

**Juvenile Salmonid Emigration Monitoring on the Mainstem Trinity River,
California, 2009**

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Abstract This report describes juvenile salmonid emigration monitoring conducted in 2009 at both Pear Tree Bar (PTRST; rkm 118) and Willow Creek (WCRST; rkm 34), California. Monitoring at PTRST is conducted to estimate juvenile salmonid population size passing PTRST during the sampling season. Monitoring at WCRST is conducted to estimate juvenile salmonid population size and emigration timing during the monitoring period. In 2009, two rotary screw traps were operated at PTRST from January 13 through August 28, with successful sampling for 215 of the 228-day sampling period. At WCRST three rotary screw traps were operated in 2009 from March 12 through September 2, with successful sampling for 159 days of the 175- day sampling period.

Age of salmonid outmigrants, length frequency distributions, migration rates, and hatchery contributions were estimated. Catch data were used to calculate flow based abundance indices for juvenile Chinook salmon (*Oncorhynchus tshawytscha*), coho salmon (*O. kisutch*), and steelhead (*O. mykiss*). Catch data of other fishes are also presented.

Weekly stratified mark-recapture population estimates of emigrating age-0 Chinook salmon were calculated for both naturally and hatchery-produced sub-populations. At PTRST between January 13 and August 28, an estimated 1,740,438 (SD=77,966; CV = 0.04) naturally-produced age-0 Chinook salmon and 734,625 (SD = 44,831; CV = 0.06) age-0 hatchery Chinook salmon passed the site. At WCRST between March 12 and September 2, an estimated 2,987,837 (SD = 212,008; CV = 0.07) naturally-produced age-0 Chinook salmon and 784,557 (SD = 88,501; CV = 0.11) age-0 hatchery Chinook salmon passed the site.

Juvenile salmonid emigration target dates were developed by the Trinity River Restoration Program (TRRP) to assess at what date 80% of the juvenile salmonid population had left the Trinity River and to help manage water temperatures in the mainstem Trinity River. The estimate of the week in which 80% of the juvenile Chinook salmon population passed WCRST, as inferred from the flow based abundance index was Week of the Year (WOY) 26 (June 25-July 1), which occurred prior to the TRRP management target date of July 9. The estimate of the week in which 80% of the steelhead smolt population passed the WCRST, as inferred from flow based abundance indices, was WOY 17 (April 23-April 29), which occurred prior to the TRRP management target date of May 22. The estimate of the week in which 80% of the natural coho salmon smolt population passed the WCRST was WOY 22 (May 28-June 3), which occurred prior to the TRRP management target date of June 4.

Introduction

This report presents the annual data collected to: (1) evaluate the production of juvenile salmonids, primarily Chinook salmon, from the upper 65 kilometers of the mainstem Trinity River below Lewiston Dam, the primary restoration reach and (2) evaluate the production and outmigrant timing of juvenile salmonids through the lower Trinity River in response to managed flow releases, the new thermal regimes, and restoration efforts. In addition to quantifying salmonid outmigrant production and timing, fish condition and health, as well as hatchery/natural composition of the outmigrants are assessed.

Quantification of annual juvenile fish production has been identified as a key performance measure to evaluate effectiveness of habitat restoration and flow management actions in increasing juvenile salmonid production (TRRP and ESSA 2009). Monitoring emigrating juvenile salmonid populations in conjunction with habitat availability and suitability studies is expected to provide a direct evaluation of restoration efforts because these studies focus on the early freshwater life-history phase which is directly affected by instream conditions and management actions. While this data series report presents the monitoring results from a single year, these data will be evaluated along with outmigrant monitoring results from other years to evaluate population responses to varying conditions (i.e.: hydrology, thermal regimes, spawning escapement) and provide feedback on the effectiveness of management actions through the Trinity River Restoration Program's adaptive management process (TRRP and ESSA 2009).

Background

The Klamath and Trinity Rivers once supported large runs of Chinook salmon (*Oncorhynchus tshawytscha*), coho salmon (*O. kisutch*), and steelhead (*O. mykiss*) that contributed to economically and culturally important tribal, ocean troll, and recreational fisheries. Declines in the Klamath Basin anadromous fish populations due to floods, water and land management, and fish harvest management (Klamath River Basin Fisheries Task Force 1991), led Congress to enact the Trinity River Basin Fish and Wildlife Restoration Act (PL 98-541) in 1984 and the Klamath River Basin Conservation Area Fishery Restoration Program (PL 99-552) in 1986. These acts directed the Secretary of the Interior to take actions necessary to restore the fishery resources of the Klamath Basin, primarily by addressing restoration of freshwater habitat.

In 2000, the Secretary of the Interior signed the Record of Decision (ROD) for the Trinity River Mainstem Fishery EIS/EIR which outlined the actions necessary to restore the natural production of anadromous salmonids in the mainstem Trinity River (USDOI 2000). The primary cause for dramatic decline in salmonid populations was attributed to loss of habitat due to decreased flows, channel simplification, excess fine sediment input, and unsuitable thermal regimes (USFWS and Hoopa Valley Tribe 1999). The strategy adopted to restore natural production of anadromous salmonids in the mainstem Trinity River is to restore a functioning alluvial river ecosystem (USFWS and Hoopa Valley Tribe 1999, USDOI 2000). Due to several flow and sediment constraints imposed by the Trinity River Division as well as other infrastructure constraints (residences in the floodplain) the new alluvial channel morphology is expected to be smaller in scale, but exhibit most of the dynamic characteristics of a healthy alluvial river (USFWS and

Hoopa Valley Tribe 1999). The primary restoration actions being undertaken are: (1) mechanical channel rehabilitation to reform the degraded channel, (2) management of flows to support habitat and temperature needs of anadromous salmonids and support physical processes necessary to create and maintain habitat in an alluvial river, and (3) coarse sediment augmentation to support physical processes that create and maintain riverine features and habitats.

A fundamental hypothesis relating to the restoration strategy is that improving spawning and rearing habitat and providing suitable thermal regimes will lead to increased juvenile salmonid production (USFWS and Hoopa Valley Tribe 1999, TRRP and ESSA 2009). Creation and maintenance of habitat should increase the production potential of the mainstem Trinity resulting in a greater number of outmigrants and suitable thermal regimes, especially water year specific temperature objectives in the lower Trinity River for outmigrating salmonids, should increase rearing and outmigration success due to increased size/health of outmigrants. A major objective of the spring/early summer flow releases is to provide optimal temperatures for outmigrating salmonids in Normal or wetter water years and to provide least marginal temperatures during Dry and Critically Dry water years (USFWS and Hoopa Valley Tribe 1999). This, in turn, will contribute to meeting the programmatic goal of increased spawning populations and increased harvest opportunity.

Study Area

The Klamath River is the second largest river system in California, draining about 26,000 square kilometers (km²) in California, and 14,400 km² in Oregon. The Trinity River is the largest tributary to the Klamath River, draining approximately 7,690 km² in California. Lewiston Dam on the Trinity River (rkm 180), is the upper limit of anadromous fish migration. The Trinity River Hatchery (TRH) was constructed to mitigate for losses of anadromous fish habitat and production upstream of Lewiston dam and is managed by California Department of Fish and Game (CDFG).

Trinity River juvenile salmonid outmigrant trapping was conducted at the Pear Tree Gulch (rkm 118) near Helena, California, and the Riverdale Campground (rkm 34) near Willow Creek, California (Figure 1).

Methods

Trap Design and Operation

At the Pear Tree rotary screw trap (PTRST) site, sampling was conducted using one 1.52 m diameter rotary screw trap and one 2.44 m diameter rotary screw trap. The traps were installed January 12 and operated from January 13 through August 28 in order to best observe the greatest portion of the expected emigration of naturally-produced age-0 juvenile Chinook salmon from the study reach (Green and Petros 2005, Schwarz et al. 2009, Petros 2011).

At the Willow Creek rotary screw trap (WCRST) site, sampling was conducted by deploying one to three 2.44 m diameter rotary screw traps, depending on river conditions such as magnitude of river discharge and debris load. In 2009, the first two traps were installed on March 12, and the third was installed on March 14 and all three traps

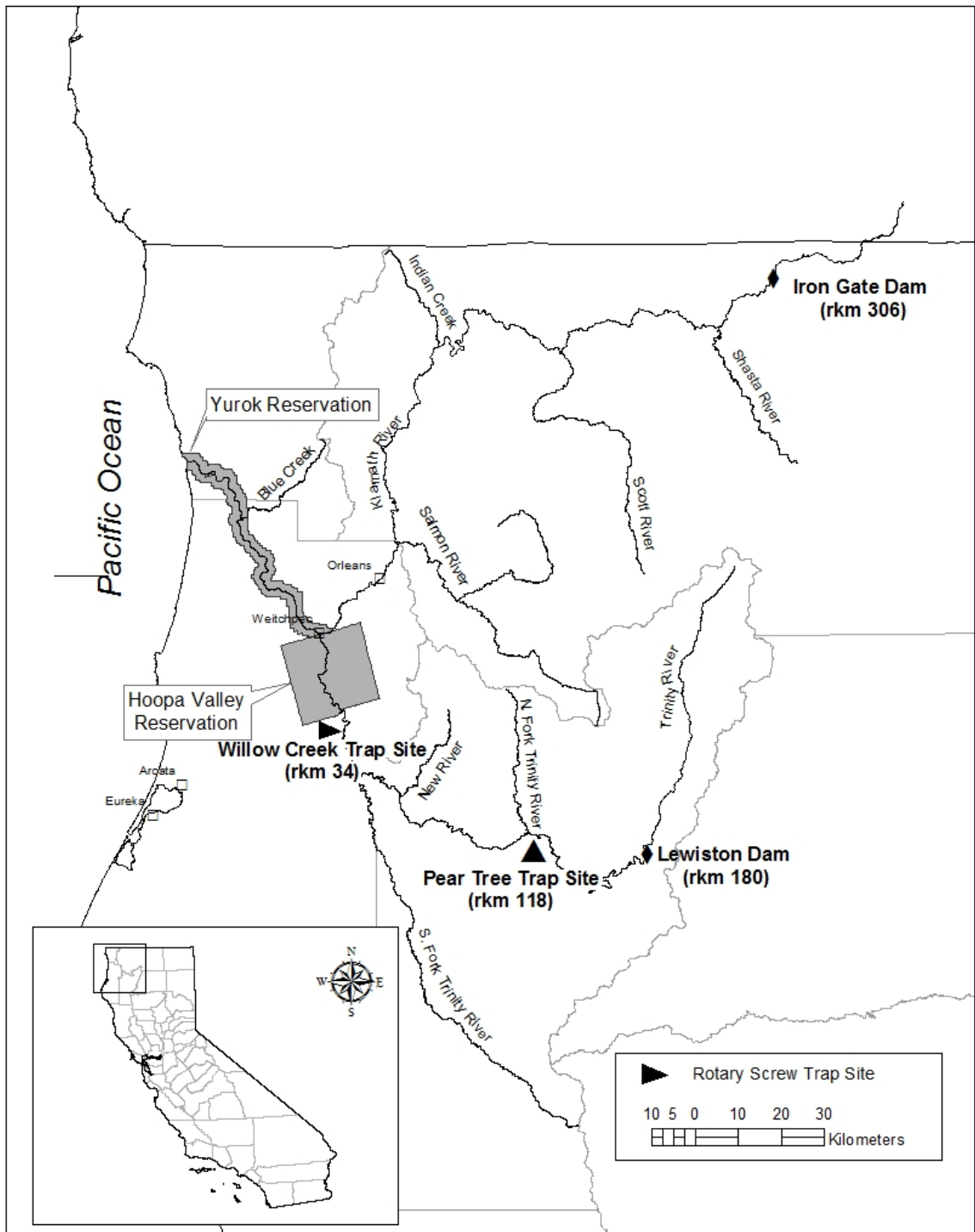


Figure 1. Location of the Trinity River rotary screw trap sites near Willow Creek (rkm 34) and Pear Tree Gulch (rkm 118), California, operated by the Yurok Tribal Fisheries Program, United States Fish and Wildlife Service, Arcata Fish and Wildlife Office, and the Hoopa Valley Tribal Fisheries Department.

monitored through September 2. An effort was made to place traps in the river early in the spring so to sample the majority of outmigrating age-0 Chinook salmon to evaluate emigration patterns and relative abundances of natural and hatchery Chinook salmon, as well as portions of the coho salmon and steelhead smolt outmigration.

Traps at both sites were anchored with 0.95 cm diameter aircraft cable to a series of steel fence stakes. One or two 0.1 x 0.15 x 6.0 m (4"x6"x10') beams were used to push the traps out from the bank. The number of cone revolutions were used to determine where and when the traps could be operated without inducing unnecessary risk to the trap; low cone revolutions (i.e. < 4 revolutions per minute) necessitated moving the trap into faster water, high revolutions (i.e. > 9 revolutions per minute) necessitated moving the trap to slower water or lifting the cone out of the water. Traps were fished on the edge of the thalweg during high river discharge, and incrementally moved back into the thalweg as river discharge decreased. When deployed, the bottom of the cone was generally <1 m from the river bottom. A sample day was defined as the time period between the setting of the trap one day and removal of captured fish approximately 24 hours later. This period encompassed all night hours, when the majority of juvenile salmonids emigrate based on past sampling. Generally, trap checks at PTRST occurred at 5 pm the day the trap was set and 8 am the following morning, with the 8 am check marking the end of one sample day. At WCRST, trap checks in the late morning or early afternoon marked the end of one sample day. At both locations the frequency of daily trap checks increased during peak emigration periods, with the frequency dictated by water temperatures, fish numbers and mortality rates.

Daily trap catch data were summarized by Week of the Year (WOY), with the first day of WOY 1 commencing on the first day of the year (Table 1). All WOYs are seven days in length except the last WOY of the year and the ninth WOY during leap years, which are both eight days in length.

Water Flow and Temperature Measurements

Normal cone operating depth was 1.21 m for the 2.44m traps and 0.762m for the 1.52m trap. Daily velocity measurements were taken directly in front of the cone as follows: the submerged portion of the cone was divided into three cells (right, center, left); within each cell, velocity was measured at 0.2 and 0.8 of the cone operating depth for 60 seconds using a General Oceanics® digital flowmeter (Model 2030; General Oceanics, Inc. 1983). Mean water velocity (ft/s) was calculated for each cell. Each calculated cell area (ft²) was multiplied by its corresponding mean water velocity (ft/s). The values for each cell were summed, yielding an estimate of volume of river discharge sampled (Qs) in cubic feet per second (ft³/s). Discharge and water temperature records for PTRST were produced by USGS from data collected at USGS Water Resources gauge station #11-526400, which is situated approximately 61 m downstream of the trap site. Discharge data from U.S. Geological Survey Water Resource gauge station Hoopa (#11-530000 at rkm 19.9) on the Trinity River was used as a surrogate measure of mean daily river discharge (Q) at WCRST.

