Juvenile Salmonid Monitoring in Clear Creek, California, from October 2006 through September 2007

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Juvenile Salmonid Monitoring in Clear Creek, California, from October 2006 through September 2007

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Abstract.—The U.S. Fish and Wildlife Service (FWS) has been conducting a juvenile salmonid monitoring project in Clear Creek, Shasta County, California, using a rotary screw trap (RST) at river mile (rm) 1.7 since December 1998. The monitoring project objectives are to determine juvenile passage indices for Chinook salmon (*Oncorhynchus tshawytscha*) and steelhead / rainbow trout (*O. mykiss*), for inter-year comparisons and obtain juvenile salmonid life history information including size, emergence, and emigration timing, and potential factors limiting survival at various life stages. Length-at-date tables show that late-fall, winter, spring and fall run sized Chinook salmon were collected. However, due to overlapping spawn timing of spring and fall Chinook it was problematic to index the juvenile passage using the RST at rm 1.7. In October of 2003 the FWS began using a second RST at rm 8.3 to more accurately estimate the passage of spring Chinook. A temporary picket weir was used below this Upper Clear Creek (UCC) RST to minimize the presence of adult fall Chinook in the upper watershed. Passage indices with 90% and 95% confidence intervals were generated for late-fall, spring and fall Chinook salmon from Broodyear (BY) 2006 and steelhead / rainbow trout from BY 2005 Age 0+, BY 2006 Age 0 and 0+ and BY 2007 Age 0. The spring Chinook index for BY 2006 from the UCC RST at RM 8.3 was 127,197. The indices of passage for BY 2006 from the Lower Clear Creek (LCC) RST were as follows; 86,918 late-fall, 9,170 spring and 4,929,544 fall-run Chinook salmon. The steelhead / rainbow trout indices from LCC were as follows; 203 BY05 Age 0+, 10,762 BY06, 26 BY06 Age 0+, and 33,987 BY 2007. Winter sized Chinook from LCC were few and produced an index of 784. Based on low catch of winter sized Chinook, non-existence of emergent fry, and lack of observations of adults and redds during our snorkel surveys, we conclude that winter Chinook salmon did not spawn in Clear Creek in 2006. It is likely that winter sized Chinook were late spawned late-fall Chinook salmon. Similarly as with spring and fall Chinook, length-at-date tables limit the ability to accurately index passage of late-fall, and winter Chinook. Mark and recapture trials were conducted from December 2006 through May 2007 to determine RST efficiency at both locations and ranged from 2.0% to 16.7%. This report presents passage data from all brood years whose emigration ended between October 1, 2006 and September 30, 2007.

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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 ongoing monitoring project has three primary objectives: 1) determine an annual juvenile passage index (JPI) for Chinook salmon (*Oncorhynchus tshawytscha*) and steelhead / rainbow trout (*O. mykiss*), for inter-year comparisons; 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. Rotary screw traps have been used as the primary means to evaluate trends in juvenile salmon abundance. While RST's 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). A naturally self-sustaining population of winter Chinook does not exist in Clear Creek. The *O. mykiss* (STT) population includes both anadromous (steelhead) and resident forms.

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).

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 (Figure 1 and Table 1). Fall Chinook salmon spawning occurs soon after and often overlaps in time with the SCS, with >99% taking place in reach 6 below the gorge cascade (L. Stafford, USFWS, personal communication). A picket weir was used to prevent FCS from spawning in the upper reaches.

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). 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 in 2003-2005. In 2006, the picket weir was placed at rm 7.4 because 13% of the 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 RST's. All passage data is from brood years whose emigration ended between October 1, 2006 and September 30, 2007. The Central Valley Project Improvement Act (CVPIA) Clear Creek Fish Restoration Program funded the initial part of the sampling season, because CALFED funds awarded in August of 2005 were not contracted and available until April 26, 2007.

Study Area

The Clear Creek watershed below Whiskeytown Dam covers an area of approximately 48.9 $miles^2$ (127 km^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 (16.1 rkm). The lower reach heads in an easterly direction to the Sacramento River for a distance of approximately 8.2 mi (13.5 rkm) (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 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 (0ºC) in winter to summer highs in excess of 115°F (46ºC). Most precipitation falls into this watershed as rainfall. The average rainfall in the Clear Creek watershed ranges from approximately 20 inches (50cm) in the lowest elevations to more than 60 in. (152 cm) 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 (rkm 13.4) 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 (rkm 2.7) above the confluence (latitude 40º 30' 22" north, longitude 122º 23' 45" west). The RST's 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* spp.), 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 RST’s 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 an aluminum 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. (30 – 46 cm) 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. (60 m) 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 October 16, 2006 through July 13, 2007. The LCC RST was fished from November 30, 2006 through July 13, 2007. 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, 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 Optic StowAway® temperature data 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 period 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 2100 turbidity meter (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 RST's. 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. To comply with Interagency Ecological Program (IEP) Steelhead Life – Stage Assessment Protocol, 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 # 42 in 2006, and the last sampling week was during Week # 28 in 2007 (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 2-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.

One hundred otolith samples were taken 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 7 marked individuals. In an effort to meet our goal of recapturing a minimum of 7 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 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 monitoring Sacramento River WCS juvenile 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 50-minute contact time.

Dual-marking techniques—To conduct our dual-marking procedures, we first single-marked the salmon with Bismarck brown, as described above. After staining with Bismarck brown was completed, the fish were anesthetized with an MS-222 solution at a concentration of 60-80 mg/l. After the salmon were anaesthetized, we used either an upper or lower caudal fin clipping to attain a second mark. To perform the fin clips, we used small surgical scissors, removing an area of approximately 2 mm^2 from the corners of the caudal fin lobe. Alternate upper and lower clips were used to discern mark groups from trial to trial and trap to trap.

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 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 of time 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:

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

   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

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

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 25th, 50th, 950th, and 975th 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 25th, 50th, 950th, and 975th 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 25th, 50th, 950th, and 975th 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 often implemented a modification in the RST to reduce potential negative affects to juvenile salmon created by overly 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-boxl.

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, and adding live-box flat panel baffles. 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 the use of day and night sampling, water chilling units, and summer work hour changes. 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 225 days. The UCC RST was installed from October 16, 2006 through July 13, 2007 (Table 2). We did not sample on 46 days from when the trap was installed until it was removed. Two days were not sampled due to high flows and 5 days due to holidays. Thirty-nine days were not sampled because temperature analysis suggested that fry would not be captured until the last week of November. 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. The length-at-date tables suggest we might capture SCS as early as October 16th of each year. However, using temperature data for 2003-2005 we calculated that SCS emergence would occur from mid to late November and our RST data catch validated this. Due to high juvenile Chinook salmon densities that were encountered and anticipated we applied the half-cone modification during the entire sampling season.

Lower Clear Creek—We operated the LCC RST for 215 days. We did not sample on 11 days due to the following reasons: 5 days due to holidays, and 6 days during non-weekend sampling early and late in the season due to little or no catch. Due to high juvenile Chinook salmon densities that were either encountered or anticipated we applied the half-cone modification during the period from November 30, 2006 through May 8, 2007. During this time the trap was put to full cone on 4 sampling days in December and 1 sampling day in January for the purpose of capturing additional fish to conduct RST efficiency trials.

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 71 cubic feet per second (cfs) in August 2007 to a maximum of 645 cfs on February 10, 2007. The maximum hourly measured discharge recorded was 1,280 cfs on the afternoon of February 10, 2007. 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 2.5 feet to 6.0 feet, with an average depth of 5.2 ft. The lowest depths were recorded during July 2007, and the deepest depths were recorded in late December 2006.

Turbidity levels ranged from 0.35 nephelometric turbidity units (NTU) in June 2007 to 7.4 NTU in February 2007, with a mean turbidity of 0.85 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 42.1^{o}F on February 2, 2007 to 59.5^{o}F on July 13, 2007. The warmest water temperatures that occurred while sampling were in July, 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 2.5 feet to 4.0 feet, with an average depth of 3.1 ft. The lowest depths were recorded during December 2006, and the deepest depths were recorded in late February 2007.

Turbidity levels ranged from 0.4 NTU in June 2007 to 26.7 NTU in February 2007, with a mean turbidity of 1.1 NTU.

Mean daily water temperatures ranged from a low of 41.8^{o}F on January 13, 2007 to 67.6^{o}F on July 9, 2007 (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 12,943 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, cottid fry (*Cottidae spp*.), riffle sculpin (*Cottus gulosus*), and California roach (*Hesperoleucus symmetricus*), (Appendix A and B). The UCC RST capture data is reported below.

Chinook salmon—The only species of salmon collected was Chinook salmon. Length-at-date tables of Greene (1992) indicated that we collected only SCS and FCS. A total of 11,619 individuals were captured during the study period. This value is the total number of Chinook captured during operations. On October 18, 2006, one 128 mm Chinook salmon was captured that was considered to be of BY 2005 and was not calculated in the BY 2006 passage index. Data trends for each run of Chinook salmon is summarized below.

Spring-run Chinook salmon—With the use of the picket weir, all Chinook designated as SCS and FCS by length-at-date tables were assigned to be spring Chinook. LCC passage indices relied exclusively on length-at-date tables to separate juvenile SCS from FCS. UCC indices relied on the picket weir to confine adult FCS below the trap and thus reclassified all length-at-date FCS as SCS. Fork lengths for all BY 2006 spring Chinook salmon captured, ranged from 31 – 115 mm, with a median of 48 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 (99%) being 39 mm or less in FL (Figure 6 and 7). The JPI for BY 2006 SCS was 127,197, with upper and lower 95% CI's of 148,539 and 111,749 (Figure 8 and Tables 3). Peak emigration occurred over a 9-week period from early December 2006 through early February 2007 (Figure 8 and Table 3). The passage indices for SCS at LCC between 1998 and 2006 on average were 20,610. In the four years (2003 – 2006) of using the UCC and the picket weir, the average SCS passage index is 111,697.

Steelhead / rainbow trout—A total of 630 STT were captured. One hundred three of the captures were BY 2006 and 527 were BY 2007. The first captures of BY 2007 were on February 28, 2007. The peak emigration for STT was from early April through mid May. Indices of passage and confidence intervals were not generated from the upper trap because the distribution of spawning was both above and below the trap site (Giovannetti and Brown 2007).

Non-Salmonids—The most abundant non-salmonids included Cottid fry, riffle sculpin, California roach, Sacramento sucker (*Catostomus occidentalis*), and hardhead (*Mylopharodon conocephalus*). The common and scientific name key for non-salmonids is described in Appendix A. All other occurrences of non-salmonid species are summarized in Appendix B.

Lower Clear Creek—A total of 173,373 individual fish, represented by 18 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, cottid fry, pacific lamprey (*Lampetra tridentata)*, cyprinid fry (*Cyprinoidea spp.)*, riffle sculpin, hardhead, and Sacramento pikeminnow (Appendix A and C). The LCC RST capture data are reported below.

Chinook salmon—Data is summarized by the following dates for BY 2006; late-fall April 1 2006 to March 31, 2007, winter Chinook July 1, 2006 to June 30, 2007, spring and fall Chinook October 1, 2006 to September 30, 2007. The only species of salmon collected was Chinook salmon. Length-at-date tables of Greene (1992) indicated that we collected individuals from all four Chinook salmon runs known from the Sacramento River basin. A total of 171,038 individuals were captured from all runs, during the study period. Fork lengths for all runs of Chinook salmon ranged from 25-111 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 3,533 LFC were captured. Of the 2,811 LFC that were measured, 97% were in the 30-39 mm FL range (Figure 11). The most common life stage for LFC was fry at 93% (Figure 12). Peak emigration occurred from approximately April 16, 2006 through May 14, 2006, when 85% passed (Figure 13).

Only one LFC was captured between July 9, 2006 and March 31, 2007. The JPI for BY 2006 LFC was 89,918 with upper and lower 95% CI's of 113, 960 and 70,716 (Tables 4).

Winter-run Chinook salmon—A total of 5 juvenile Chinook salmon classified as winter-run Chinook were captured. Due to the low number of WCS captured passage index was not generated. Four of the five Chinook were captured in December and were designated based on proportionate extrapolation of capture data. Only 1 of the juvenile Chinook that was captured in July was assigned as winter-run. This Chinook was 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 redd observations in late April during the LFC Kayak survey, suggesting there was not any production from adult WCS during the late winter and spring months. Adult snorkel surveys by the USFWS RBFWO did not recover any spawned out carcasses or make any observations of Chinook redds during the months of May and June of 2006.

Spring-run Chinook salmon—Length-at date tables show SCS were collected at LCC. Two hundred ninety six SCS were captured at the LCC. Peak emigration occurred from late November through December. The JPI for BY 2006 SCS was 9,170 with upper and lower 95% CI's of 15,394 and 5,497. The passage index for SCS is determined by using the UCC RST. The data presented here for LCC RST is clearly underestimated, and provided for comparison purposes.

Fall-run Chinook salmon—A total of 163,965 FCS were captured. Fall-run Chinook salmon constituted >97% by number 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 88.2% (Figure 15). Peak emigration occurred from January 2007 through March 2007 (Figure 16). The highest weekly passage occurred between February 19 and 25, 2007 where 1,181,016 individuals passed (Figure 16 and Table 5). The JPI for BY 2007 FCS was 4,929,544 with upper and lower 95% CI's of 5,832,272 and 4,275,282 (Table 5).

Steelhead / Rainbow Trout—Passage indices were generated for both BY 2006 and 2007, from January 1 to December 31 in each year. During BY 2006 a total of 371 STT were captured. Steelhead / rainbow trout during 2006 had forklength measurements ranging from 20-129 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 88% of the total catch while, 85% of those measured were in the 20-39 mm size range (Figures 19 and 20). The JPI for BY 2006 STT was 10,762 with upper and lower 95% CI's of 12,632 and 9,362 (Table 6). Peak emigration of juvenile steelhead fry occurred from mid March through April of 2006 (Figure 21). Eight STT were captured that were considered to be Age 0+ from BY 2005 or earlier. A passage index of 203 was generated on those captures (Table 6).

During 2007, 1,172 were captured. Steelhead / rainbow trout during 2007 had forklength measurements ranging from 21-135 mm (Figure 22). Steelhead / rainbow trout were captured from the life stage classifications yolk-sac fry, fry, parr, and silvery parr (Figure 23). No STT captured were labeled as smolt based on visual characteristics and protocol criteria. Steelhead / rainbow trout fry made up 81% of the total catch while, 85% of those measured were in the 20-39 mm size range (Figures 24 and 25). The JPI for BY 2007 was 33,987 with upper and lower

95% CI's of 43,376 and 27,585 (Table 6). Peak emigration of juvenile steelhead fry occurred from mid March to early April of 2007 (Figure 26). Two STT that were captured were considered to be Age 0+ from BY 2006 or earlier. The passage index generated on those captures was 26 (Table 6).

Non-salmonids—We collected a total of 1,163 individual non-salmonids from 16 taxa. The most abundant non-salmonids included Cottid fry (*Cottidae spp.),* Pacific lamprey Cyprinoidea fry, riffle sculpin, hardhead, and Sacramento pikeminnow (*Ptychocheilus grandis*). The common and scientific name key for non-salmonids is presented in Appendix A. These dominant non-salmonid taxa are discussed below; all others are summarized in Appendix C.

Cottid fry—A total of 428 unidentified cottid fry was collected. Individuals from this taxon were likely prickly (*Cottus asper*) or riffle sculpin. The prickly and riffle sculpin are the only two species of sculpin that have been identified on Clear Creek.

Cyprinoidea fry—A total of 138 unidentified Cyprinid fry were collected. Individuals from this taxon were likely hardhead, Sacramento sucker (*Catostomus occidentalis*), Sacramento pikeminnow, and speckled dace (*Rhinichthys osculus*).

Hardhead.—A total of 60 were collected. Hardhead were collected throughout the sampling season with peak capture in May and June.

Lamprey fry—A total of 40 unidentified lamprey fry were collected. Individuals from this taxon were likely Pacific lamprey (*Lampetra tridentatus*), and possibly may have also included western brook lamprey (*L. richardsoni*) and river lamprey (*L. ayresi*).

Pacific lamprey—A total of 311 Pacific lampreys were collected. Pacific lampreys were collected throughout the sampling season with peak passage in December 2006.

Riffle sculpin—A total of 61 riffle sculpin were collected. Riffle sculpin were collected throughout the sampling season.

Sacramento pikeminnow—A total of 52 Sacramento pikeminnow were collected. Sacramento pikeminnow were collected throughout the sampling season with peak capture in June 2007.

Genetic and otolith sampling—We collected 479 genetic samples of Chinook salmon during this sampling season. One hundred seventy-six samples were collected from UCC and 303 were collected from LCC. Samples at both locations 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.

Mark and recapture efficiency estimates

Upper Clear Creek—We conducted 18 mark-recapture trials to test for RST efficiency. The release of marked fish started on December 12, 2006 and ended on May 19, 2007. A total of 6,469 Chinook salmon were released, 78 mortalities occurred from the marking procedures and 687 were recaptured (Table 7). During all 18 trials Chinook were dual marked with Bismarck Brown and either an upper or lower caudal fin clip, to distinguish between multiple weekly release groups and trap locations. Two trials conducted on May 3 and 15, 2007 used fish that were greater than 55 mm in forklength for the purpose of more closely matching the forklengths of the fish that were being captured. These trials were not included in determining the season average, as the selection of trial fish was not conducted in the same manner (targeting specific forklengths) as the previous 16 trials.

The number of individual fish released for each trial ranged from 89-501, with an average of 365. Recaptured fish numbers per trial ranged from 7-65 with an average of 38. Efficiencies ranged from 7% to 19.7% per trial, with an average of 10.6% (Table 8).

Due to low fish collection numbers, we were unable to conduct mark and recapture studies from October 16 until December 12, 2006 and after May 19, 2007. As described in the methods, for the periods from November 26 through December 9, 2006 (weeks 48-49), April 16-29, 2007 (weeks 16-17), and May 21-July 17, 2007 (weeks 21-29), we substituted the "season" efficiency. The seasonal efficiency was calculated by dividing the average number of released fish (391+1) of the first 16 trials by the average number of recaptures (41+1). Therefore, the seasonal average was 10.7% (41+1/391+1).

Lower Clear Creek—We conducted 19 mark-recapture trials to test for RST efficiency. The release of marked fish started on January 7, 2007 and ended on May 19, 2007. A total of 7,412 Chinook salmon were released, 115 mortalities occurred from the marking procedures, and 687 were recaptured (Table 9). During all 19 trials Chinook were dual marked with Bismarck Brown and either an upper or lower caudal fin clip, to distinguish between multiple weekly release groups and concurrent trials conducted upstream. Four trials conducted on February 13, March 7, April 13 and May 3, 2007 were excluded for failing to meet the minimum number of recaptures. In all four instances, the "season" efficiency was used because no other weekly trials were conducted to pool the data with.

The number of individual fish marked for each trial ranged from 323-432, with an average of 399. Recaptured fish numbers per trial ranged from 3-30 with an average of 12. Efficiencies ranged from 3.0% to 5.8% per trial, with an average of 3.8% (Table 10).

Due to low fish collection numbers, we were unable to conduct mark and recapture studies from October 16 until December 12, 2006. As described in the methods, for the period from November 26 through December 9, 2006 (weeks 48-49), April 16-29, 2007 (weeks 16-17), and May 21-July 17, 2007 (weeks 21-29), we substituted the "season" efficiency. The seasonal efficiency was calculated by dividing the average number of fish released (309) of the other15 trials by the average number of recaptures (11). Therefore, the seasonal average was 3.9% (11+1/309+1).

Mortality

Marking Mortality—A total of 193 mortalities occurred among the 13,881 marked Chinook salmon, for a total marking mortality (= total marking mortalities / total number of fish released = 193/13,881) of 1.4%. Mortalities resulting from our marking procedures for each efficiency trial ranged from 0 – 14.3%. The highest mortalities occurred during March, April and May 2007 (Table 7 and 9).

Trapping Mortality—A total of 3,072 mortalities for all runs of Chinook salmon and steelhead / rainbow trout occurred as a result of RST sampling for BY 2006.

Upper Clear Creek spring-run Chinook salmon—There were 11,619 BY 2006 SCS captured in the Clear Creek RSTs. Of these captures 900 were recorded as mortalities generating a 7.7% mortality rate of fish handled and a 0.07% mortality rate of the total passage index of 127,197 (Table11).

Late-fall-run Chinook salmon—There were 2,839 BY 2006 LFC captured in the Clear Creek RST. Of these captures 35 were recorded as mortalities generating a 1.2% mortality rate of fish handled and a 0.04% mortality rate of the total passage index of 86,918 (Table12).

Winter-run Chinook salmon—There were 5 WCS (according to length at date criteria) captured in the Clear Creek RST of which the passage index was 117. No WCS mortalities were recorded.

Spring-run Chinook salmon—There were 459 BY 2006 SCS captured in the lower Clear Creek RST. Of these captures 30 were recorded as mortalities generating a 6.5% mortality rate of fish handled and a 0.1% mortality rate of the total passage index of 29,143 (Table 13).

Fall-run Chinook salmon—There were 163,963 BY 2006 FCS captured in the Clear Creek RST. Of these captures 2,091 were recorded as mortalities generating a 1.3% mortality rate of fish handled and a 0.01% mortality rate of the total passage index of 4,929,544 (Table 14).

Steelhead / rainbow Trout—There were 630 BY 2006 and 1,178 BY 2007 Steelhead trout captured in the Clear Creek RSTs. Broodyear 2006 had 3 mortalities and BY 2007 had 13.

Discussion and Recommendations

Sampling Effort—Flow conditions during the BY 2006 rotary screw trap sampling season were very good with few high flow events. At the UCC RST 2 days were missed for high flow events. The LCC RST sampled as scheduled and was able to fish during the 2 high flow events in February that the UCC RST was not fishing. The LCC RST is better suited to fishing higher flows than the UCC RST due to the stream configuration at rm 1.7.

Due to reduced catch at LCC and limited staff, in the months of May and June of 2006 our effort was reduced to 4 days a week. Reduced sampling at LCC in May and June of 2006 may have the greatest impact on LFC and STT passage indices as this is during peak emigration. Sampling was not reduced in 2007 at LCC during May or June. In July 2007, LCC was not sampled for the July 4th holiday and first weekend prior to being pulled for the season. Previous years catch data show a very small percent of the annual passage estimates for LFC, SCS and FCS occurs from July to October. STT catch is variable during June and July and may be dependent on the number of returning adults, the timing of spawning and water temperature.

We have found that predicting emergence timing using water temperatures during the spawning and incubation period, and 1,850 daily temperature units to emergence (Brown and Earley 2007) is the best means for determining when the RST operations should begin for the season

Spring Chinook abundance—Over the past 4 years we have been successful in generating a more accurate juvenile passage index of spring Chinook salmon. The use of the UCC RST and the picket weir is essential for achieving this. Its 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 in the UCC as SCS. The average passage index for SCS as determined by LCC between 2003 and 2006 was 19,762. In these four years (2003 – 2006) of using the UCC RST and the picket weir, the average SCS passage index was 111,697 (Figure 27). The average index generated with UCC was within the range of expected values based on the average number of redds (52) and the juvenile output per redd (2,226).

In 2006, SCS passage at UCC increased 17% from 3 years previous; from 108,338 to 127,197 (Figure 27 and Table 15). An analysis of scales recovered from carcasses above the picket weir and during snorkel surveys in 2003, found 78% to be 3 year old fish. The 2006 scale analysis found that 86% of the carcasses sampled above the picket weir were 3 year olds. Although the 17% is an improvement from 2003 with the 208% increase in adult escapement and 30% more redds, we expected a 30% increase in passage. The redd productivity decreased from 2,083 to 1,843.

