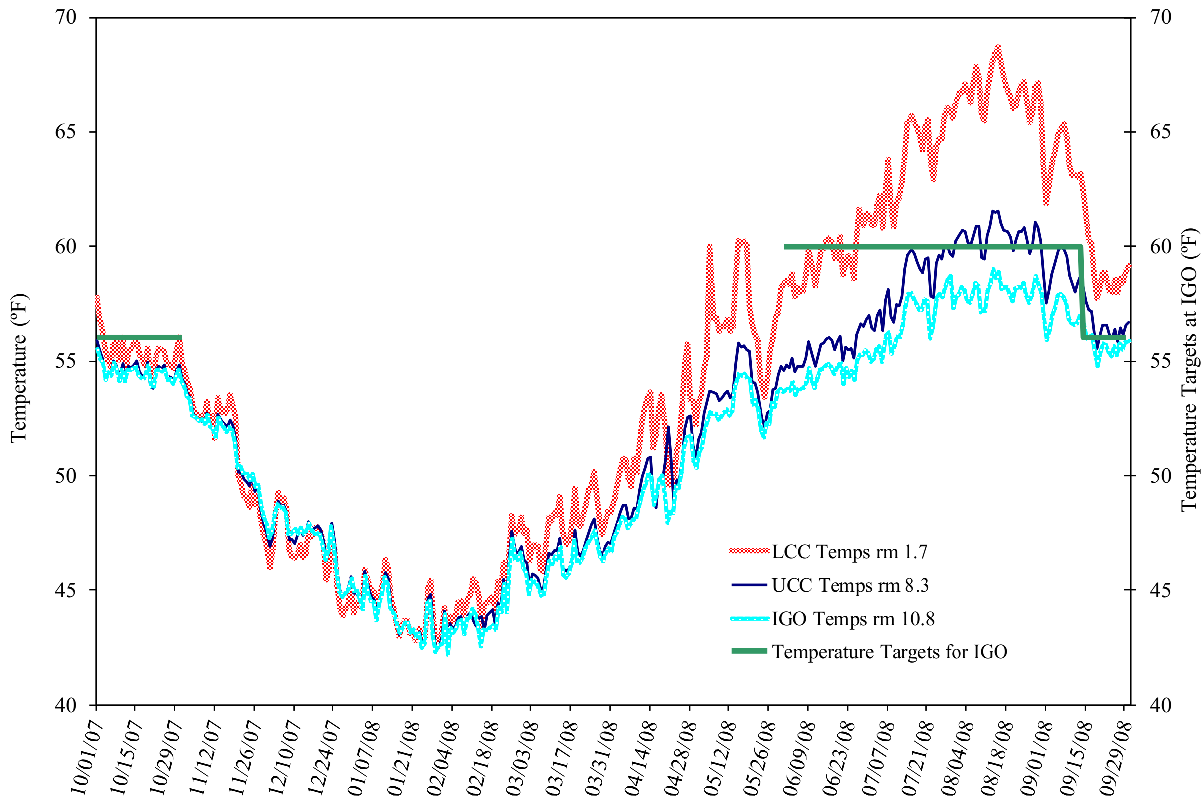


Figure 3. Mean daily water temperatures (°F) recorded at the upper (UCC) and lower (LCC) rotary screw trap sampling stations at river mile 8.3 and 1.7 in Clear Creek, Shasta County, California by the U S. Fish and Wildlife Service from October 1, 2007 through September 30, 2008. Clear Creek Fish Restoration Program temperature targets for fish protection and the temperatures recorded at the Clear Creek IGO gauge are provided for comparison**.**

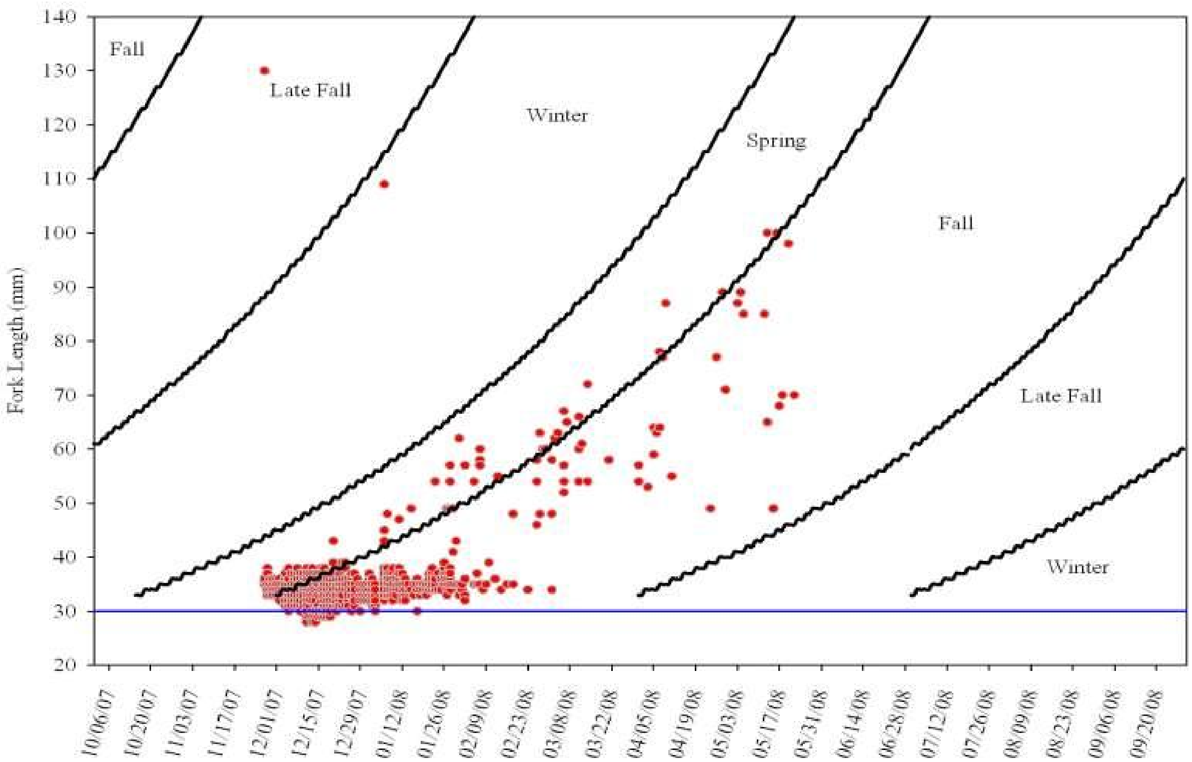


Figure 4. Fork length (mm) distribution by date and run for Chinook salmon captured by the upper rotary screw trap at river mile 8.3 in Clear Creek, Shasta County, California by the U.S. Fish and Wildlife Service from November 26, 2007 through June 30, 2008. Spline curves represent the maximum fork lengths expected for each run by date, based upon tables of projected annual growth developed by the California Department of Water Resources (Greene 1992).

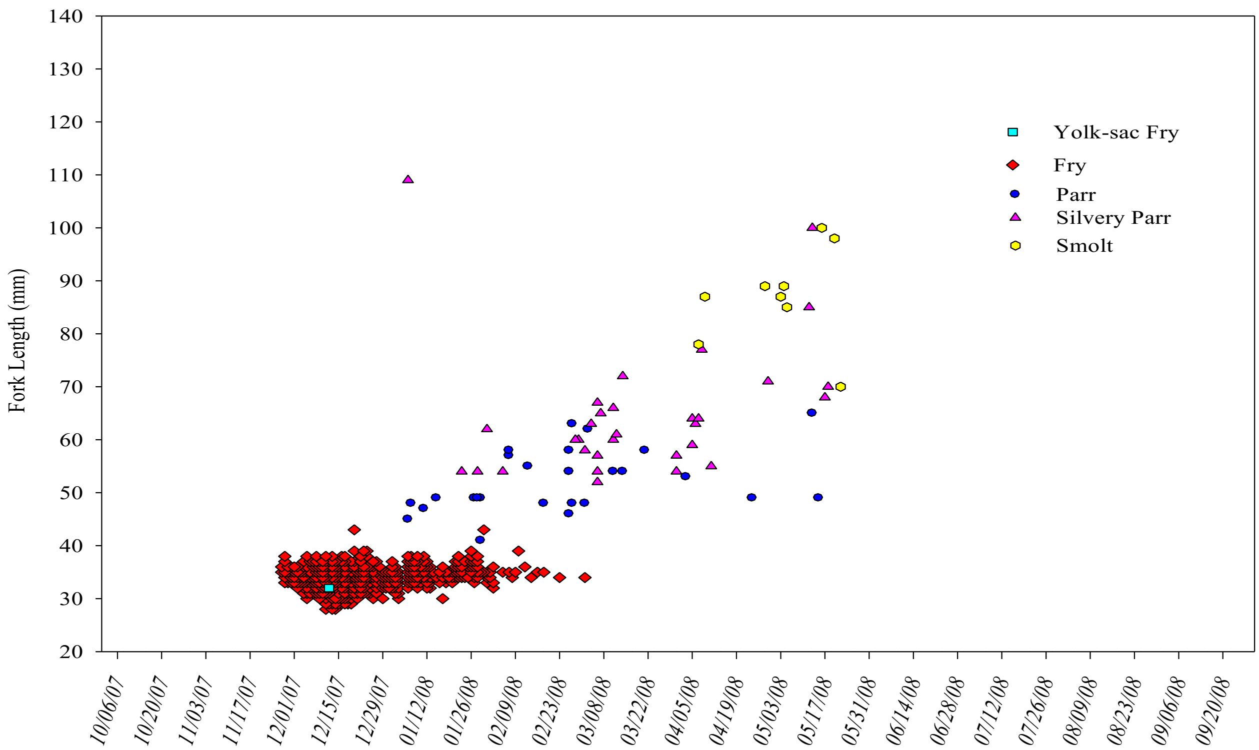


Figure 5. Life stage ratings for BY 2007 juvenile Chinook salmon captured by the upper rotary screw trap at river mile 8.3 in Clear Creek, Shasta County, California by the U.S. Fish and Wildlife Service from November 26, 2007 through June 30, 2008.