At WCRST, water temperature data were collected using an Onset Stow Away Tidbit® temperature logger attached to the back of a trap's portside pontoon. Water temperature was recorded once per hour for the entire sampling season. Mean daily water temperatures were calculated by averaging over 24-hour periods.

Table 1. Week of the Year and corresponding first calendar date.

Week of the Year	Week beginning	Week of the Year	Week beginning	Week of the Year	Week Beginning
1	1/1	18	4/30	35	8/27
2	1/8	19	5/7	36	9/3
3	1/15	20	5/14	37	9/10
4	1/22	21	5/21	38	9/17
5	1/29	22	5/28	39	9/24
6	2/5	23	6/4	40	10/1
7	2/12	24	6/11	41	10/8
8	2/19	25	6/18	42	10/15
9	2/26	26	6/25	43	10/22
10	3/5	27	7/2	44	10/29
11	3/12	28	7/9	45	11/5
12	3/19	29	7/16	46	11/12
13	3/26	30	7/23	47	11/19
14	4/2	31	7/30	48	11/26
15	4/9	32	8/6	49	12/3
16	4/16	33	8/13	50	12/10
17	4/23	34	8/20	51	12/17
				52	12/24

Biological Sampling Procedures

All juvenile fish captured were anesthetized with tricaine methanesulfonate (MS-222) prior to processing. Up to 30 individuals of each species, age class (based on size), ad-clipped and unclipped, were randomly subsampled (biosampled) from the daily catch. Biosampled salmonids were measured to the nearest mm fork length (FL), weighed to the nearest 0.1g by digital scale, and examined for external marks (stains, fin clips, tattoos, and brands), and physical irregularities. All captured salmonids that were not biosampled were tallied by species, age, and origin, and examined for external marks.

All anesthetized fish not retained (see paragraph below) were allowed to resuscitate in buckets of ambient river water before being released downstream of the trap. NovAqua® water conditioner was added to recovery buckets to help protect fish during handling, minimize infection, reduce stress and aid in recovery. Rarely captured adult salmonids were not anesthetized. Adult salmonid FLs were either measured or approximated based on comparing to a known length object on the trap (i.e. live box lid) before release. Any salmonid mortality in the live box was checked for a fin clip and measured if included in the subsample. If a salmonid escaped during netting or handling before it could be identified to species or checked for a hatchery mark (i.e. adipose fin or maxillary clip), it was counted in the sample tally as an "unknown". Unknown salmonids were not included in catch totals.

When present, daily subsamples of marked hatchery Chinook salmon were collected at WCRST. A missing adipose fin (ad-clip) was the external marker indicating a Chinook

salmon with a coded wire tag (CWT) embedded in the snout. A maximum of five ad-clipped Chinook salmon were collected daily and sacrificed for subsequent CWT retrieval. Collected fish were stored in a freezer until time of dissection. Occasionally, ad-clipped fish were also collected for disease sampling, after which the CWTs were removed. Marked hatchery Chinook salmon were not regularly collected at PTRST.

Juvenile Chinook salmon were classified as age-0 (young-of-year) or age-1, based on size and date of capture. Coho salmon were classified as either age-0 or age-1; the latter of which were much larger in size, silvery, and lacked distinct parr marks. Steelhead were classified by age based on length-to-age analysis of scales collected from a subsample of steelhead captured (WCRST) or by length frequency distributions (PTRST). Analysis of scale samples collected from unmarked steelhead over the sampling season provided length-to-age relationships. Un-aged steelhead were assigned an age based on the length-to-age relationship derived from aged samples.

Fish other than Chinook salmon, coho salmon, or steelhead were considered non-target species. Non-target fishes captured were identified to species (or genus in some cases), enumerated, and up to five specimens of each species were measured to FL. Total length (TL) was measured on species without a forked caudal fin.

Hatchery and Natural Stocks Estimate

The catch of Chinook salmon, coho salmon, and steelhead was partitioned into either hatchery or natural origin based on external marks, CWT data, and hatchery marking rates. Hatchery release strategies for Chinook salmon consist of fingerling releases in the spring and yearling releases in the fall. These two distinct release periods prompted the division of the trapping season into spring and fall monitoring periods. The spring monitoring period was designated as WOY 1 through 39 and the fall period as WOY 40 through 52 in years when extended sampling was conducted. This project does not sample during the fall Chinook yearling release. Hatchery-reared steelhead and coho salmon are typically volitionally released as smolts or yearling-plus (age-1) in early spring.

Chinook salmon

All collected ad-clipped Chinook salmon from WCRST were passed through a magnetic field detector manufactured by Northwest Marine Technology® to determine the presence or absence of a CWT. The snout of each fish that registered positive for a tag was dissected until the CWT was recovered. If the tag was not recovered, the fish was considered an ad-clipped fish that had shed its tag. Recovered tags were decoded using a dissection microscope. Coded Wire Tag recoveries were summed by specific CWT code for each WOY.

The number of CWT fish captured for each code was estimated by multiplying the number of CWTs recovered by an expansion factor (E) which accounts for all subsampling, CWTs that were lost during dissection, and unreadable tags. The expansion factor (E) for a given WOY(j) was calculated using the formula:

$$E_{WOY(j)} = (C/MS)(AD/H)(T/TR)$$

Where: C = Total # of Chinook salmon captured,
 MS = Number of Chinook salmon examined for ad-clips,
 AD = Number of ad-clipped Chinook salmon observed,
 H = Number of ad-clipped Chinook salmon collected,
 T = Number of collected ad-clipped Chinook salmon with a CWT,
 TR = Total number of CWTs recovered and decoded after processing.

To account for unmarked hatchery fish in the catch over a WOY, the expanded estimates for each CWT code (i) were multiplied by a production multiplier ($PM_{code(i)}$) specific to each CWT code. Each $PM_{code(i)}$ was calculated from hatchery release data (Pacific States Marine Fisheries Commission 2009), using the following formula:

$$PM_{code(i)} = (\# \text{ Tagged} + \# \text{ Poor Tagged} + \# \text{ Unmarked}) / \# \text{ Tagged}$$

Where: # Tagged = The actual number of ad-clipped Chinook salmon released with a CWT,
 # Poor Tagged = The number of ad-clipped Chinook salmon that were tagged and shed the tag (No-Tags),
 # Unmarked = The number of unmarked Chinook salmon in a release group.

The estimated contribution of hatchery Chinook salmon attributable to a specific CWT code for a given WOY was calculated by the following formula:

$$\# \text{ Hatchery}_{code(i)WOY(j)} = (\# \text{ recovered}_{code(i)}) * (E_{WOY(j)}) * (PM_{code(i)})$$

The total weekly estimated hatchery contribution to the catch was the sum of all daily estimated hatchery Chinook salmon attributable to CWT codes. The weekly contribution of naturally-produced Chinook salmon to the catch was estimated by subtracting the estimated hatchery contribution from the total weekly catch. Occasionally, the daily estimated hatchery contribution exceeded the total daily catch. In these instances, the estimated hatchery contribution was limited to the actual daily catch.

At PTRST, CWTs were not recovered for the purpose of estimating the proportion of hatchery Chinook salmon in the catch. Instead, the number of ad-clipped fish in the weekly catch was expanded by the TRH fin-clip rate (approximately 25%) to produce an estimate of the number of hatchery Chinook salmon captured in any given week. The estimated number of naturally-produced Chinook salmon in the weekly catch were calculated as the difference between the total weekly Chinook salmon catch and the estimated number of hatchery Chinook salmon.

Estimation of weekly hatchery and natural stock contribution was carried out under the assumptions that 1) differential post-release mortality between ad-clipped and non-ad-clipped fish of the same release group is negligible, 2) ad-clip and non-clip Chinook salmon are equally vulnerable to capture, and 3) mark-fraction estimates of Chinook salmon released from TRH are accurate.

During the beginning and end of hatchery fish emigration periods it was possible that juvenile Chinook salmon of hatchery origin were captured but not represented by ad-clipped fish. If no ad-clipped hatchery Chinook salmon were captured within a given week, the hatchery contribution for that week could not be differentiated from the natural component and all Chinook salmon captured during that week were assumed to be of natural origin. Conversely, when the ad-clip proportion of the weekly catch equaled or exceeded the clip fraction of the most recent release of Chinook salmon from TRH, all Chinook salmon captured during that week were assumed to be of hatchery origin.

Coho salmon

All hatchery coho salmon released from TRH were marked with a right-maxillary clip (max-clip). The weekly contribution of naturally-produced coho salmon to the catch was estimated by subtracting the catch of marked hatchery fish from the total catch.

Steelhead

All hatchery steelhead released from TRH were marked with an ad-clip. The weekly contribution of naturally-produced steelhead to the catch was estimated by subtracting the catch of marked hatchery fish from the total catch.

Abundance Indices – Emigration Timing

A weekly abundance index for each age class of Chinook salmon, coho salmon, and steelhead was estimated for each WOY based on catch-effort data. Daily abundance indices ($Index_{DC}$) for each species and development stage were calculated by the following equation:

$$Index_{DC} = Catch_{DC} / (Q_C/Q)$$

Where: $Catch_{DC}$ = Sum of daily catch of a species/life stage/age class from all traps.
 Q_C = Sum of discharge sampled (ft^3/s) by all traps
 Q = Mean daily river discharge (ft^3/s) at trap site

Weekly abundance indices ($Index_{CWOYi}$) were calculated for each WOY using the following equation:

$$Index_{CWOYi} = \sum Index_{DC} (nt_i / (\sum TD_i))$$

Where: nt_i = Number of days in the WOY with at least one trap fishing
 TD_i = Sum of the days in the WOY

The estimated proportion of hatchery-produced fish, based on catches of marked fish and marking rates, were used to partition abundance indices into hatchery and natural production. The usefulness of this index as an estimator of abundance is contingent upon assumptions that abundance is directly proportional to the percentage of river flow sampled and that individuals from a given species are equally susceptible to capture. The abundance index is not intended to represent a population estimate, but is used to compare relative abundance between weeks during the trapping season, and between years.

Emigration duration is defined as the period of time between the first and last WOYs that a species of a given age and origin is present in the catch. This definition applies strictly to the sampling period, and is potentially longer for species of a given age and origin that have a longer emigration period than the sampling period. Emigration peaks are defined as the largest weekly abundance index for a species of a given age and origin.

Abundance indices are greatly influenced by river discharge, and thus require caution in order to compare indices within or between years for absolute numbers of fish passing a site. However, abundance indices are generally thought to be adequate indicators of emigration timing and duration if sampling occurred in all weeks of the appropriate sampling period for emigration timing of a specific species and life stage (Schwarz et al. 2009).

Migration Rate

Migration rates were calculated for marked Chinook salmon released at PTRST and recaptured at WCRST (see mark-recapture technique section below for marking methods). In addition, maximum migration rates for hatchery Chinook salmon, hatchery steelhead, and hatchery coho salmon were estimated by dividing the distance (rkm) traveled by the number of days elapsed between the initial hatchery release date and capture date at each trap site for specific CWT codes or marked fish. Due to potential delays in outmigration during volitional releases, mean migration rates were not calculated for volitional release groups.

Population Estimation

An intensive mark-recapture technique was employed to generate population estimates for natural and hatchery age-0 Chinook salmon in 2009. Population estimates were generated using a Bayesian time-stratified spline-based method (Schwarz et al. 2009; hereafter Schwarz method) stratified by WOY. Juvenile Chinook salmon were obtained from TRH to conduct mark-recapture trap efficiency tests early in the season when numbers of natural fish were too low to obtain adequate sample sizes to accurately calculate trap efficiency. Mark-recapture population estimates were not calculated for coho salmon and steelhead due to inadequate numbers necessary for valid estimates.

Mark-Recapture Technique

Two types of marks were utilized in 2009, photonic marks and freeze brands. Photonic marks unique to each sampling week and trap site were applied to anesthetized Chinook salmon utilizing a BMX 1000 POW'R-Jet marking unit with photonic marking formula manufactured by NewWest Technologies®. Trap-caught Chinook salmon at each site were generally the source for photonic-marked fish, which were assumed to be of natural origin prior to the hatchery release in June, where after they became an unknown mix of naturally-produced age-0 and hatchery-produced age-0 fish. Marks were made by subcutaneously injecting photonic solution at the base of various fins specific to the color and fin mark designated for that week. After marking, fish were allowed to recover in in-river holding pens or bait tanks filled with river water aerated and iced to remain within 1.7°C of ambient river temperatures. Following recovery, marked fish were investigated for bad marks and mortalities, which were removed from the number of marks released.

Freeze brands were applied only to hatchery-produced juvenile Chinook salmon at TRH, which were held in raceways until brands became fully visible (approximately 5-10 days). Branded fish were transported to the appropriate release site in insulated tanks filled with aerated water. At the release site, all the freeze-branded fish were examined for mark quality, and those with poorly defined marks received either a secondary photonic mark or were excluded from the number of marked fish released. Hatchery fish with unique brands for each WOY and site were delivered from the hatchery weekly.

Releases generally occurred one hour before sunset approximately 0.9 km upstream near the stream margin (PTRST) or in late-afternoon at approximately 0.4 km upstream into a large, still pool (WCRST) to mix with the population of outmigrating fish yet to pass the sampling site. During periods with low daily captures, fish were held for several days until adequate numbers for estimating trap efficiency were available. Some TRH-source Chinook salmon also received photonic marks instead of freeze brands, but marks were unique to ensure that release location and time could be identified upon recovery. All recaptures were identified and recorded during normal trapping operations, but were not counted as part of the catch for that day.

Results

Sampling Season Overview

Monitoring at PTRST was conducted from January 13 to August 28, a 228-day period encompassing the bulk of annual non-hatchery age-0 Chinook salmon emigration from the study reach. Due to occasional sampling disruptions caused by large woody debris, high flows and mechanical difficulties, the site was effectively operated for 215 days, or 94%, of the 228-day sampling period (Table 2).

Monitoring at WCRST was conducted from March 12 to September 2, a 175-day period. In combination, traps were effectively fished for 159 of the 175 possible trap days (91%), while individual trap rates ranged from 71% to 88% (Table 2). Consistent daily data collection was disrupted (flawed set) intermittently by large woody debris, high flows, and mechanical difficulties, but sampling occurred in each of the WOYs during the sampling period.

Table 2. Period and duration of spring/summer monitoring and percent of time sampled at PTRST (rkm 118) and WCRST (rkm 34). Combined value is total number of days sampled with at least one trap.

Site	Trap	Start-End dates	Days Trapped	Days possible	Trapping Rate
PTRST	1 (2.4m)	13 Jan- 28 Aug	210	228	92%
PTRST	2 (1.5m)	13 Jan- 28 Aug	215	228	94%
	Combined	13 Jan- 28 Aug	215	228	94%
WCRST	1 (2.4m)	12 Mar- 2 Sept	155	175	89%
WCRST	2 (2.4m)	12 Mar- 2 Sept	151	175	86%
WCRST	3 (2.4m)	14 Mar- 2 Sept	124	173	72%
	Combined	12 Mar- 2 Sept	159	175	91%

Maximum mean daily discharge at PTRST was 7120 ft³/s, and the minimum was 464 ft³/s. Maximum mean daily water temperature was 20.4°C and minimum mean daily water temperature was 4.3°C (Figure 2)

Maximum mean daily discharge at WCRST was 18,963 ft³/s and minimum mean daily discharge was 644 ft³/s. Maximum mean daily water temperature, as recorded at the trap site, was 25.1 °C and minimum mean daily water temperature was 7.4 °C (Figure 2).