It may be increasingly difficult to obtain accurate FCS passage estimates from the LCC because of the potentially increasing number of SCS which are included in the FCS estimate. The average passage of Spring Chinook salmon from the UCC RST is a relatively small percentage of the average FCS production for the same period from the LCC RST(111,697 / 5,036,614 = 2.2%). The restoration goals anticipate potentially 2-3,000 SCS returning adults. It is possible that 1,500 returning females producing an average of 2,226 juveniles each could generate a passage estimate of 3.3 million juveniles. With increased SCS escapement from continued restoration efforts and variable production of FCS, the percentage of SCS passage index from the upper watershed may be in upwards of 50-75% of the FCS passage at the LCC RST. It may be problematic to determine how many SCS may be captured at the LCC RST because LCC run classifications are based on length-at-date tables. We have shown that length-at-date tables misclassify the large majority of SCS as FCS (Brown and Earley 2007). We may have to adjust or reduce the sampling to reduce the impacts to the threatened SCS.

The smolt production from upper Clear Creek appears to be very low (>0.2% of all captures). There is very limited data from the upper trap operations to determine if smolt production, relative to fry production, has a large effect on a cohort's adult escapement. Because so many SCS appear to migrate out of Clear Creek as fry it may be likely that SCS use the Sacramento River for rearing and smolting rather than the upper Clear Creek.

Recommendation 1: We recommend an analysis of the smolt to escapement relationship. 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. It should be noted that the capture of smolts through means other than the RST may bias the results.

Late-fall Chinook abundance—The late-fall run passage index was higher this year than in the previous three years but approximately half of the BY 2002 index (Table 16). 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 2002-2005 showed adult LFC to be both 3 and 4 year olds with the 4 year olds ranging from 25% to 92% annually (USFWS, RBFWO, unpublished data). 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 BY 2003 and 2007 CWT data recovered on Clear Creek showed 100% were 4 year olds (N=4) (Giovannetti 2007). The small sample size of the CWT data for 2003 and 2007 is not compelling however worth noting. The FCS adult escapement of 2002 was record high, and may have contributed to an overestimate of the LFC passage index. However, if the majority of adult LFC in 2006 were 4 year olds, it is also possible that the increased passage index for 2006 reflects the high passage index in 2002 of actual LFC.

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 6,208 from 2003-2006. Late-fall Chinook population indices are likely inaccurately indexed because 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. This practice is dependent on staffing and, although it occurred for BY 2006 LFC, it did not for BY 2007.

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.

Fall Chinook abundance—The fall Chinook passage index of 4,929,544 is 99% of average for the previous 5 years (4,972,812) (Table 17). The adult escapement of 8,422 is below the average of 11,520 for the past 5 years. Fall Chinook juvenile productivity is in a declining trend overall in every year with the exception of 2004. Coincidentally, 2004 is the lowest escapement in the past 8 years of record (Table 17). 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 sediment or scouring flows reducing productivity is currently being analyzed. As mentioned above, the excessive fines can be problematic and contribute to low redd productivity. High sediment can 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 yields of the spawning habitat.

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 impacting spawning success.

Steelhead emigration timing—Central Valley steelhead / rainbow trout present in Clear Creek exhibit characteristics of a winter-run steelhead, with adults migrating upstream in the late fall and winter with most outmigration peaking during the months of April and May. Steelhead / rainbow trout use portions of the upper and lower watershed for spawning (i.e., above and below UCC). Due to the variability in spawning area use, passage indices are generated by catch data from the LCC RST. The JPI's of STT are variable over the past 5 years although appear to be increasing (Table 18).

The passage indices are generated using the same trap-efficiency data gathered by conducting Chinook mark and recapture trials. We would like to capture enough STT juvenile outmigrants to conduct paired releases with Chinook and compare the results to validate the use of the same efficiency data. Passage indices are challenging to compare year to year because juvenile winter run 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. However, we assume that STT captured in the RST's are emigrating and/or smolting and not rearing or relocating within the creek.

There is not sufficient data on steelhead/ rainbow trout fecundity and juvenile productivity in Clear Creek. 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 the STT captures 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 sampling of UCC Chinook from 2003 and 2004 has assisted us in understanding the genetic run makeup of the upper watershed. The genetics data analysis generates a percent likelihood of the sample being from a specific genetic population. The genetic analysis of 2003 and 2004 Chinook from UCC suggests that the majority were spring Chinook (USFWS, RBFWO, unpublished data). 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 2005-2007 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 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.

Recommendations 10: We recommend using SCS from the UCC RST for one season to validate efficiencies and assumptions of behaviors between SCS and FCS populations. In the future when population sizes are much larger, we would like to consider using UCC SCS for trials all year.

Recommendation 11: Efficiencies at both trap sites need to be conducted to compare the half cone versus full cone assumption; that half-cone efficiencies are indeed one half of the full-cone efficiencies.

Mortality

Marking mortality—Mortality occurring from conducting mark and recapture studies is 1.4% and has been progressively improving from year to year based on refining the marking techniques. The main challenge is dealing with Chinook during the spring time where warm weather and physiological changes put fish at a greater risk for 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—Mortality associated with trapping has decreased from previous years, yet is still above ideal ranges for incidental take. The UCC RST observed 900 mortalities of which 95% occurred in the month of December. We reduced mortality by scheduling multiple daily shifts. However, we have found that during peak emergence and concurrent rain or high flow events RST's with threatened SCS need to be monitored 24 hours a day. During the BY 2006 operations multiple shifts were scheduled, yet mortality still occurred during the time crews were moving between trap sites.

Trap Modifications—We used two trap modification to reduce juvenile mortality in the trap live box; expanded aluminum excluders and live-well baffles. Excluders were designed to create refugia in the live box between large (>250 mm) and small (<250mm) fishes. These appeared to work well, although we found that 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).

Live-box flat panel baffles are flat aluminum panels mounted perpendicular to the live box lid and flow and are designed to prevent debris from building up and crushing, squashing or lifting fish out of the water and stranding them. Our observations indicated that baffles might actually be responsible for high fish mortality. On one heavy debris day at the UCC RST, we found that debris was backing up against the panel and moving forward towards the cod end of the cone, causing a no flow plug. Salmonids were then subject to immediate mortality as they passed into the live-box. We removed the panels from the RST at the conclusion of the season. We will discontinue their use until a further analysis of live-box conditions is completed. In the future we plan on using a video camera to evaluate fish behavior within the trap live-box with high debris and higher flows.

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Figures

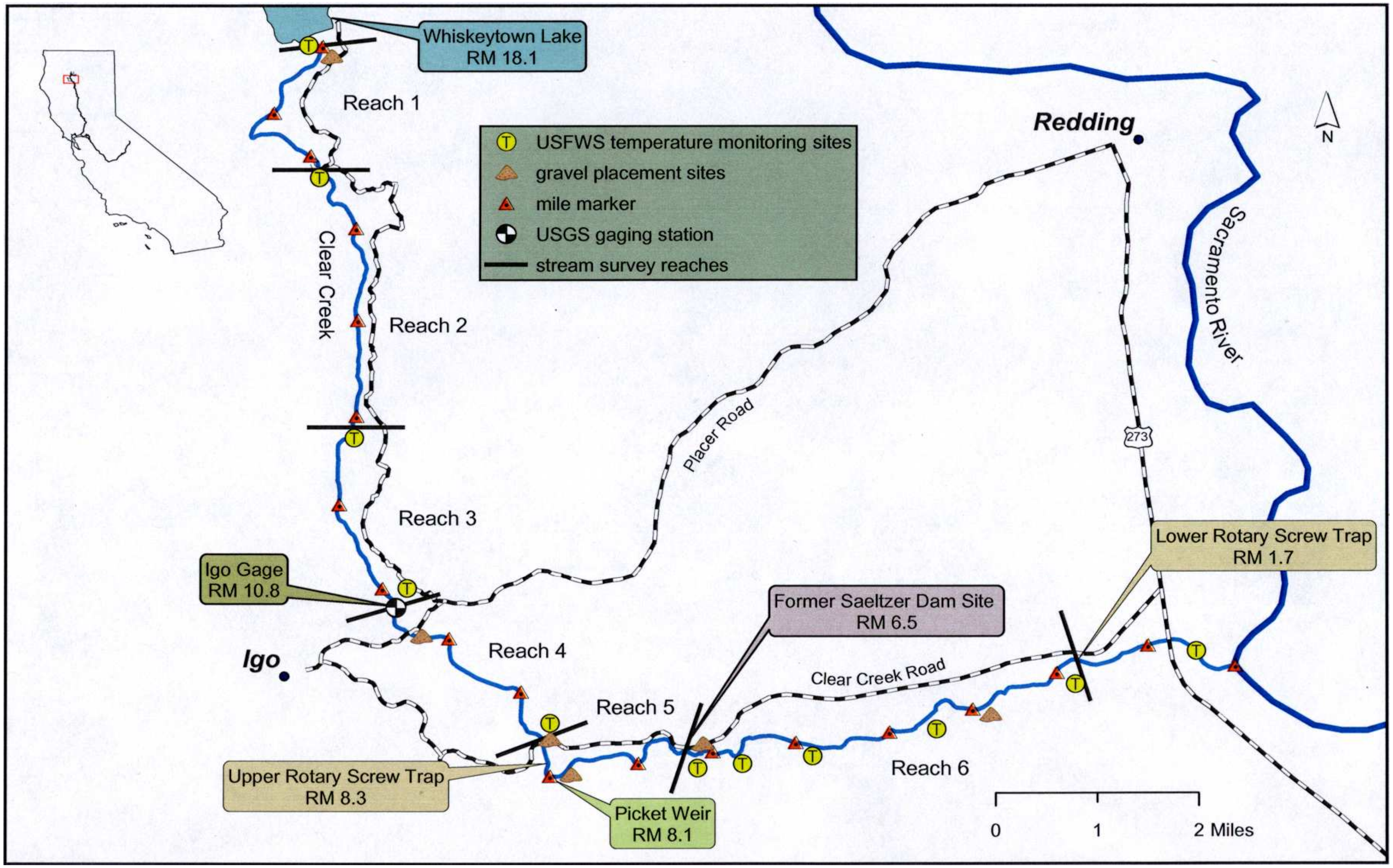

Figure 1. Locations of the upper (UCC) and lower (LCC) rotary screw trap sampling stations used for juvenile salmonid monitoring at river mile 8.3 and 1.7 in Clear Creek, Shasta County, California by the U.S. Fish and Wildlife Service from October 16, 2006 through July 13, 2007.

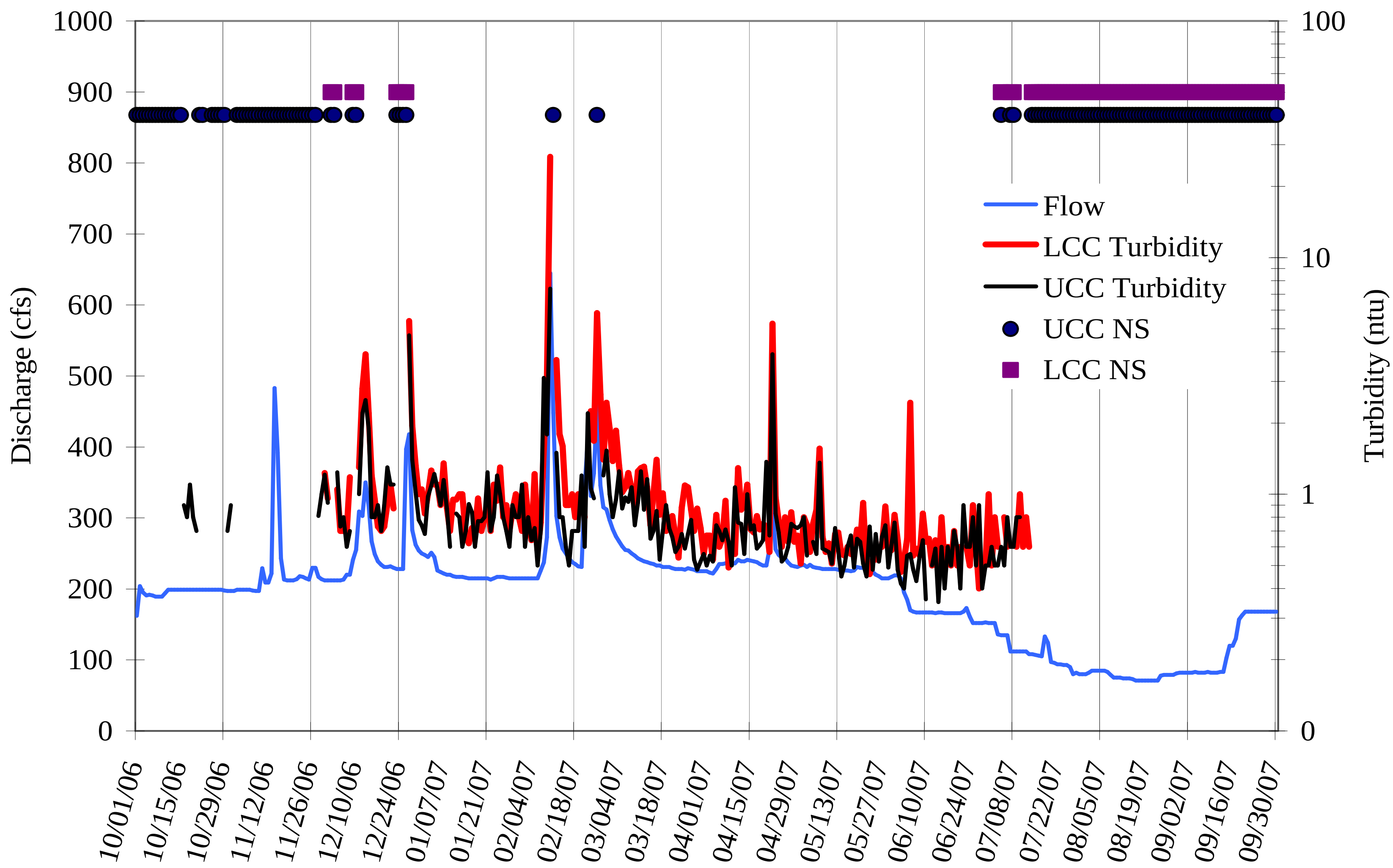

Figure 2. Mean daily flow in cubic feet per second (cfs) measured at the USGS IGO station, non sampling days (NS), and momentary turbidity in nephelometric turbidity units (NTU's) recorded at the upper and lower rotary screw trap sampling stations at river mile 8.3 and 1.7 in Clear Creek, Shasta County, California by the U S. Fish and Wildlife Service from October 16, 2006 through September 30, 2007.

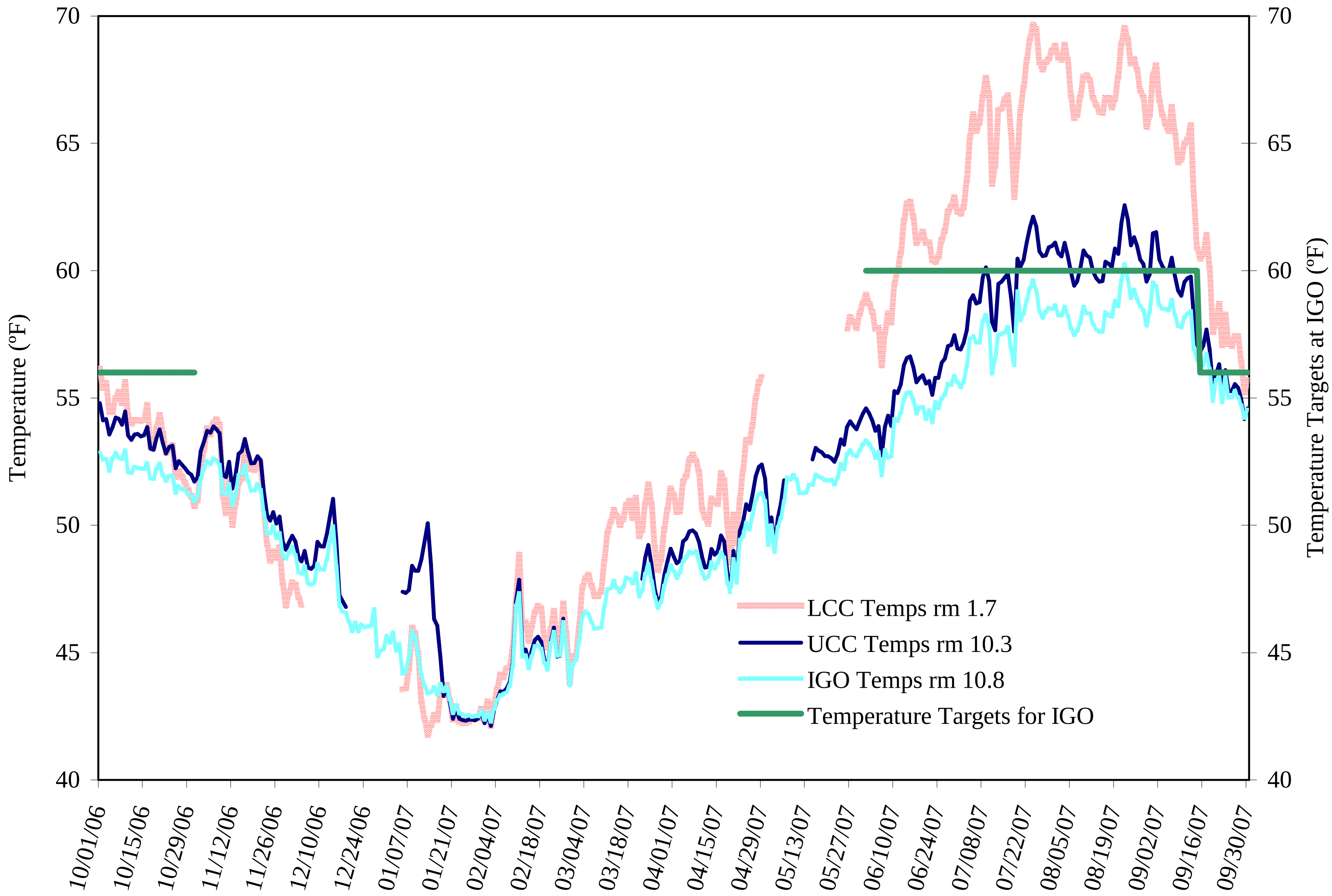

Figure 3. Mean daily water temperatures (°F) recorded at the upper (UCC) and lower (LCC) rotary screw trap sampling stations at river mile 8.3 and 1.7 in Clear Creek, Shasta County, California by the U S. Fish and Wildlife Service from October 1, 2006 through September 30, 2007. Clear Creek Fish Restoration Program temperature targets for fish protection and the temperatures recorded at the Clear Creek IGO gauge are provided for comparison.

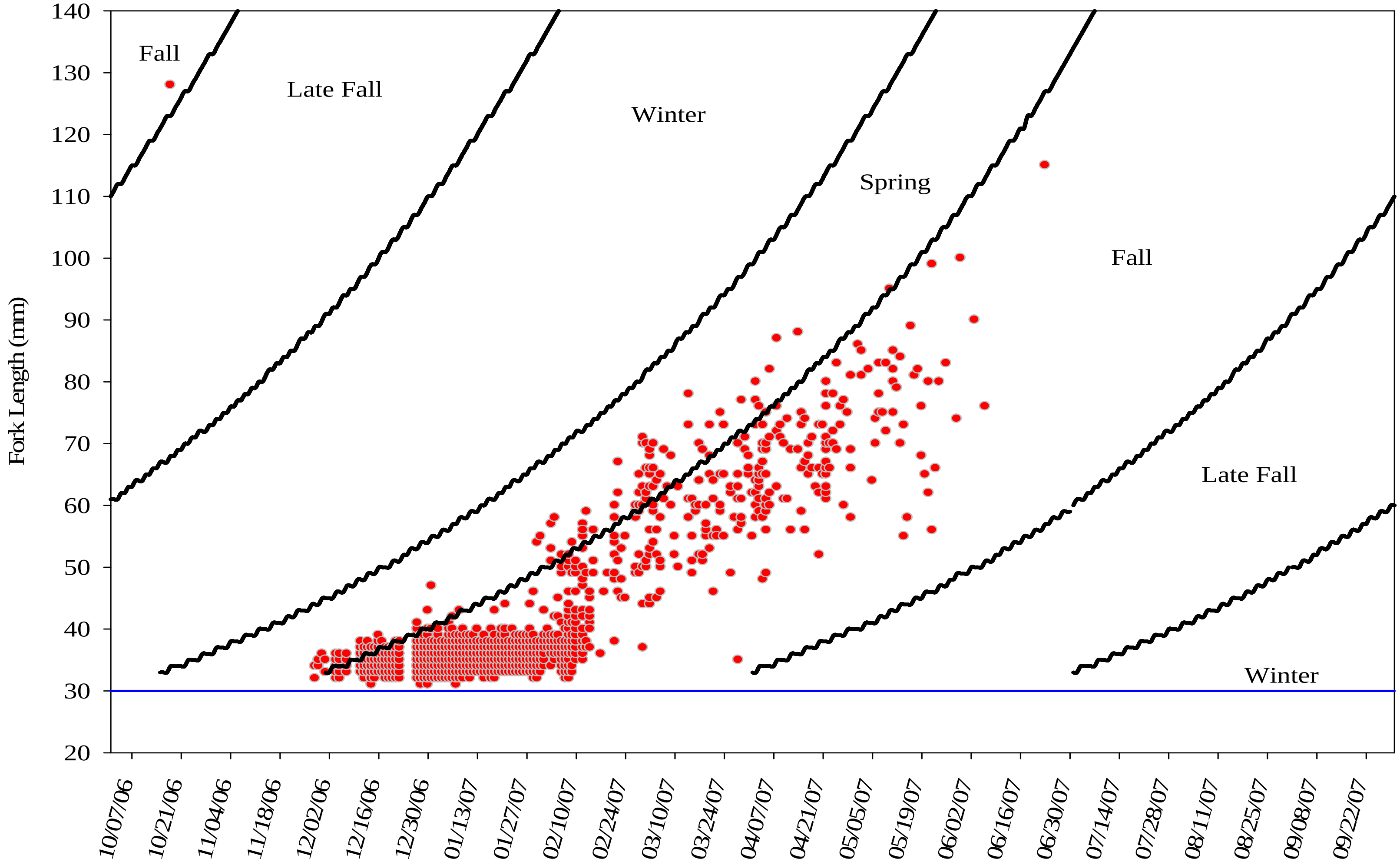

Figure 4. Fork length (mm) distribution by date and run for Chinook salmon captured by the upper rotary screw trap at river mile 8.3 in Clear Creek, Shasta County, California by the U.S. Fish and Wildlife Service from October 16, 2006 through July 13, 2007. Spline curves represent the maximum fork lengths expected for each run by date, based upon tables of projected annual growth developed by the California Department of Water Resources (Greene 1992).