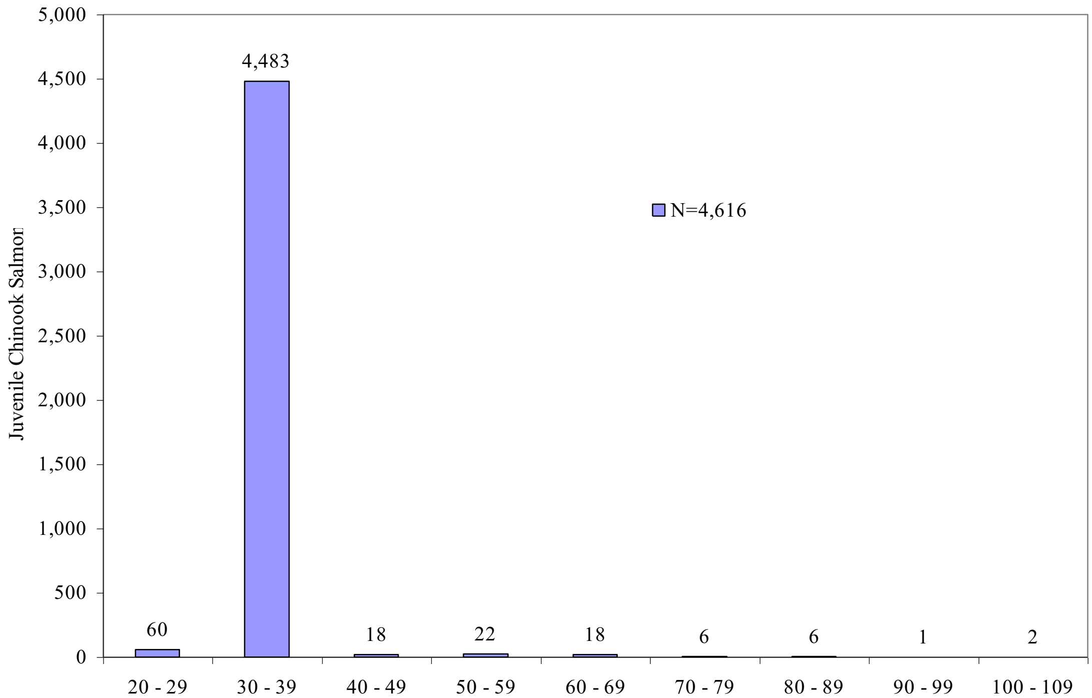


Figure 6. Fork length (mm) frequency distribution of BY 2007 juvenile spring Chinook salmon captured by the upper rotary screw trap at river mile 8.3 in Clear Creek, Shasta County, California by the U.S. Fish and Wildlife Service from November 26, 2007 through June 30, 2008. Fork length frequencies were assigned based on the proportional frequency of occurrence, in 10 mm increments.

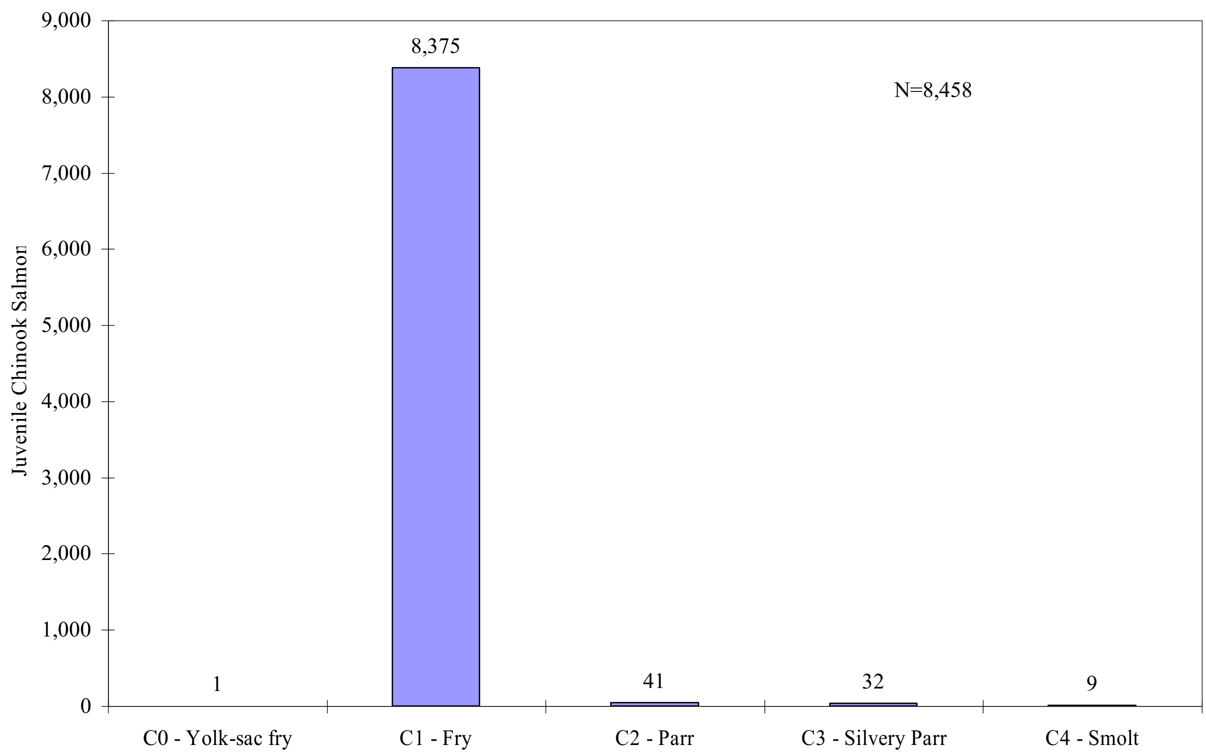


Figure 7. Life stage ratings for BY 2007 juvenile spring-run Chinook salmon captured by the upper rotary screw trap at river mile 8.3 in Clear Creek, Shasta County, California by the U.S. Fish and Wildlife Service from November 26, 2007 through June 30, 2008.

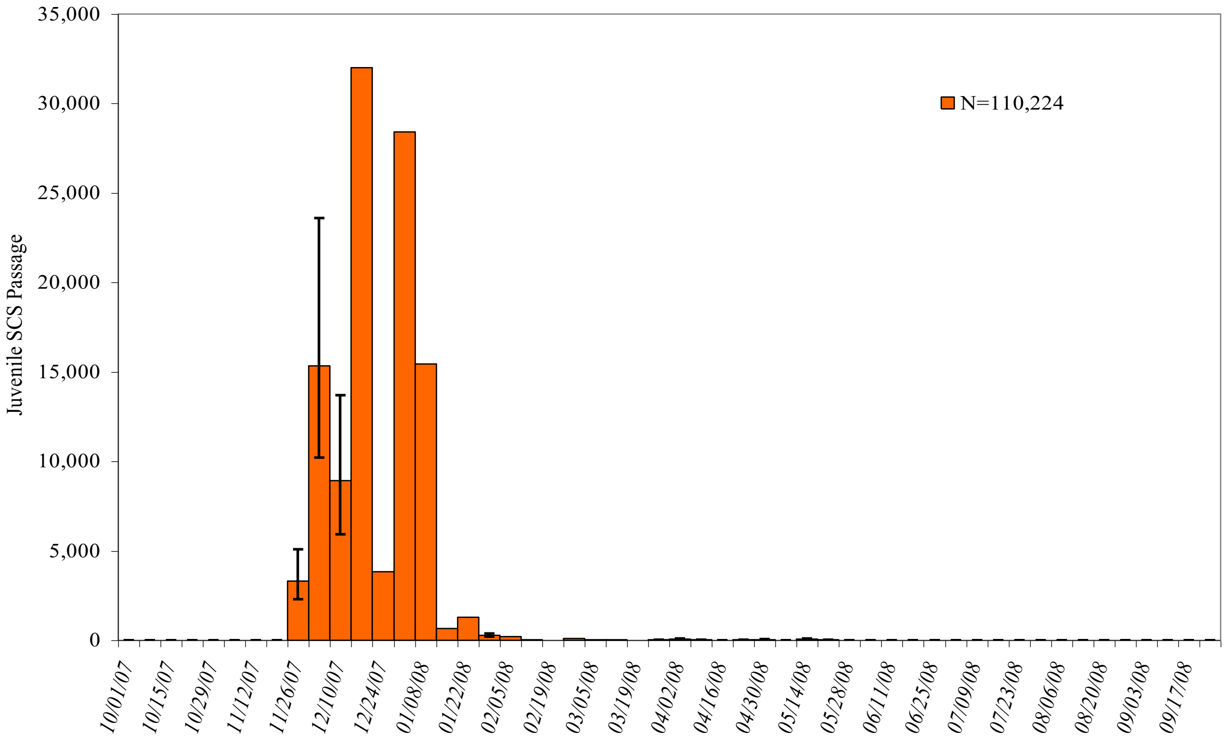


Figure 8. Weekly passage index with 95% Confidence Intervals (CI's) of juvenile spring Chinook salmon captured by the upper rotary screw trap at river mile 8.3 in Clear Creek, Shasta County, California by the U.S. Fish and Wildlife Service from November 26, 2007 through June 30, 2008. Spring Chinook passage for Clear Creek is calculated using total catch from the UCC rotary screw trap and weekly trap efficiencies**.** Where CI's are not shown, see Table 3, as weeks with multiple strata, efficiencies, and calculations do not have a single CI. Passage totals may be added for a weekly passage estimate however, CI's cannot.