Catch Totals

Chinook salmon

Pear Tree

At total of 84,428 Chinook salmon were captured at PTRST in 2009 and the catch was composed predominantly of naturally-produced age-0 fish, which accounted for 65% of the total season Chinook salmon catch (Table 3, Appendix 1). There were 28,113 hatchery-produced age-0 Chinook salmon captured, which made up 33% of the total season Chinook salmon catch. Naturally-produced age-1 and hatchery-produced age-1 Chinook salmon were relatively uncommon, and comprised only 1% and 0.4% of the total season catch of Chinook salmon, respectively.

There were two distinctly different capture periods for Chinook salmon at PTRST. Prior to the arrival of brood year 2008 hatchery Chinook salmon (released from TRH as age-0 on June 1, 2009), the Chinook salmon catch was composed predominantly of naturally-produced age-0 fry mixed with small numbers of hatchery-produced and naturally-produced age-1 pre-smolts. In samples collected prior to the hatchery release, from WOY 2 through WOY 22, naturally-produced age-0 fish accounted for 97% of the total Chinook catch. Following the hatchery release, there was a dramatic shift in relative abundance through the remainder of the season, as age-0 hatchery fish accounted for 70% of the Chinook salmon catch and naturally produced age-0 Chinook accounted for 31% of the Chinook catch. Age-1 Chinook were virtually absent from the catch following the hatchery release, as only one individual was captured.

Willow Creek

Catches of Chinook salmon in 2009 at WCRST were predominately natural fish with a catch of 127,074, comprising 78% of the total catch. Except for 166 age-1 fish, the entire Chinook salmon catch was composed of age-0 fish. A total of 36,284 hatchery age-0 fish were captured during the monitoring period, comprising 22% of the total catch (Table 3, Appendix 2).

Natural age-0 Chinook salmon were captured throughout the sampling period (WOY 11-WOY 35), peaking in WOY 26 with 31,880 natural age-0 Chinook salmon caught. The majority of hatchery-produced Chinook salmon were captured from early June through the end of July. Presence of age-0 Chinook salmon during the first week of sampling indicates that emigration past the site had already begun, with an unknown number of fish migrating past the trap site prior to the initiation of sampling (Appendix 2).

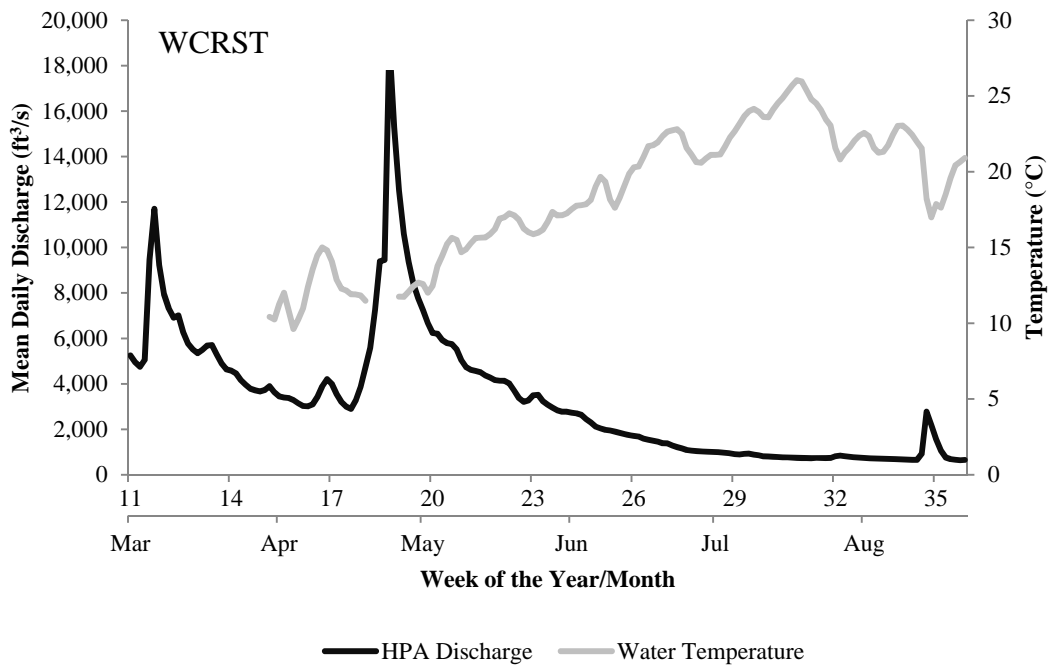
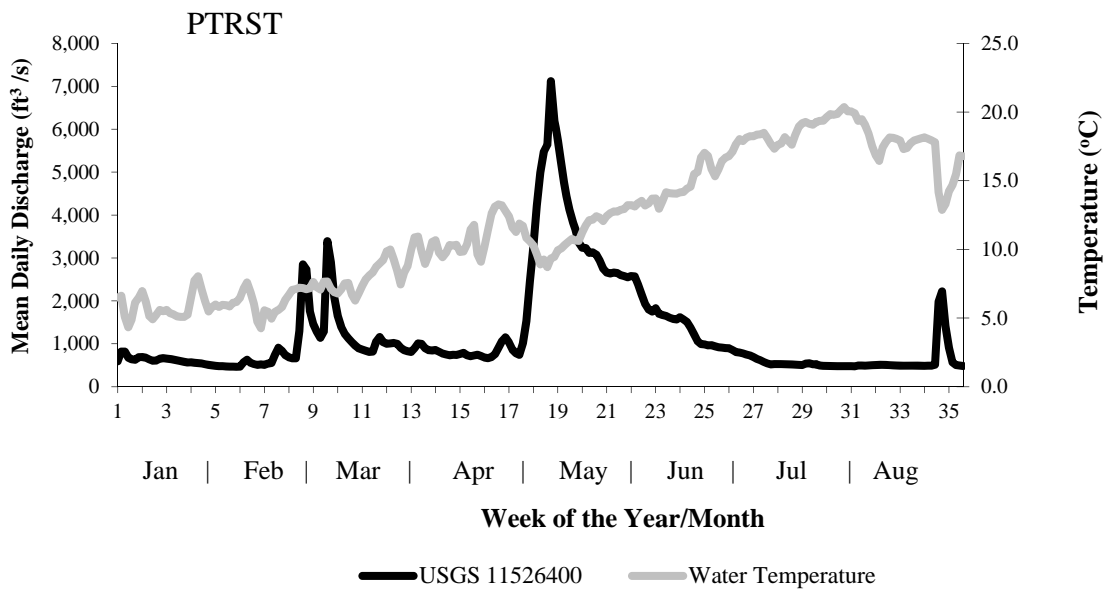


Figure 2. Mean daily discharge (ft³/s) as recorded at Pear Tree Bar (US Geological Survey Water Resource gauge station #11-526400) and Hoopa (HPA; US Geological Survey Water Resource gauge station #11-530000), California. Mean daily water temperatures (°C) recorded at PTRST and WCRST in 2009.

Table 3. Juvenile salmonid catch totals in 2009 for trapping at PTRST (rkm 118) and WCRST (rkm 34), on the Trinity River, California, operated by the Hoopa Valley Tribal Fisheries Department, United States Fish and Wildlife Service, Arcata Fish and Wildlife Office and the Yurok Tribal Fisheries Program.

Site	Species	Hatchery Age-0	Hatchery Age-1+	Natural Age-0	Natural Age-1+	Natural Age-2+	Total
PTRST	Chinook salmon	28,113	300	55,187	828	N/A	84,428
PTRST	coho salmon	N/A	255	336	658	N/A	1,249
PTRST	steelhead	N/A	4,149	1,293	3,419	66	8,927
WCRST	Chinook salmon	36,284	0	126,908	166	N/A	163,358
WCRST	coho salmon	N/A	246	58	209	N/A	513
WCRST	steelhead	N/A	4,287	275	4,356	100	9,018

Approximately 2.9 million age-0 Chinook salmon (spring- and fall-run) were released from TRH in the spring of 2009. Spring releases included ad-clip CWT groups, representing 25% of released Chinook salmon. In the fall of 2009, TRH released approximately 1.4 million age-0 Chinook salmon, of which 24% were ad-clip CWT groups (Table 4).

Table 4. California Department of Fish and Game, TRH juvenile salmonid releases, 2009.

Species	Release Season	Number Released	Percentage AD-clipped or Marked	Release Dates
Chinook salmon	Spring	2,959,517	24.8	06/01/2009-06/15/2009
Chinook salmon	Fall	1,471,059	24.8	10/01/2009-10/15/2009
coho salmon	Spring	459,546	100	03/16/2009-03/27/2009
steelhead	Spring	820,430	100	03/16/2009-03/27/2009

Coho salmon

Pear Tree

The coho salmon catch at PTRST was predominantly composed of naturally-produced fish. A total of 658 naturally-produced age-1 coho salmon were captured, comprising 53% of the total coho salmon catch of 1,249 (Table 3, Appendix 3). Additionally, 336 naturally-produced age-0, and 255 age-1+ hatchery coho salmon were captured, comprising 27% and 20%, respectively, of the total season coho salmon catch

The majority of age-1 naturally-produced coho salmon were captured between WOY 2 and 13, with 65% of the total season catch occurring in WOY 8 through WOY 10. Age-0 coho salmon first appeared at the site in WOY 10 and small numbers were captured nearly every week of the remaining season, with 63% of captures occurring WOY 28 through WOY 32. Hatchery-produced coho salmon smolts arrived in WOY 11 and passed the site abruptly, with 74% of the total season catch of hatchery coho occurring in WOY 12.

Willow Creek

Catches of coho salmon at WCRST in 2009 were nearly evenly split between hatchery and natural fish. A total of 246 hatchery age-1 coho salmon were captured, comprising 48% of the total catch. A total of 267 natural coho salmon were captured, comprised of 209 age-1 and 58 age-0 fish, or 40% and 11% of the total catch, respectively (Table 3, Appendix 4).

The majority of age-1 coho salmon, both hatchery and naturally-produced, were captured from WOY 11 through WOY 30. Trapping was initiated a week prior to the release of hatchery-produced coho salmon, and age-1 hatchery coho salmon did not appear in traps until the second week of sampling, indicating that emigration past the site had not yet begun. Natural age-0 coho salmon also did not appear in sampling until the second week; however, natural age-1 coho salmon were captured during the initial week of trapping, with an unknown number of fish having passed the traps prior to their operation (Appendix 4).

The largest numbers of age-0 coho salmon were captured from WOY 12 through WOY 27. Natural age-1 coho salmon were captured through WOY 31, but total numbers dropped below ten per week by WOY 25. The majority of hatchery age-1 coho salmon were captured between WOY 12 and WOY 24 (Appendix 4).

TRH released 459,000 yearling coho salmon during March, 2009 (Table 4). All hatchery coho salmon were marked with a right maxillary clip (max-clip).

Steelhead

Pear Tree

A total of 8,927 steelhead were captured at PTRST in 2009 (Table 3, Appendix 5). Most of the steelhead captured were age-1+ and age-2 smolts and pre-smolts, which combined accounted for 86% of the total season steelhead catch. Approximately 54% of the steelhead smolts captured were age-1+ hatchery fish. There were 1,293 naturally-produced age-0 steelhead captured (Table 3) which accounted for 15% of the total season steelhead catch.

Prior to the hatchery steelhead smolt release from TRH on March 15, 2009, the steelhead catch was composed entirely of naturally-produced age-1+ and age-2 pre-smolts and smolts, which accounted for 99% and 1% of the catch, respectively. From WOY 12, the week marking the arrival of TRH steelhead, through WOY 35, the steelhead catch was composed of 62% hatchery age-1 smolts, 18% age-1 naturally-produced smolts and presmolts, 0.6% naturally produced age-2 smolts, and 19% naturally produced age-0 fry.

Willow Creek

Catches of steelhead at WCRST during 2009 were nearly evenly split between natural and hatchery fish, though natural fish were predominantly age-1 or older (94%). A catch total of 9,018 included 4,287 hatchery age-1 steelhead (48%), 275 natural age-0 (3%), 4,356 natural age-1+ (48%), and 100 natural age-2+ (1%); Table 3, Appendix 6).

The majority of age-1 hatchery steelhead were captured from late March through mid-June, while the majority of natural age-1+ steelhead were captured from early March through late July. Trapping was initiated the week prior to the release of hatchery-produced steelhead, and catches of age-1 hatchery steelhead did not occur until the third week of trapping (WOY 13). The majority of age-0 steelhead were captured from mid-June through late July, but a small peak appeared in mid-March shortly after trapping began (Appendix 6).

TRH released 820,430 yearling steelhead during March of 2009 (Table 4). All hatchery steelhead were marked with an adipose fin clip prior to release from the hatchery.

Non-Target Species

Pear Tree

Lamprey ammocetes (*Entosphenus* spp.) were by far the most common non-target genus/life-stage captured at PTRST in 2009 (Table 5) and were most abundant in weekly samples conducted during rising stream conditions caused by winter storms and controlled dam releases. Juvenile brown trout (*Salmo trutta*), speckled dace (*Rhinichthys osculus*) and the Klamath smallscale sucker (*Catostomus rimiculus*) were also relatively abundant in the catch. Brown trout were most abundant in winter and early spring samples, and were more common than naturally-produced age-0 and age-1 coho salmon.

Willow Creek

Suckers (*Catostomus* spp.) were the most common non-target fish captured during 2009 at WCRST. Other abundant species included Lamprey ammocetes (*Entosphenus* spp.), speckled dace (*Rhinichthys osculus*), three-spined stickleback (*Gasterosteus aculeatus*), and sculpin (*Cottus* spp.; Table 5).

Abundance Indices, Emigration Timing and Duration

Chinook salmon

Pear Tree

The total season abundance index for Chinook salmon at PTRST was 606,930 (Table 6), and was composed predominantly of naturally-produced age-0 fish, which accounted for 70% of the total season Chinook index. The total season index of hatchery-produced age-0 Chinook salmon was 173,849, which made up 29% of the total season Chinook index. Naturally-produced and hatchery-produced age-1 Chinook salmon were relatively uncommon, and comprised only 1% and 0.3% of the total season Chinook salmon index, respectively

There were two distinctly different capture periods for Chinook salmon at PTRST (Figure 3). Prior to the arrival of brood year 2008 hatchery Chinook salmon (released as age-0 on June 1, 2009), the Chinook salmon catch was composed predominantly of naturally-produced age-0 fry mixed with small numbers of hatchery-produced and naturally-produced age-1 pre-smolts. During the pre-hatchery release period, from WOY 2 through WOY 22, naturally-produced age-0 fish accounted for 98% of the total Chinook index.