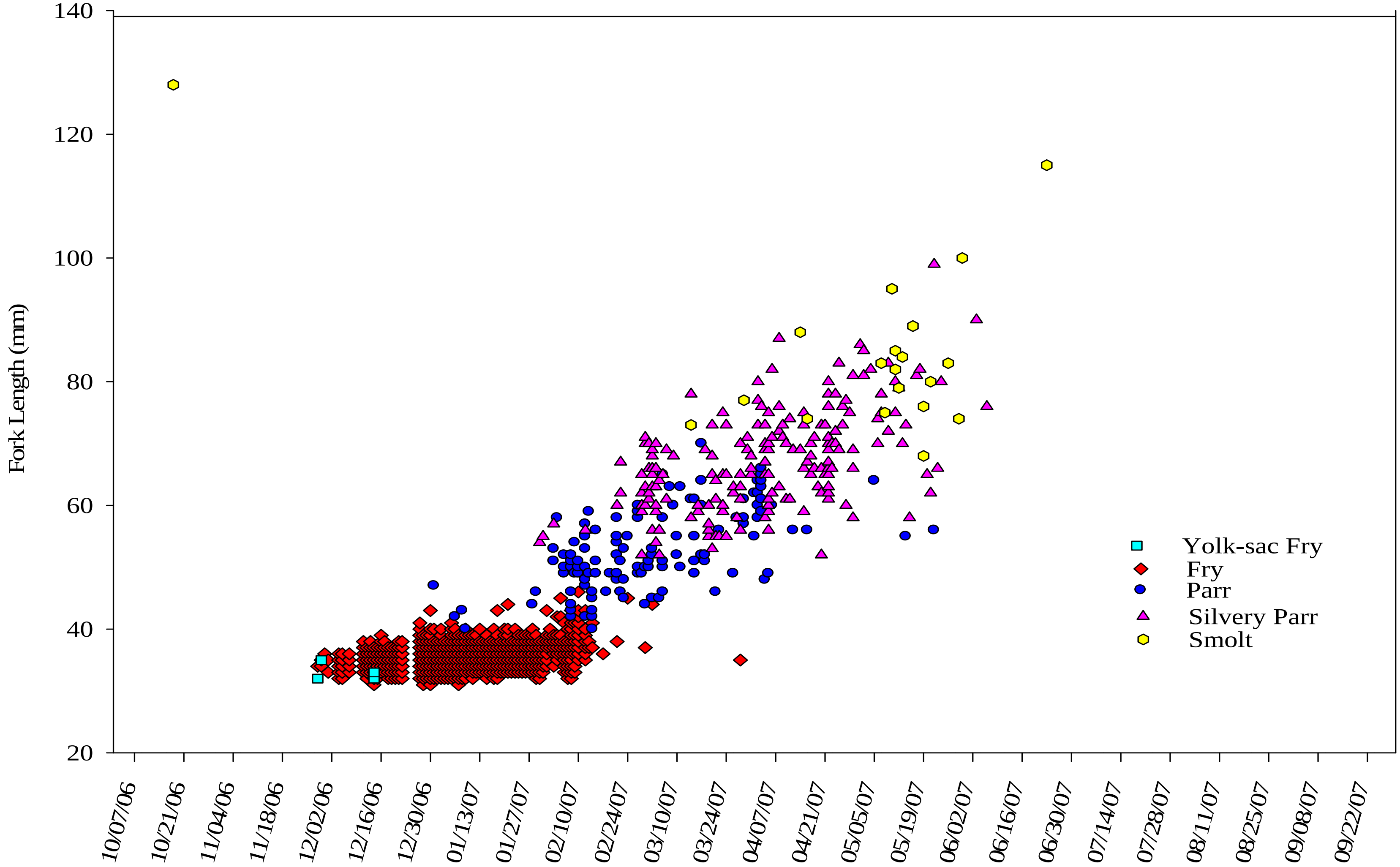

Figure 5. Life stage ratings for BY 2006 juvenile Chinook salmon captured by the upper rotary screw trap at river mile 8.3 in Clear Creek, Shasta County, California by the U.S. Fish and Wildlife Service from October 16, 2006 through July 13, 2007.

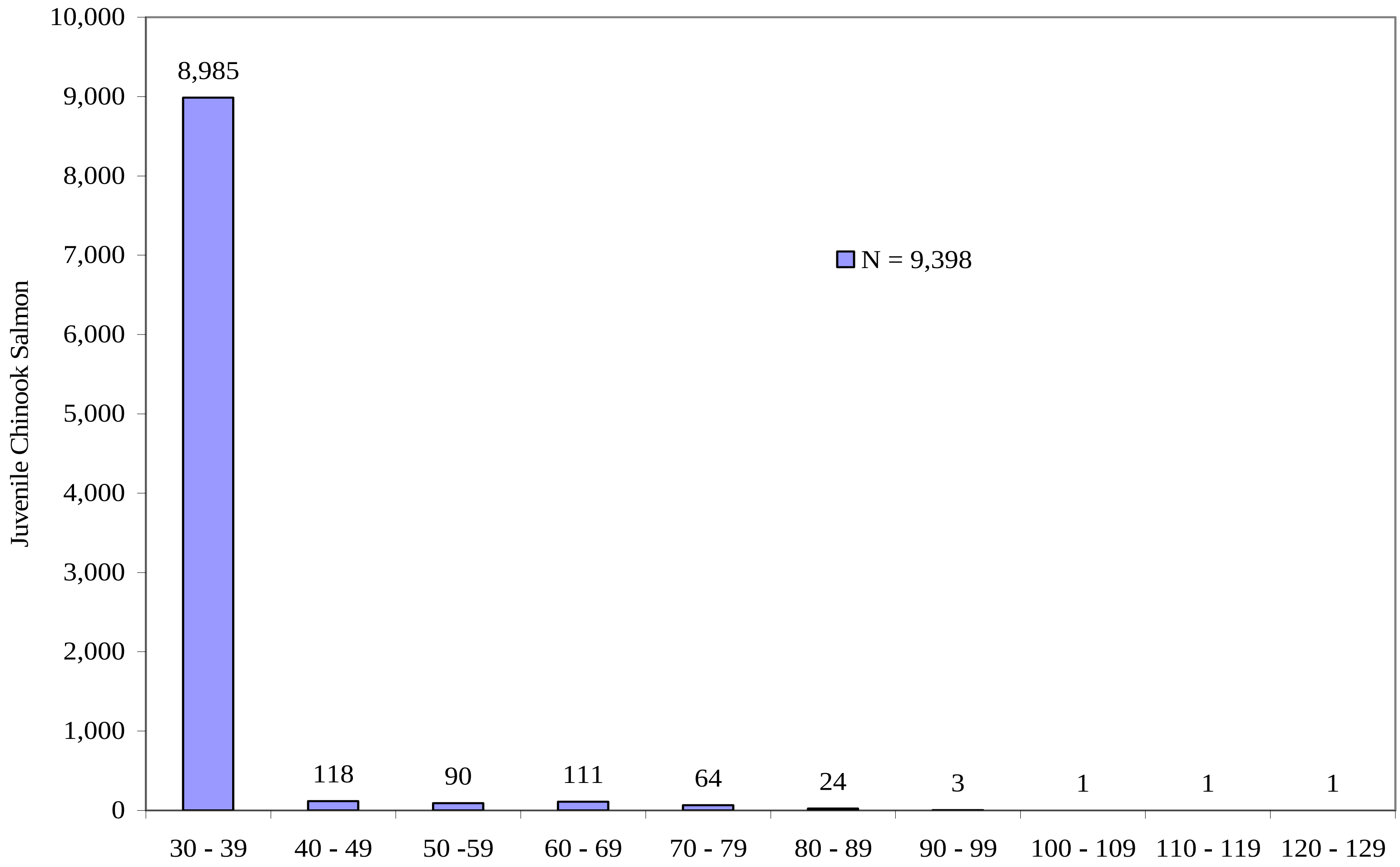

Figure 6. Fork length (mm) frequency distribution of BY 2006 juvenile spring Chinook salmon captured by the upper rotary screw trap at river mile 8.3 in Clear Creek, Shasta County, California by the U.S. Fish and Wildlife Service from October 16, 2006 through July 13, 2007. Fork length frequencies were assigned based on the proportional frequency of occurrence, in 10 mm increments.

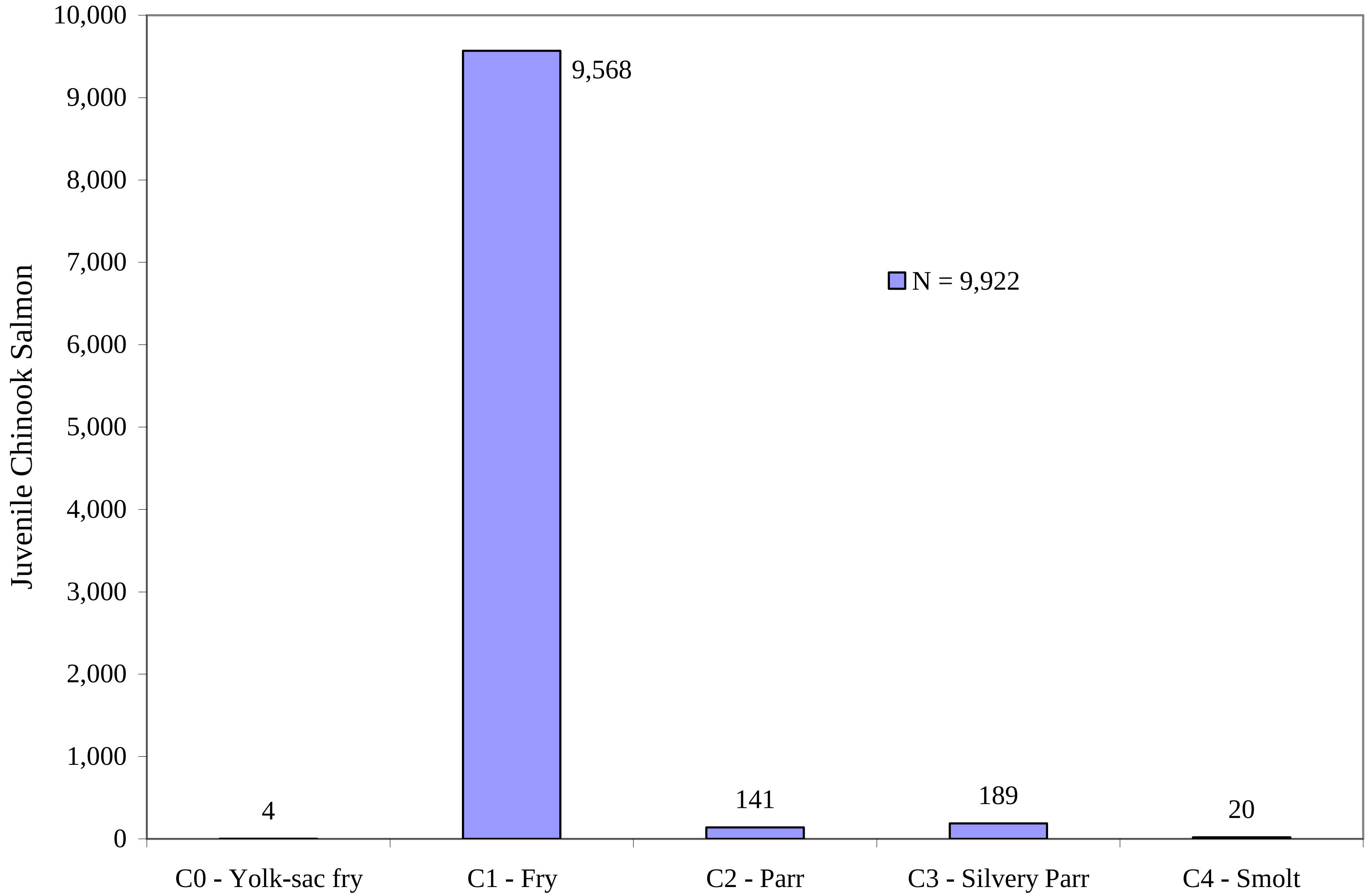

Figure 7. Life stage ratings for BY 2006 juvenile spring-run Chinook salmon captured by the upper rotary screw trap at river mile 8.3 in Clear Creek, Shasta County, California by the U.S. Fish and Wildlife Service from October 16, 2006 through July 13, 2007.

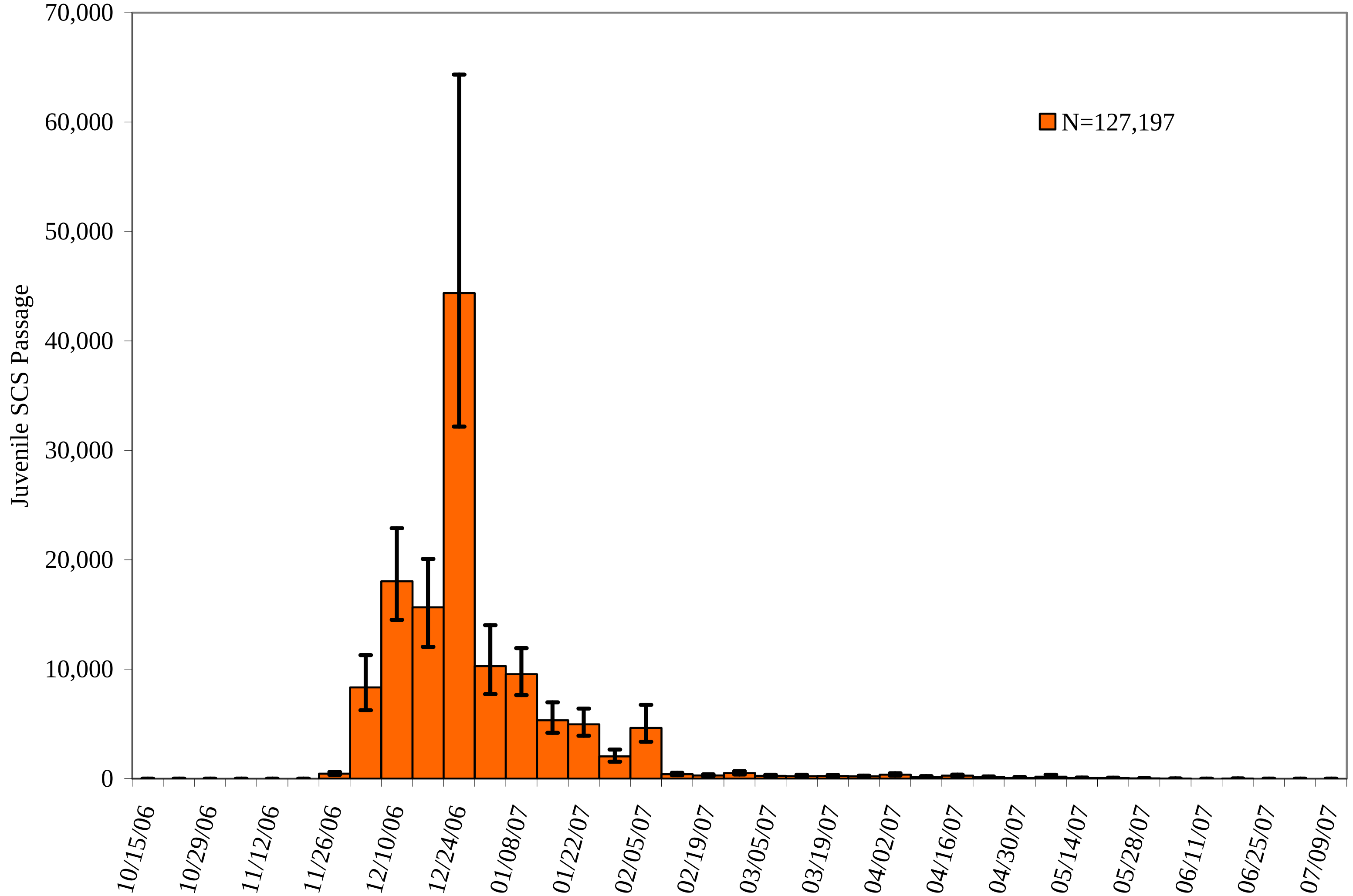

Figure 8. Weekly passage indices with 95% confidence intervals for BY 2006 juvenile spring Chinook salmon captured by the upper rotary screw trap at river mile 8.3 in Clear Creek, Shasta County, California by the U.S. Fish and Wildlife Service from October 16, 2006 through July 13, 2007. Spring Chinook passage for Clear Creek is calculated using total catch from the UCC rotary screw trap and weekly trap efficiencies.

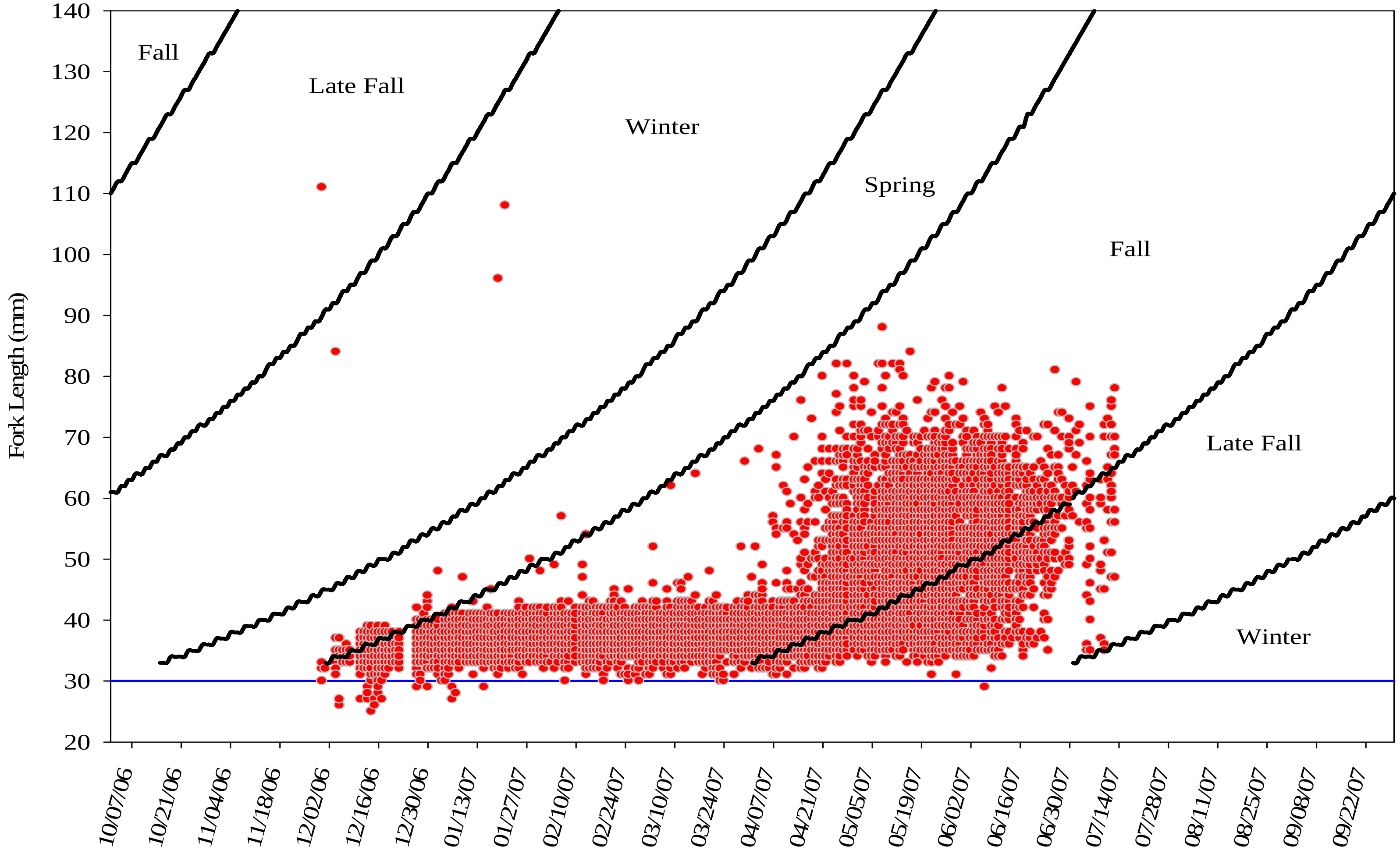

Figure 9. Fork length (mm) distribution by date and run for Chinook salmon captured by the lower rotary screw trap at river mile 1.7 in Clear Creek, Shasta County, California by the U.S. Fish and Wildlife Service from November 30, 2006 through July 13, 2007. Spline curves represent the maximum fork lengths expected for each run by date, based upon tables of projected annual growth developed by the California Department of Water Resources (Greene 1992).

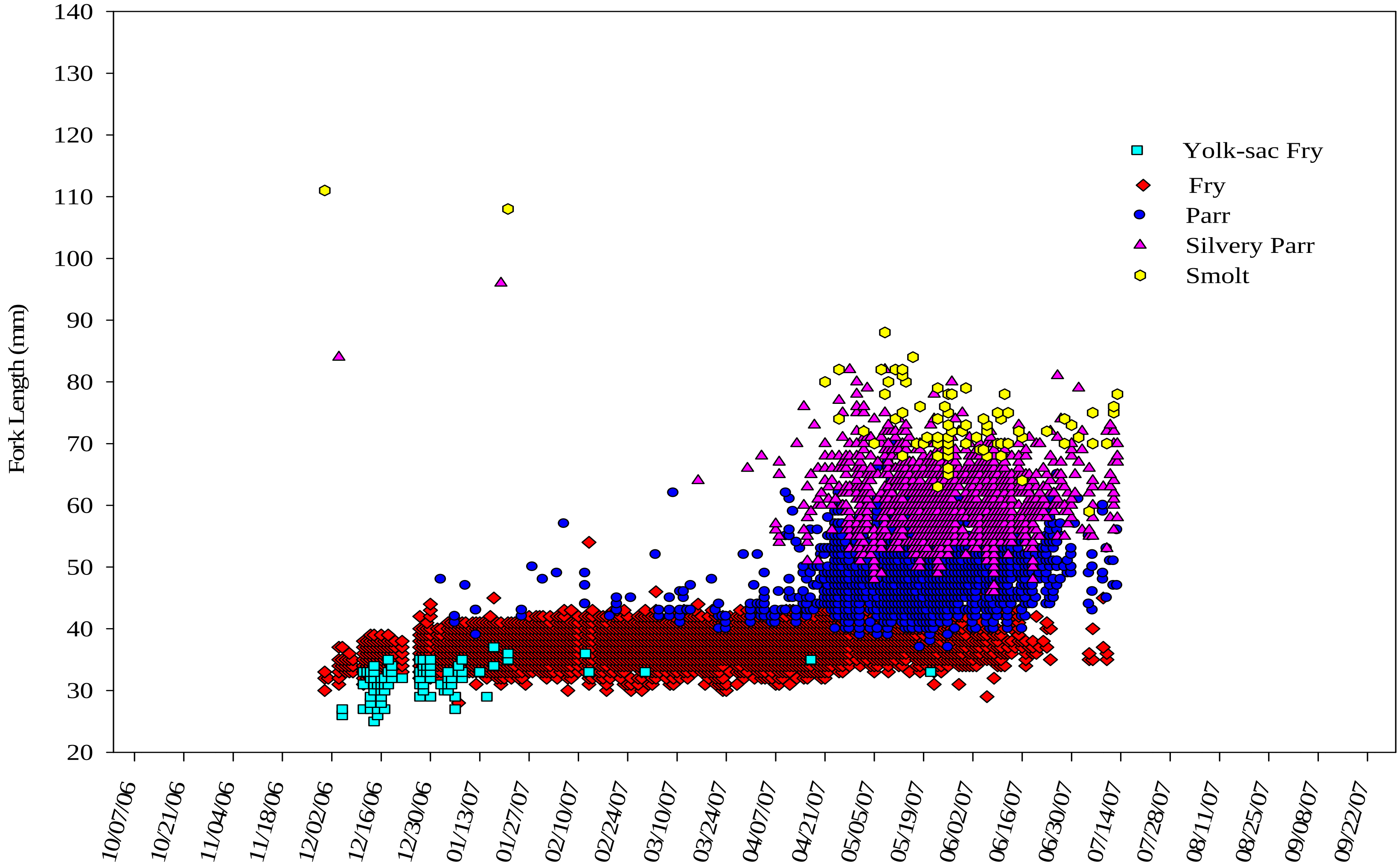

Figure 10. Life stage ratings and forklength distribution for BY 2006 juvenile Chinook salmon captured by the lower rotary screw trap at river mile 1.7 in Clear Creek, Shasta County, California by the U.S. Fish and Wildlife Service from November 30, 2006 through July 13, 2007.