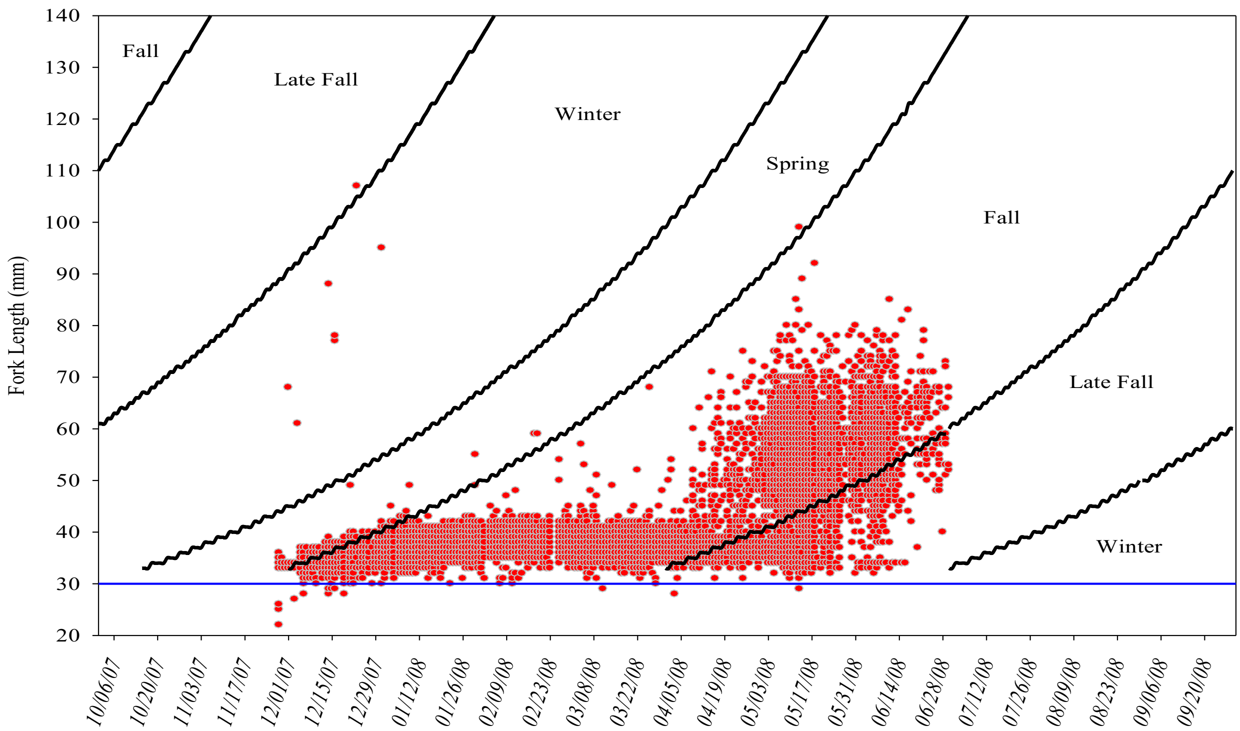


Figure 9. Fork length (mm) distribution by date and run for Chinook salmon captured by the lower rotary screw trap at river mile 1.7 in Clear Creek, Shasta County, California by the U.S. Fish and Wildlife Service from November 26, 2007 through June 30, 2008. Spline curves represent the maximum fork lengths expected for each run by date, based upon tables of projected annual growth developed by the California Department of Water Resources (Greene 1992).

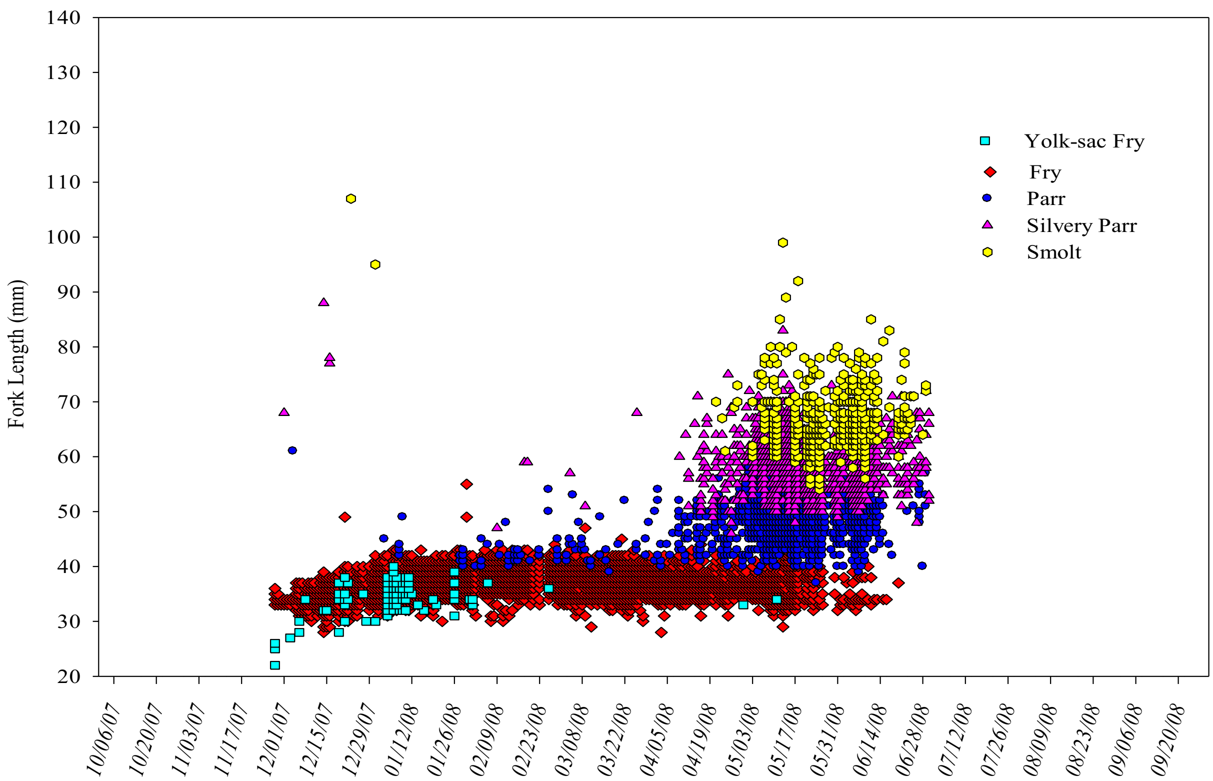


Figure 10. Life stage ratings and forklength distribution for BY 2007 juvenile Chinook salmon captured by the lower rotary screw trap at river mile 1.7 in Clear Creek, Shasta County, California by the U.S. Fish and Wildlife Service from November 26, 2007 through June 30, 2008.

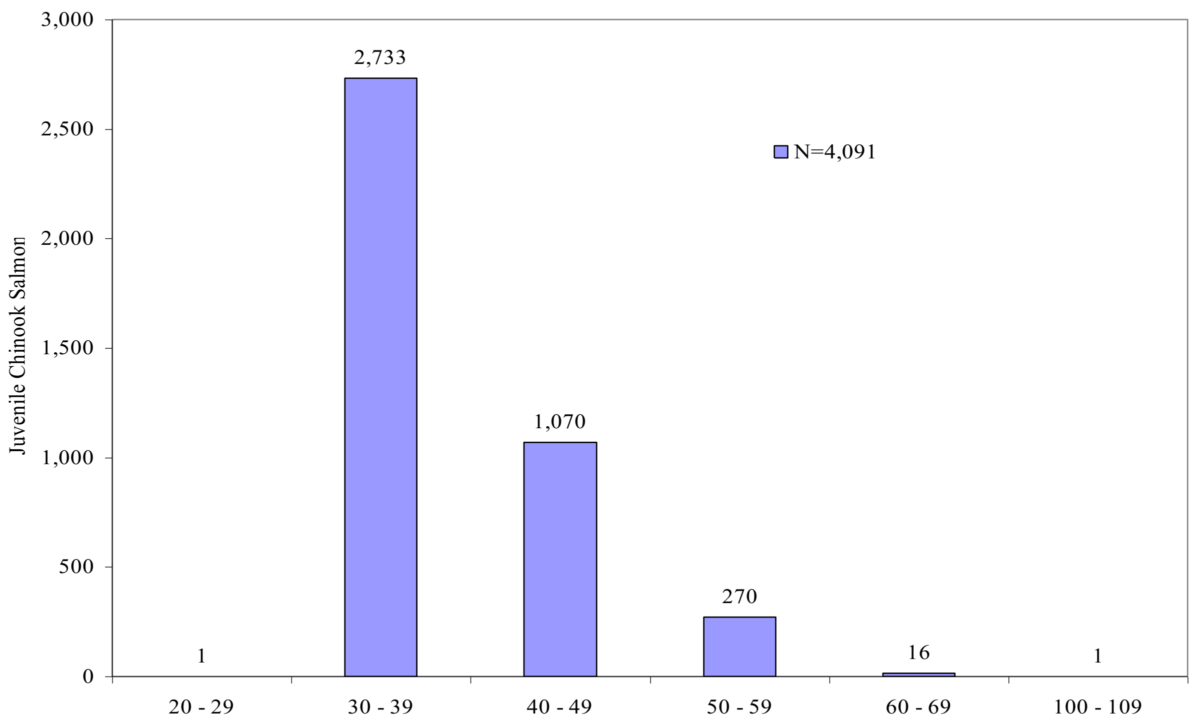


Figure 11. Fork length (mm) frequency distribution of BY 2007 juvenile late fall-run Chinook salmon captured by the lower rotary screw trap at river mile 1.7 in Clear Creek, Shasta County, California by the U.S. Fish and Wildlife Service from April 1, 2007 through March 31, 2008. Fork length frequencies were assigned based on the proportional frequency of occurrence, in 10 mm increments.