Table 5. Catch totals of non-target fish species captured at PTRST and WCRST on the mainstem Trinity River, California, 2009.

Common name	Species	Life stage	Pear Tree Catch(n)	Willow Creek Catch (n)
Lamprey	<i>Entosphenus</i> spp.	Ammocete	3,848	428
		Eyed juvenile	83	0
Pacific Lamprey	<i>Entosphenus tridentata</i>	Ammocete	0	1,364
		Eyed juvenile	0	8
		Adult	14	10
Sucker	<i>Catostomus</i> spp.		225	3,562
Speckled Dace	<i>Rhinichthys osculus</i>		663	673
Three-spine Stickleback	<i>Gasterosteus aculeatus</i>		87	187
Marbled Sculpin	<i>Cottus klamathensis</i>		0	59
Golden Shiner	<i>Notemigonus crysoleucas</i>		13	15
Coastrange Sculpin	<i>Cottus aleuticus</i>		0	83
Prickly Sculpin	<i>Cottus asper</i>		1	106
Green Sturgeon	<i>Acipenser medirostris</i>		0	71
Brown Trout	<i>Salmo trutta</i>	Juvenile	1,278	55
Sunfish	<i>Lepomis</i> spp.		0	6
Fathead Minnow	<i>Pimephales promelas</i>		0	22
Sockeye salmon	<i>Oncorhynchus nerka</i>		0	8
American Shad	<i>Alosa sapidissima</i>		0	3
Season Total			6,212	6,660

Table 6. Juvenile salmonid proportional discharge based abundance indices, at PTRST and WCRST, 2009.

Site	Species	Hatchery Age-0	Hatchery Age-1	Natural Age-0	Natural Age-1+	Natural Age-2+	Total
PTRST	Chinook salmon	171,984	1,865	427,126	5,955	N/A	606,930
PTRST	coho salmon	N/A	1,894	1,834	6,785	N/A	10,513
PTRST	steelhead	N/A	24,976	11,716	34,951	530	72,173
WCRST	Chinook salmon	251,094	0	1,277,357	7,070	N/A	1,535,521
WCRST	coho salmon	N/A	8,132	1,010	4,098	N/A	13,240
WCRST	steelhead	N/A	81,409	3,180	82,955	7,471	175,015

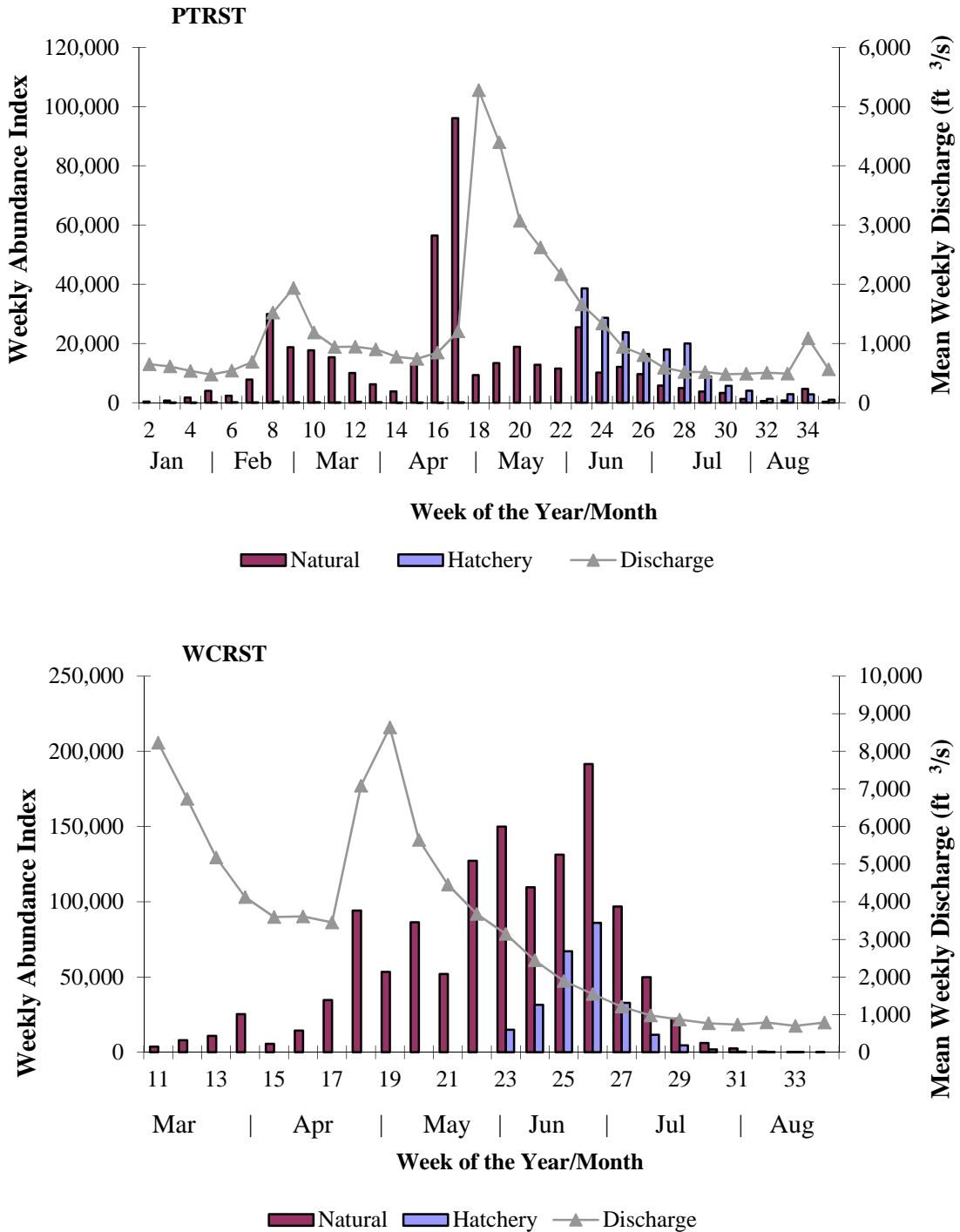


Figure 3. Weekly proportional discharge based abundance indices for natural age-0 and hatchery age-0 Chinook salmon captured at PTRST (rkm 118) and WCRST (rkm 34). Mean daily discharge (ft³/s) was recorded near Helena, California (US Geological Survey Water Resource gauge station #11-526400) and at Hoopa, California (US Geological Survey Water Resource stream gage station #11-530000). Please note differences in scale of axes.

Following the hatchery release there was a dramatic shift in relative abundance through the remainder of the season, as age-0 hatchery fish accounted for 68% of the Chinook salmon index, and only 28% of the indexed Chinook were of natural origin. Age-1 Chinook were virtually absent following the hatchery release, as only nine individuals were indexed.

Naturally-produced age-0 Chinook salmon emigration duration spanned the entire season, with peak emigration occurring in WOY 17 (Table 7, Figure 3, Appendix 1).

Hatchery-produced age-0 Chinook salmon first arrived at the site in WOY 23, and were captured every week through the remainder of the season. Emigration of hatchery-produced Chinook peaked in WOY 23 (Table 7, Figure 3, Appendix 1).

Naturally-produced age-1 Chinook salmon were captured at the onset of sampling, and relatively large catches occurred in the early weeks of the season indicating that an unknown proportion of emigrating fish passed the site prior to the initiation of sampling. Peak emigration occurred in WOY 8 (Table 7), though a substantial portion of the total season index occurred in WOY 9 as well (Figure 3, Appendix 1). Emigration duration, as observed within the season, occurred from WOY 2-24.

Hatchery produced age-1 Chinook salmon were captured in small numbers near the onset of sampling. CWTs collected from several individuals indicated that most of these were brood year 2007 fall race individuals released from TRH as age-1 pre-smolts on October 1, 2008. Emigration duration, occurred from WOY 3-17.

Table 7. Juvenile salmonid emigration duration and peak as inferred from proportional discharge based abundance indices, at PTRST and WCRST, 2009. Values represent week of the year.

Site	Species	Emigration Duration			Emigration Peak		
		Natural Age-0	Natural Age-1+	Hatchery Age-0	Natural Age-0	Natural Age-1+	Hatchery Age-0
PTRST	Chinook salmon	2-35	2-24	23-35	17	8	23
PTRST	coho salmon	10-35	2-33	11-31	30	9	12
PTRST	steelhead	12-35	2-35	12-33	21	9	13
WC	Chinook salmon	11-35	11-19	23-35	26	11	26
WC	coho salmon	12-31	11-31	12-30	18	15	18
WC	steelhead	12-35	11-35	13-29	12	14	18

Willow Creek

The total abundance index for natural age-0 Chinook salmon was 1,277,357 (Table 6). Natural age-0 Chinook salmon had one distinct emigration period from WOY 11-35 peaking in WOY 26, but also two smaller peaks appear relative to surrounding weeks in WOY 14 and 18 (Appendix 2, Table 7). The date at which 80% of the natural age-0 Chinook salmon population, based on the flow based abundance index, passed the site was June 22, 2009 or WOY 26 which met the TRRP management target date of July 9.

Natural age-1 Chinook salmon were collected from WOY 11-19 with an abundance index of 7,070. The peak occurred in the first week of sampling, WOY 11, suggesting that natural age-1 Chinook were emigrating past the site in unknown numbers prior to trap operation (Appendix 2, Table 7).

The 2009 abundance index total for hatchery age-0 Chinook salmon was 251,094 (Table 6, Appendix 2). Emigration duration of hatchery age-0 Chinook salmon was WOY 23-35 with a peak in WOY 26 (Table 7, Appendix 2). Weekly abundance indices of hatchery age-0 Chinook salmon increased through June, then decreased from the start of July through the end of August.

Coho salmon

Pear Tree

The total season coho salmon abundance index at PTRST was 10,513 (Table 6), and included 1,894 (18% of the total index) hatchery-produced age-1 fish, 6,785 naturally-produced age 1 fish (65% of the total coho index), and 1,834 naturally-produced age-0 fish (17% of the total coho index).

Natural age-0 coho salmon emigration duration was WOY 10-35, with a peak in WOY 30 (Table 7) that accounted for 15% of the total season indexed passage.

Natural age-1 coho salmon smolt peak emigration occurred in WOY 9, after which their weekly abundance index dropped off rapidly. Emigration duration for age-1 non-hatchery coho salmon was WOY 2-33, with 60% of the total indexed passage occurring by WOY 9, and 82% of the indexed passage occurring by the end of WOY 11.

Hatchery age-1 coho salmon smolt emigration duration was WOY 11-23 (Table 7, Figure 4), though there were a few captured later in the season (pooled WOY 24-31 index = 16, or 1% of the annual passage index). Peak emigration was abrupt, with 64% of the indexed passage occurring in WOY 12, after which the catch dropped off dramatically.

Willow Creek

In 2009, age-0 coho salmon abundance index total was 1,010 (Table 6), and the emigration duration was WOY 12-31, peaking in WOY 18 with a smaller peak in WOY 22 (Table 7, Appendix 4).

Natural age-1 coho abundance index was 4,098 (Table 6). Emigration duration for natural age-1 coho salmon was WOY 11-31, with several similar peaks in WOY 15, WOY 18 and 22 (Table 7, Figure 4, Appendix 4). The date at which 80% of the natural age-1 coho salmon population, based on the flow based abundance index, passed the site was May 25, 2009 or WOY 21 which met the TRRP management target date of June 4.

Hatchery age-1 coho salmon abundance index total was 8,132 (Table 6). Emigration duration for hatchery age-1 coho salmon was WOY 12-30 with two distinct emigration periods, one from WOY 12-14 peaking WOY 12, and another from WOY 17-30 peaking WOY 18 (Table 7, Figure 4, Appendix 4).

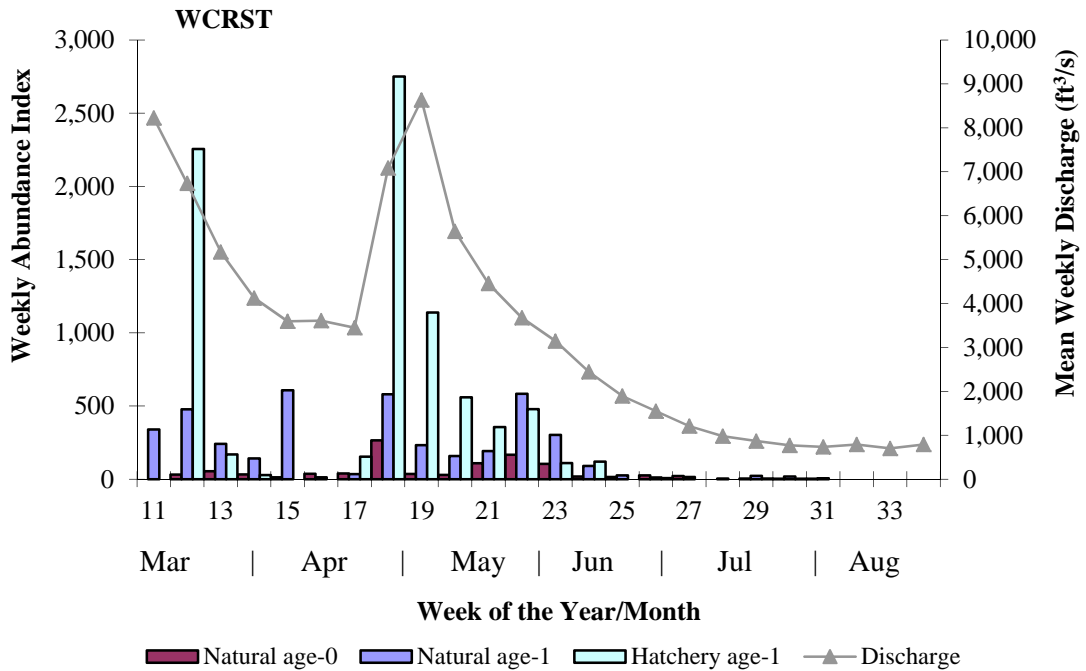
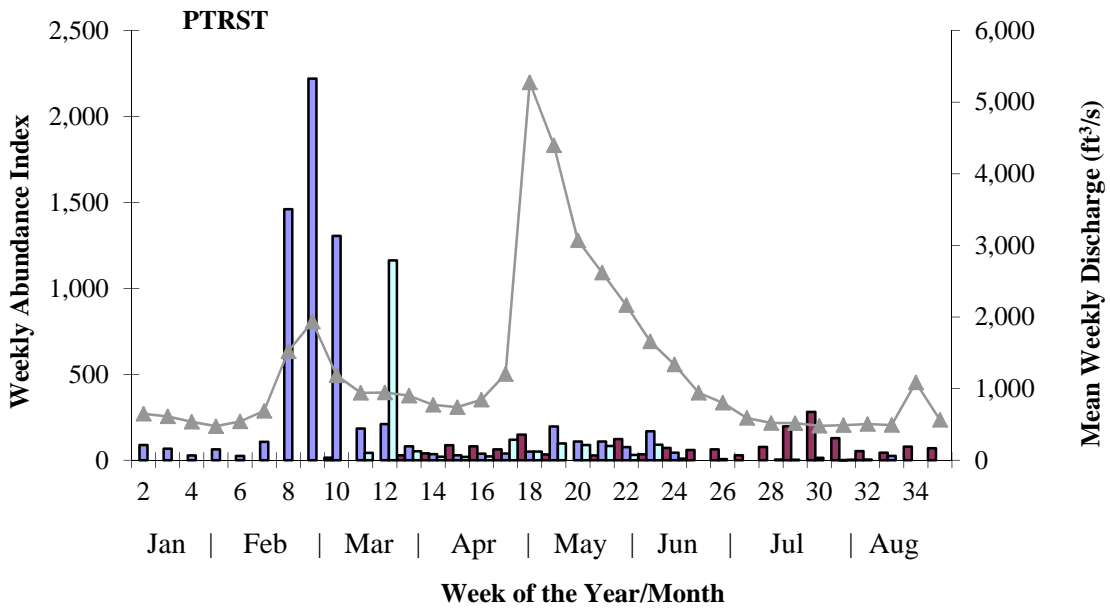


Figure 4. Weekly proportional discharge based abundance indices for natural age-0, age-1, and hatchery age-1 coho salmon captured at PTRST and WCRST. Mean daily discharge (ft³/s) was recorded by US Geological Survey Water Resource gauge station #11-526400, near Helena (rkm 118), California, and US Geological Survey Water Resource gauge station #11-530000 at Hoopa (rkm 34), California, 2009. Please note differences in scale of axes.