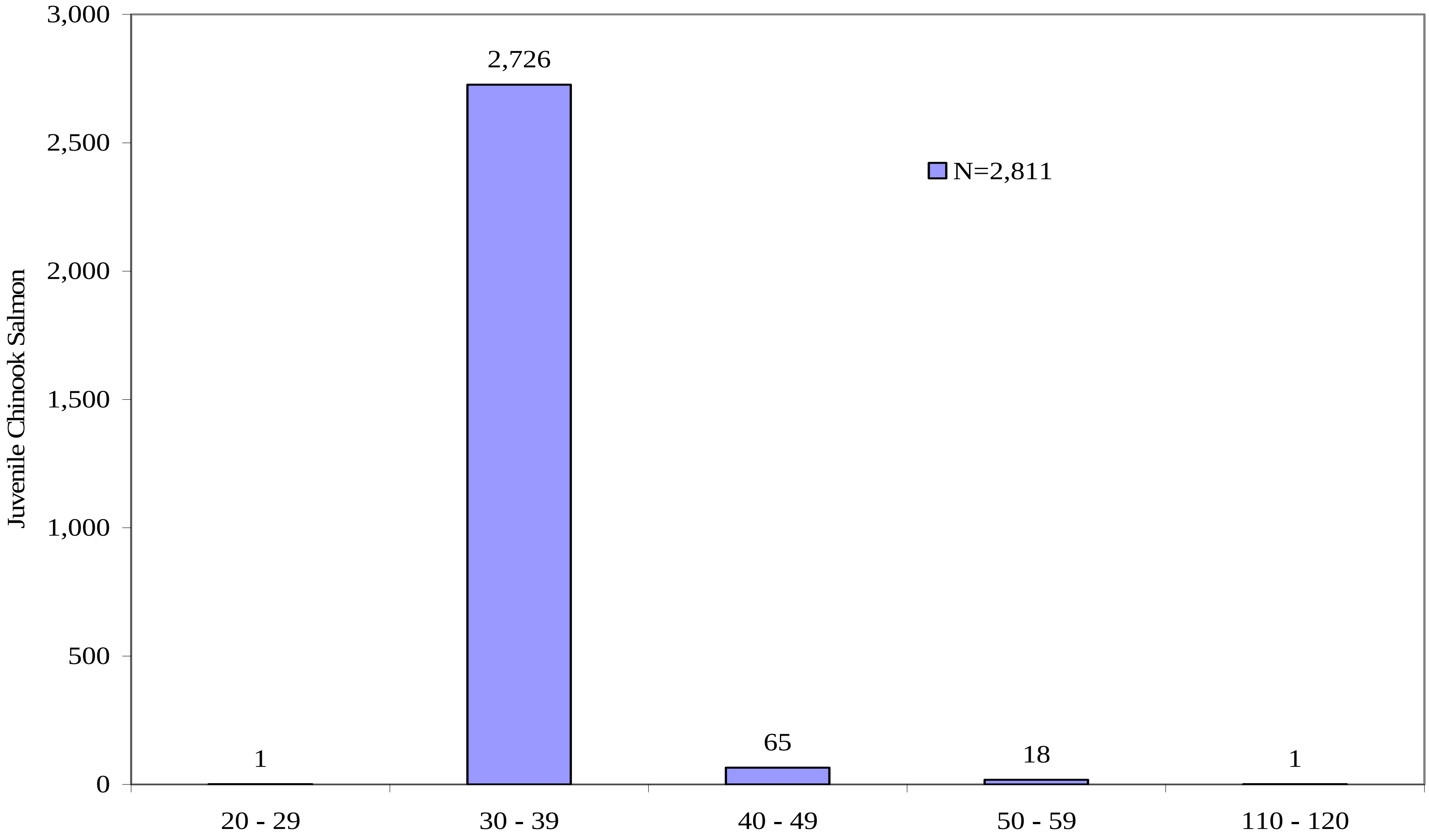

Figure 11. Fork length (mm) frequency distribution of BY 2006 juvenile late fall-run Chinook salmon captured by the lower rotary screw trap at river mile 1.7 in Clear Creek, Shasta County, California by the U.S. Fish and Wildlife Service from April 1, 2006 through March 31, 2007. Fork length frequencies were assigned based on the proportional frequency of occurrence, in 10 mm increments.

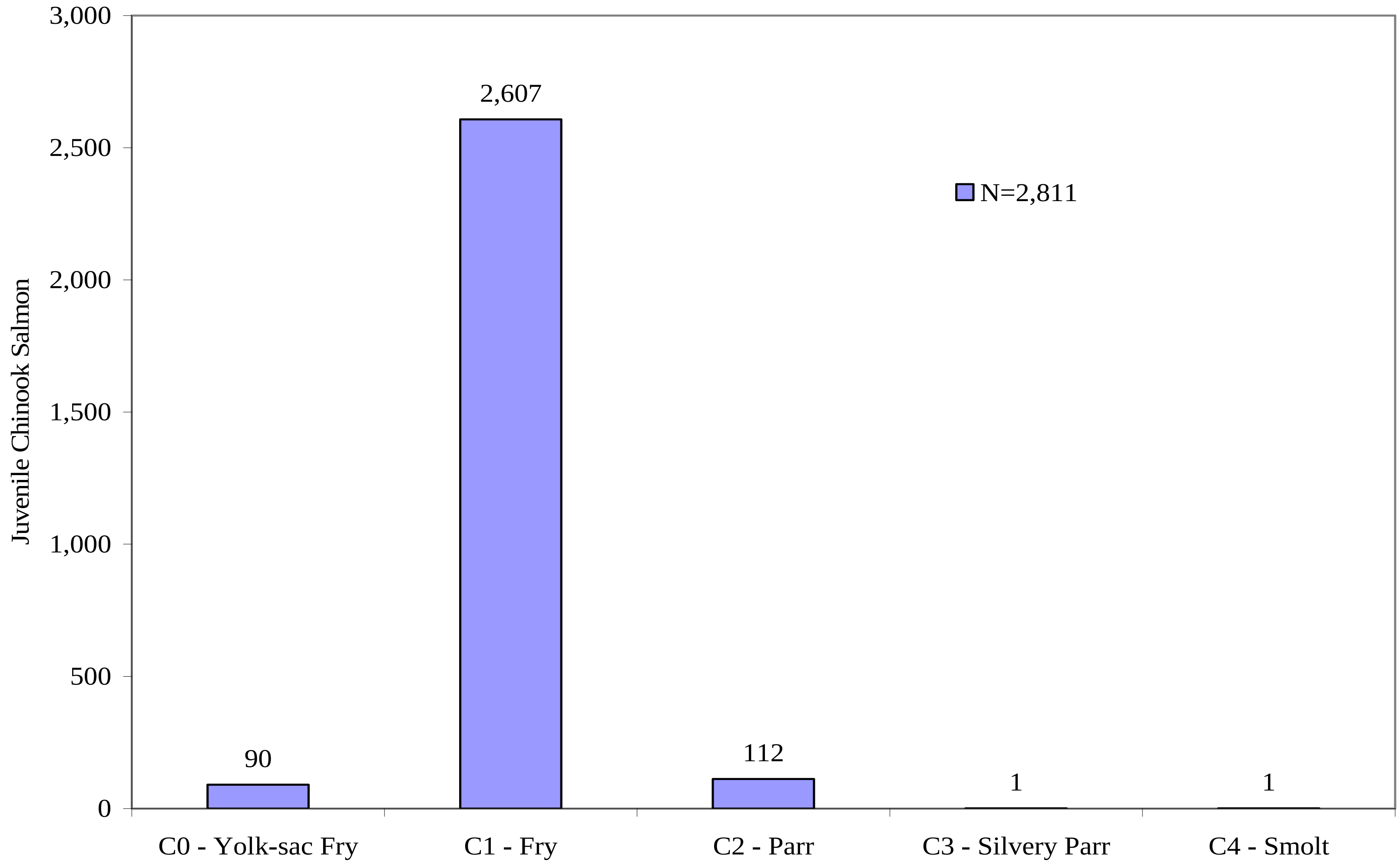

Figure 12. Life stage ratings for BY 2006 juvenile late fall-run Chinook salmon captured by the lower rotary screw trap at river mile 1.7 in Clear Creek, Shasta County, California by the U.S. Fish and Wildlife Service from April 1, 2006 through March 31, 2007.

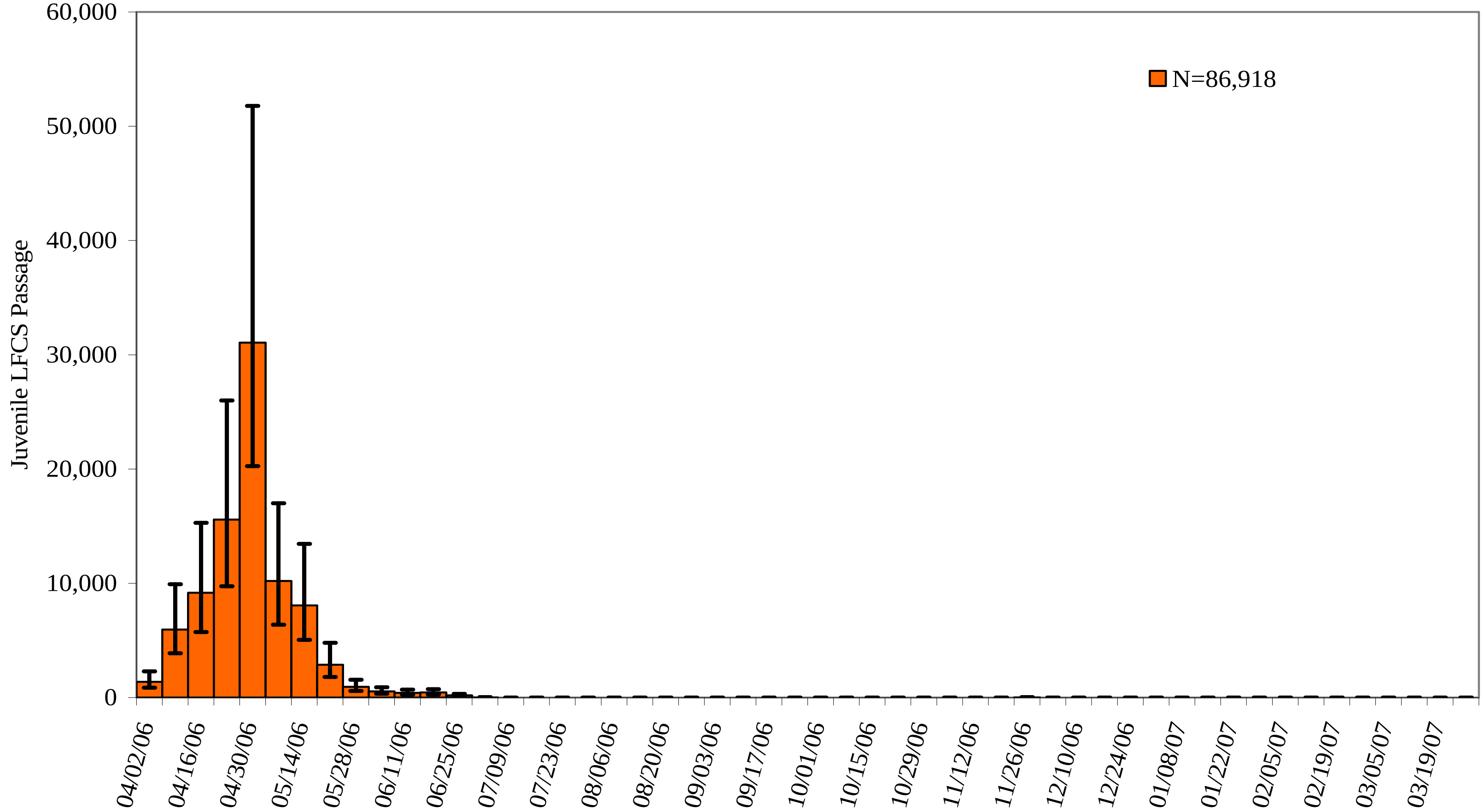

Figure 13. Weekly passage index with 95% confidence intervals of BY 2006 juvenile late-fall run Chinook captured by the lower rotary screw trap at river mile 1.7 in Clear Creek, Shasta County, California by the U.S. Fish and Wildlife Service from April 1, 2006 through March 31, 2007.

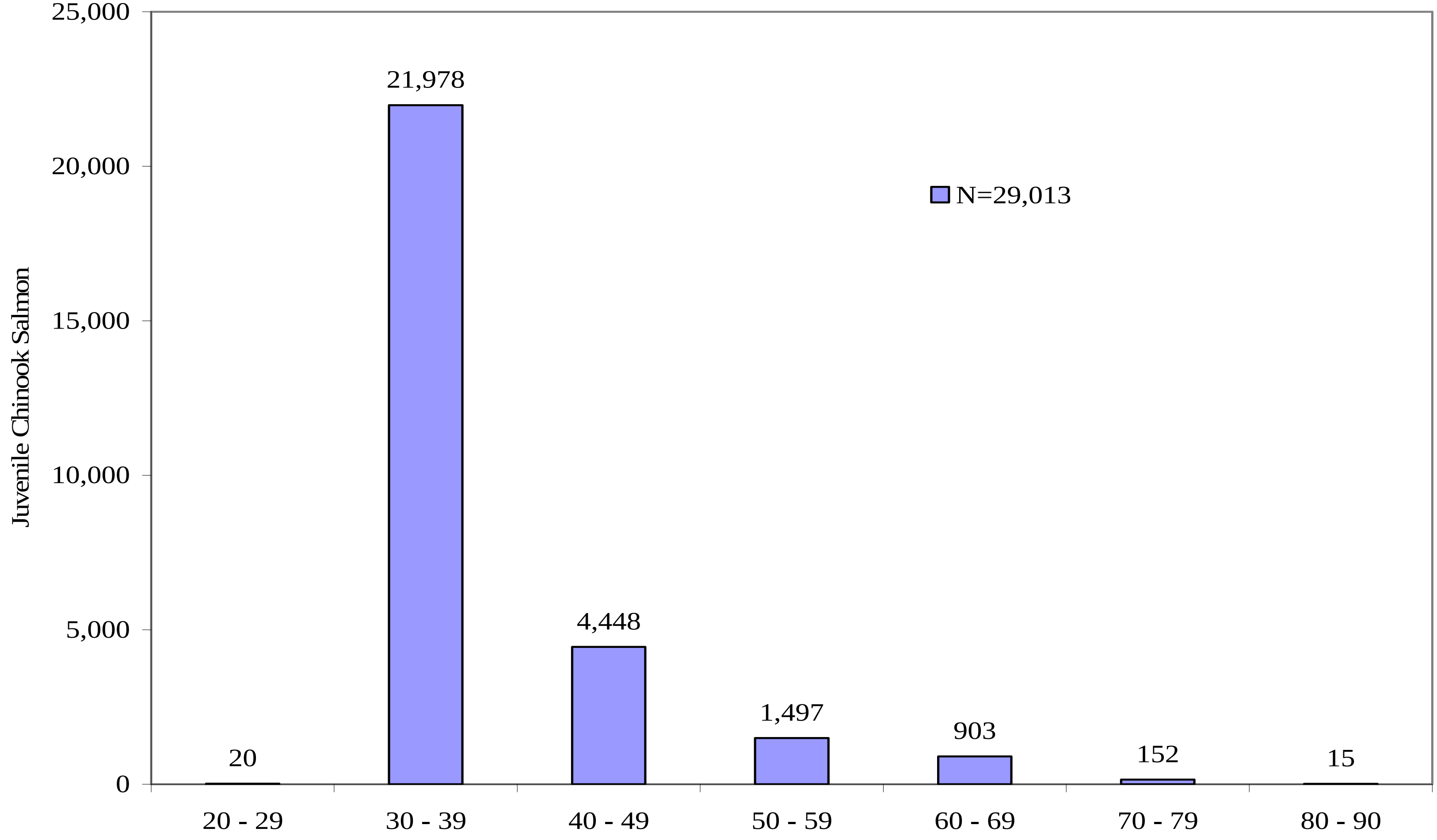

Figure 14. Fork length (mm) frequency distribution of BY 2006 juvenile fall-run Chinook salmon captured by the lower rotary screw trap at river mile 1.7 in Clear Creek, Shasta County, California by the U.S. Fish and Wildlife Service from November 30, 2006 through July 13, 2007. Fork length frequencies were assigned based on the proportional frequency of occurrence, in 10 mm increments.

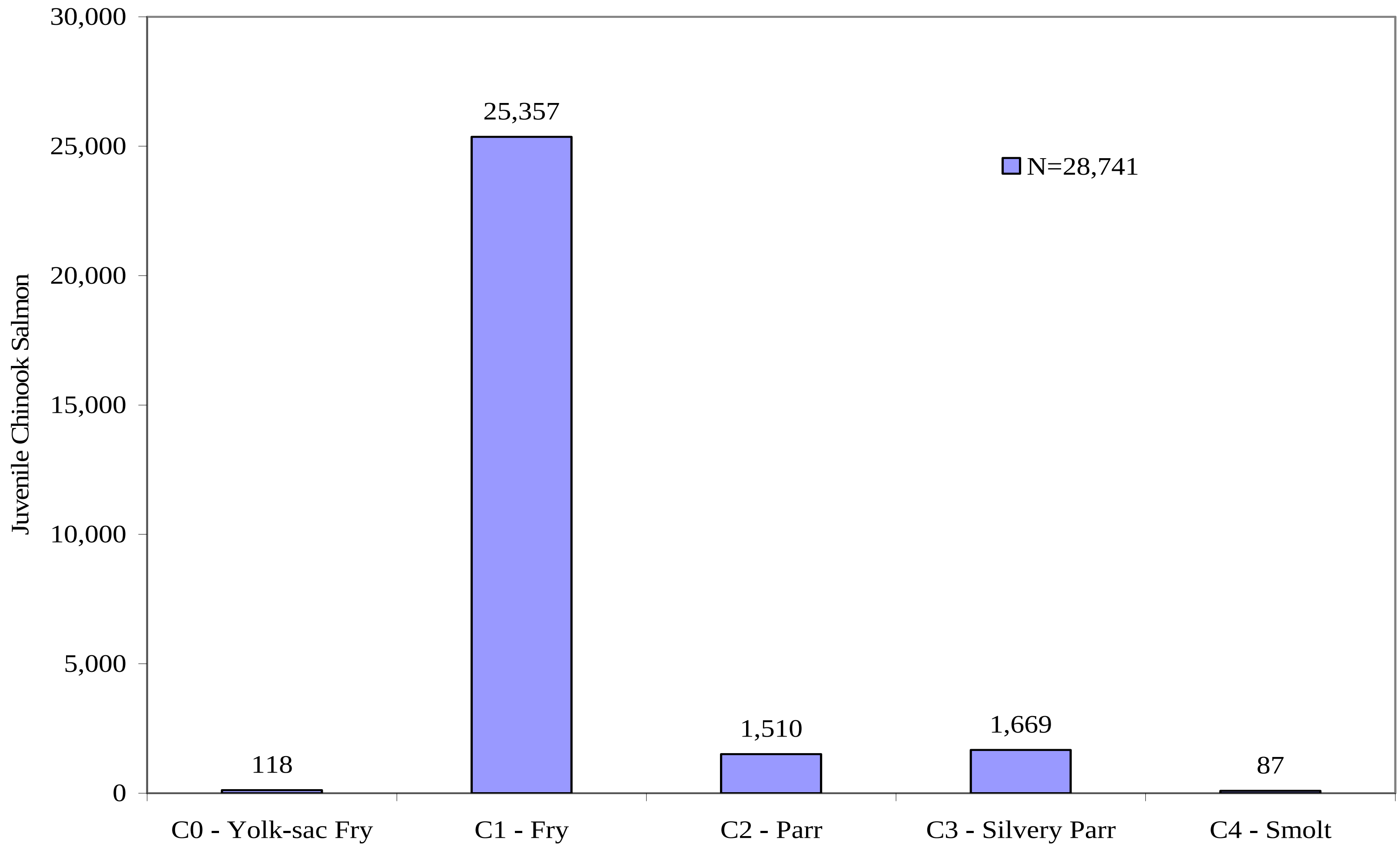

Figure 15. Life stage ratings for juvenile BY 2006 fall-run Chinook salmon by the lower rotary screw trap at river mile 1.7 in Clear Creek, Shasta County, California by the U.S. Fish and Wildlife Service from November 30, 2006 through July 13, 2007.

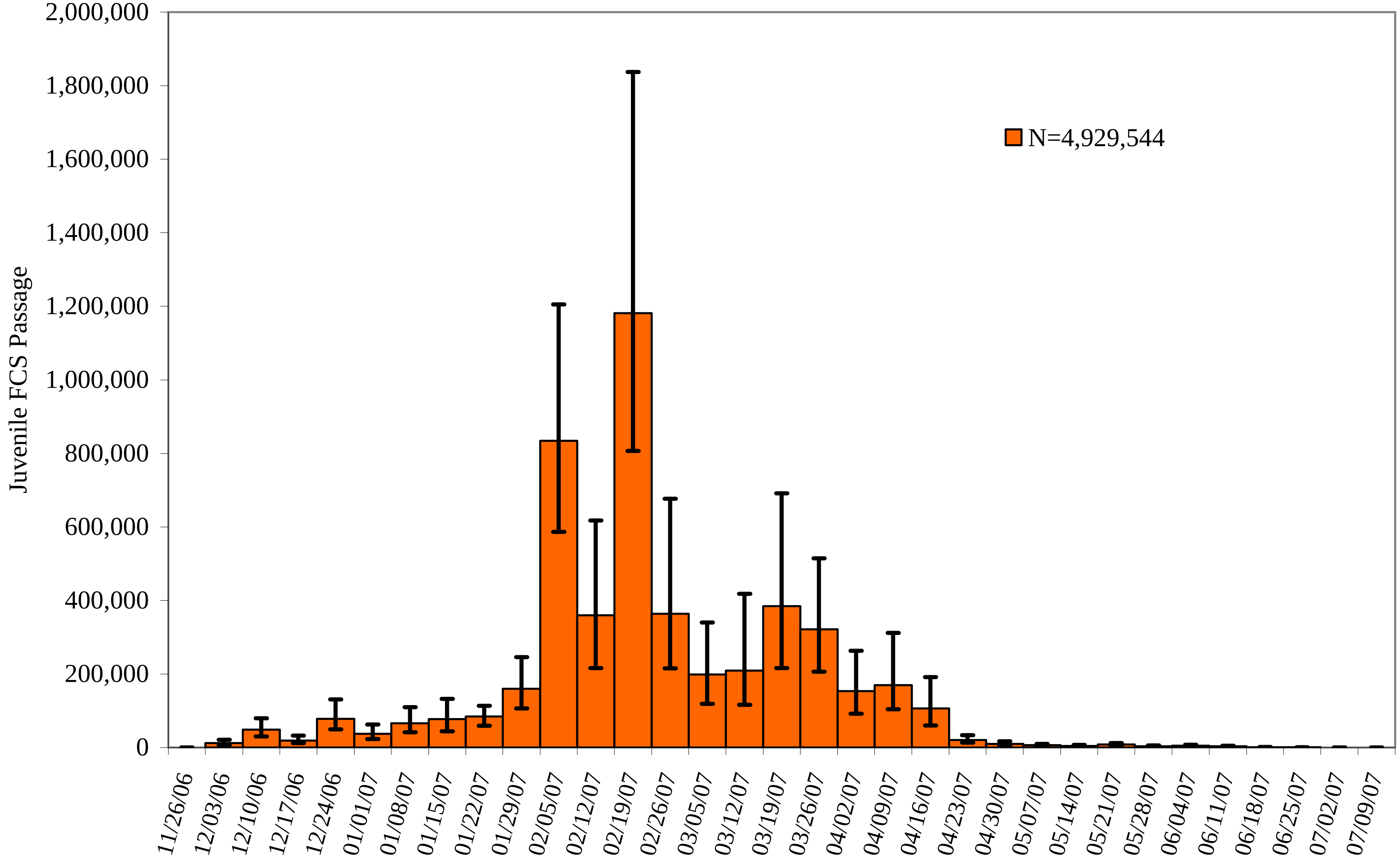

Figure 16. Passage index with 95% confidence intervals of BY 2006 juvenile fall-run Chinook captured by the lower rotary screw trap at river mile 1.7 in Clear Creek, Shasta County, California by the U.S. Fish and Wildlife Service from November 30, 2006 through July 13, 2007.