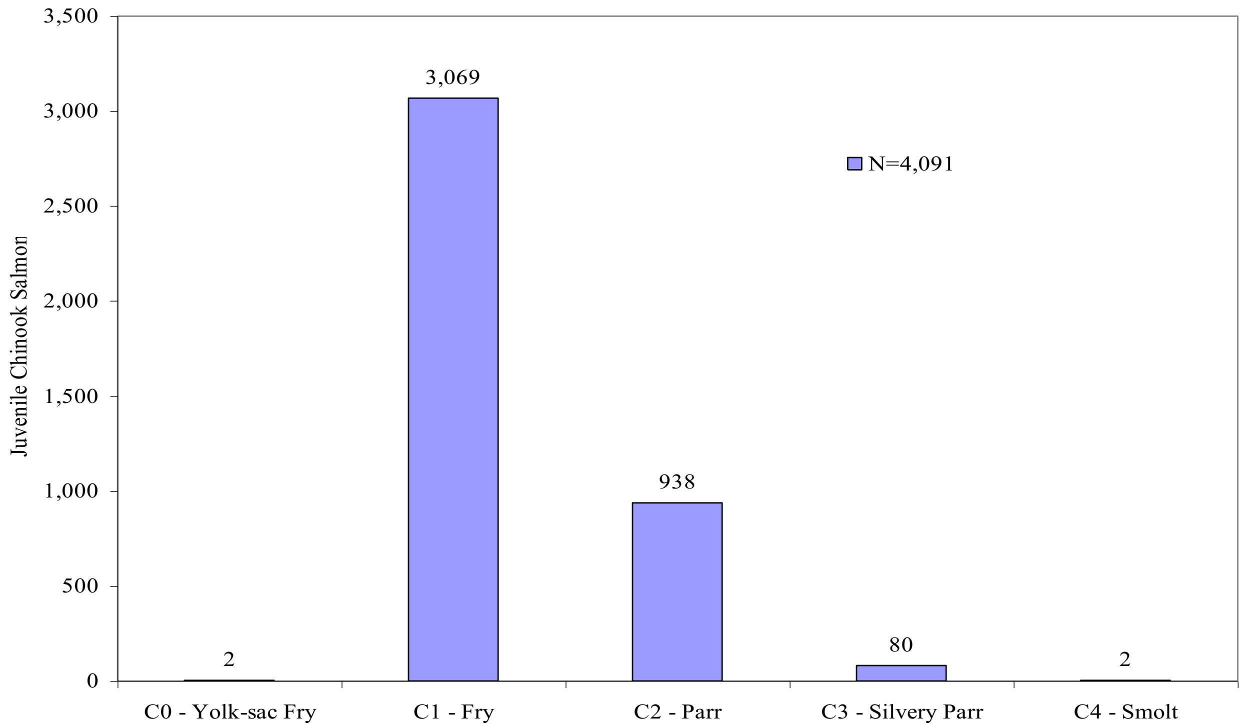


Figure 12. Life stage ratings for BY 2007 juvenile late fall-run Chinook salmon captured by the lower rotary screw trap at river mile 1.7 in Clear Creek, Shasta County, California by the U.S. Fish and Wildlife Service from April 1, 2007 through March 31, 2008.

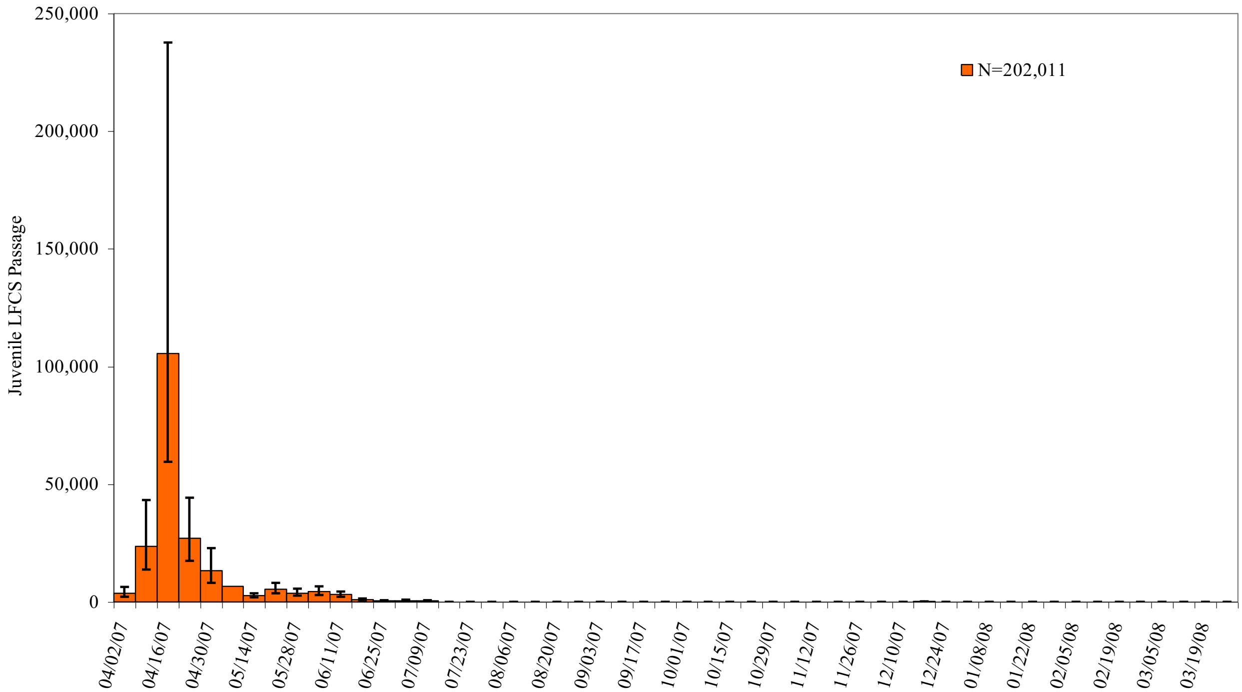


Figure 13. Weekly passage index with 95% confidence intervals of BY 2007 juvenile late-fall run Chinook captured by the lower rotary screw trap at river mile 1.7 in Clear Creek, Shasta County, California by the U.S. Fish and Wildlife Service from April 1, 2007 through March 31, 2008. Where CI's are not shown, see Table 4, as weeks with multiple strata, efficiencies, and calculations do not have a single CI. Passage totals may be added for a weekly passage estimate however, CI's cannot.

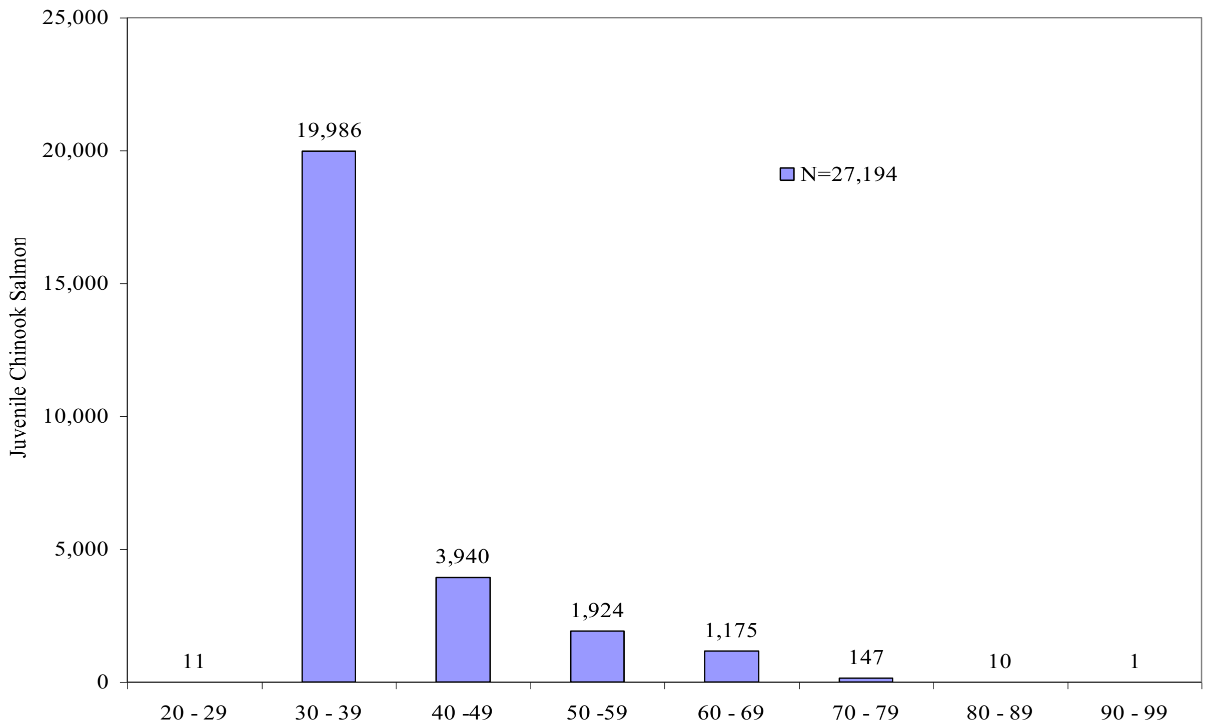


Figure 14. Fork length (mm) frequency distribution of BY 2007 juvenile fall-run Chinook salmon captured by the lower rotary screw trap at river mile 1.7 in Clear Creek, Shasta County, California by the U.S. Fish and Wildlife Service from November 26, 2007 through June 30, 2008. Fork length frequencies were assigned based on the proportional frequency of occurrence, in 10 mm increments.