Steelhead

Pear Tree

The total season steelhead abundance index at PTRST was 72,173 (Table 6, Appendix 5). The abundance index of naturally-produced age-1 smolts was 34,951, which accounted for 48% of the total steelhead index. The total season age-1 hatchery steelhead index was 24,976, which accounted for 35% of the total steelhead index. Natural age-2 steelhead accounted for only 1% of the total index. The age-0 steelhead index was 11,716, and accounted for 16% of the total season steelhead abundance index.

The emigration duration of age-1 natural steelhead smolts at PTRST was WOY 2-35 (Figure 5, Table 7, Appendix 5), with a sharp peak in emigration occurring in WOY 9, and 70% of the indexed passage occurring in WOY 8-10. Emigration duration of natural age-2 steelhead smolts at PTRST was WOY 2-30, with a poorly defined peak occurring WOY 22. The emigration duration of natural age-0 steelhead at PTRST was WOY 12-35, with a peak occurring in WOY 21 and 44% of the indexed passage occurring in WOY 18-22.

Hatchery steelhead smolts were absent from the catch at the onset of sampling and did not appear at the site until March 19 (WOY 12), four days after being released from TRH. Emigration peaked dramatically in WOY 13, with 36% of the indexed passage occurring in that week. Emigration duration was WOY 12-33, though relatively few, approximately 0.1% of the annual index, passed the site after WOY 25.

Willow Creek

In 2009, age-0 steelhead abundance index total was 3,180 (Table 6). Emigration duration was WOY 12-35, peaking WOY 12 (Table 7, Appendix 6).

Natural age-1+ steelhead abundance index total was 82,955 (Table 6). Natural age-1+ steelhead had one distinct emigration period (WOY 11-35) peaking in WOY 14 (Figure 5, Table 7, Appendix 6). The date at which 80% of the natural age-1 steelhead population, based on the flow based abundance index, passed the site was April 28, 2009 or WOY 17 which met the TRRP management target date of May 22.

Hatchery age-1+ steelhead abundance index total was 81,409 (Table 6). The emigration duration of natural age-1+ steelhead had one distinct period (WOY 13-29) with a peak in WOY 18 (Figure 5, Table 7, Appendix 6).

Migration Rates

Chinook salmon

Mean migration rate of marked juvenile Chinook salmon released at PTRST and recaptured at WCRST was 16.8 rkm/day, (SD 9.3 rkm/day). No significant correlation (t-test) was found between migration rate and release date ($p=0.38$), fork length ($p=0.71$), or river discharge at the Pear Tree gauge ($p=0.45$).

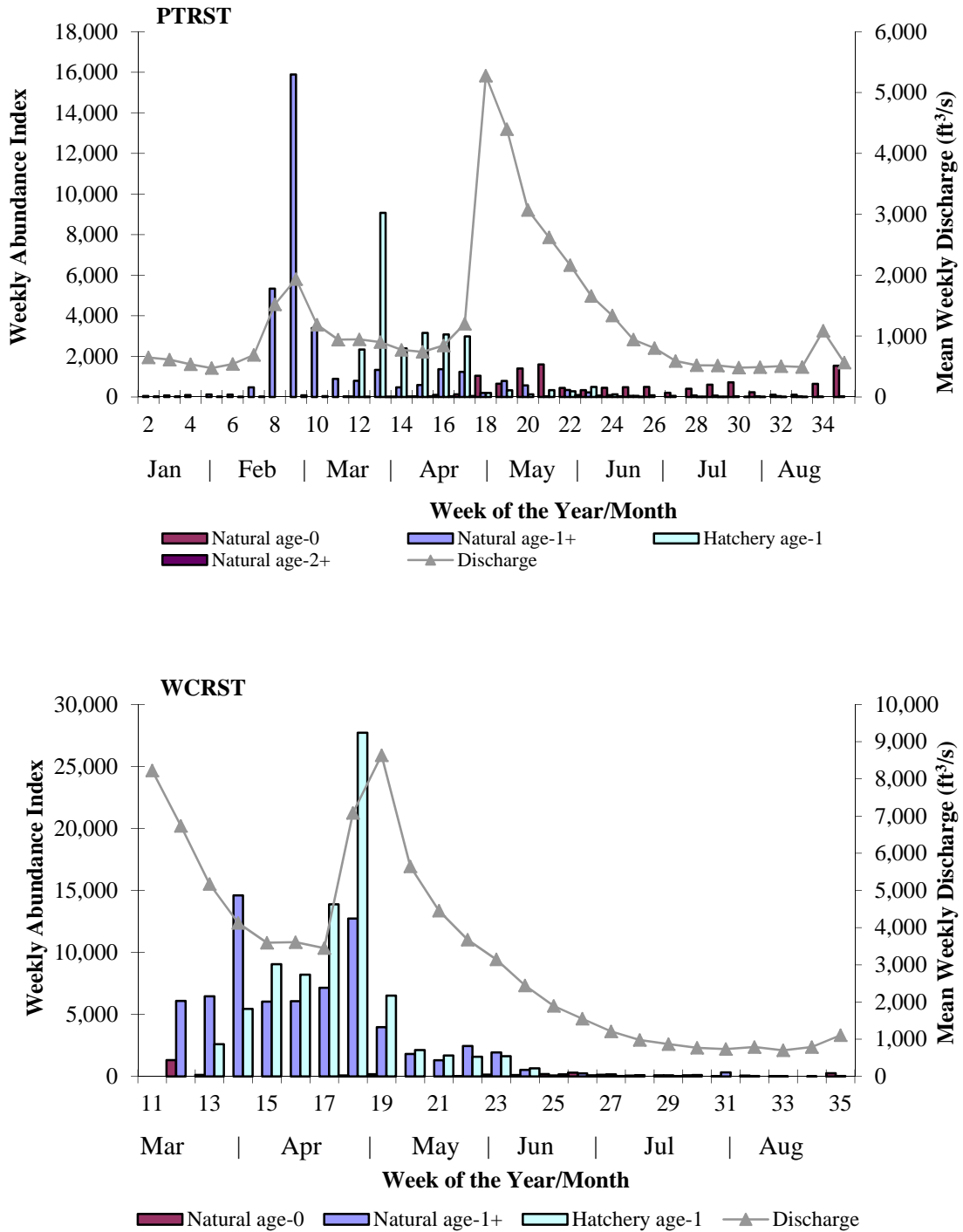


Figure 5. Weekly proportional discharge based abundance indices for natural age-0, natural age-1+, and hatchery age-1 steelhead captured at PTRST and WCRST. Mean daily discharge (ft³/s) was recorded by US Geological Survey Water Resource gauge station #11-526400, near Helena (rkm 118), California, and US Geological Survey Water Resource gauge station #11-530000 at Hoopa (rkm 34), California, 2009. Please note differences in scale of axes.

Juvenile Chinook salmon were released from TRH on June 1, 2009, and first captured at PTRST on June 4, 2009. The initial/maximum migration rate at PTRST for hatchery Chinook salmon calculated from the initial release date and first ad-clip captured was 21.3 rkm/day (Table 8). Juvenile Chinook salmon released from TRH were first captured at WCRST on June 6, 2009. The initial/maximum migration rate at WCRST for hatchery Chinook salmon calculated from the initial release date and first ad-clip captured was 29.2 rkm/day (Table 8).

Coho salmon

Coho salmon yearlings released from TRH on March 15, 2009, were first captured at PTRST on March 18, 2009. The maximum migration rate calculated from the initial release date and first max-clip captured was 21.3 rkm/day (Table 8). Coho salmon yearlings released from TRH were first captured at WCRST on March 21, 2009. The maximum migration rate calculated from the initial release date and first max-clip captured was 24.3 rkm/day (Table 8).

Steelhead

Steelhead yearlings released from TRH on March 15, 2009, were first captured at PTRST on March 19, 2009. The migration rate calculated from the initial release date and first ad-clip captured was 16.0 rkm/day (Table 8). Steelhead yearlings released from TRH were first captured at WCRST on March 29, 2009. The migration rate calculated from the initial release date and first ad-clip captured was 10.4 rkm/day (Table 8).

Table 8. Juvenile salmonid maximum migration rate from TRH to PTRST and WCRST California, operated by the Hoopa Valley Tribal Fisheries Department, United States Fish and Wildlife Service, Arcata Fish and Wildlife Office, and the Yurok Tribal Fisheries Program, 2009.

Site	Species	Date First Released	Date First Captured	# of Days	Maximum Migration Rate
PTRST	Chinook salmon	6/01/2009	6/04/2009	3	21.3 rkm/day
PTRST	coho salmon	3/15/2009	3/18/2009	3	21.3 rkm/day
PTRST	steelhead	3/15/2009	3/19/2009	4	16.0 rkm/day
WCRST	Chinook salmon	6/01/2009	6/06/2009	5	29.2 rkm/day
WCRST	coho salmon	3/15/2009	3/21/2009	6	24.3 rkm/day
WCRST	steelhead	3/15/2009	3/29/2009	14	10.4 rkm/day

Population Estimate

Pear Tree

Mark recapture tests were conducted WOY 4-34 (Appendix 7). A total of 72,813 marked age-0 Chinook salmon were released and 2,991 marks were recovered for a season-wide recapture rate of 4%. The average weekly recapture rate was 5% and weekly recapture rates ranged from 0.2% during periods of high discharge, to 16% at base flows (481 cfs). The total season population estimate of age-0 non-hatchery Chinook salmon passing the site from WOY 2-35 was 1,740,438, (SD 152,814). The total season estimate of hatchery Chinook salmon age-0 was 743,625, (SD 87,987).

Willow Creek

Mark-recapture tests were conducted from WOY 24-31 (Appendix 8). A total of 23,040 marked age-0 Chinook salmon were released and the season-wide recapture rate was 5% with 1,227 recaptures. The age-0 Chinook salmon population estimate for the period from WOY 11-35 was 2,987,837 (SD 212,008). The total season estimate of hatchery Chinook salmon age-0 was 784,557, (SD 88,501).

Fork Lengths

Chinook salmon

Pear Tree

During the pre-hatchery release sampling period (WOY 2 - WOY 22), weekly mean FL ranged from 40 mm to 66 mm and there was a general increase in mean FL, although the pattern of increasing FL was not consistent (Figure 6, Appendix 9). Between WOY 2 and WOY 12 mean weekly FL increased by only 5 mm as newly emerged fish were common in the catch. Between WOY 12-22 mean weekly fork length increased by 22 mm. Between WOY 22-23, with hatchery Chinook first arriving at the site, age-0 mean weekly FL increased by 22 mm and continued to increase steadily as the season progressed, ranging from 86 mm to 97 mm.

Mean weekly FL of age-1 Chinook salmon, for weeks where three or more were sampled, ranged from 87 mm to 108 mm. There was no discernible trend in mean weekly FL as the season progressed, as mean and maximum weekly FL fluctuated from week to week with no apparent pattern (Figure 6, Appendix 9).

Willow Creek

Mean FL of age-0 Chinook salmon at WCRST was fairly stable with a gradual increase from 42 mm to 63 mm between WOY 11-22, before jumping quickly in WOY 23 and 24 to 79 mm and 86 mm, respectively, with the arrival of hatchery fish. This increase in mean FL was maintained and fork lengths fluctuated moderately in the high 70's and low 80's until the end of sampling, when a jump was seen in the average FL (Figure 6, Appendix 10).

Coho salmon

Pear Tree

Mean weekly FL of naturally-produced age-0 coho salmon, for weeks when three or more were measured, ranged from 35 mm in April, to 109 mm in August, and increased steadily through much of the season. Mean weekly FL of naturally-produced age-1 coho salmon, for weeks when three or more were measured, ranged from 88 mm to 170 mm, and remained fairly stable from January through late April before increasing inconsistently through the remainder of the season. Mean weekly FL of hatchery coho salmon ranged from 150 mm to 210 mm, and fluctuated without increasing as the season progressed (Figure 7, Appendix 9).