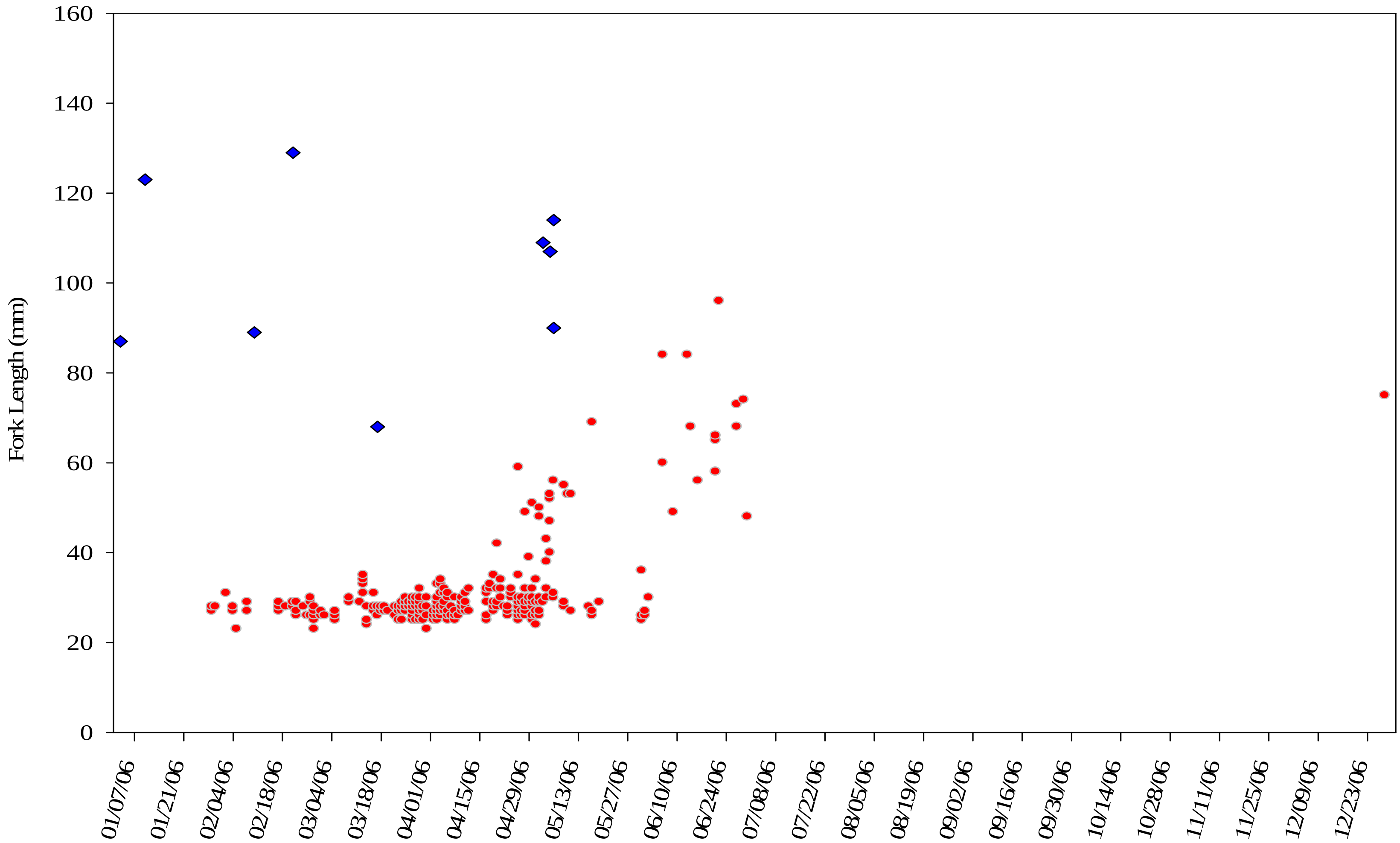

Figure 17. Fork length (mm) distribution by date for BY 2006 and BY 2005 Age 0+ steelhead / rainbow trout captured by the lower rotary screw trap at river mile 1.7 in Clear Creek, Shasta County, California by the U.S. Fish and Wildlife Service from January 1, 2006 through December 31, 2006. Blue diamonds represent age 0+ steelhead trout that are of BY 2005 or earlier, while the red dots represent production from BY 2006.

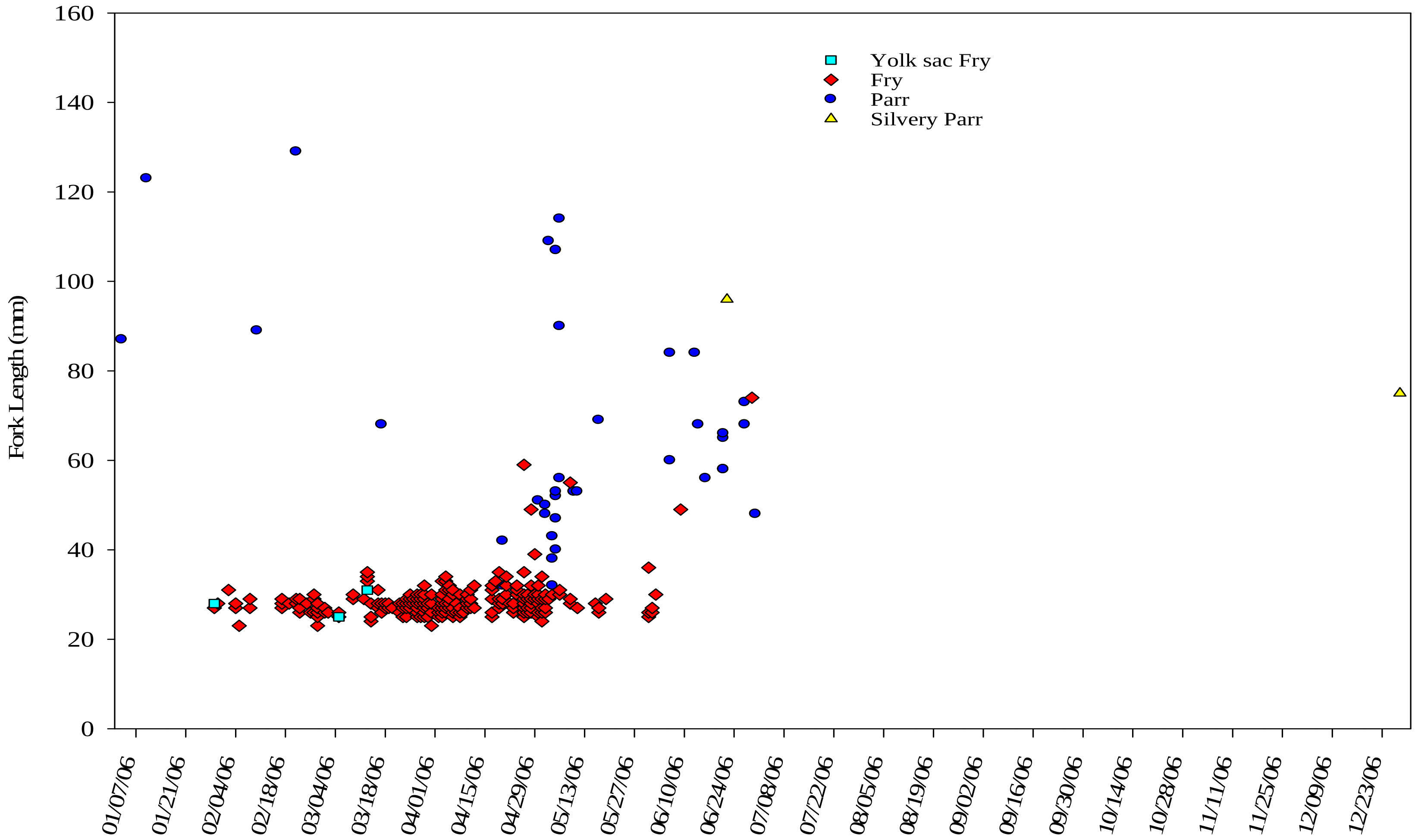

Figure 18. Life stage ratings and forklength distribution for BY 2006 and BY 2005 Age 0+ juvenile steelhead / rainbow trout captured by the lower rotary screw trap at river mile 1.7 in Clear Creek, Shasta County, California by the U.S. Fish and Wildlife Service from January 1, 2006 through December 31, 2006.

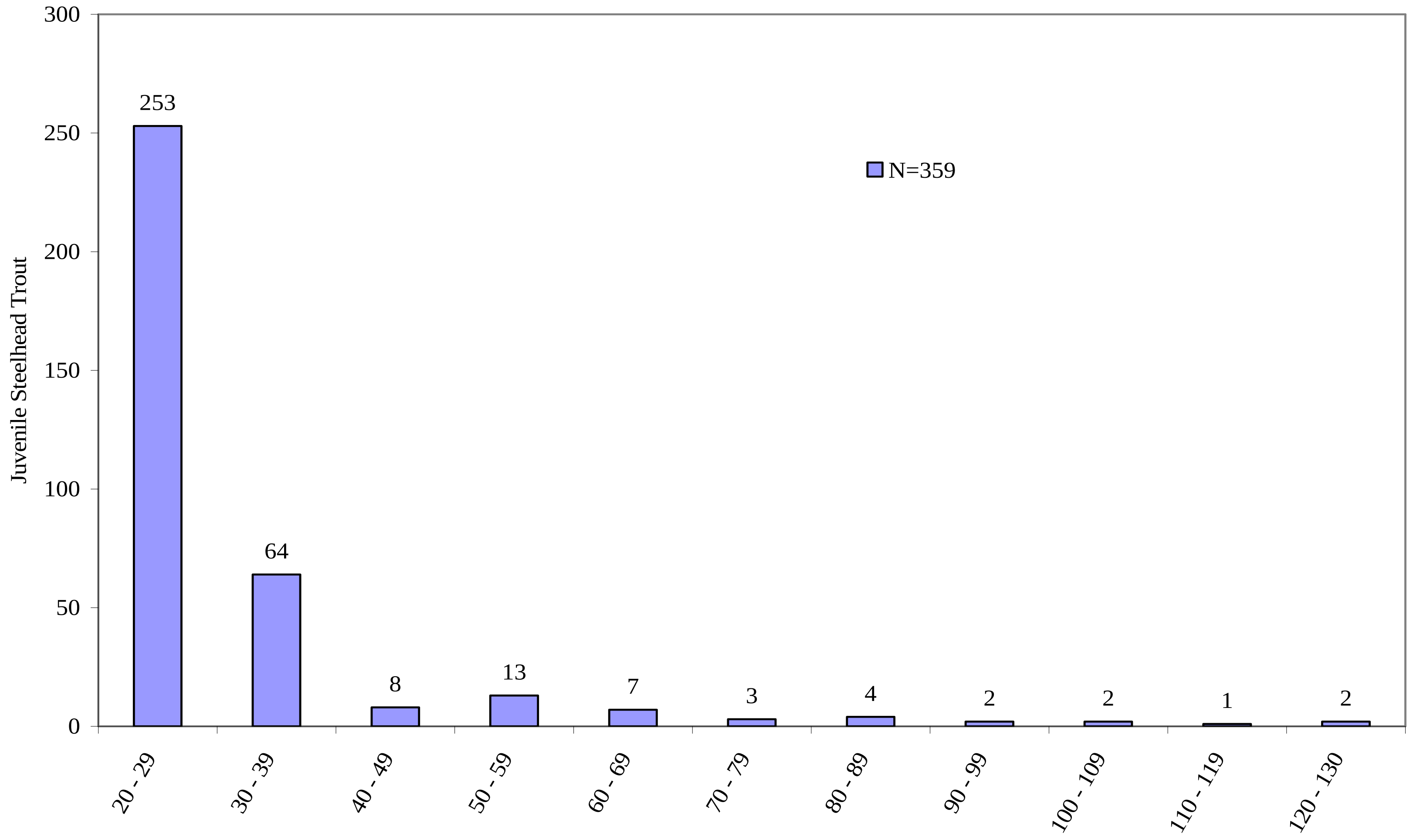

Figure 19. Fork length (mm) frequency distribution for BY 2006 and BY 2005 Age 0+ steelhead / rainbow trout captured by the lower rotary screw trap at river mile 1.7 in Clear Creek, Shasta County, California by the U.S. Fish and Wildlife Service from January 1, 2006 through December 31, 2006.

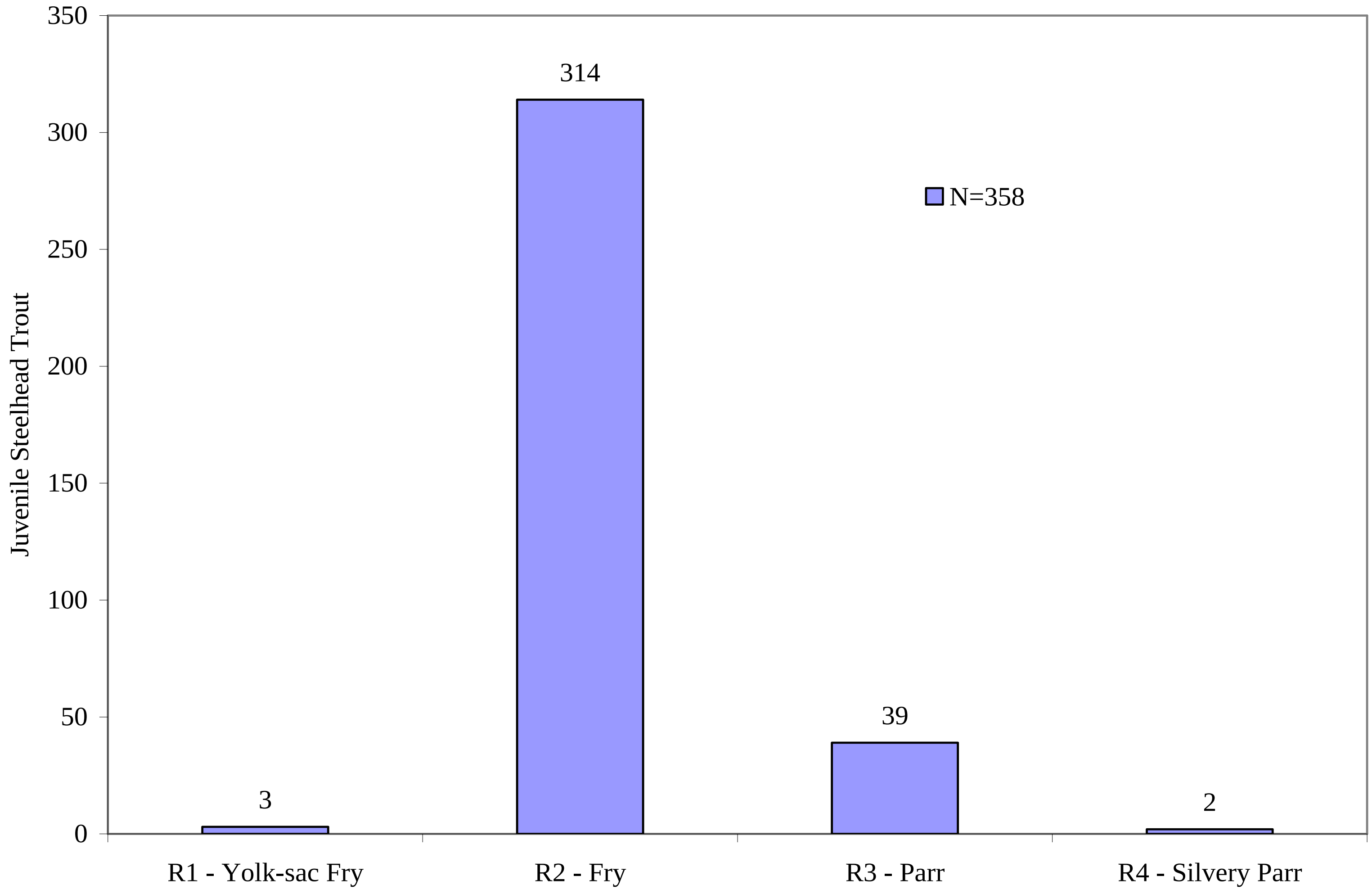

Figure 20. Life stage ratings for BY 2006 and BY 2005 Age 0+ juvenile steelhead / rainbow trout captured by the lower rotary screw trap at river mile 1.7 in Clear Creek, Shasta County, California by the U.S. Fish and Wildlife Service from January 1, 2006 through December 31, 2006.

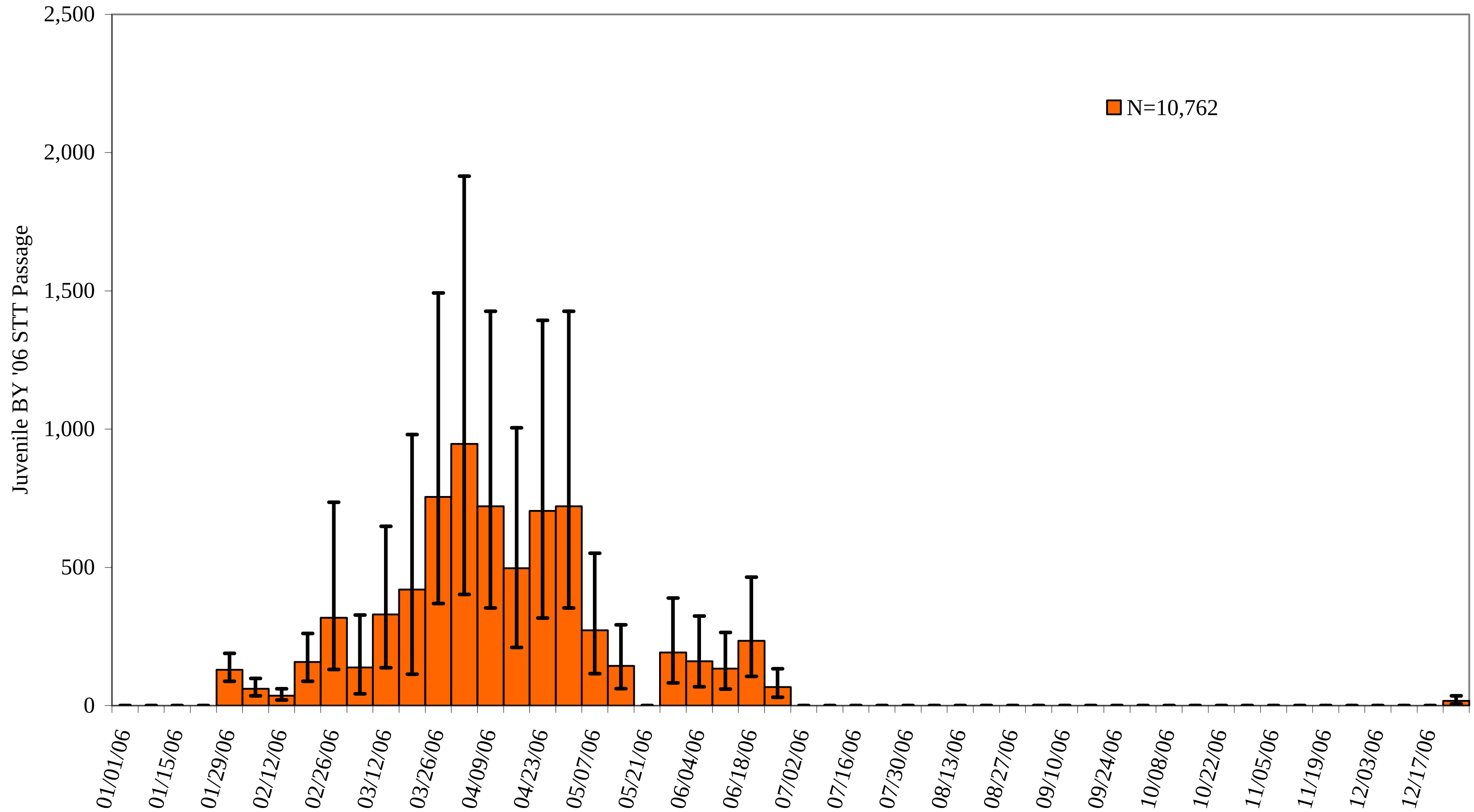

Figure 21. Passage index with 95% confidence intervals of BY 2006 juvenile steelhead / rainbow trout captured by the lower rotary screw trap at river mile 1.7 in Clear Creek, Shasta County, California by the U.S. Fish and Wildlife Service from January 1, 2006 through December 31, 2006.

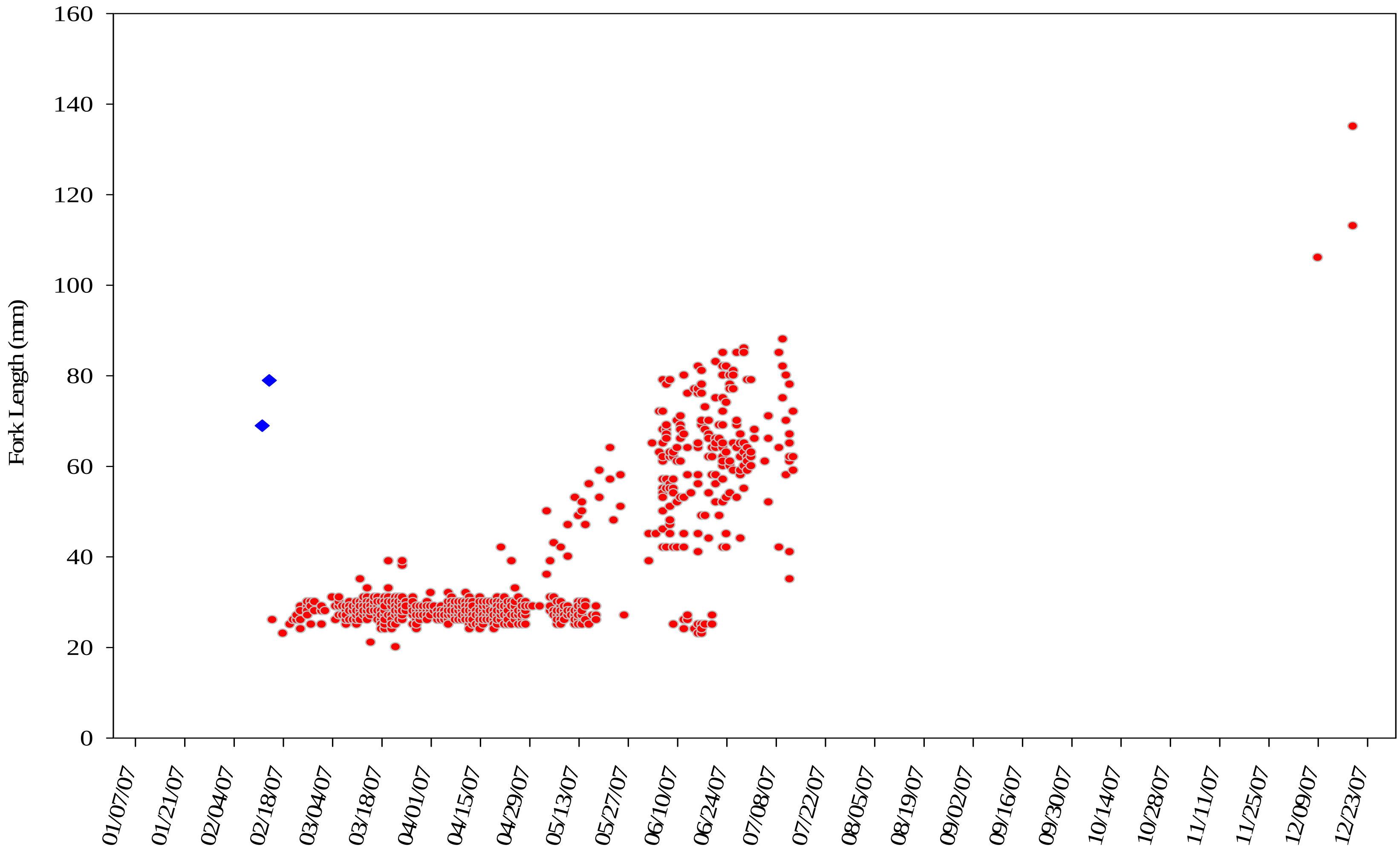

Figure 22. Fork length (mm) distribution by date for BY 2007 and BY 2006 Age 0+ steelhead / rainbow trout captured by the lower rotary screw trap at river mile 1.7 in Clear Creek, Shasta County, California by the U.S. Fish and Wildlife Service from January 1, 2007 through December 31, 2007. Blue diamonds represent age 0+ steelhead trout that are of BY 2006 or earlier, while the red dots represent production from BY 2007.