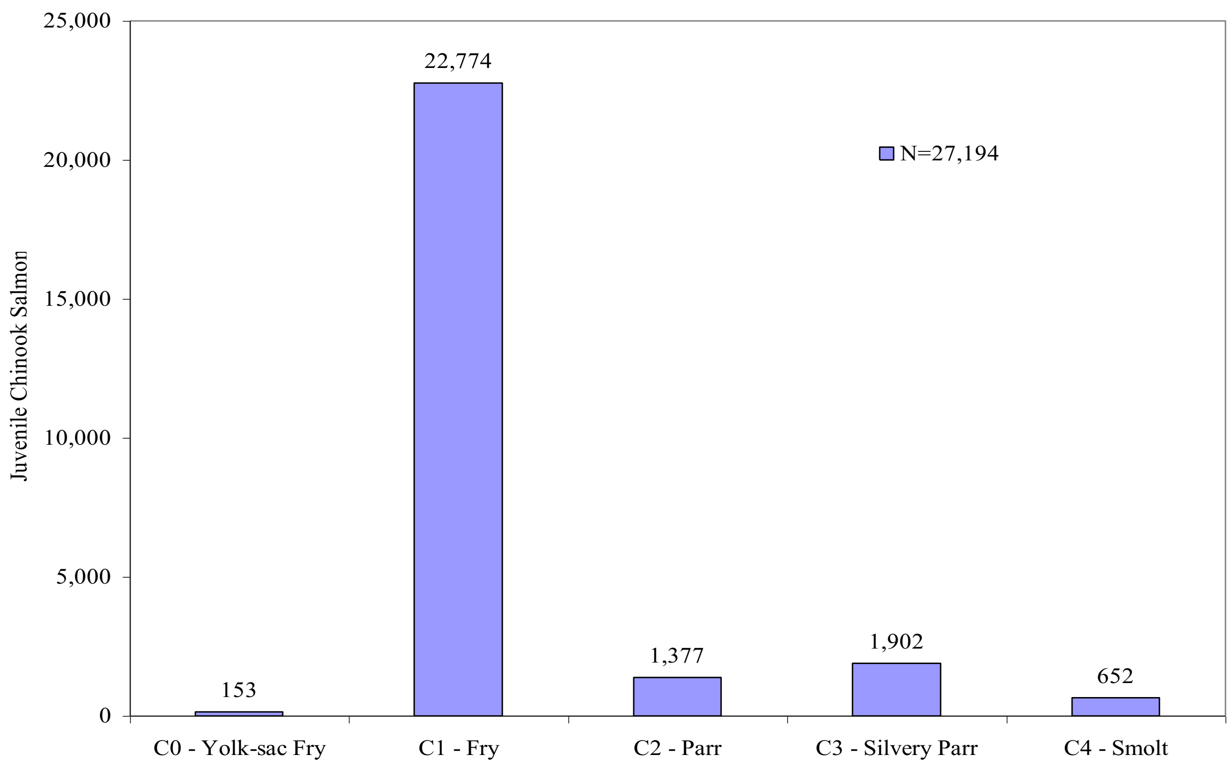


Figure 15. Life stage ratings for juvenile BY 2007 fall-run Chinook salmon by the lower rotary screw trap at river mile 1.7 in Clear Creek, Shasta County, California by the U.S. Fish and Wildlife Service from November 26, 2007 through June 30, 2008.

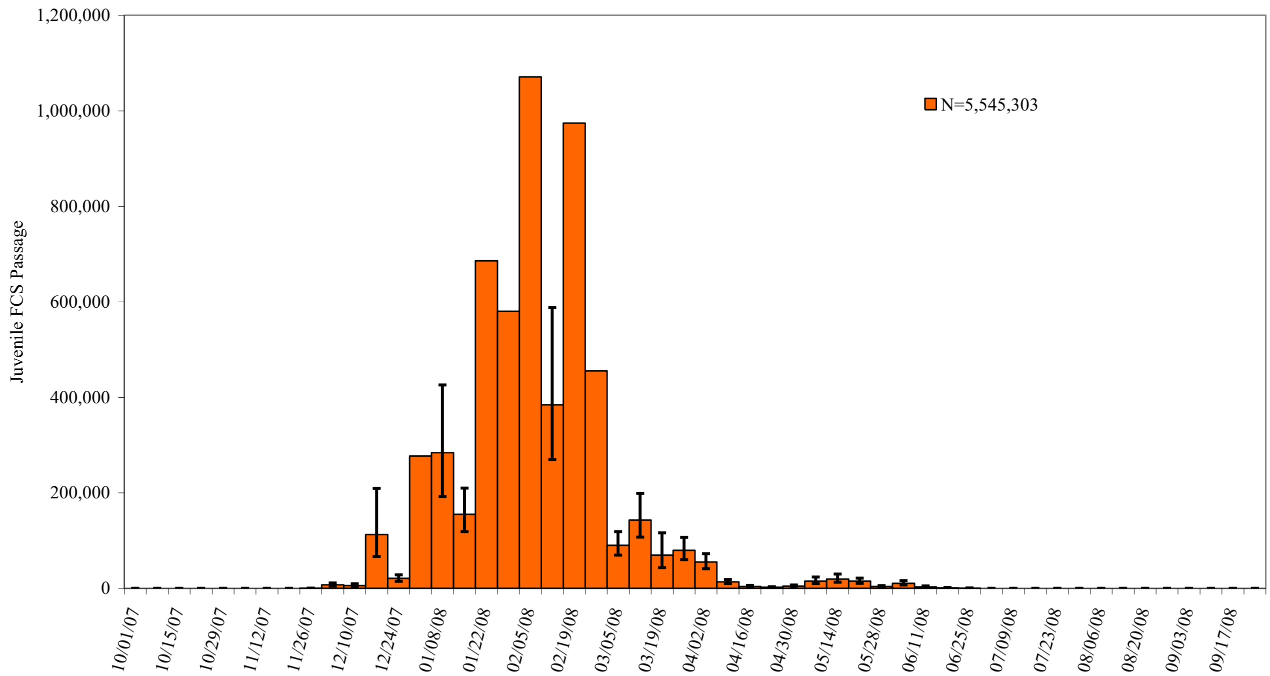


Figure 16. Passage index with 95% confidence intervals of BY 2007 juvenile fall-run Chinook captured by the lower rotary screw trap at river mile 1.7 in Clear Creek, Shasta County, California by the U.S. Fish and Wildlife Service from November 26, 2007 through July 13, 2008. Where CI's are not shown, see Table 3, as weeks with multiple strata, efficiencies, and calculations do not have a single CI. Passage totals may be added for a weekly passage estimate however, CI's cannot.

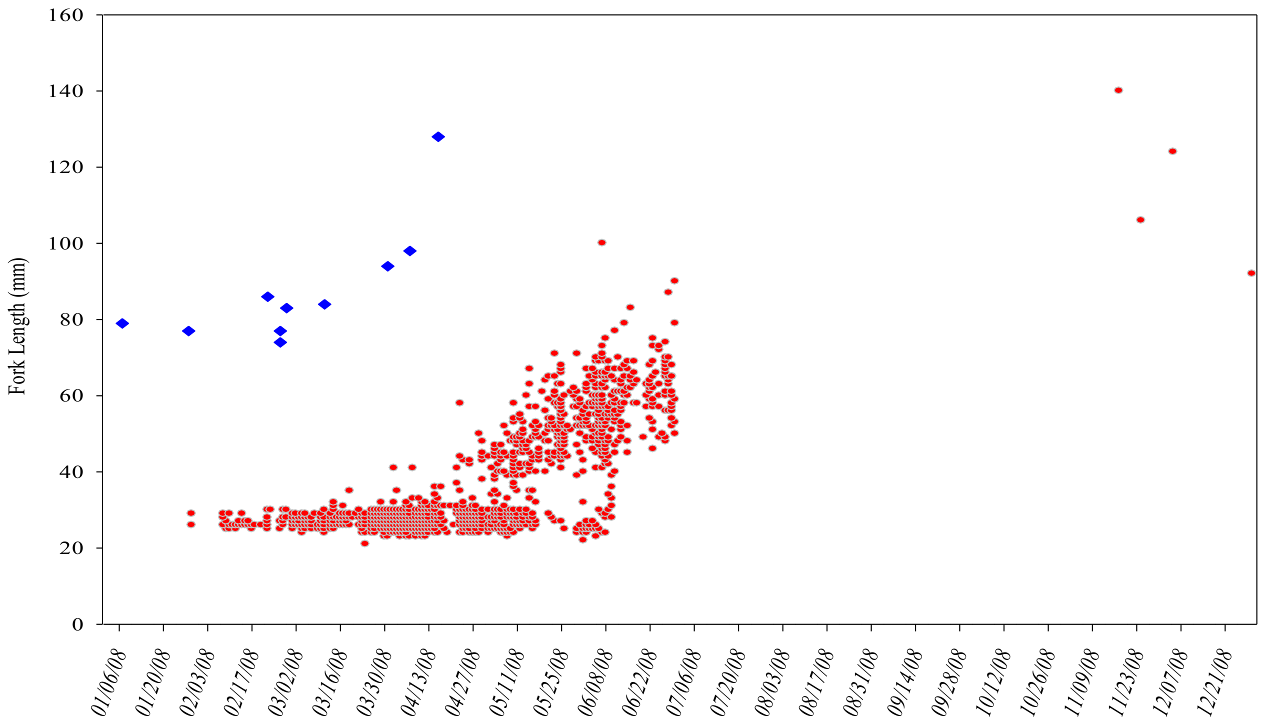


Figure 17. Fork length (mm) distribution by date for BY 2008 and BY 2007 Age 0+ steelhead / rainbow trout captured by the lower rotary screw trap at river mile 1.7 in Clear Creek, Shasta County, California by the U.S. Fish and Wildlife Service from January 1, 2008 through December 31, 2008. Blue diamonds represent age 0+ steelhead trout that are of BY 2007 or earlier, while the red dots represent production from BY 2008.