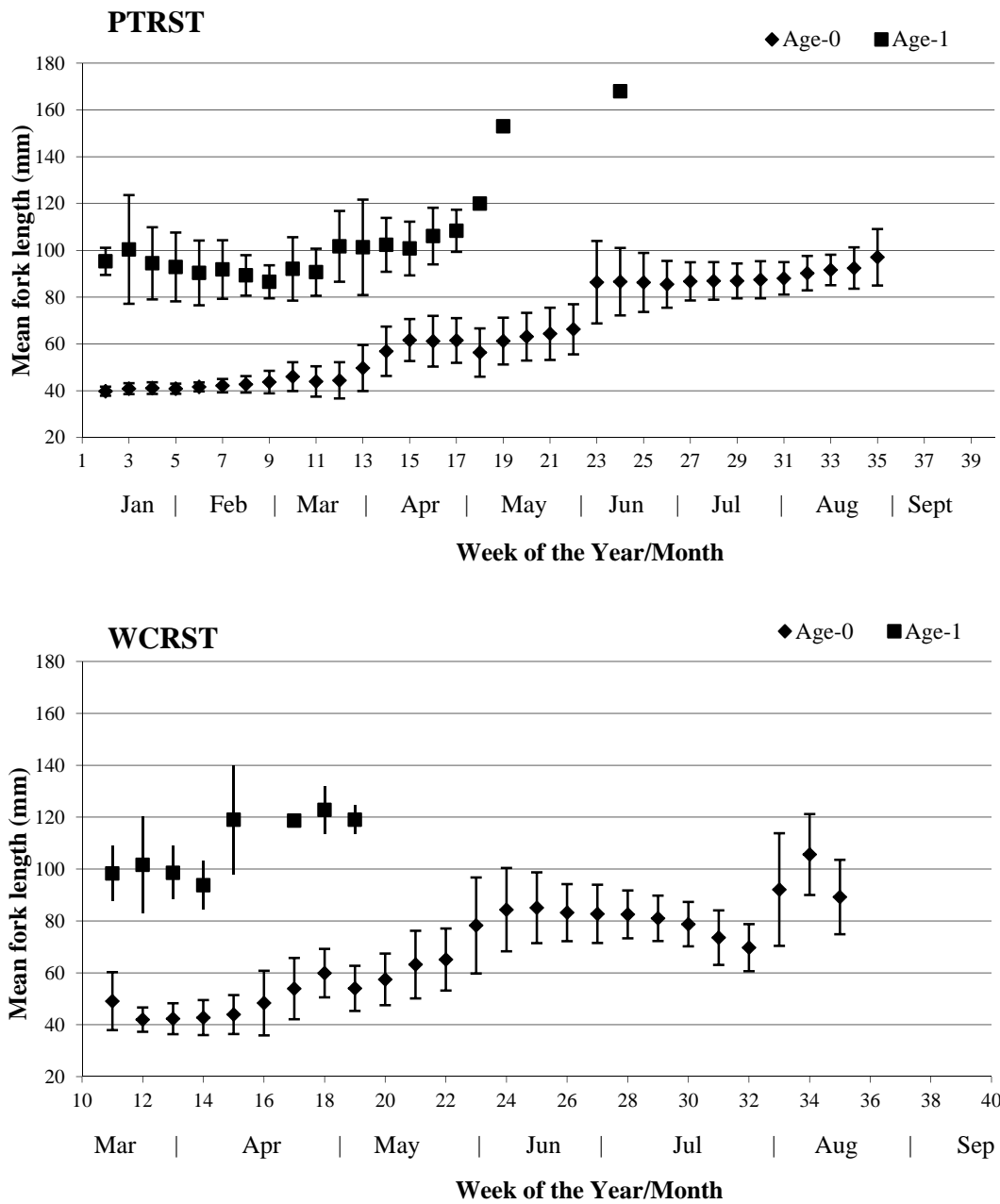


Figure 6. Weekly mean fork lengths of age-0 and age-1 Chinook salmon captured at PTRST and WCRST, 2009. Error bars represent one standard deviation of the mean.

Willow Creek

Mean FL of age-0 coho salmon generally increased over the 2009 sampling season, but averages fluctuated greatly due to low catch rates, e.g., only WOY 21 and 22 had catches of more than three age-0 coho. Mean FL of hatchery age-1 coho salmon was generally steady between 154 and 181 mm with no discernible pattern. Mean FL of natural age-1 coho salmon generally varied between 93 and 175 mm, with the three highest averages all in the month of April (Figure 7, Appendix 10).

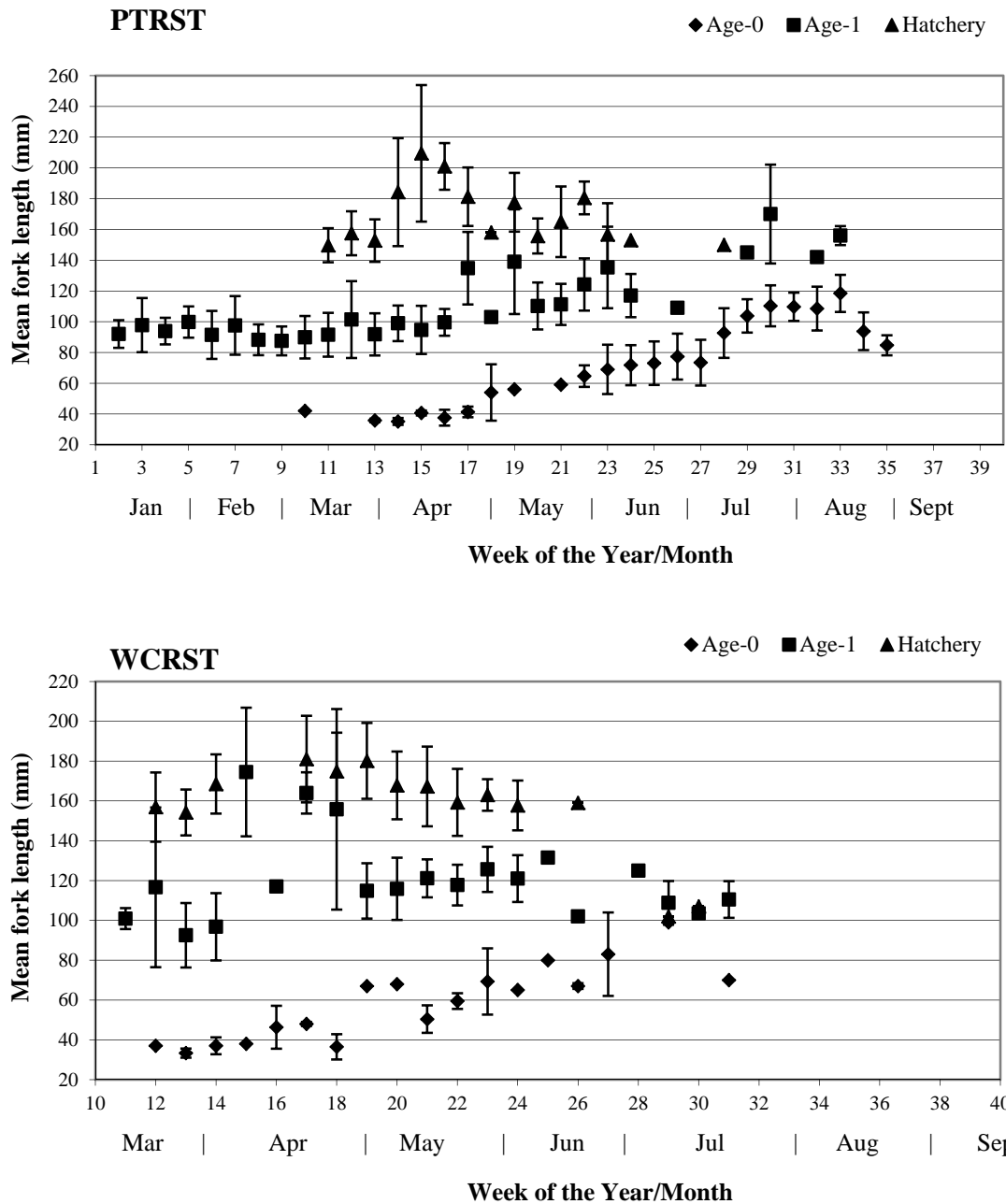


Figure 7. Weekly mean fork lengths for natural age-0, natural age-1, and hatchery coho salmon captured at PTRST and WCRST, 2009. Error bars represent one standard deviation of the mean.

Steelhead

Pear Tree

Naturally-produced age-0 steelhead weekly mean FL ranged from 29 mm in April, to 74 mm in late August, and increased steadily as the season progressed. Naturally-produced age-1 steelhead mean weekly FL ranged from 85 mm to 148 mm, and remained fairly consistent from January through mid-May before increasing steadily from June through the remainder of the season. Age-2 steelhead mean weekly FL, in weeks when three or more were measured, ranged from 170 mm to 197 mm, but no clear pattern in FL change

was seen as the season progressed. Hatchery steelhead mean weekly FL, when the sample size was three or more, ranged from 172 mm to 205 mm, with no discernible increase in mean FL as the season progressed (Figure 8, Appendix 11).

Willow Creek

Mean FL of age-0 steelhead generally increased over the 2009 sampling season when catch numbers were three or greater. Natural age-1 steelhead generally increased in size through the season, and the size of natural age-2+ steelhead was mostly constant with a small peak in April. Mean FL of hatchery age-1 steelhead generally decreased from an early average above 200 mm in March and April (Figure 8, Appendix 12).

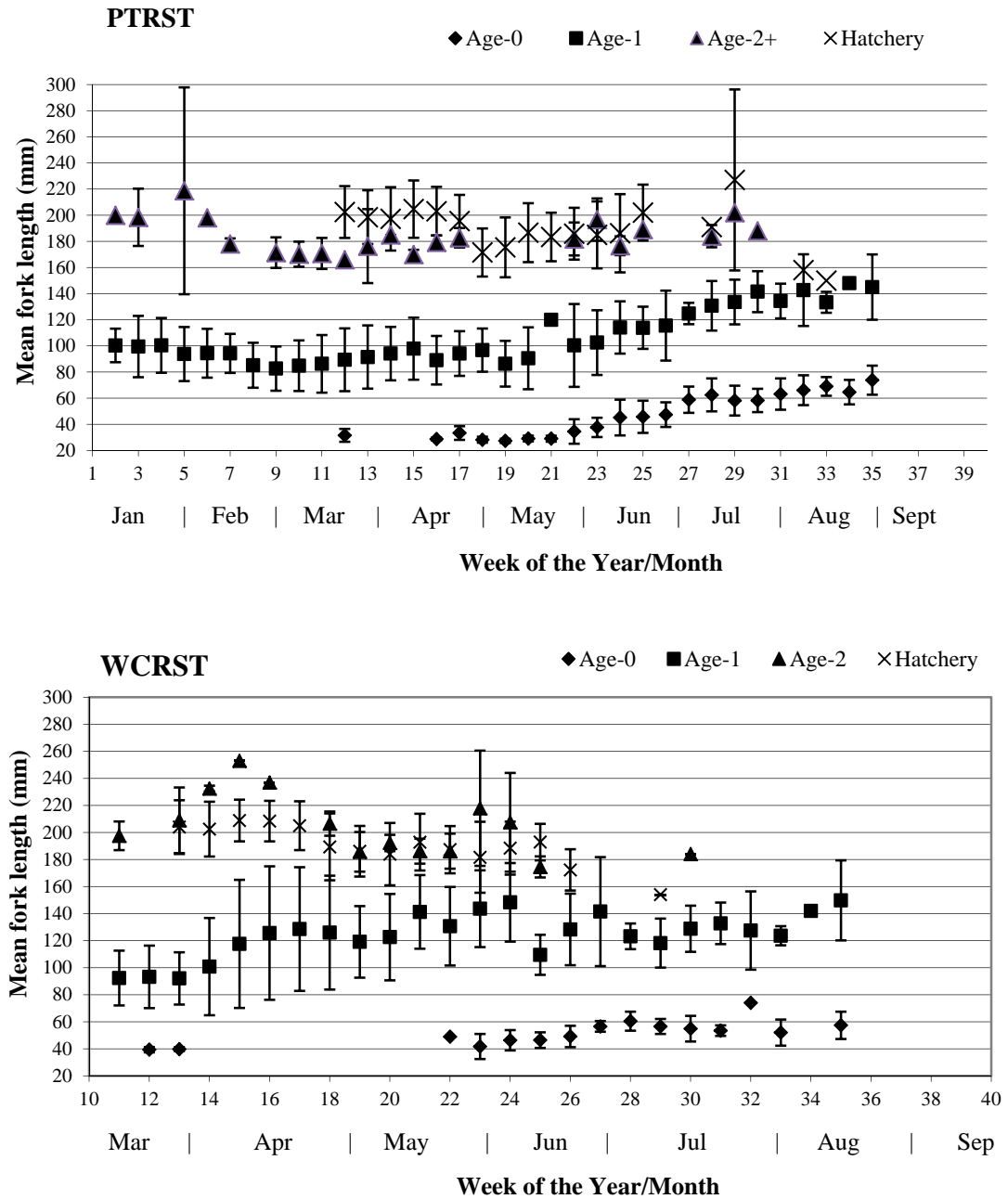


Figure 8. Weekly mean fork lengths for natural age-0, age-1, age-2, and hatchery age-1 steelhead captured at PTRST and WCRST, 2009. Error bars represent one standard deviation of the mean.

Summary

Juvenile salmonid emigration from the mainstem Trinity River has been monitored since 1989 with rotary screw traps. This data series report summarizes the outmigrant monitoring data collected in 2009 cooperatively by the Arcata Fish and Wildlife Office, Hoopa Valley Tribal Fisheries Department, and Yurok Tribal Fisheries Program. It is intended that this information will provide basic biological information that can be used by managers to evaluate the effectiveness of habitat restoration efforts, especially the new flow regimes recommended in the Record of Decision, in restoring the fishery resources of the Trinity River.

Sampling Efforts

The utilization of multiple traps beginning in 2002 has improved the ability to generate population estimates due to greater capture efficiency and a decreased possibility of losing catch data for a day if one trap has a flawed set, typically due to being clogged with debris. It is recommended that multiple traps continue to be utilized at both Trinity River trapping sites. While trapping operations have been refined to operate the traps at greater flows ($>12,000 \text{ ft}^3/\text{s}$), high and variable flows during the beginning of the trapping seasons create challenges in maintaining effective sampling.

In 2009, trapping at PTRST and WCRST were initiated in the second week of January and March, respectively. To ensure that the greatest portion of the natural Chinook salmon emigration, as well as portions of the hatchery and natural coho salmon and steelhead smolt emigration, is sufficiently sampled, efforts were made to install the traps as early as possible and continue sampling throughout the summer. This allows comparable data, especially similar time periods, to be collected for inter-annual comparisons in emigration timing (duration and peak) and abundance. Additionally, it is important to point out that sampling a portion of the year (i.e. the spring/summer season) samples only a portion of the annual production, and all estimates of production refer only to the sampling period.

Salmonid Biological Information

The Chinook salmon population in the Trinity River is composed of both naturally-produced and hatchery-produced fish of both spring and fall races. The vast majority of juveniles during the spring/summer emigration period emigrate as age-0 fish, with the natural and hatchery emigration periods overlapping. Chinook salmon were captured at PTRST and WCRST throughout the 2009 sampling season with the spring/summer emigration dominated by naturally-produced fish comprising 70% and 79%, respectively, of the total emigration, based on mark-recapture population estimates. The estimate of the week in which 80% of the juvenile Chinook salmon population passed WCRST, as inferred from the flow based abundance index was WOY 26 (June 25-July 1), which occurred prior to the Trinity River Restoration Program (TRRP) management target date of July 9.

The coho salmon population in the Trinity River is composed of both naturally-produced and hatchery populations. The vast majority of Trinity River coho salmon emigrate to the ocean as age-1 smolts while the emigration of age-0 fish is presumably a

redistribution of juveniles rearing in the mainstem. Natural age-1 coho salmon emigrated through the Trinity River at PTRST and WCRST beginning prior to trap installation and continued through to late July in 2009, while hatchery age-1 coho salmon emigrated following their release in mid-March through late June. The age-1 coho salmon emigration is composed primarily of hatchery-produced fish at WCRST, comprising 61% of the total index in 2009, and dominated by naturally-produced fish at PTRST, comprising 82% of the total index in 2009 based on abundance indices. The data suggest that the sampling period did not encompass the entire naturally-produced age-1 coho salmon emigration period at WCRST. It is possible that these naturally-produced age-1 coho salmon spend extended rearing in the Trinity Basin and emigrate in the late fall as larger individuals. The estimate of the week in which 80% of the natural coho salmon smolt population passed the WCRST was WOY 22 (May 28-June 3), which occurred prior to the TRRP management target date of June 4.