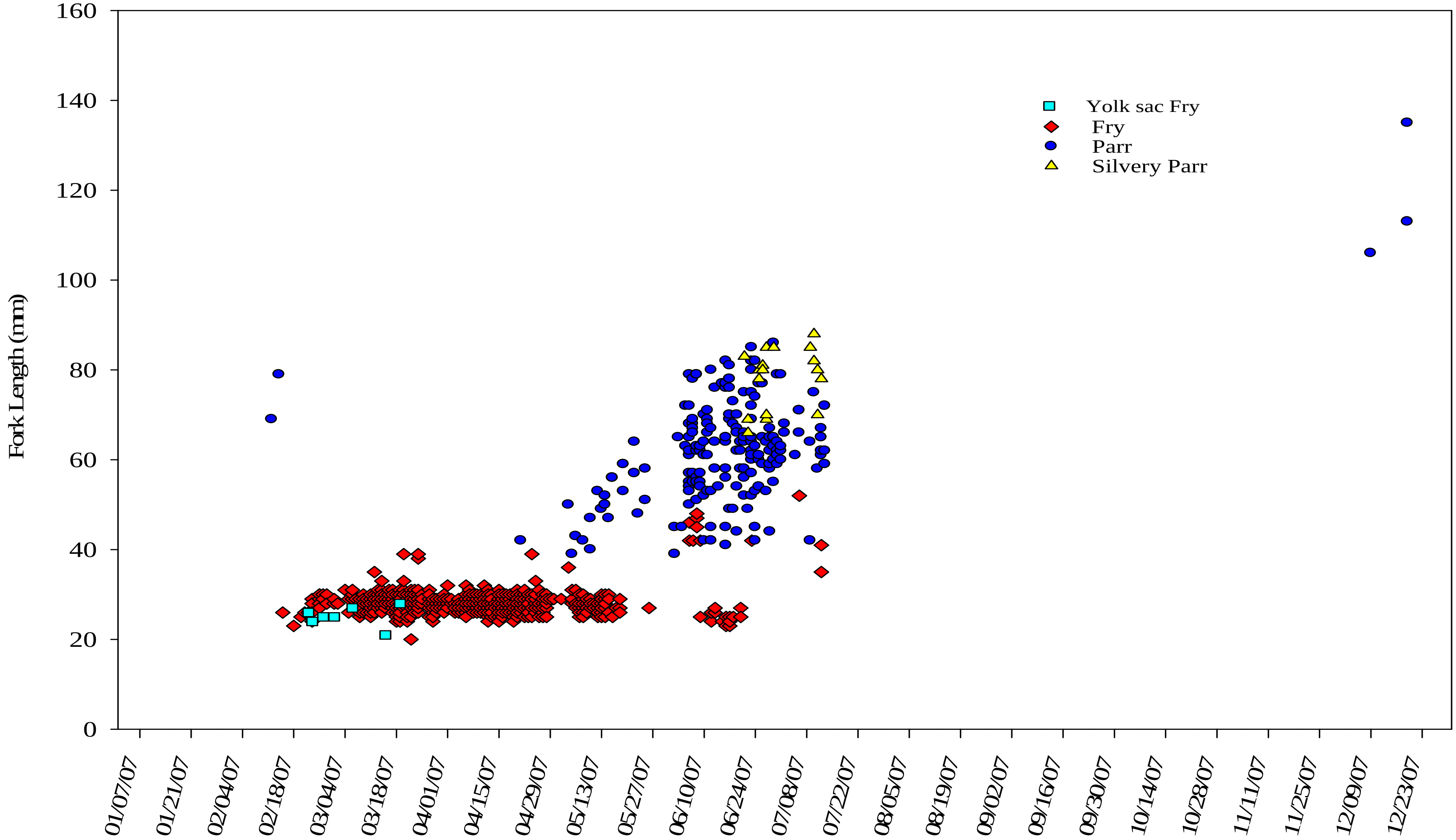

Figure 23. Life stage ratings and forklength distributions for BY 2007 and BY 2006 Age 0+ juvenile steelhead / rainbow trout captured by the lower rotary screw trap at river mile 1.7 in Clear Creek, Shasta County, California by the U.S. Fish and Wildlife Service from January 1, 2007 through December 31, 2007.

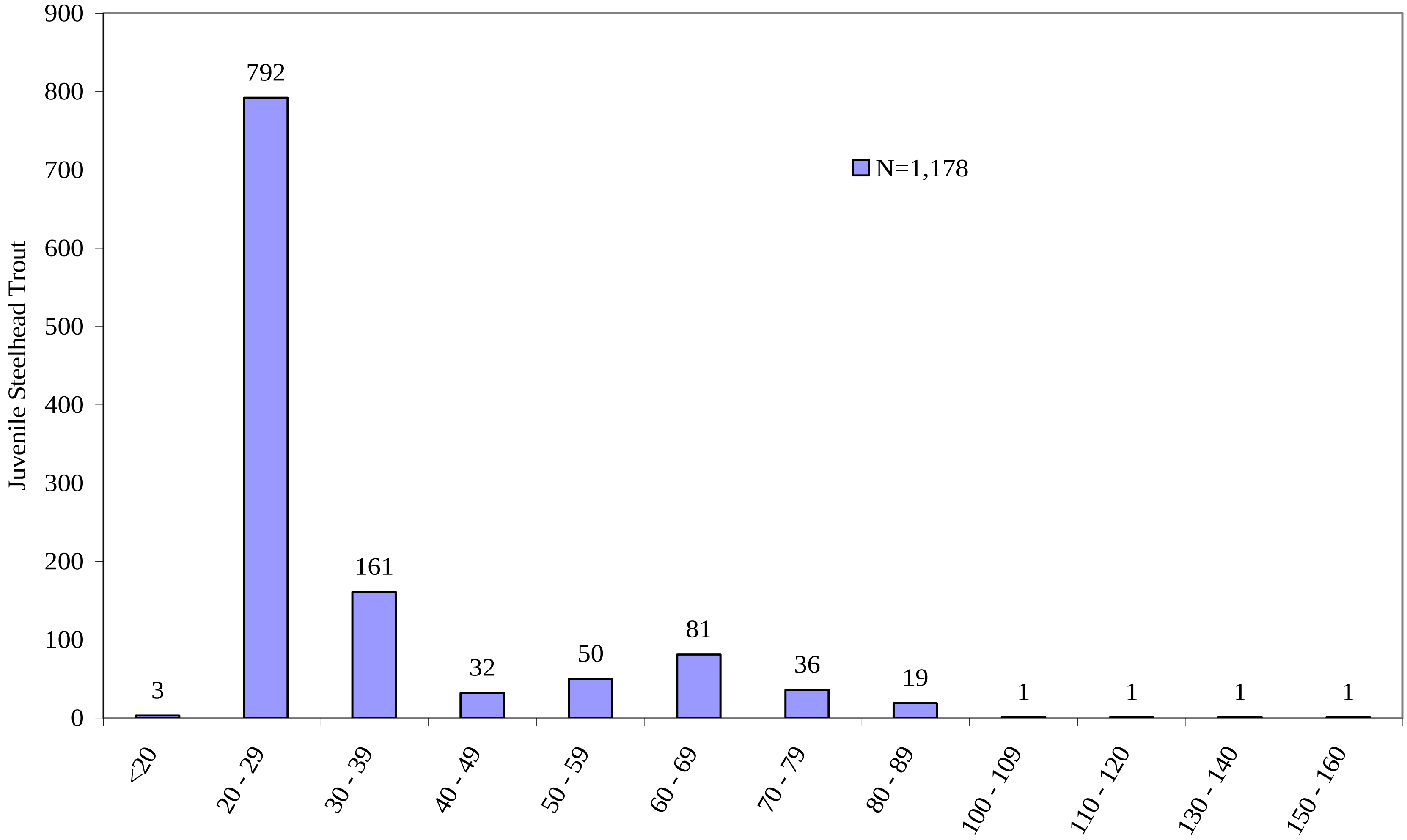

Figure 24. Fork length (mm) frequency distribution for BY 2007 and BY 2006 Age 0+ steelhead / rainbow trout captured by the lower rotary screw trap at river mile 1.7 in Clear Creek, Shasta County, California by the U.S. Fish and Wildlife Service from January 1, 2007 through December 31, 2007.

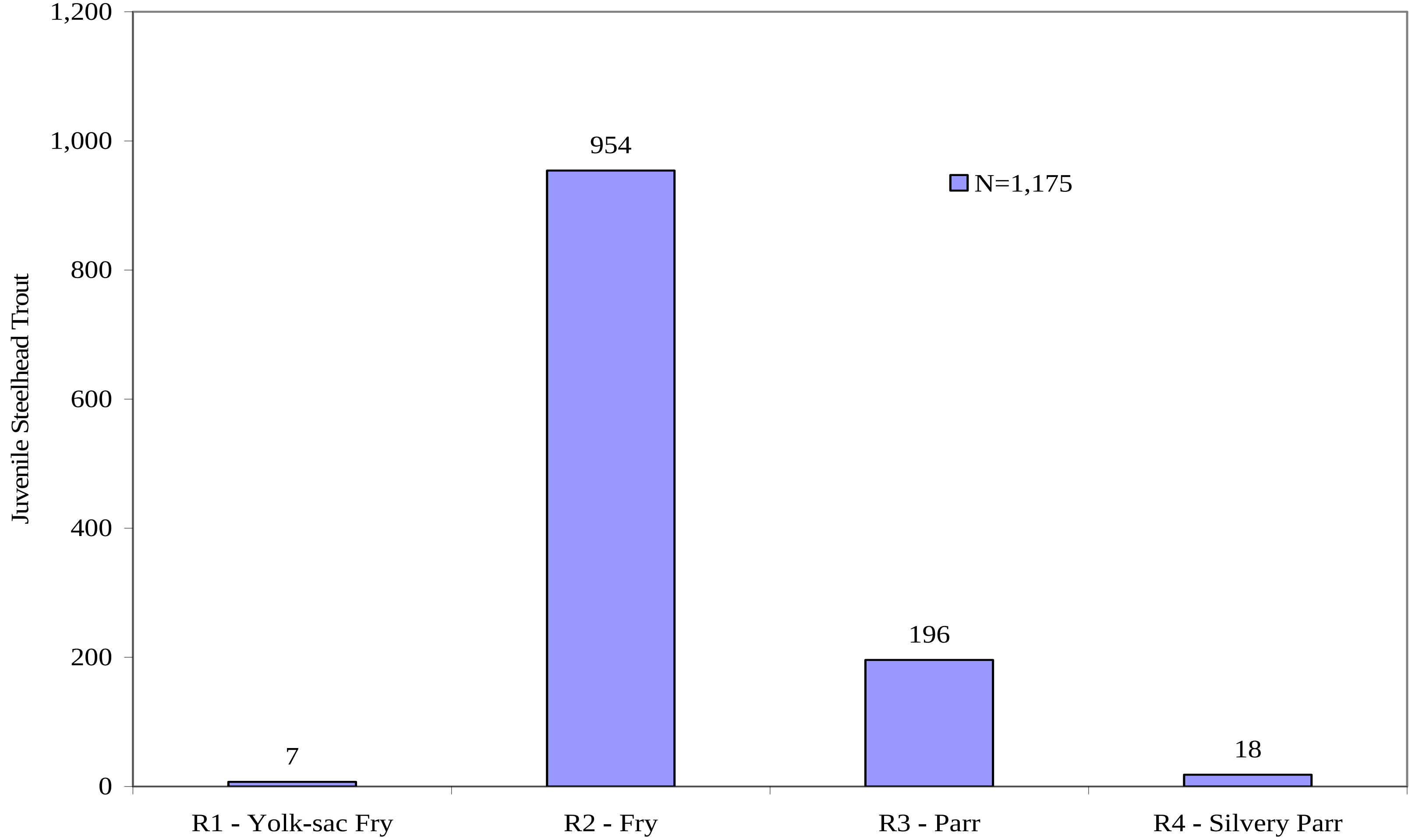

Figure 25. Life stage ratings for BY 2007 and BY 2006 Age 0+ juvenile steelhead / rainbow trout captured by the lower rotary screw trap at river mile 1.7 in Clear Creek, Shasta County, California by the U.S. Fish and Wildlife Service from January 1, 2007 through December 31, 2007.

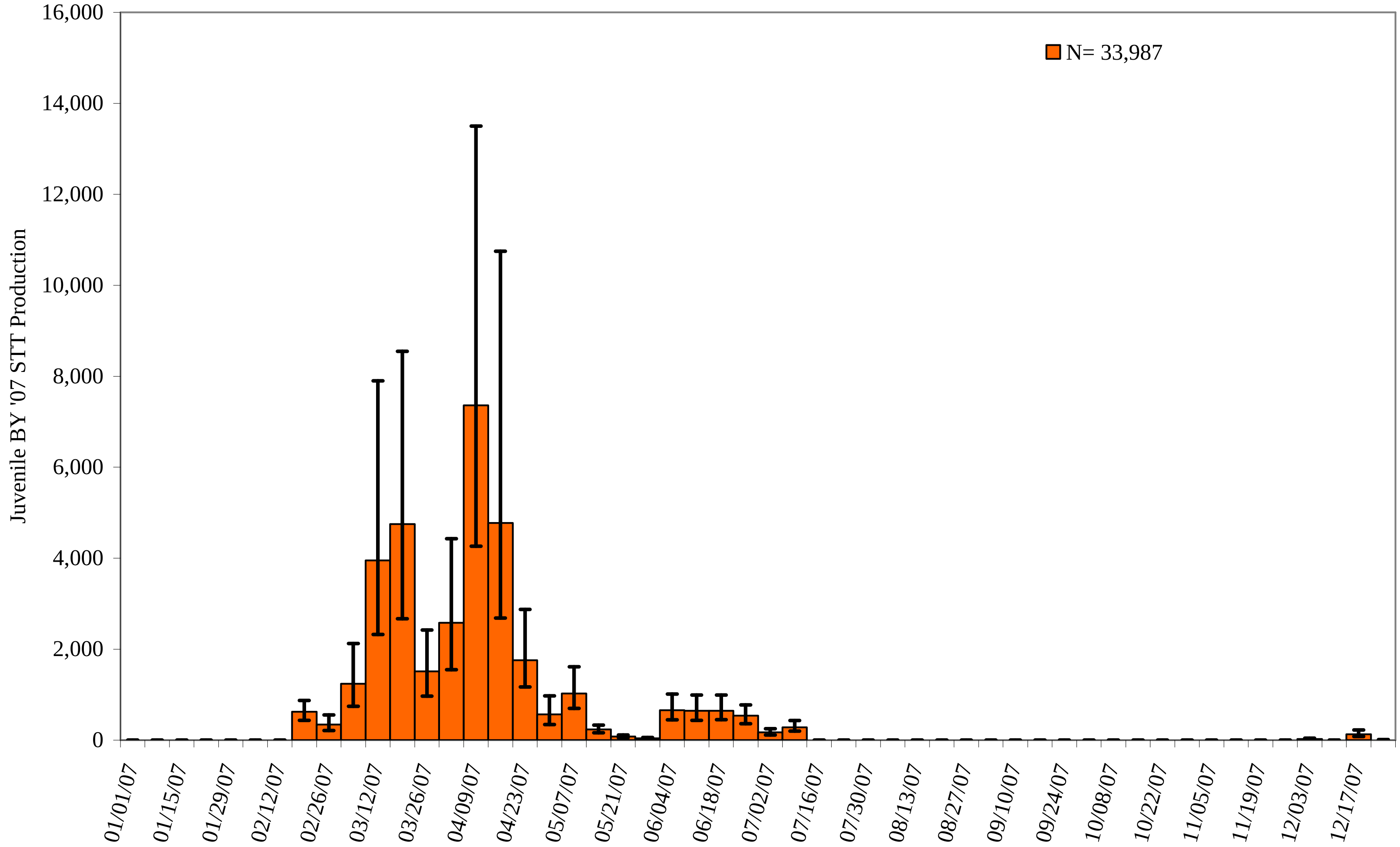

Figure 26. Passage index with 95% confidence intervals of BY 2007 juvenile steelhead / rainbow trout captured by the lower rotary screw trap at river mile 1.7 in Clear Creek, Shasta County, California by the U.S. Fish and Wildlife Service from January 1, 2007 through December 31, 2007.

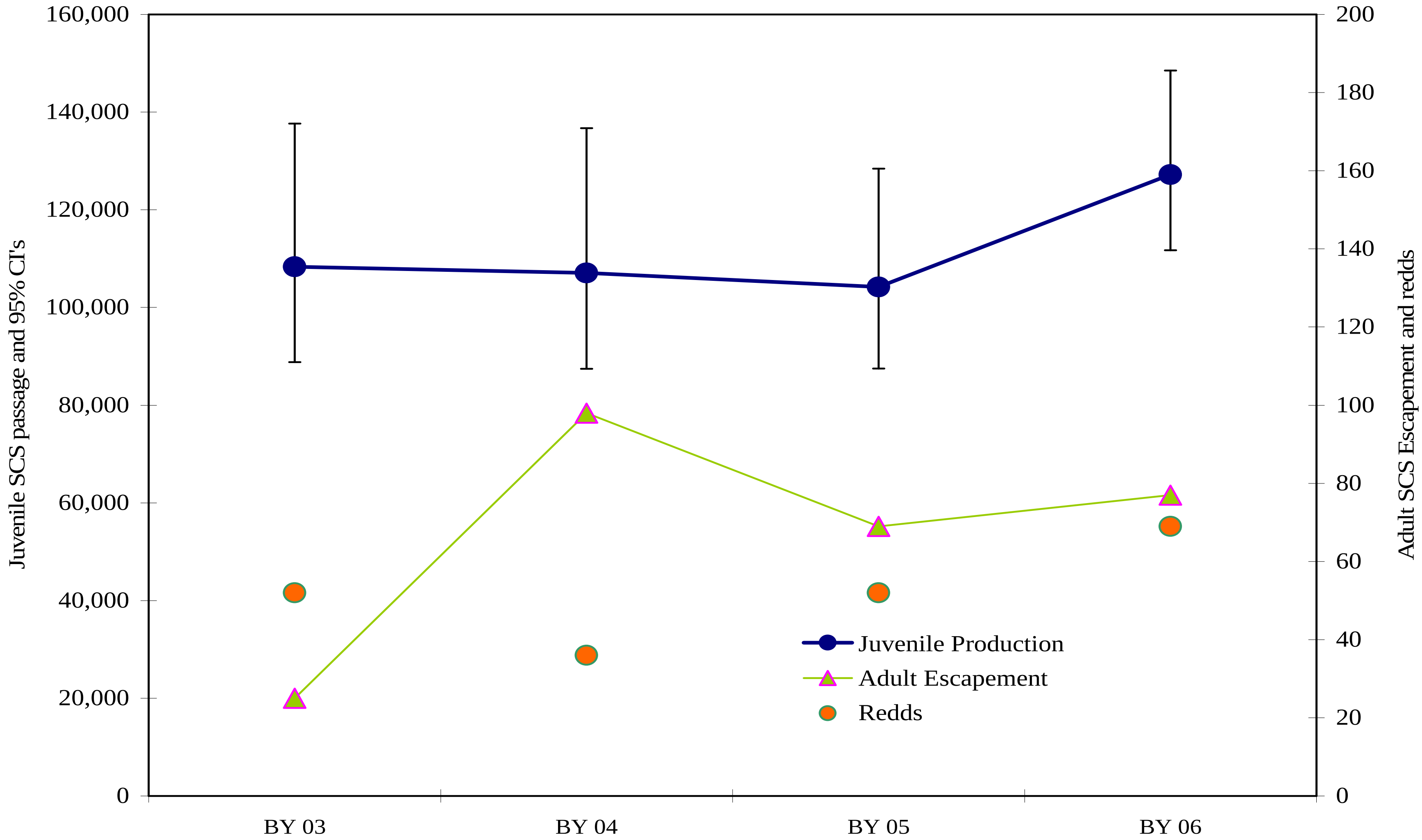

Figure 27. Spring-run Chinook passage indices with 95% Confidence Intervals (CI's), adult escapement and redds observed for BY 2003 - 2006 in Upper Clear Creek. Spring Chinook passage indices were calculated using data from the upper rotary screw trap at rm 8.3.

Tables

Table 1. The 2006 Clear Creek snorkel survey reach numbers and locations and river miles. In August 2006 the Clear Creek picket weir was placed instream at river mile 7.4. Due to repeat vandalism at first weir a second weir was placed upstream at river mile 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 16, 2006 through July 13, 2007.

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 2006 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 October 16, 2006 through July 13, 2007.