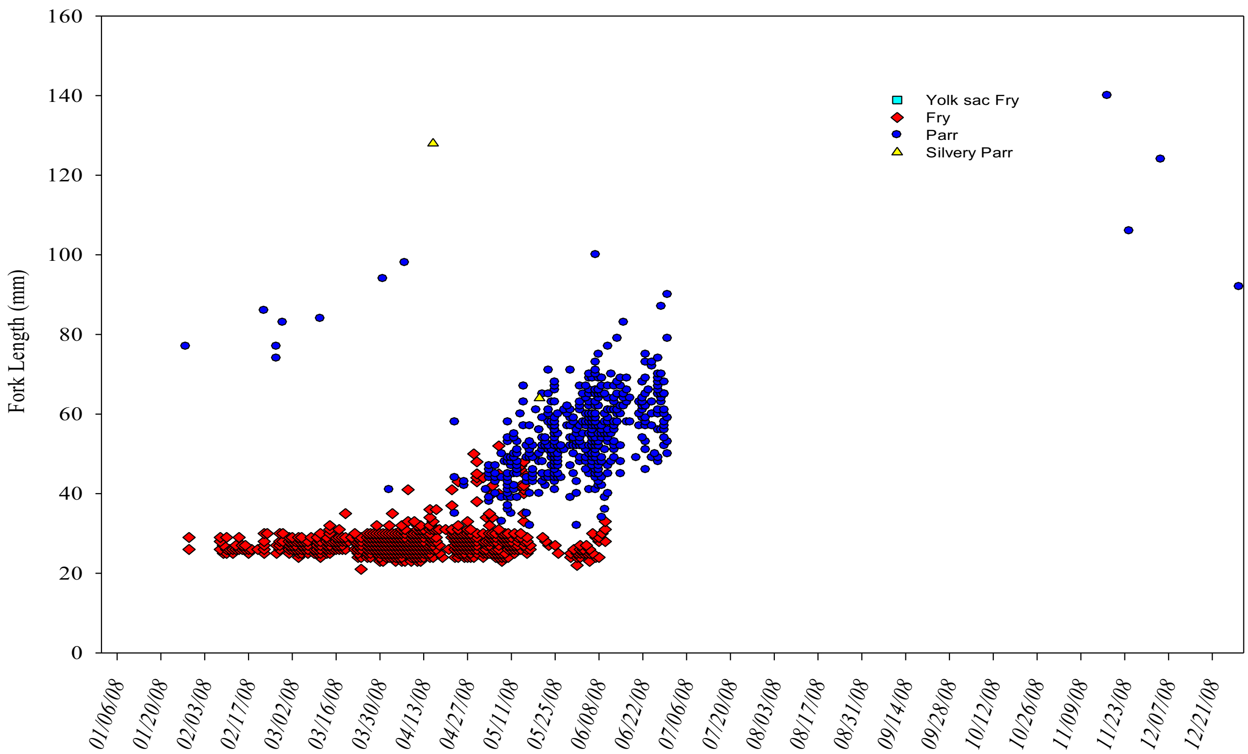


Figure 18. Life stage ratings and forklength distribution for BY 2008 and BY 2007 Age 0+ juvenile steelhead / rainbow trout captured by the lower rotary screw trap at river mile 1.7 in Clear Creek, Shasta County, California by the U.S. Fish and Wildlife Service from January 1, 2008 through December 31, 2008.

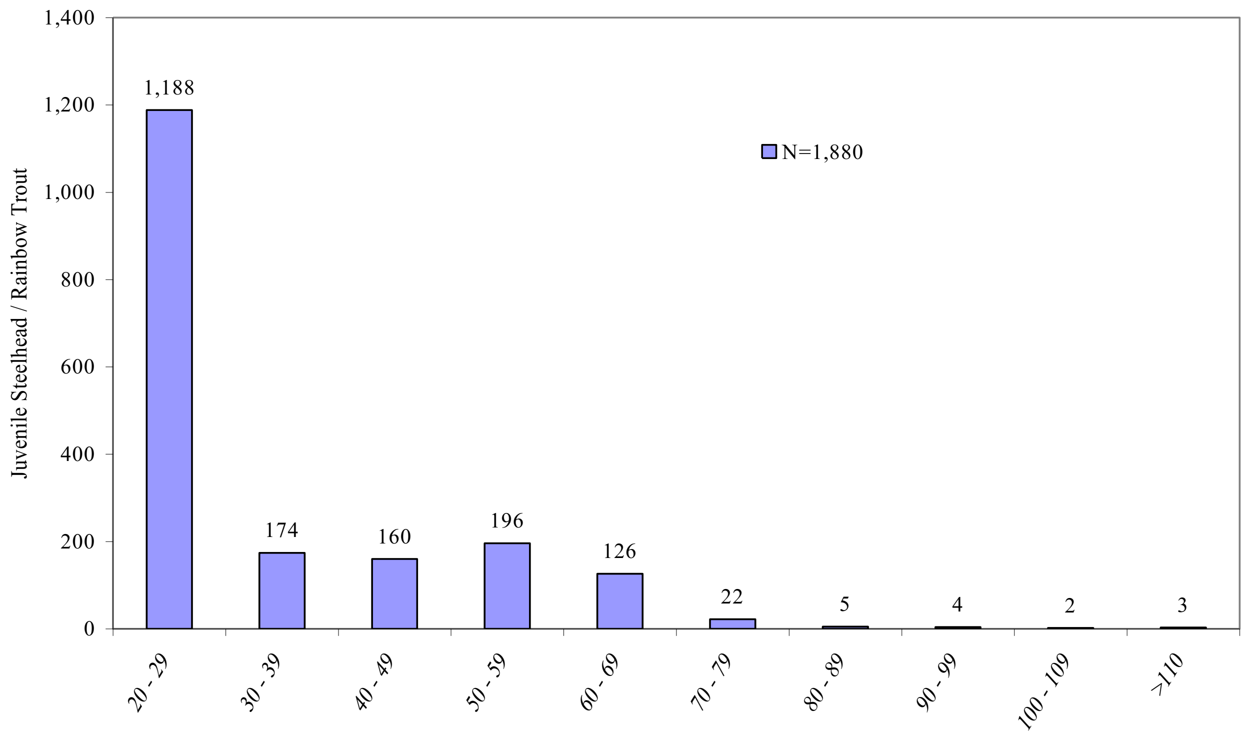


Figure 19. Fork length (mm) frequency distribution for BY 2008 and BY 2007 Age 0+ steelhead / rainbow trout captured by the lower rotary screw trap at river mile 1.7 in Clear Creek, Shasta County, California by the U.S. Fish and Wildlife Service from January 1, 2008 through December 31, 2008.

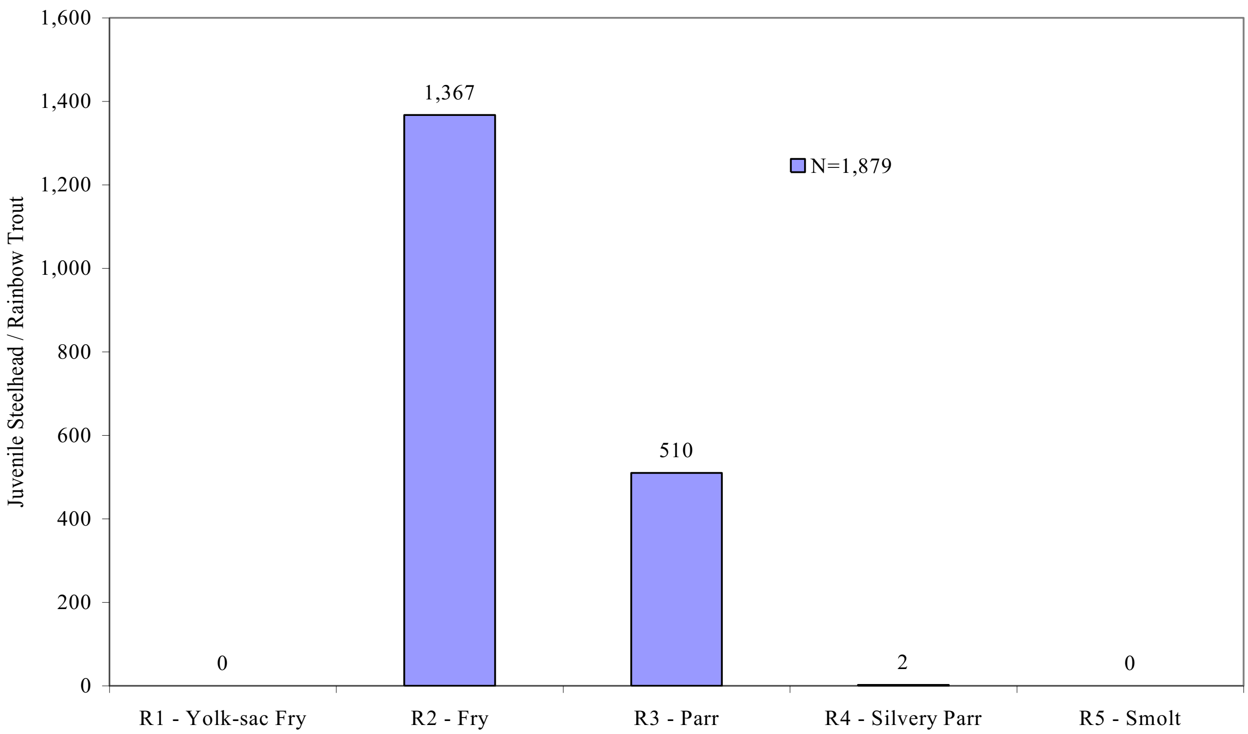


Figure 20. Life stage ratings for BY 2008 and BY 2007 Age 0+ juvenile steelhead / rainbow trout captured by the lower rotary screw trap at river mile 1.7 in Clear Creek, Shasta County, California by the U.S. Fish and Wildlife Service from January 1, 2008 through December 31, 2008.