The steelhead populations (summer, fall, and winter races) in the Trinity River are composed of both tributary and mainstem spawning and rearing populations that exhibit highly variable juvenile life history patterns, as well as a hatchery-produced component. All age classes of steelhead were generally captured throughout the sampling season at PTRST and WCRST, with peaks in abundance occurring during the early portion of sampling for age-1, and in June for age-0 fish. Age-1 or older natural steelhead were present throughout the sampling period. The majority of hatchery-produced age-1 steelhead emigrated by the end of June. Based on abundance indices at PTRST and WCRST, the age-1+ steelhead emigration is composed of 47% and 35%, respectively, hatchery-produced fish. As with coho salmon smolts, it is likely that naturally-produced age-1 steelhead exhibit extended rearing in the Trinity Basin and emigrate in the fall/winter as larger individuals. The estimate of the week in which 80% of the steelhead smolt population passed the WCRST, as inferred from flow based abundance indices, was WOY 18 (April 30-May 6), which occurred prior to the TRRP management target date of May 22.

Abundance Indices

Since natural age-0 Chinook salmon were captured on the first day of trap operation in 2009, it is possible that a portion of the early spring natural age-0 Chinook salmon emigrated prior to trap installation.

Chinook Salmon Population Estimation

Since 2002, mark-recapture efforts to estimate the size of the emigrating Chinook salmon population, as well as estimate the precision of these estimates, were incorporated into trapping operations. These efforts in previous years were limited due to lack of sufficient funding. Flow based abundance indices calculated by catch numbers and the proportion of flow sampled by the trap(s) have been the quantification method employed for many years (USFWS 1991, 1994, 1998, 1999, and 2001), and are generally thought to be adequate indicators of emigration timing and duration if sampling occurred in all weeks of the sampling period. A shortcoming of the abundance indices is that they do not provide a measure of the precision of the indices, making inter-year comparisons questionable. Mark-recapture efforts employed since 2002 (Pinnix et al. 2007; Pinnix and Quinn 2009, Pinnix et al. 2010) indicate that precise population estimates can be obtained (95% confidence intervals ranging from 9% to 55% of the estimate) depending

on the proportion of the population marked (marking rate), and capture efficiency (recapture rate).

During the 2009 sampling season, marked hatchery Chinook salmon were used to estimate capture efficiency to generate population estimates during the sampling period. The population estimate of naturally-produced age-0 Chinook salmon at PTRST was approximately 1.74 million while the estimate at WCRST was approximately 2.99 million. It is likely that the WCRST estimate is higher due to recruitment of juvenile Chinook salmon from tributaries (i.e. North Fork Trinity River, South Fork Trinity River, and Willow Creek) and mainstem spawning below PTRST. It is interesting to note that the hatchery age-0 Chinook salmon estimates at the two sites were nearly the same, lending evidence to the theory that the higher natural estimate at WCRST is due to additions to the population downstream of PTRST, since there is no hatchery input between the two sites.

Acknowledgements

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Appendices

Appendix 1. Trinity River at PTRST weekly Chinook salmon catches, and abundance indices, 2009. NC = no clip, AD = adipose fin clip. Hatchery fish captured before WOY 23 were assumed to be age-1.

Week Starting	Week of the Year	Mean Daily Discharge	Trap Days Sampled	Weekly Chinook Catch					Weekly Chinook Index Totals				Index Total
				Hatchery		Natural		Catch Total	Hatchery		Natural		
				NC	AD	Age-0	Age-1		NC	AD	Age-0	Age-1	
01/08/09	2	649	4	0	0	15	10	25	0	0	220	147	367
01/15/09	3	613	14	3	1	94	87	185	12	4	372	344	732
01/22/09	4	536	14	6	2	385	106	499	21	7	1,355	373	1,756
01/30/09	5	475	14	36	12	1,162	104	1,314	115	38	3,677	328	4,158
02/05/09	6	540	14	30	10	592	73	705	109	36	2,105	257	2,507
02/12/09	7	689	10	12	4	1,151	82	1,249	75	25	7,274	519	7,893
02/19/09	8	1,521	11	21	7	2,258	100	2,386	269	89	28,678	1,268	30,304
02/26/09	9	1,936	12	6	2	1,123	74	1,205	94	31	17,559	1,157	18,841
03/05/09	10	1,185	14	15	5	2,277	42	2,339	115	38	17,377	320	17,850
03/12/09	11	941	14	12	4	2,492	15	2,523	75	25	15,264	90	15,454
03/19/09	12	946	14	42	14	1,579	46	1,681	263	87	9,767	281	10,398
03/26/09	13	901	14	15	5	1,046	30	1,096	88	29	6,042	172	6,331
04/02/09	14	773	14	9	3	766	4	782	45	15	3,813	20	3,893
04/09/09	15	741	14	3	1	2,702	6	2,712	15	5	13,067	29	13,116
04/16/09	16	845	14	6	2	10,408	12	10,428	33	11	56,395	65	56,504
04/23/09	17	1,203	14	9	3	12,145	6	12,163	72	24	96,031	47	96,174
04/30/09	18	5,276	12	0	0	186	1	187	0	0	9,256	50	9,306
05/07/09	19	4,397	14	0	0	407	2	409	0	0	13,317	65	13,382
05/14/09	20	3,070	14	0	0	862	0	862	0	0	18,882	0	18,882
05/21/09	21	2,620	10	0	0	465	0	465	0	0	12,808	0	12,808
05/28/09	22	2,166	14	0	0	724	27	751	0	0	11,111	414	11,525
06/04/09	23	1,659	14	2,588	854	2,272	0	5,714	29,025	9,576	25,472	0	64,073
06/11/09	24	1,336	14	2,405	794	1,134	1	4,334	21,560	7,113	10,146	9	38,828
06/18/09	25	942	14	2,741	904	1,856	0	5,501	17,877	5,898	12,113	0	35,888
06/25/09	26	802	14	2,145	708	1,674	0	4,527	12,363	4,079	9,638	0	26,080
07/02/09	27	590	10	2,311	762	989	0	4,062	13,527	4,463	5,800	0	23,790
07/09/09	28	520	14	4,111	1,356	1,349	0	6,816	15,046	4,964	4,940	0	24,950
07/16/09	29	517	14	1,860	614	1,058	0	3,532	6,659	2,197	3,780	0	12,636
07/23/09	30	481	14	1,272	420	980	0	2,672	4,265	1,407	3,280	0	8,952
07/30/09	31	489	14	875	289	365	0	1,529	3,037	1,002	1,261	0	5,300
08/06/09	32	505	14	262	87	166	0	515	937	309	583	0	1,829
08/13/09	33	492	8	345	114	119	0	578	2,158	712	738	0	3,608
08/20/09	34	1,086	8	159	53	356	0	568	2,116	698	4,662	0	7,476
08/27/09	35	564	4	63	21	30	0	114	749	247	343	0	1,339
Totals			425	21,362	7,051	55,187	828	84,428	130,720	43,129	427,126	5,955	606,930

Appendix 2. Trinity River at WCRST weekly Chinook salmon catches, and abundance indices, 2009. NC = no clip, AD = adipose fin clip.

Week Starting	Week Of the Year	Mean Daily Discharge	Days Sampled	Weekly Chinook Catch					Weekly Chinook Index Totals				
				Hatchery		Natural		Catch Total	Hatchery		Natural		Index Total
				NC	AD	Age-0	Age-1		NC	AD	Age-0	Age-1	
03/12/09	11	8,225	12	0	0	134	99	233	0	0	3,760	5,548	9,308
03/19/09	12	6,735	13	0	0	262	24	287	0	0	7,973	865	8,902
03/26/09	13	5,175	21	0	0	591	22	617	0	0	10,889	276	11,338
04/02/09	14	4,125	21	0	0	1,643	7	1,654	0	0	25,339	58	25,496
04/09/09	15	3,595	21	0	0	435	8	443	0	0	5,559	102	5,661
04/16/09	16	3,610	21	0	0	1,126	0	1,126	0	0	14,370	0	14,370
04/23/09	17	3,450	21	0	0	2,859	0	2,862	0	0	34,693	0	34,728
04/30/09	18	7,085	12	0	0	2,028	3	2,034	0	0	94,130	70	94,514
05/07/09	19	8,635	12	0	0	1,140	3	1,143	0	0	53,425	151	53,576
05/14/09	20	5,645	14	0	0	3,101	0	3,101	0	0	86,381	0	86,381
05/21/09	21	4,455	14	0	0	2,375	0	2,375	0	0	51,976	0	51,976
05/28/09	22	3,675	16	0	0	8,106	0	8,106	0	0	127,256	0	127,256
06/04/09	23	3,145	16	747	249	9,494	0	10,490	11,215	3,739	149,932	0	164,886
06/11/09	24	2,445	21	2,688	896	12,183	0	15,767	23,649	7,883	109,594	0	141,126
06/18/09	25	1,895	20	6,729	2,243	17,081	0	26,053	50,342	16,781	131,320	0	198,443
06/25/09	26	1,550	21	10,437	3,479	31,880	0	45,796	64,489	21,497	191,519	0	277,505
07/02/09	27	1,210	15	3,372	1,124	13,618	0	18,114	24,618	8,206	96,828	0	129,652
07/09/09	28	980	21	1,845	615	10,230	0	12,690	8,719	2,906	49,907	0	61,532
07/16/09	29	869	21	855	285	5,693	0	6,833	3,402	1,134	22,360	0	26,896
07/23/09	30	771	21	426	142	1,835	0	2,403	1,439	480	6,194	0	8,113
07/30/09	31	736	18	84	28	738	0	850	289	96	2,537	0	2,922
08/06/09	32	791	16	3	1	127	0	131	16	5	529	0	550
08/13/09	33	702	15	12	4	66	0	82	64	21	193	0	278
08/20/09	34	791	10	9	3	29	0	41	53	18	119	0	190
08/27/09	35	1,107	20	6	2	134	0	142	25	8	574	0	607
Total			433	27,213	9,071	126,908	166	163,373	188,320	62,774	1,277,357	7,070	1,536,206

Appendix 3. Trinity River at PTRST weekly coho salmon catches, and abundance indices, 2009. R-MAX = right maxillary clip.

Week Starting	Week of the Year	Mean Daily Discharge	Trap Days Sampled	Weekly coho salmon catches				Weekly coho salmon indices			
				Hatchery	Natural		Catch	Hatchery	Natural		Index
				R-MAX	Age-0	Age-1	Total	R-MAX	Age-0	Age-1	Total
01/08/09	2	649	4	0	0	6	6	0	0	88	88
01/15/09	3	613	14	0	0	17	17	0	0	67	67
01/22/09	4	536	14	0	0	8	8	0	0	28	28
01/30/09	5	475	14	0	0	20	20	0	0	63	63
02/05/09	6	540	14	0	0	7	7	0	0	25	25
02/12/09	7	689	10	0	0	17	17	0	0	107	107
02/19/09	8	1,521	11	0	0	115	115	0	0	1,461	1,461
02/26/09	9	1,936	12	0	0	142	142	0	0	2,220	2,220
03/05/09	10	1,185	14	0	2	171	173	0	15	1,305	1,320
03/12/09	11	941	14	7	0	30	37	43	0	184	227
03/19/09	12	946	14	188	0	34	222	1,163	0	210	1,373
03/26/09	13	901	14	9	5	14	28	52	29	81	162
04/02/09	14	773	14	4	8	7	19	20	40	35	95
04/09/09	15	741	14	4	18	6	28	19	87	29	135
04/16/09	16	845	14	4	15	7	26	22	81	38	141
04/23/09	17	1,203	14	15	8	5	28	119	63	39	221
04/30/09	18	5,276	12	1	3	1	5	50	149	50	249
05/07/09	19	4,397	14	3	1	6	10	98	33	196	327
05/14/09	20	3,070	14	4	0	5	9	88	0	109	197
05/21/09	21	2,620	10	3	1	4	8	83	28	109	220
05/28/09	22	2,166	14	2	8	5	15	31	123	76	230
06/04/09	23	1,659	14	8	3	15	26	90	34	168	292
06/11/09	24	1,336	14	1	8	5	14	9	72	44	125
06/18/09	25	942	14	0	9	0	9	0	59	0	59
06/25/09	26	802	14	0	11	1	12	0	63	6	69
07/02/09	27	590	10	0	5	0	5	0	29	0	29
07/09/09	28	520	14	1	21	0	22	4	77	0	81
07/16/09	29	517	14	0	55	1	56	0	197	3	200
07/23/09	30	481	14	0	84	4	88	0	281	14	295
07/30/09	31	489	14	1	37	0	38	3	128	1	132
08/06/09	32	505	14	0	15	1	16	0	53	4	57
08/13/09	33	492	8	0	7	4	11	0	44	25	69
08/20/09	34	1,086	8	0	6	0	6	0	79	0	79
08/27/09	35	564	4	0	6	0	6	0	70	0	70
Total			425	255	336	658	1,249	1,894	1,834	6,785	10,513

Appendix 4. Trinity River at WCRST weekly coho salmon catches, and abundance indices, 2009. R-MAX = right maxillary clip.

Week Starting	Week of the Year	Man Daily Discharge	Trap Days Sampled	Weekly coho salmon catches			Weekly coho salmon indices				
				Hatchery R-MAX	Natural Age-0	Natural Age-1	Catch Total	Hatchery R-MAX	Natural Age-0	Natural Age-1	Index Total
03/12/09	11	8,225	12	0	0	10	10	0	0	340	340
03/19/09	12	6,735	13	64	1	16	81	2255	32	477	2,764
03/26/09	13	5,175	21	10	3	13	26	169	54	241	464
04/02/09	14	4,125	21	2	2	9	13	28	33	142	203
04/09/09	15	3,595	21	0	1	47	48	0	13	607	620
04/16/09	16	3,610	21	0	3	1	4	0	37	13	50
04/23/09	17	3,450	21	12	3	3	18	154	39	35	228
04/30/09	18	7,085	12	52	4	11	67	2750	265	580	3,595
05/07/09	19	8,635	12	22	1	5	28	1139	36	233	1,408
05/14/09	20	5,645	14	21	1	6	28	559	29	158	746
05/21/09	21	4,455	14	16	5	9	30	356	109	192	657
05/28/09	22	3,675	16	25	13	31	69	478	167	583	1,228
06/04/09	23	3,145	16	6	7	20	33	110	105	303	518
06/11/09	24	2,445	21	13	2	10	25	120	18	90	228
06/18/09	25	1,895	20	0	2	3	5	0	15	26	41
06/25/09	26	1,550	21	1	4	2	7	7	26	12	45
07/02/09	27	1,210	15	0	3	2	5	0	22	15	37
07/09/09	28	980	21	0	0	1	1	0	0	4	4
07/16/09	29	869	21	1	1	5	7	4	4	23	31
07/23/09	30	771	21	1	1	3	5	3	3	18	24
07/30/09	31	736	18	0	1	2	3	0	3	6	9
08/06/09	32	791	16	0	0	0	0	0	0	0	0
08/13/09	33	702	15	0	0	0	0	0	0	0	0
08/20/09	34	791	10	0	0	0	0	0	0	0	0
08/27/09	35	1,107	20	0	0	0	0	0	0	0	0
Total			433	246	58	209	513	8,132	1,010	4,098	13,240

Appendix 5. Trinity River at PTRST weekly steelhead catches, and abundance indices, 2009. AD = adipose fin clip.