Days Sampled	Week	Date	95% CI Lower	90% CI Lower	Weekly Passage	90% CI Upper	95% CI Upper	S.D.
3 of 7	Week 42	10/15/06	0	0	0	0	0	0
2 of 7	Week 43	10/22/06	0	0	0	0	0	0
0 of 7	Week 44	10/29/06	0	0	0	0	0	0
0 of 7	Week 45	11/05/06	0	0	0	0	0	0
0 of 7	Week 46	11/12/06	0	0	0	0	0	0
0 of 7	Week 47	11/19/06	0	0	0	0	0	0
3 of 7	Week 48	11/26/06	349	362	457	582	600	69
5 of 7	Week 49	12/03/06	6,251	6,483	8,335	10,608	11,292	1,281
6 of 7	Week 50	12/10/06	14,515	15,066	18,034	21,640	22,889	2,092
6 of 7	Week 51	12/17/06	12,046	12,629	15,660	19,575	20,077	2,160
5 of 8	Week 52*	12/24/06	32,170	32,995	44,372	58,491	64,340	8,377
7 of 7	Week 1	01/01/07	7,719	8,125	10,292	13,232	14,034	1,532
7 of 7	Week 2	01/08/07	7,637	7,846	9,546	11,455	11,933	1,163
7 of 7	Week 3	01/15/07	4,187	4,320	5,336	6,638	6,978	690
7 of 7	Week 4	01/22/07	3,919	4,039	4,954	6,106	6,403	663
7 of 7	Week 5	01/29/07	1,554	1,608	2,027	2,520	2,664	285
6 of 7	Week 6	02/05/07	3,373	3,534	4,638	5,937	6,746	797
7 of 7	Week 7	02/12/07	316	327	409	500	529	57
5 of 7	Week 8	02/19/07	221	229	290	361	397	44
6 of 7	Week 9	02/26/07	379	394	508	666	690	82
7 of 7	Week 10	03/05/07	183	192	251	335	350	43
7 of 7	Week 11	03/12/07	172	181	238	328	345	44
7 of 7	Week 12	03/19/07	172	182	240	320	336	42
7 of 7	Week 13	03/26/07	158	164	204	262	279	31
7 of 7	Week 14	04/02/07	286	296	377	488	503	56
7 of 7	Week 15	04/09/07	123	128	165	213	230	27
7 of 7	Week 16	04/16/07	214	222	280	346	368	41
7 of 7	Week 17	04/23/07	119	126	159	196	202	23

Days Sampled	Week	Date	95% CI Lower	90% CI Lower	Weekly Passage	90% CI Upper	95% CI Upper	S.D.
7 of 7	Week 18	04/30/07	40	46	75	120	151	34
7 of 7	Week 19	05/07/07	98	106	172	275	344	91
7 of 7	Week 20	05/14/07	44	46	65	95	103	16
7 of 7	Week 21	05/21/07	50	52	65	83	89	10
7 of 7	Week 22	05/28/07	21	22	28	36	37	4
7 of 7	Week 23	06/04/07	7	7	9	12	12	1
7 of 7	Week 24	06/11/07	0	0	0	0	0	0
7 of 7	Week 25	06/18/07	7	7	9	12	13	1
7 of 7	Week 26	06/25/07	0	0	0	0	0	0
4 of 7	Week 27	07/02/07	0	0	0	0	0	0
5 of 7	Week 28	07/09/07	0	0	0	0	0	0
		Total	111,749	113,659	127,197	144,692	148,539	

*Week 52 (12/24/06-12/31/06) contains 8 days for the purpose of 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 2006 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, 2006 through March 31, 2007.

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	04/02/06	861	898	1,390	2,066	2,296	380
4 of 7	Week 15	04/09/06	3,883	4,059	5,955	8,930	9,922	1,557
6 of 7	Week 16	04/16/06	5,735	5,984	9,178	13,764	15,293	2,393
7 of 7	Week 17	04/23/06	9,748	10,634	15,584	23,395	25,994	4,566
7 of 7	Week 18	04/30/06	20,263	21,184	31,070	46,605	51,783	9,912
4 of 7	Week 19	05/07/06	6,381	6,658	10,209	15,314	17,015	3,020
4 of 7	Week 20	05/14/06	5,043	5,262	8,069	12,103	13,448	2,176
4 of 7	Week 21	05/21/06	1,799	1,877	2,878	4,317	4,797	765
3 of 7	Week 22	05/28/06	584	610	935	1,402	1,558	255
4 of 7	Week 23	06/04/06	338	369	541	812	902	147
4 of 7	Week 24	06/11/06	261	285	418	627	697	117
4 of 7	Week 25	06/18/06	277	302	443	664	738	126
4 of 7	Week 26	06/25/06	128	134	197	295	328	56
1 of 7	Week 27	07/02/06	15	17	25	37	41	7
0 of 7	Week 28	07/09/06	0	0	0	0	0	0
0 of 7	Week 29	07/16/06	0	0	0	0	0	0
0 of 7	Week 30	07/23/06	0	0	0	0	0	0
0 of 7	Week 31	07/30/06	0	0	0	0	0	0
0 of 7	Week 32	08/06/06	0	0	0	0	0	0
0 of 7	Week 33	08/13/06	0	0	0	0	0	0
0 of 7	Week 34	08/20/06	0	0	0	0	0	0
0 of 7	Week 35	08/27/06	0	0	0	0	0	0
0 of 7	Week 36	09/03/06	0	0	0	0	0	0
0 of 7	Week 37	09/10/06	0	0	0	0	0	0
0 of 7	Week 38	09/17/06	0	0	0	0	0	0
0 of 7	Week 39	09/24/06	0	0	0	0	0	0
0 of 7	Week 40	10/01/06	0	0	0	0	0	0
0 of 7	Week 41	10/08/06	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 42	10/15/06	0	0	0	0	0	0
0 of 7	Week 43	10/22/06	0	0	0	0	0	0
0 of 7	Week 44	10/29/06	0	0	0	0	0	0
0 of 7	Week 45	11/05/06	0	0	0	0	0	0
0 of 7	Week 46	11/12/06	0	0	0	0	0	0
0 of 7	Week 47	11/19/06	0	0	0	0	0	0
2 of 7	Week 48	11/26/06	16	16	26	39	44	8
5 of 7	Week 49	12/03/06	0	0	0	0	0	0
6 of 7	Week 50	12/10/06	0	0	0	0	0	0
6 of 7	Week 51	12/17/06	0	0	0	0	0	0
5 of 8	Week 52	12/24/06	0	0	0	0	0	0
7 of 7	Week 1	01/01/07	0	0	0	0	0	0
7 of 7	Week 2	01/08/07	0	0	0	0	0	0
7 of 7	Week 3	01/15/07	0	0	0	0	0	0
7 of 7	Week 4	01/22/07	0	0	0	0	0	0
7 of 7	Week 5	01/29/07	0	0	0	0	0	0
7 of 7	Week 6	02/05/07	0	0	0	0	0	0
7 of 7	Week 7	02/12/07	0	0	0	0	0	0
7 of 7	Week 8	02/19/07	0	0	0	0	0	0
7 of 7	Week 9	02/26/07	0	0	0	0	0	0
7 of 7	Week 10	03/05/07	0	0	0	0	0	0
7 of 7	Week 11	03/12/07	0	0	0	0	0	0
7 of 7	Week 12	03/19/07	0	0	0	0	0	0
7 of 7	Week 13	03/26/07	0	0	0	0	0	0
		Total	70,716	72,560	86,918	105,130	113,960	

*Week 52 (12/24/06-12/31/06) contains 8 days for the purpose of 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 2006 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 30, 2006 through July 13, 2007.

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	10/01/06	0	0	0	0	0	0
0 of 7	Week 41	10/08/06	0	0	0	0	0	0
0 of 7	Week 42	10/15/06	0	0	0	0	0	0
0 of 7	Week 43	10/22/06	0	0	0	0	0	0
0 of 7	Week 44	10/29/06	0	0	0	0	0	0
0 of 7	Week 45	11/05/06	0	0	0	0	0	0
0 of 7	Week 46	11/12/06	0	0	0	0	0	0
0 of 7	Week 47	11/19/06	0	0	0	0	0	0
2 of 7	Week 48	11/26/06	93	98	155	233	266	48
5 of 7	Week 49	12/03/06	6,997	7,734	12,245	18,368	20,991	3,816
6 of 7	Week 50	12/10/06	16,833	17,719	28,065	42,083	48,094	9,206
	Week 50 Pt.II		13,768	14,628	20,349	29,256	31,207	4,475
6 of 7	Week 51	12/17/06	9,006	10,006	15,009	22,514	25,730	5,025
	Week 51 Pt.II		2,918	3,100	4,313	5,835	6,613	923
5 of 8	Week 52*	12/24/06	34,612	36,433	57,687	86,529	98,890	16,440
	Week 52* Pt.II		14,438	14,890	20,719	29,779	31,765	4,441
7 of 7	Week 1	01/01/07	18,166	19,122	30,277	45,415	51,903	9,389
	Week 1 Pt.II		4,778	5,076	7,063	10,153	10,829	1,574
7 of 7	Week 2	01/08/07	41,190	44,935	65,904	98,856	109,840	19,104
7 of 7	Week 3	01/15/07	44,050	48,686	77,097	115,630	132,149	22,095
7 of 7	Week 4	01/22/07	59,423	62,253	84,337	108,942	113,679	14,605
7 of 7	Week 5	01/29/07	106,347	110,014	159,520	227,886	245,415	37,150
7 of 7	Week 6	02/05/07	586,334	619,839	834,413	1,141,809	1,205,243	166,541
7 of 7	Week 7	02/12/07	216,024	227,393	360,039	540,059	617,210	118,146
7 of 7	Week 8	02/19/07	806,547	870,222	1,181,016	1,653,422	1,837,135	240,374
7 of 7	Week 9	02/26/07	215,162	236,678	364,120	591,694	676,222	102,790
7 of 7	Week 10	03/05/07	119,118	125,387	198,529	297,794	340,336	69,958
7 of 7	Week 11	03/12/07	116,242	130,772	209,236	348,726	418,471	69,735

Days Sampled	Week	Date	95% CI Lower	90% CI Lower	Weekly Passage	90% CI Upper	95% CI Upper	S.D.
7 of 7	Week 12	03/19/07	216,109	230,516	384,194	576,291	691,549	166,064
7 of 7	Week 13	03/26/07	205,964	223,873	321,818	468,099	514,909	80,927
7 of 7	Week 14	04/02/07	92,101	96,948	153,495	230,253	263,146	46,370
7 of 7	Week 15	04/09/07	103,860	109,969	169,946	267,068	311,579	56,031
7 of 7	Week 16	04/16/07	59,824	63,813	106,367	159,532	191,438	35,635
7 of 7	Week 17	04/23/07	13,666	14,192	20,492	30,749	33,545	5,154
7 of 7	Week 18	04/30/07	5,983	6,298	9,972	14,958	17,094	3,091
7 of 7	Week 19	05/07/07	264	277	439	659	753	140
	Week 19 Pt.II		4,265	4,398	6,123	8,796	9,383	1,313
7 of 7	Week 20	05/14/07	3,197	3,375	4,502	6,075	6,750	889
7 of 7	Week 21	05/21/07	5,498	5,842	8,127	10,996	11,683	1,694
7 of 7	Week 22	05/28/07	2,544	2,790	3,760	5,406	5,766	790
7 of 7	Week 23	06/04/07	3,565	3,788	5,270	7,130	7,576	1,074
7 of 7	Week 24	06/11/07	2,273	2,344	3,262	4,413	5,001	681
7 of 7	Week 25	06/18/07	582	601	836	1,131	1,201	177
7 of 7	Week 26	06/25/07	291	310	418	565	641	83
4 of 7	Week 27	07/02/07	160	165	229	310	329	47
5 of 7	Week 28	07/09/07	141	145	202	274	310	43
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
		Total	4,275,282	4,359,617	4,929,544	5,667,355	5,832,272	

*Week 52 (12/24/06-12/31/06) contains 8 days for the purpose of keeping Jan. 1 as Julian calendar day 1.

Table 6. Weekly passage indices with 90% and 95% confidence intervals, standard deviation (SD) of the weekly strata for BY 2005 Age 0+, BY 2006, BY 2006 Age 0+ and BY 2007 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, 2006 through December 31, 2007.

Days Sampled	Week	BY2005 0+	95% CI Lower	90% CI Lower	Weekly Passage	90% CI Upper	95% CI Upper	S.D.
6 of 7	Week 1	01/01/06	15	17	25	37	41	7
7 of 7	Week 2	01/08/06	15	16	25	37	41	7
7 of 7	Week 3	01/15/06	0	0	0	0	0	0
7 of 7	Week 4	01/22/06	0	0	0	0	0	0
7 of 7	Week 5	01/29/06	0	0	0	0	0	0
7 of 7	Week 6	02/05/06	19	20	28	38	40	6
7 of 7	Week 7	02/12/06	0	0	0	0	0	0
7 of 7	Week 8	02/19/06	12	13	19	27	29	4
6 of 7	Week 9	02/26/06	0	0	0	0	0	0
5 of 7	Week 10	03/05/06	0	0	0	0	0	0
7 of 7	Week 11	03/12/06	20	21	32	46	52	10
7 of 7	Week 12	03/19/06	0	0	0	0	0	0
7 of 7	Week 13	03/26/06	0	0	0	0	0	0
7 of 7	Week 14	04/02/06	0	0	0	0	0	0
4 of 7	Week 15	04/09/06	0	0	0	0	0	0
6 of 7	Week 16	04/16/06	0	0	0	0	0	0
7 of 7	Week 17	04/23/06	0	0	0	0	0	0
7 of 7	Week 18	04/30/06	48	50	74	111	123	19
4 of 7	Week 19	05/07/06	0	0	0	0	0	0
4 of 7	Week 20	05/14/06	0	0	0	0	0	0
4 of 7	Week 21	05/21/06	0	0	0	0	0	0
3 of 7	Week 22	05/28/06	0	0	0	0	0	0
4 of 7	Week 23	06/04/06	0	0	0	0	0	0
4 of 7	Week 24	06/11/06	0	0	0	0	0	0
4 of 7	Week 25	06/18/06	0	0	0	0	0	0

Days Sampled	Week	BY2005 0+	95% CI Lower	90% CI Lower	Weekly Passage	90% CI Upper	95% CI Upper	S.D.
4 of 7	Week 26	06/25/06	0	0	0	0	0	0
1 of 7	Week 27	07/02/06	0	0	0	0	0	0
0 of 7	Week 28	07/09/06	0	0	0	0	0	0
0 of 7	Week 29	07/16/06	0	0	0	0	0	0
0 of 7	Week 30	07/23/06	0	0	0	0	0	0
0 of 7	Week 31	07/30/06	0	0	0	0	0	0
0 of 7	Week 32	08/06/06	0	0	0	0	0	0
0 of 7	Week 33	08/13/06	0	0	0	0	0	0
0 of 7	Week 34	08/20/06	0	0	0	0	0	0
0 of 7	Week 35	08/27/06	0	0	0	0	0	0
0 of 7	Week 36	09/03/06	0	0	0	0	0	0
0 of 7	Week 37	09/10/06	0	0	0	0	0	0
0 of 7	Week 38	09/17/06	0	0	0	0	0	0
0 of 7	Week 39	09/24/06	0	0	0	0	0	0
0 of 7	Week 40	10/01/06	0	0	0	0	0	0
0 of 7	Week 41	10/08/06	0	0	0	0	0	0
0 of 7	Week 42	10/15/06	0	0	0	0	0	0
0 of 7	Week 43	10/22/06	0	0	0	0	0	0
0 of 7	Week 44	10/29/06	0	0	0	0	0	0
0 of 7	Week 45	11/05/06	0	0	0	0	0	0
0 of 7	Week 46	11/12/06	0	0	0	0	0	0
0 of 7	Week 47	11/19/06	0	0	0	0	0	0
2 of 7	Week 48	11/26/06	0	0	0	0	0	0
5 of 7	Week 49	12/03/06	0	0	0	0	0	0
6 of 7	Week 50	12/10/06	0	0	0	0	0	0
6 of 7	Week 51	12/17/06	0	0	0	0	0	0
5 of 8	Week 52*	12/24/06	0	0	0	0	0	0
		Total	161	167	203	244	259	24

Days Sampled	Week	BY2006	95% CI Lower	90% CI Lower	Weekly Passage	90% CI Upper	95% CI Upper	S.D.
6 of 7	Week 1	01/01/06	0	0	0	0	0	0
7 of 7	Week 2	01/08/06	0	0	0	0	0	0
7 of 7	Week 3	01/15/06	0	0	0	0	0	0
7 of 7	Week 4	01/22/06	0	0	0	0	0	0
7 of 7	Week 5	01/29/06	126	130	168	213	227	27
7 of 7	Week 6	02/05/06	57	61	83	109	121	17
7 of 7	Week 7	02/12/06	34	36	49	66	74	10
7 of 7	Week 8	02/19/06	153	158	223	306	326	46
6 of 7	Week 9	02/26/06	302	318	489	706	907	148
5 of 7	Week 10	03/05/06	131	139	227	357	416	77
7 of 7	Week 11	03/12/06	315	330	508	826	826	151
7 of 7	Week 12	03/19/06	394	420	700	1,050	1,260	231
7 of 7	Week 13	03/26/06	722	755	1,107	1,661	1,845	302
7 of 7	Week 14	04/02/06	907	947	1,451	2,177	2,419	399
4 of 7	Week 15	04/09/06	690	721	1,058	1,587	1,763	276
6 of 7	Week 16	04/16/06	477	497	763	1,144	1,271	199
7 of 7	Week 17	04/23/06	646	704	1,033	1,550	1,722	302
7 of 7	Week 18	04/30/06	690	721	1,058	1,587	1,763	337
4 of 7	Week 19	05/07/06	261	273	418	627	697	124
4 of 7	Week 20	05/14/06	138	144	221	332	369	60
4 of 7	Week 21	05/21/06	0	0	0	0	0	0
3 of 7	Week 22	05/28/06	185	193	295	443	492	78
4 of 7	Week 23	06/04/06	154	160	246	369	410	67
4 of 7	Week 24	06/11/06	123	134	197	295	328	54
4 of 7	Week 25	06/18/06	215	235	344	517	574	96
4 of 7	Week 26	06/25/06	62	67	98	148	164	28
1 of 7	Week 27	07/02/06	0	0	0	0	0	0
0 of 7	Week 28	07/09/06	0	0	0	0	0	0

Days Sampled	Week	BY2006	95% CI Lower	90% CI Lower	Weekly Passage	90% CI Upper	95% CI Upper	S.D.
0 of 7	Week 29	07/16/06	0	0	0	0	0	0
0 of 7	Week 30	07/23/06	0	0	0	0	0	0
0 of 7	Week 31	07/30/06	0	0	0	0	0	0
0 of 7	Week 32	08/06/06	0	0	0	0	0	0
0 of 7	Week 33	08/13/06	0	0	0	0	0	0
0 of 7	Week 34	08/20/06	0	0	0	0	0	0
0 of 7	Week 35	08/27/06	0	0	0	0	0	0
0 of 7	Week 36	09/03/06	0	0	0	0	0	0
0 of 7	Week 37	09/10/06	0	0	0	0	0	0
0 of 7	Week 38	09/17/06	0	0	0	0	0	0
0 of 7	Week 39	09/24/06	0	0	0	0	0	0
0 of 7	Week 40	10/01/06	0	0	0	0	0	0
0 of 7	Week 41	10/08/06	0	0	0	0	0	0
0 of 7	Week 42	10/15/06	0	0	0	0	0	0
0 of 7	Week 43	10/22/06	0	0	0	0	0	0
0 of 7	Week 44	10/29/06	0	0	0	0	0	0
0 of 7	Week 45	11/05/06	0	0	0	0	0	0
0 of 7	Week 46	11/12/06	0	0	0	0	0	0
0 of 7	Week 47	11/19/06	0	0	0	0	0	0
2 of 7	Week 48	11/26/06	0	0	0	0	0	0
5 of 7	Week 49	12/03/06	0	0	0	0	0	0
6 of 7	Week 50	12/10/06	0	0	0	0	0	0
6 of 7	Week 51	12/17/06	0	0	0	0	0	0
5 of 8	Week52*	12/24/06	16	17	26	39	44	9
		Total	9,362	9,547	10,762	12,313	12,632	

Days Sampled	Week	BY2006 0+	95% CI Lower	90% CI Lower	Weekly Passage	90% CI Upper	95% CI Upper	S.D.
7 of 7	Week 7	02/12/07	16	16	26	39	44	8

*Week 52 (12/24/06-12/31/06) contains 8 days for the purpose of keeping Jan. 1 as Julian calendar day 1.

Days Sampled	Week	BY2007	95% CI Lower	90% CI Lower	Weekly Passage	90% CI Upper	95% CI Upper	S.D.
7 of 7	Week 1	01/01/07	0	0	0	0	0	0
7 of 7	Week 2	01/08/07	0	0	0	0	0	0
7 of 7	Week 3	01/15/07	0	0	0	0	0	0
7 of 7	Week 4	01/22/07	0	0	0	0	0	0
7 of 7	Week 5	01/29/07	0	0	0	0	0	0
7 of 7	Week 6	02/05/07	0	0	0	0	0	0
7 of 7	Week 7	02/12/07	16	16	26	39	44	8
7 of 7	Week 8	02/19/07	437	449	625	833	875	123
7 of 7	Week 9	02/26/07	213	223	344	496	558	96
7 of 7	Week 10	03/05/07	744	783	1,240	1,860	2,126	374
7 of 7	Week 11	03/12/07	2,324	2,469	3,950	6,584	7,900	1,328
7 of 7	Week 12	03/19/07	2,672	2,850	4,749	7,124	8,549	1,762
7 of 7	Week 13	03/26/07	969	1,009	1,514	2,202	2,422	386
7 of 7	Week 14	04/02/07	1,550	1,632	2,583	3,875	4,429	778
7 of 7	Week 15	04/09/07	4,263	4,499	7,363	11,570	13,498	2,497
7 of 7	Week 16	04/16/07	2,687	2,866	4,776	8,597	10,746	1,869
7 of 7	Week 17	04/23/07	1,171	1,216	1,756	2,635	2,874	456
7 of 7	Week 18	04/30/07	341	359	568	853	974	172
7 of 7	Week 19 Pt.I	05/07/07	109	114	181	271	310	55
	Week 19 Pt.II		592	630	849	1,149	1,302	180
7 of 7	Week 20	05/14/07	163	172	236	318	335	46
7 of 7	Week 21	05/21/07	56	58	81	109	116	16
7 of 7	Week 22	05/28/07	28	29	40	58	62	9
7 of 7	Week 23	06/04/07	447	475	660	949	1,013	142
7 of 7	Week 24	06/11/07	438	465	647	930	992	144
7 of 7	Week 25	06/18/07	451	465	647	930	992	144
7 of 7	Week 26	06/25/07	365	388	539	729	775	108
7 of 7	Week 27	07/02/07	115	122	175	237	252	35
7 of 7	Week 28	07/09/07	197	203	283	383	434	60
0 of 7	Week 29	07/16/07	0	0	0	0	0	0

Days Sampled	Week	BY2007	95% CI Lower	90% CI Lower	Weekly Passage	90% CI Upper	95% CI Upper	S.D.
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
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	0	0	0	0	0	0
7 of 7	Week 49	12/03/07	15	16	26	39	44	8
7 of 7	Week 50	12/10/07	0	0	0	0	0	0
7 of 7	Week 51	12/17/07	78	82	129	194	221	40
7 of 7	Week 52*	12/24/07	15	16	26	39	44	8
		Total	27,585	28,428	33,987	41,496	43,376	

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

Table 7. Summary of efficiency test 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 12, 2006 through May 19, 2007.

Trial	Mark Date	Release Date	Fish Released	Mortality	% Mortality	Trap Catch	Efficiency
1	12-Dec-06	12-Dec-06	485	7	1.40%	65	13.40%
2	19-Dec-06	19-Dec-06	361	0	0.00%	49	13.57%
3	28-Dec-06	28-Dec-06	401	0	0.00%	28	06.98%
4	7-Jan-07	8-Jan-07	353	0	0.00%	59	16.71%
5	17-Jan-07	18-Jan-07	401	0	0.00%	50	12.47%
6	24-Jan-07	25-Jan-07	398	2	0.50%	52	13.07%
7	30-Jan-07	31-Jan-07	408	0	0.00%	45	11.03%
8	7-Feb-07	9-Feb-07	409	0	0.00%	31	07.58%
9	12-Feb-07	13-Feb-07	399	1	0.25%	43	10.78%
10	27-Feb-07	28-Feb-07	393	0	0.00%	37	09.41%
11	6-Mar-07	7-Mar-07	382	19	4.75%	31	08.12%
12	12-Mar-07	13-Mar-07	382	0	0.00%	28	07.33%
13	20-Mar-07	20-Mar-07	319	0	0.00%	27	08.46%
14	27-Mar-07	28-Mar-07	380	19	4.75%	40	10.53%
15	2-Apr-07	3-Apr-07	394	9	2.23%	43	10.91%
16	9-Apr-07	10-Apr-07	383	16	3.96%	34	08.88%
17	2-May-07	3-May-07	85	4	4.49%	7	08.24%
18	14-May-07	15-May-07	136	1	0.72%	18	13.24%
	Total		6,469	78		687	
	Average of efficiency trials		6,469			687	10.62%

Table 8. Mark and recapture 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 October 16, 2006 to July 13, 2007. Shaded rows indicate where season efficiency was used.