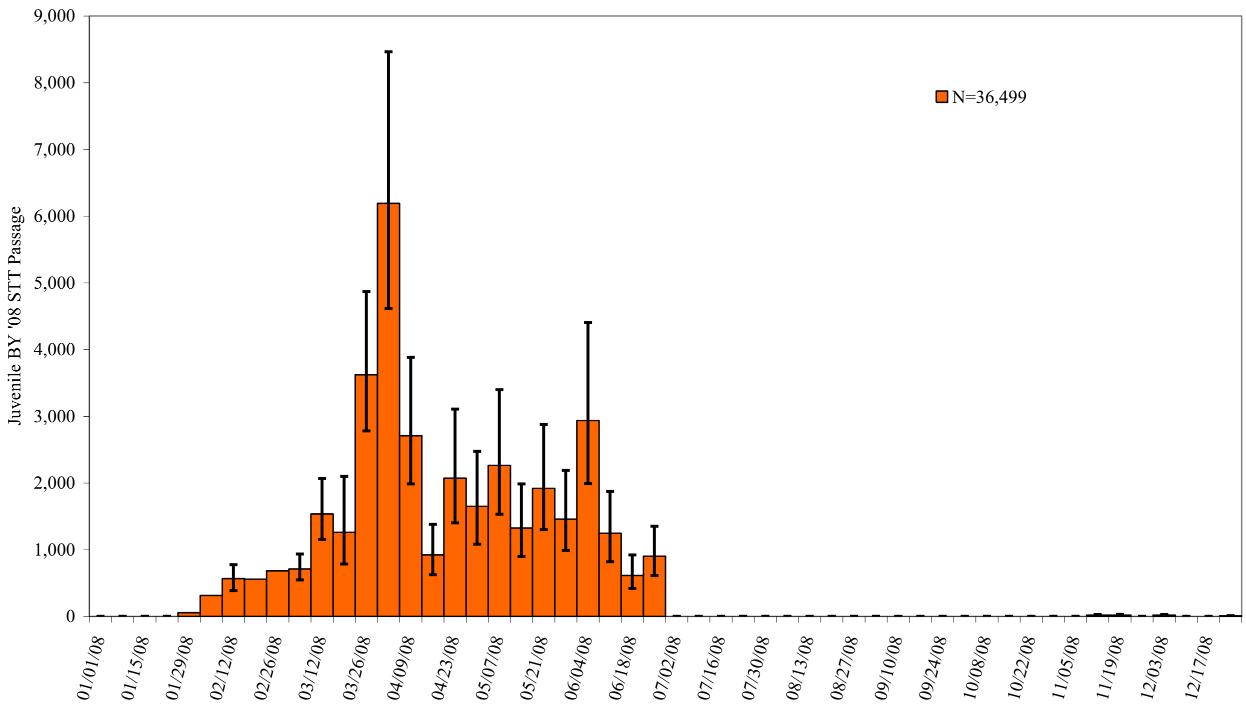


Figure 21. Passage index with 95% confidence intervals of BY 2008 juvenile steelhead / rainbow trout captured by the lower rotary screw trap at river mile 1.7 in Clear Creek, Shasta County, California by the U.S. Fish and Wildlife Service from January 1, 2008 through December 31, 2008. Where CI's are not shown, see Table 3, as weeks with multiple strata, efficiencies, and calculations do not have a single CI. Passage totals may be added for a weekly passage estimate however, CI's cannot.

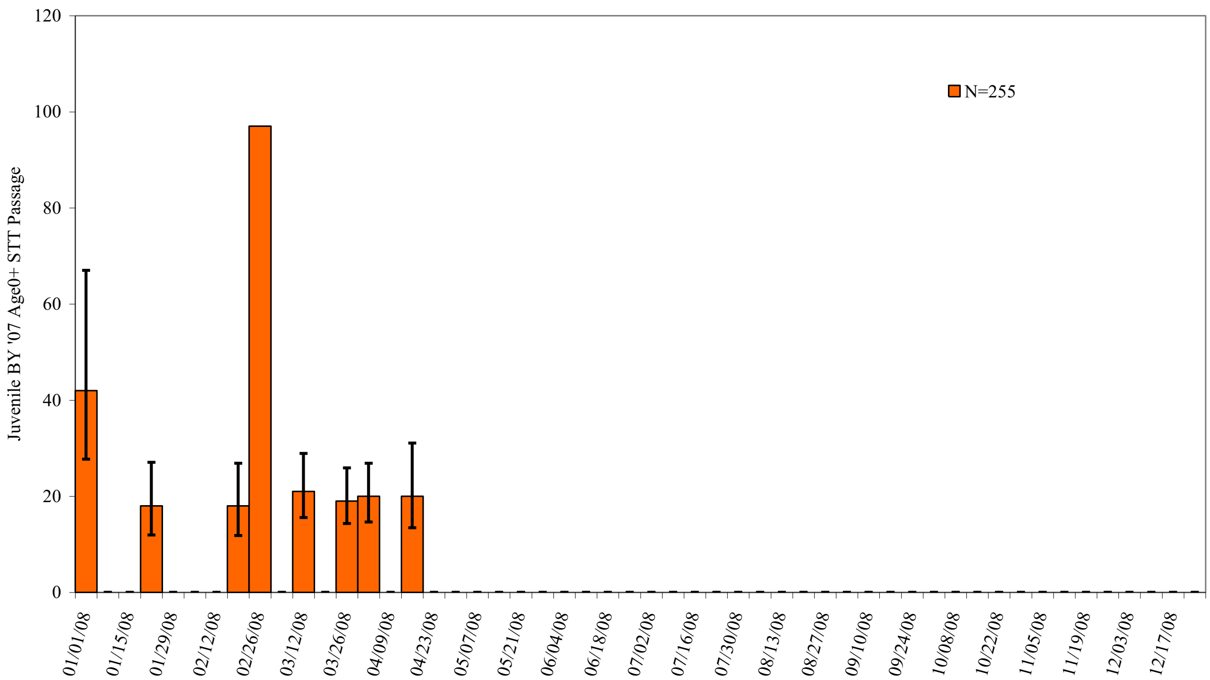


Figure 22. Passage index with 95% confidence intervals of BY 2007 Age 0+ juvenile steelhead / rainbow trout captured by the lower rotary screw trap at river mile 1.7 in Clear Creek, Shasta County, California by the U.S. Fish and Wildlife Service from January 1, 2008 through December 31, 2008. Where CI's are not shown, see Table 7, as weeks with multiple strata, efficiencies, and calculations do not have a single CI. Passage totals may be added for a weekly passage estimate, however CI's cannot.

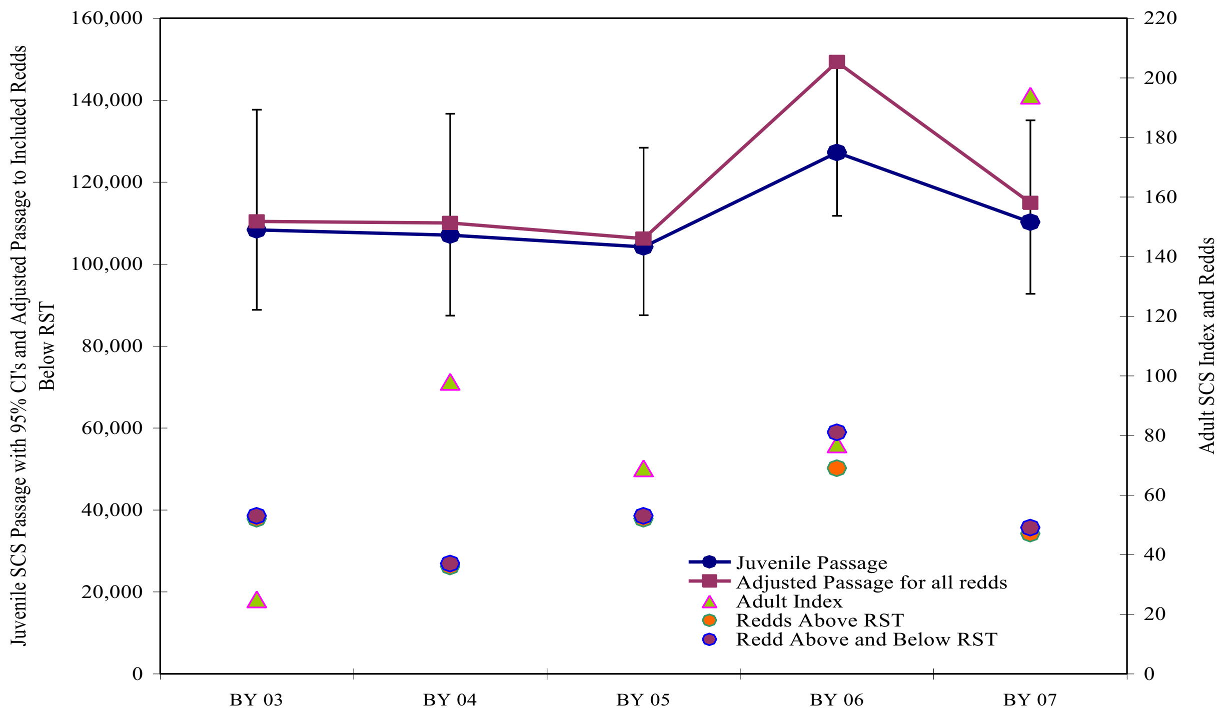


Figure 23. Spring-run Chinook passage indices with 95% Confidence Intervals (CI's), adult escapement and redds observed for BY 2003 - 2007 in Upper Clear Creek. Spring Chinook passage indices were calculated using data from the upper rotary screw trap at rm 8.3. The adjusted passage does not include CI's because the values were calculated by dividing the passage estimate by number of redds above the RST and multiplying by total number of redds.

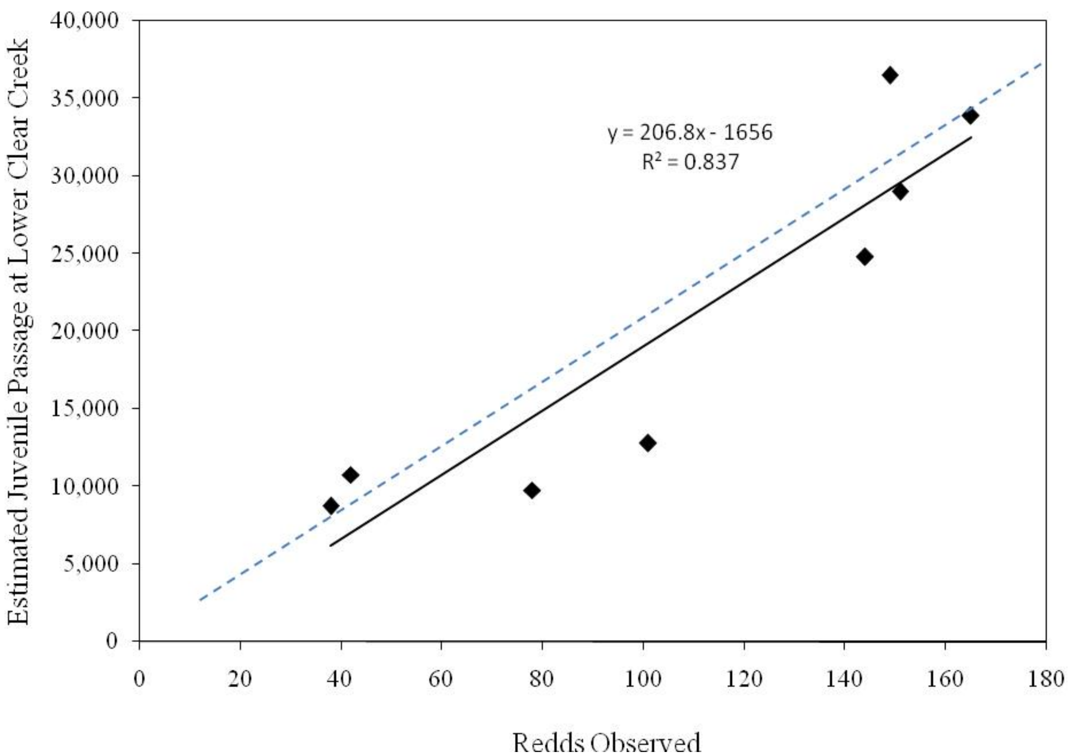


Figure 24. Juvenile Steelhead Age 0 passage indices and the relationship to redd counts measured in Clear Creek, Shasta County, California by the U.S. Fish and Wildlife Service from 2001 to 2008. Although capture data has been recorded from 1999 to 2008 only 2001 to 2008 was used, as there were no redd counts in 1999 and 2000. The dashed line represents an equal proportion line of juveniles per redd based on the scale of 206.8 juveniles per redd. The average number of juveniles per redd over the last 8 years is 194.

**Appendix**

Appendix 1. Name key of non salmonid fish taxa captured by the upper and lower Clear Creek rotary screw traps at river mile 8.3 and 1.7 in, Shasta County, California, by U.S. Fish and Wildlife Service from October 1, 2007 through September 30, 2008.

| Abbreviation | Common Name | Scientific Name |
|---|---|---|
| CAR | California Roach | *Hesperoleucus symmetricus* |
| CENFRY | Unknown Centrarchidae | *Centrarchidae spp.* |
| COTFRY | Unknown Cottidae | *Cottus spp.* |
| CYPFRY | Unknown Cyprinidae | *Cyprinidae spp.* |
| DACE | Speckled Dace | *Rhinichthys osculus* |
| GSF | Green Sunfish | *Lepomis cyanellus* |
| GSN | Golden Shiner | *Notomigonus crysoleucas* |
| HH | Hardhead | *Mylopharodon conocephalus* |
| LFRY | Unknown Lampetra | *Lampetra spp.* |
| MICFRY | Bass Fry | *Micropterus spp.* |
| MQF | Western Mosquitofish | *Gambusia affinis* |
| PL | Pacific Lamprey | *Lampetra tridentata* |
| PRS | Prickly Sculpin | *Cottus asper* |
| RFS | Riffle Sculpin | *Cottus gulosus* |
| SPM | Sacramento Pikeminnow | *Ptychocheilus grandis* |
| SASU | Sacramento Sucker | *Catostomus occidentalis* |
| SPB | Spotted Bass | *Micropterus punctulatus* |
| TSS | Threespine Stickleback | *Gasterosteus aculeatus* |

Appendix 2. Summary of non salmonid fish taxa captured by the upper Clear Creek rotary screw trap at river mile 8.3 in, Shasta County, California, by U.S. Fish and Wildlife Service from October 1, 2007 through September 30, 2008.

| Species | Dec '07 | Jan '08 | Feb | Mar | Apr | May | Jun | Species Totals |
|---|---|---|---|---|---|---|---|---|
| CAR | 4 | 0 | 6 | 7 | 5 | 23 | 14 | 59 |
| COTFRY | 3 | 2 | 0 | 0 | 16 | 25 | 0 | 46 |
| CYPFRY | 0 | 1 | 2 | 0 | 0 | 0 | 0 | 3 |
| RFS | 2 | 1 | 5 | 10 | 104 | 231 | 81 | 434 |
| SPM | 1 | 0 | 1 | 0 | 0 | 2 | 0 | 4 |
| SASU | 2 | 0 | 4 | 1 | 4 | 7 | 15 | 33 |
| SMB | 0 | 1 | 0 | 0 | 0 | 0 | 0 | 1 |
| | | | | | | | Total | 580 |

Appendix 3. Summary of non salmonid fish taxa captured by the lower Clear Creek rotary screw trap at river mile 1.7 in, Shasta County, California, by U.S. Fish and Wildlife Service from October 1, 2007 through September 30, 2008.

| Species | Nov '07 | Dec | Jan '08 | Feb | Mar | Apr | May | Jun | Species Totals |
|---|---|---|---|---|---|---|---|---|---|
| CAR | 0 | 1 | 0 | 2 | 1 | 2 | 7 | 5 | 18 |
| CENFRY | 0 | 0 | 1 | 0 | 0 | 0 | 0 | 0 | 1 |
| COTFRY | 0 | 2 | 5 | 1 | 0 | 1 | 0 | 2 | 11 |
| CYPFRY | 0 | 3 | 4 | 3 | 2 | 4 | 3 | 1 | 20 |
| DACE | 1 | 2 | 0 | 0 | 0 | 0 | 0 | 0 | 3 |
| GSF | 1 | 0 | 2 | 3 | 1 | 0 | 1 | 1 | 9 |
| GSN | 0 | 0 | 1 | 0 | 0 | 0 | 0 | 0 | 1 |
| HH | 0 | 3 | 2 | 1 | 1 | 0 | 1 | 6 | 14 |
| LFRY | 0 | 5 | 12 | 35 | 21 | 14 | 22 | 12 | 121 |
| MICFRY | 0 | 0 | 0 | 0 | 0 | 0 | 311 | 16 | 327 |
| MQF | 0 | 0 | 2 | 2 | 1 | 0 | 0 | 1 | 6 |
| PL | 0 | 25 | 29 | 2 | 1 | 0 | 0 | 0 | 57 |
| RFS | 1 | 16 | 56 | 7 | 9 | 15 | 22 | 8 | 134 |
| SPM | 0 | 0 | 6 | 4 | 0 | 0 | 1 | 0 | 11 |
| SASU | 0 | 2 | 5 | 2 | 0 | 0 | 0 | 4 | 13 |
| SPB | 0 | 0 | 0 | 0 | 0 | 0 | 32 | 0 | 32 |
| TSS | 0 | 0 | 4 | 0 | 1 | 0 | 0 | 5 | 10 |
| | | | | | | | | Total | 788 |