Dates	Week	Marks	Recaptures	Efficiency
11/26-12/02	48	392	42	10.62%
12/03-12/15	49	392	42	10.62%
12/10-12/16	50	485	65	13.40%
12/17-12/23	51	361	49	13.57%
12/24-12/31	52	401	28	6.98%
01/01-01-07	1	392	42	10.62%
01/08-01/14	2	353	59	16.71%
01/15-01/21	3	401	50	12.47%
01/22-01/28	4	398	52	13.07%
01/29-02/04	5	408	45	11.03%
02/05-02/11	6	409	31	7.58%
02/12-02/18	7	399	43	10.78%
02/19-02/25	8	392	42	10.62%
02/26-03/04	9	393	37	9.41%
03/05-03/11	10	382	31	8.12%
03/12-03/18	11	382	28	7.33%
03/19-03/25	12	319	27	8.46%
03/26-04/01	13	380	40	10.53%
04/02-04/08	14	394	43	10.91%
04/09-04/15	15	383	34	8.88%
04/16-04/22	16	392	42	10.62%
04/23-04/29	17	392	42	10.62%
04/30-05/06	18	85	7	8.24%
05/07-05/13	19	392	42	10.62%
05/14-05/20	20	136	18	13.24%
05/21-07/17	21-29	392	42	10.62%
Season Efficiency		392	42	10.62%

Table 9. Summary of 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 January 7, 2007 through May 19, 2007.

Trial	Mark Date	Release Date	Fish Released	Mortality	% Mortality	Actual Trap Catch	Efficiency
1	7-Jan-07	8-Jan-07	340	0	0.00%	14	04.12%
2	24-Jan-07	25-Jan-07	401	0	0.00%	30	07.48%
3	30-Jan-07	31-Jan-07	399	0	0.00%	19	04.76%
4	5-Feb-07	6-Feb-07	378	2	0.49%	14	03.70%
5	7-Feb-07	9-Feb-07	400	4	0.98%	11	02.75%
6	12-Feb-07	13-Feb-07	389	0	0.00%	3	0.77%
7	20-Feb-07	21-Feb-07	432	0	0.00%	15	03.47%
8	22-Feb-07	22-Feb-07	400	0	0.00%	12	03.00%
9	27-Feb-07	28-Feb-07	405	0	0.00%	12	02.96%
10	6-Mar-07	7-Mar-07	398	1	0.25%	4	01.01%
11	12-Mar-07	13-Mar-07	398	2	0.50%	9	02.26%
12	19-Mar-07	20-Mar-07	410	1	0.24%	8	01.95%
13	27-Mar-07	28-Mar-07	396	8	1.99%	15	03.79%
14	2-Apr-07	3-Apr-07	413	5	1.20%	6	01.45%
15	9-Apr-07	10-Apr-07	396	6	1.50%	10	02.53%
16	17-Apr-07	17-Apr-07	397	4	1.00%	8	02.02%
17	24-Apr-07	25-Apr-07	415	5	1.23%	17	04.10%
18	2-May-07	3-May-07	343	57	14.25%	5	01.46%
19	14-May-07	15-May-07	302	20	6.19%	13	04.30%
	Totals		7,412	115		225	
	Average of efficiency trials		7,412			225	03.04%

Table 10. Mark and recapture 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 30, 2006 through July 13, 2007. 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
11/30-01/07	48-1	310	12	3.04%
01/08-01/14	2	340	14	4.12%
01/15-01/21	3	310	12	3.04%
01/22-01/28	4	401	30	7.48%
01/29-02/04	5	399	19	4.76%
02/05-02/11	6	778	25	3.21%
02/12-02/18	7	310	12	3.04%
02/19-02/25	8	832	27	3.25%
02/26-03/04	9	405	12	2.96%
03/05-03/11	10	310	12	3.04%
03/12-03/18	11	398	9	2.26%
03/19-03/25	12	410	8	1.95%
03/26-04/01	13	396	15	3.79%
04/02-04/08	14	310	12	3.04%
04/09-04/15	15	396	10	2.53%
04/16-04/22	16	397	8	2.02%
04/23-04/29	17	415	17	4.10%
04/30-05/06	18	310	12	3.04%
05/07-05/13	19	310	12	3.04%
05/14-05/20	20	302	13	4.30%
05/21-07/17*	21-29	310	23	7.42%

*The season efficiency during the last part of the sampling season was doubled because the half-cone modification was removed and the efficiency was assumed to be doubled

Table 11. 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 October 16, 2006 through July 13, 2007.

Week	Date	Weekly Estimate	Catch	Mortality	% Passage	% Catch
Week 42	10/15/06	0	0	0	0.00%	0.00%
Week 43	10/22/06	0	0	0	0.00%	0.00%
Week 44	10/29/06	0	0	0	0.00%	0.00%
Week 45	11/05/06	0	0	0	0.00%	0.00%
Week 46	11/12/06	0	0	0	0.00%	0.00%
Week 47	11/19/06	0	0	0	0.00%	0.00%
Week 48	11/26/06	457	12	0	0.00%	0.00%
Week 49	12/03/06	8,335	561	10	0.12%	1.78%
Week 50	12/10/06	18,034	2,154	154	0.85%	7.15%
Week 51	12/17/06	15,660	1,771	7	0.04%	0.40%
Week 52*	12/24/06	44,372	2,025	684	1.54%	33.78%
Week 1	01/01/07	10,292	1,235	11	0.11%	0.89%
Week 2	01/08/07	9,546	1,618	9	0.09%	0.56%
Week 3	01/15/07	5,336	677	4	0.07%	0.59%
Week 4	01/22/07	4,954	658	11	0.22%	1.67%
Week 5	01/29/07	2,027	228	4	0.20%	1.75%
Week 6	02/05/07	4,638	335	2	0.04%	0.60%
Week 7	01/12/07	409	45	0	0.00%	0.00%
Week 8	02/19/07	290	25	2	0.69%	8.00%
Week 9	02/26/07	508	44	0	0.00%	0.00%
Week 10	03/05/07	251	21	0	0.00%	0.00%
Week 11	03/12/07	238	18	0	0.00%	0.00%
Week 12	03/19/07	240	21	0	0.00%	0.00%
Week 13	03/26/07	204	22	1	0.49%	4.55%
Week 14	04/02/07	377	42	0	0.00%	0.00%
Week 15	04/09/07	165	15	0	0.00%	0.00%
Week 16	04/16/07	280	30	0	0.00%	0.00%
Week 17	04/23/07	159	17	0	0.00%	0.00%
Week 18	04/30/07	75	7	0	0.00%	0.00%
Week 19	05/07/07	172	16	1	0.58%	6.25%
Week 20	05/14/07	65	9	0	0.00%	0.00%
Week 21	05/21/07	65	7	0	0.00%	0.00%
Week 22	05/28/07	28	3	0	0.00%	0.00%
Week 23	06/04/07	9	1	0	0.00%	0.00%
Week 24	06/11/07	0	0	0	0.00%	0.00%
Week 25	06/18/07	9	1	0	0.00%	0.00%
Week 26	06/25/07	0	0	0	0.00%	0.00%
Week 27	07/02/07	0	0	0	0.00%	0.00%
Week 28	07/09/07	0	0	0	0.00%	0.00%

Table 12. 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, 2006 through March 31, 2007.

Week	Date	Weekly Passage	Catch	Mortality	% Passage	% Catch
Week 14	04/02/06	1,390	64	0	0.00%	0.00%
Week 15	04/09/06	5,955	68	0	0.00%	0.00%
Week 16	04/16/06	9,178	329	15	0.16%	4.56%
Week 17	04/23/06	15,584	634	15	0.10%	2.37%
Week 18	04/30/06	31,070	1,263	3	0.01%	0.24%
Week 19	05/07/06	10,209	196	0	0.00%	0.00%
Week 20	05/14/06	8,069	191	0	0.00%	0.00%
Week 21	05/21/06	2,878	46	1	0.03%	2.17%
Week 22	05/28/06	935	10	0	0.00%	0.00%
Week 23	06/04/06	541	12	0	0.00%	0.00%
Week 24	06/11/06	418	10	0	0.00%	0.00%
Week 25	06/18/06	443	10	1	0.23%	10.00%
Week 26	06/25/06	197	4	0	0.00%	0.00%
Week 27	07/02/06	25	1	0	0.00%	0.00%
Week 28	07/09/06	0	0	0	0.00%	0.00%
Week 29	07/16/06	0	0	0	0.00%	0.00%
Week 30	07/23/06	0	0	0	0.00%	0.00%
Week 31	07/30/06	0	0	0	0.00%	0.00%
Week 32	08/06/06	0	0	0	0.00%	0.00%
Week 33	08/13/06	0	0	0	0.00%	0.00%
Week 34	08/20/06	0	0	0	0.00%	0.00%
Week 35	08/27/06	0	0	0	0.00%	0.00%
Week 36	09/03/06	0	0	0	0.00%	0.00%
Week 37	09/10/06	0	0	0	0.00%	0.00%
Week 38	09/17/06	0	0	0	0.00%	0.00%
Week 39	09/24/06	0	0	0	0.00%	0.00%
Week 40	10/01/06	0	0	0	0.00%	0.00%
Week 41	10/08/06	0	0	0	0.00%	0.00%
Week 42	10/15/06	0	0	0	0.00%	0.00%
Week 43	10/22/06	0	0	0	0.00%	0.00%
Week 44	10/29/06	0	0	0	0.00%	0.00%
Week 45	11/05/06	0	0	0	0.00%	0.00%
Week 46	11/12/06	0	0	0	0.00%	0.00%
Week 47	11/19/06	0	0	0	0.00%	0.00%
Week 48	11/26/06	26	1	0	0.00%	0.00%
Week 49	12/03/06	0	0	0	0.00%	0.00%
Week 50	12/10/06	0	0	0	0.00%	0.00%
Week 51	12/17/06	0	0	0	0.00%	0.00%
Week 52*	12/24/06	0	0	0	0.00%	0.00%
Week 1	01/01/07	0	0	0	0.00%	0.00%
Week 2	01/08/07	0	0	0	0.00%	0.00%
Week 3	01/15/07	0	0	0	0.00%	0.00%

Week	Date	Weekly Passage	Catch	Mortality	% Passage	% Catch
Week 4	01/22/07	0	0	0	0.00%	0.00%
Week 5	01/29/07	0	0	0	0.00%	0.00%
Week 6	02/05/07	0	0	0	0.00%	0.00%
Week 7	01/12/07	0	0	0	0.00%	0.00%
Week 8	02/19/07	0	0	0	0.00%	0.00%
Week 9	02/26/07	0	0	0	0.00%	0.00%
Week 10	03/05/07	0	0	0	0.00%	0.00%
Week 11	03/12/07	0	0	0	0.00%	0.00%
Week 12	03/19/07	0	0	0	0.00%	0.00%
Week 13	03/26/07	0	0	0	0.00%	0.00%

Table 13. 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 November 30, 2006 through July 13, 2007.

Week	Date	Weekly Estimate	Catch	Mortality	% Passage	% Catch
Week 40	10/01/06	0	0	0	0.00%	0.00%
Week 41	10/08/06	0	0	0	0.00%	0.00%
Week 42	10/15/06	0	0	0	0.00%	0.00%
Week 43	10/22/06	0	0	0	0.00%	0.00%
Week 44	10/29/06	0	0	0	0.00%	0.00%
Week 45	11/05/06	0	0	0	0.00%	0.00%
Week 46	11/12/06	0	0	0	0.00%	0.00%
Week 47	11/19/06	0	0	0	0.00%	0.00%
Week 48	11/26/06	155	3	0	0.00%	0.00%
Week 49	12/03/06	1,757	22	0	0.00%	0.00%
Week 50	12/10/06	5,936	225	5	0.08%	2.22%
Week 51	12/17/06	276	13	0	0.00%	0.00%
Week 52*	12/24/06	515	17	3	0.58%	17.65%
Week 1	01/01/07	26	1	0	0.00%	0.00%
Week 2	01/08/07	23	1	0	0.00%	0.00%
Week 3	01/15/07	0	0	0	0.00%	0.00%
Week 4	01/22/07	57	4	0	0.00%	0.00%
Week 5	01/29/07	0	0	0	0.00%	0.00%
Week 6	02/05/07	285	10	0	0.00%	0.00%
Week 7	02/12/07	0	0	0	0.00%	0.00%
Week 8	02/19/07	0	0	0	0.00%	0.00%
Week 9	02/26/07	0	0	0	0.00%	0.00%
Week 10	03/05/07	0	0	0	0.00%	0.00%
Week 11	03/12/07	0	0	0	0.00%	0.00%
Week 12	03/19/07	0	0	0	0.00%	0.00%
Week 13	03/26/07	0	0	0	0.00%	0.00%
Week 14	04/02/07	0	0	0	0.00%	0.00%
Week 15	04/09/07	0	0	0	0.00%	0.00%
Week 16	04/16/07	0	0	0	0.00%	0.00%
Week 17	04/23/07	0	0	0	0.00%	0.00%
Week 18	04/30/07	0	0	0	0.00%	0.00%

Week	Date	Weekly Estimate	Catch	Mortality	% Passage	% Catch
Week 19	05/07/07	0	0	0	0.00%	0.00%
Week 20	05/14/07	0	0	0	0.00%	0.00%
Week 21	05/21/07	0	0	0	0.00%	0.00%
Week 22	05/28/07	0	0	0	0.00%	0.00%
Week 23	06/04/07	0	0	0	0.00%	0.00%
Week 24	06/11/07	0	0	0	0.00%	0.00%
Week 25	06/18/07	0	0	0	0.00%	0.00%
Week 26	06/25/07	0	0	0	0.00%	0.00%
Week 27	07/02/07	0	0	0	0.00%	0.00%
Week 28	07/09/07	0	0	0	0.00%	0.00%
Week 29	07/16/07	0	0	0	0.00%	0.00%
Week 30	07/23/07	0	0	0	0.00%	0.00%
Week 31	07/30/07	0	0	0	0.00%	0.00%
Week 32	08/06/07	0	0	0	0.00%	0.00%
Week 33	08/13/07	0	0	0	0.00%	0.00%
Week 34	08/20/07	0	0	0	0.00%	0.00%
Week 35	08/27/07	0	0	0	0.00%	0.00%
Week 36	09/03/07	0	0	0	0.00%	0.00%
Week 37	09/10/07	0	0	0	0.00%	0.00%
Week 38	09/17/07	0	0	0	0.00%	0.00%
Week 39	09/24/07	0	0	0	0.00%	0.00%

Table 14. 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 November 30, 2006 through July 13, 2007.

Week	Date	Weekly Passage	Catch	Mortality	% Passage	% Catch
Week 40	10/01/06	0	0	0	0.00%	0.00%
Week 41	10/08/06	0	0	0	0.00%	0.00%
Week 42	10/15/06	0	0	0	0.00%	0.00%
Week 43	10/22/06	0	0	0	0.00%	0.00%
Week 44	10/29/06	0	0	0	0.00%	0.00%
Week 45	11/05/06	0	0	0	0.00%	0.00%
Week 46	11/12/06	0	0	0	0.00%	0.00%
Week 47	11/19/06	0	0	0	0.00%	0.00%
Week 48	11/26/06	155	2	0	0.00%	0.00%
Week 49	12/03/06	12,245	49	2	0.02%	4.08%
Week 50	12/10/06	48,414	2,175	27	0.06%	1.24%
Week 51	12/17/06	19,322	533	6	0.03%	1.13%
Week 52	12/24/06	78,406	2,666	126	0.16%	4.73%
Week 1	01/01/07	37,340	1,696	6	0.02%	0.35%
Week 2	01/08/07	65,904	2,899	12	0.02%	0.41%
Week 3	01/15/07	77,097	2,984	7	0.01%	0.23%
Week 4	01/22/07	84,337	6,504	4	0.00%	0.06%
Week 5	01/29/07	159,520	7,976	2	0.00%	0.03%
Week 6	02/05/07	834,413	23,923	36	0.00%	0.15%
Week 7	02/12/07	360,039	13,417	32	0.01%	0.24%
Week 8	02/19/07	1,181,016	39,438	8	0.00%	0.02%
Week 9	02/26/07	364,120	11,659	9	0.00%	0.08%
Week 10	03/05/07	198,529	7,685	2	0.00%	0.03%
Week 11	03/12/07	209,236	5,244	5	0.00%	0.10%
Week 12	03/19/07	384,194	7,350	12	0.00%	0.16%
Week 13	03/26/07	321,818	10,898	6	0.00%	0.06%
Week 14	04/02/07	153,495	5,942	3	0.00%	0.05%
Week 15	04/09/07	169,946	4,709	4	0.00%	0.08%
Week 16	04/16/07	106,367	2,405	8	0.01%	0.33%
Week 17	04/23/07	20,492	843	4	0.02%	0.47%
Week 18	04/30/07	9,972	386	3	0.03%	0.78%
Week 19	05/07/07	6,562	471	3	0.05%	0.64%
Week 20	05/14/07	4,502	401	3	0.07%	0.75%
Week 21	05/21/07	8,127	603	8	0.10%	1.33%
Week 22	05/28/07	3,760	279	2	0.05%	0.72%
Week 23	06/04/07	5,270	391	1	0.02%	0.26%
Week 24	06/11/07	3,262	169	0	0.00%	0.00%
Week 25	06/18/07	836	62	0	0.00%	0.00%
Week 26	06/25/07	418	31	0	0.00%	0.00%
Week 27	07/02/07	229	8	0	0.00%	0.00%
Week 28	07/09/07	202	15	0	0.00%	0.00%
Week 29	07/16/07	0	0	0	0.00%	0.00%
Week 30	07/23/07	0	0	0	0.00%	0.00%

Week	Date	Weekly Passage	Catch	Mortality	% Passage	% Catch
Week 31	07/30/07	0	0	0	0.00%	0.00%
Week 32	08/06/07	0	0	0	0.00%	0.00%
Week 33	08/13/07	0	0	0	0.00%	0.00%
Week 34	08/20/07	0	0	0	0.00%	0.00%
Week 35	08/27/07	0	0	0	0.00%	0.00%
Week 36	09/03/07	0	0	0	0.00%	0.00%
Week 37	09/10/07	0	0	0	0.00%	0.00%
Week 38	09/17/07	0	0	0	0.00%	0.00%
Week 39	09/24/07	0	0	0	0.00%	0.00%

Table 15. Passage indices of spring-run Chinook salmon with 90% and 95% confidence intervals for Broodyear 2003-2006 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**
95% Lower CI	88,817	87,439	87,516	111,749
90% Lower CI	90,113	90,417	89,516	113,659
Passage Index	108,338	107,054	104,197	127,197
90% Upper CI	130,960	131,700	122,580	144,692
95% Upper CI	137,672	136,701	128,418	148,539

Table 16. Passage indices of late-fall run Chinook salmon with 90% and 95% confidence intervals for Broodyear 2002-2006 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	**2002**	**2003**	**2004**	**2005**	**2006**
95% Lower CI	156,297	29,432	9,570	17,808	70,716
90% Lower CI	158,835	30,130	9,915	18,163	72,560
Passage Index	172,708	33,902	11,906	20,401	86,918
90% Upper CI	189,998	38,705	14,701	22,733	105,130
95% Upper CI	192,685	39,638	15,644	23,384	113,960

Table 17. Passage indices of fall-run Chinook salmon with 90% and 95% confidence intervals for Broodyear 2001-2006 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	**2001**	**2002**	**2003**	**2004**	**2005**	**2006**
95% Lower CI	5,577,387	3,560,468	5,311,235	5,361,896	2,570,162	4,275,282
90% Lower CI	5,602,563	3,609,632	5,406,501	5,465,198	2,609,782	4,359,617
Passage Index	5,788,701	3,858,446	6,056,834	6,190,757	2,969,321	4,929,544
90% Upper CI	6,007,409	4,102,132	6,797,575	6,987,786	3,444,467	5,667,355
95% Upper CI	6,042,987	4,174,685	7,003,322	7,216,897	3,566,470	5,832,272
Passage per adult female	1,031	472	1,114	1,663	309	947

Table 18. Passage indices of steelhead / rainbow trout with 90% and 95% confidence intervals for Broodyear 2002-2007 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	**2002**	**2003**	**2004**	**2005**	**2006**	**2007**
95% Lower CI	11,731	8,758	24,137	22,247	9,362	27,515
90% Lower CI	11,926	8,910	24,697	22,670	9,547	28,349
Passage Index	12,803	9,772	28,989	24,791	10,762	33,910
90% Upper CI	13,860	10,761	34,454	28,211	12,313	41,428
95% Upper CI	14,193	10,954	36,746	29,454	12,632	43,292

Appendix

Appendix A. 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, 2006 through September 30, 2007.

Abbreviation	Common Name	Scientific Name
BGS	Bluegill	*Lepomis macrochirus*
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*
HH	Hardhead	*Mylopharodon conocephalus*
LFRY	Unknown Lampetra	*Lampetra 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*
TP	Tule Perch	*Hysterocarpus traski*
TSS	Threespine Stickleback	*Gasterosteus aculeatus*

Appendix B. 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, 2006 through September 30, 2007.

Species	Oct '06	Nov	Dec	Feb '07	Mar	Apr	May	Jun	Jul	Species Totals
CAR	0	2	0	0	1	3	15	3	0	24
COTFRY	0	0	0	0	0	0	0	119	456	575
CYPFRY	0	0	0	1	0	0	0	0	0	1
GSF	0	0	1	0	0	0	0	0	0	1
HH	0	0	1	0	2	2	0	0	0	5
LFRY	0	0	1	0	0	0	0	0	0	1
MQF	0	0	1	0	0	0	0	0	0	1
RFS	0	0	0	1	0	17	30	22	2	72
SPM	0	0	0	0	0	0	1	0	0	1
SASU	5	1	0	0	0	1	1	3	1	12
TP	0	0	0	0	1	0	0	0	0	1
									Total	694

Appendix C. 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, 2006 through September 30, 2007.

Species	Dec '06	Jan '07	Feb	Mar	Apr	May	Jun	Jul	Species Totals
BGS	0	0	0	0	0	2	0	0	2
CAR	1	0	0	2	1	1	6	3	14
CENFRY	0	0	0	0	1	0	0	0	1
COTFRY	0	0	0	0	0	4	131	293	428
CYPFRY	12	2	3	6	9	19	16	71	138
DACE	1	0	0	1	3	0	0	0	5
GSF	4	0	0	0	0	0	0	0	4
HH	5	1	2	1	2	21	23	5	60
LFRY	17	0	5	1	3	5	8	1	40
MQF	2	2	2	1	0	2	1	1	11
PL	287	7	12	0	1	0	3	1	311
PRS	0	0	0	1	1	1	0	0	3
RFS	7	6	9	10	8	12	4	5	61
SPM	3	1	1	1	2	13	27	4	52
SASU	9	3	2	0	0	1	6	0	21
TSS	0	0	1	1	0	2	1	7	12
								Total	1,163