Week Starting	Week of the Year	Trap Mean Flow	Trap Days Sampled	Weekly Steelhead Catch					Weekly Steelhead Abundance Indices				
				Hatchery AD	Natural Age-0	Natural Age-1+	Natural Age 2+	Catch Total	Hatchery AD	Natural Age-0	Natural Age-1+	Natural Age 2+	Index Total
01/08/09	2	649	4	0	0	3	1	4	0	0	44	15	59
01/15/09	3	613	14	0	0	18	5	23	0	0	71	20	91
01/22/09	4	536	14	0	0	27	0	27	0	0	95	0	95
01/30/09	5	475	14	0	0	38	3	41	0	0	120	9	129
02/05/09	6	540	14	0	0	33	1	34	0	0	117	4	121
02/12/09	7	689	10	0	0	75	2	77	0	0	474	13	487
02/19/09	8	1,521	11	0	0	420	0	420	0	0	5,334	0	5,334
02/26/09	9	1,936	12	0	0	1,016	5	1,021	0	0	15,886	78	15,964
03/05/09	10	1,185	14	0	0	445	5	450	0	0	3,396	38	3,434
03/12/09	11	941	14	0	0	146	4	150	0	0	894	25	919
03/19/09	12	946	14	378	2	128	1	509	2,338	12	792	6	3,148
03/26/09	13	901	14	1,570	0	230	1	1,801	9,069	0	1,329	6	10,404
04/02/09	14	773	14	481	1	95	2	579	2,394	5	473	10	2,882
04/09/09	15	741	14	653	3	122	4	782	3,158	15	590	19	3,782
04/16/09	16	845	14	568	19	252	6	845	3,078	103	1,365	33	4,579
04/23/09	17	1,203	14	377	16	156	6	555	2,981	127	1,233	47	4,388
04/30/09	18	5,276	12	4	21	4	0	29	199	1,045	199	0	1,443
05/07/09	19	4,397	14	10	20	24	0	54	327	654	785	0	1,766
05/14/09	20	3,070	14	6	64	26	0	96	131	1,402	570	0	2,103
05/21/09	21	2,620	10	12	58	1	0	71	331	1,598	28	0	1,957
05/28/09	22	2,166	14	18	29	22	6	75	276	445	338	92	1,151
06/04/09	23	1,659	14	44	30	20	6	100	493	336	224	67	1,120
06/11/09	24	1,336	14	14	50	10	3	77	125	448	90	27	690
06/18/09	25	942	14	8	73	8	1	90	52	476	52	7	587
06/25/09	26	802	14	0	86	14	0	100	0	495	81	0	576
07/02/09	27	590	10	0	35	9	0	44	0	205	53	0	258
07/09/09	28	520	14	1	110	20	2	133	4	403	73	7	487
07/16/09	29	517	14	2	168	19	1	190	7	601	68	4	680
07/23/09	30	481	14	0	214	10	1	225	0	717	34	3	754
07/30/09	31	489	14	1	67	9	0	77	3	232	31	0	266
08/06/09	32	505	14	1	30	11	0	42	4	107	39	0	150
08/13/09	33	492	8	1	17	4	0	22	6	106	25	0	137
08/20/09	34	1,086	8	0	49	1	0	50	0	645	13	0	658
08/27/09	35	564	4	0	131	3	0	134	0	1,539	35	0	1,574
Total			425	4,149	1,293	3,419	66	8,927	24,976	11,716	34,951	530	72,173

Appendix 6. Trinity River at WCRST weekly steelhead catches, and abundance indices, 2009. AD = adipose fin clip.

Week Starting	Week of the Year	Mean Flow	Trap Days Sampled	Weekly Steelhead Catch					Weekly Steelhead Abundance Indices				
				Hatchery AD	Natural Age-0	Natural Age-1	Natural Age-2+	Catch Total	Hatchery AD	Natural Age-0	Natural Age-1	Natural Age-2+	Index Total
03/12/09	11	8,225	12	0	0	251	2	253	0	0	10,622	194	10,816
03/19/09	12	6,735	13	0	23	184	0	207	0	1,311	6,090	0	7,401
03/26/09	13	5,175	21	173	5	376	4	558	2,597	119	6,464	593	9,773
04/02/09	14	4,125	21	367	0	980	2	1,349	5,453	0	14,608	203	20,264
04/09/09	15	3,595	21	722	0	473	1	1,196	9,046	0	6,034	392	15,472
04/16/09	16	3,610	21	625	0	463	1	1,089	8,210	0	6,062	384	14,656
04/23/09	17	3,450	21	1,146	0	592	0	1,738	13,885	0	7,146	0	21,031
04/30/09	18	7,085	12	655	1	250	9	915	27,717	73	12,733	1,088	40,611
05/07/09	19	8,635	12	135	4	81	16	236	6,514	179	3,973	1,100	11,766
05/14/09	20	5,645	14	76	0	67	8	151	2,129	0	1,814	518	4,461
05/21/09	21	4,455	14	78	0	60	11	149	1,690	0	1,309	1,188	3,917
05/28/09	22	3,675	16	89	1	145	26	261	1,581	12	2,449	1,371	5,413
06/04/09	23	3,145	16	111	7	123	9	250	1,626	149	1,934	208	3,917
06/11/09	24	2,445	21	71	13	56	8	148	655	108	526	186	1,475
06/18/09	25	1,895	20	20	26	9	2	57	170	194	78	38	480
06/25/09	26	1,550	21	12	50	35	0	97	89	301	242	0	632
07/02/09	27	1,210	15	4	20	24	0	48	31	139	168	0	338
07/09/09	28	980	21	0	11	21	0	32	0	65	100	0	165
07/16/09	29	869	21	3	23	22	0	48	16	94	92	0	202
07/23/09	30	771	21	0	26	32	1	59	0	87	106	8	193
07/30/09	31	736	18	0	5	94	0	99	0	17	323	0	340
08/06/09	32	791	16	0	6	7	0	13	0	65	33	0	98
08/13/09	33	702	15	0	3	4	0	7	0	11	14	0	25
08/20/09	34	791	10	0	0	2	0	2	0	0	8	0	8
08/27/09	35	1,107	20	0	51	5	0	56	0	256	27	0	283
Total			433	4,287	275	4,356	100	9,018	81,409	3,180	82,955	7,471	175,015

Appendix 7. PTRST weekly age-0 Chinook salmon population estimate input and results, 2009.

WOY	Sampling Fraction	Catch NC	Catch AC	Marks Released	Marks Recaptured	Recapture Rate	Estimated Natural	SD Natural	Estimated Hatchery	SD Hatchery
2	0.29	15	0	0	0		2,357	1,815		
3	1	94	0	0	0		4,117	2,844		
4	1	385	0	833	52	0.062	6,358	903		
5	1	1,162	0	852	67	0.079	14,933	1,786		
6	1	592	0	1,495	77	0.052	11,734	1,362		
7	0.71	1,151	0	1,356	182	0.134	12,220	893		
8	0.86	2,258	0	1,889	145	0.077	34,433	2,859		
9	1	1,123	0	2,934	89	0.030	36,903	3,922		
10	1	2,277	0	1,546	53	0.034	64,694	8,303		
11	1	2,492	0	4,001	232	0.058	43,128	2,860		
12	1	1,579	0	2,955	158	0.053	29,894	2,405		
13	1	1,046	0	529	14	0.026	43,252	11,279		
14	1	766	0	1,172	49	0.042	19,739	2,854		
15	1	2,702	0	3,204	232	0.072	37,813	2,542		
16	1	10,408	0	1,328	57	0.043	241,567	28,764		
17	1	12,145	0	3,540	114	0.032	372,688	32,424		
18	1	186	0	4,791	45	0.009	21,309	3,532		
19	1	407	0	4,808	11	0.002	138,091	34,338		
20	1	862	0	5,952	44	0.007	112,139	16,245		
21	0.71	465	0	3,852	55	0.014	46,789	6,479		
22	1	724	0	2,621	17	0.006	101,028	22,264		
23	1	4,860	854	2,131	37	0.017	124,394	20,683	190,445	30,380
24	1	3,539	794	5,002	152	0.030	37,562	4,450	106,260	9,217
25	1	4,597	904	3,706	120	0.032	56,619	6,281	111,551	11,085
26	1	3,819	708	1,225	44	0.036	45,699	6,636	78,360	10,444
27	0.71	3,300	762	723	45	0.062	22,834	3,879	71,153	11,093
28	1	5,460	1,356	2,895	167	0.058	23,030	2,859	94,294	7,529
29	1	2,918	614	1,395	117	0.084	12,796	1,571	30,195	2,937
30	1	2,252	420	479	77	0.161	6,457	834	11,204	1,273
31	1	1,240	289	964	74	0.077	4,908	956	15,732	1,984
32	1	428	87	2,803	288	0.103	1,690	324	3,490	397
33	0.57	464	114	952	51	0.054	3,620	976	14,908	2,243
34	0.57	515	53	880	126	0.143	4,327	455	2,722	354
35	0.29	93	21	0	0	0.000	1,315	870	4,310	2,734
		76,324	6,976	72,813	2,991	0.041	1,740,438	77,966	734,625	44,891

Appendix 8. Trinity River at WCRST weekly age-0 Chinook salmon population estimate input and results, 2009.

WOY	Sampling Fraction	Catch NC	Catch AC	Marks Released	Marks Recaptured	Recapture Rate	Estimated Natural	SD Natural	Estimated Hatchery	SD Hatchery
11	0.86	233	0	1,570	34	0.022	11,683	1,954		
12	0.93	287	0	1,381	105	0.076	4,309	470		
13	1	617	0	580	29	0.050	12,059	2,171		
14	1	1,654	0	500	82	0.164	18,976	9,407		
15	1	443	0	500	88	0.176	13,815	6,195		
16	1	1,126	0	1,000	121	0.121	9,972	926		
17	1	2,862	0	1,651	99	0.060	48,240	4,728		
18	0.86	2,034	0	1,188	14	0.012	136,713	28,138		
19	0.86	1,143	0	1,188	15	0.013	89,322	18,966		
20	1	3,101	0	944	55	0.058	101,621	29,259		
21	1	2,375	0	1,659	46	0.028	87,753	11,819		
22	0.76	7,984	0	2,454	110	0.045	234,459	22,519		
23	0.76	10,241	249	1,454	76	0.052	237,114	23,792	24,919	2,853
24	1	14,871	896	911	38	0.042	325,214	61,325	96,277	19,114
25	0.95	23,810	2,243	672	26	0.039	483,343	108,367	254,105	57,339
26	1	42,317	3,479	778	40	0.051	558,657	72,493	243,859	31,351
27	0.71	16,990	1,124	843	65	0.077	266,599	24,409	88,314	8,358
28	1	12,075	615	714	50	0.070	161,131	21,265	38,868	5,367
29	1	6,548	285	855	41	0.048	117,138	15,890	23,350	3,329
30	1	2,269	140	0	0	na	37,624	12,507	11,280	3,879
31	0.86	829	23	0	0	na	19,420	7,263	2,442	1,001
32	0.76	139	1	957	27	0.028	6,464	1,277	539	237
33	0.71	75	2	428	11	0.026	3,297	868	373	177
34	0.71	38	3	813	55	0.068	771	164	167	78
35	0.95	140	1	0	0	na	2,141	1,170	65	65
Totals		154,201	9,061	23,040	1,227	0.053	2,987,837	212,008	784,557	88,501

Appendix 9. Trinity River at PTRST weekly Chinook salmon and coho salmon fork lengths, 2009.

Week	of the	Chinook salmon										Natural coho salmon										Hatchery coho salmon				
		Age-0					Age-1					Age-0					Age-1					Age-1				
Starting	Year	n	mean	min	max	SD	n	mean	min	max	SD	n	mean	min	max	SD	n	mean	min	max	SD	n	mean	min	max	SD
1/8/09	2	14	39.8	35	44	1.9	10	95.3	87	106	5.8	0	----	----	----	----	6	92.0	81	102	9.0	0	----	----	----	----
1/15/09	3	94	40.9	37	56	2.3	91	100.4	71	184	23.2	0	----	----	----	----	17	97.8	63	142	17.6	0	----	----	----	----
1/22/09	4	281	41.1	37	69	2.5	114	94.5	74	178	15.4	0	----	----	----	----	8	93.9	83	104	8.7	0	----	----	----	----
1/29/09	5	424	40.9	32	61	2.2	152	92.9	71	185	14.7	0	----	----	----	----	20	99.8	83	115	10.2	0	----	----	----	----
2/5/09	6	314	41.6	35	50	1.9	110	90.4	70	200	13.9	0	----	----	----	----	7	91.4	71	116	15.6	0	----	----	----	----
2/12/09	7	297	42.2	37	65	2.9	97	91.8	74	190	12.5	0	----	----	----	----	17	97.6	74	156	19.1	0	----	----	----	----
2/19/09	8	408	42.7	37	58	3.5	128	89.3	70	124	8.6	0	----	----	----	----	83	88.2	68	114	10.0	0	----	----	----	----
2/26/09	9	453	43.7	35	75	4.8	82	86.5	73	107	7.1	0	----	----	----	----	129	87.5	63	122	9.4	0	----	----	----	----
3/5/09	10	574	46.0	35	75	6.2	61	92.1	75	170	13.5	2	42.0	42	42	----	162	89.9	65	185	13.8	0	----	----	----	----
3/12/09	11	554	44.0	36	70	6.5	29	90.7	75	110	10.1	0	----	----	----	----	30	91.5	65	120	14.2	7	149.7	128	163	11.1
3/19/09	12	499	44.4	35	75	7.7	102	101.7	75	164	15.2	0	----	----	----	----	34	101.4	73	184	25.0	158	157.5	129	200	14.3
3/26/09	13	416	49.7	36	77	9.8	50	101.3	80	200	20.4	5	35.8	34	37	1.1	14	91.8	75	122	13.7	9	152.8	126	170	13.8
4/2/09	14	426	56.9	37	84	10.5	16	102.4	85	120	11.5	8	35.1	30	37	2.2	7	99.0	85	114	11.6	4	184.3	157	235	35.2
4/9/09	15	416	61.7	36	85	9.0	10	100.8	80	125	11.5	18	40.7	37	44	1.6	6	94.7	76	119	15.6	4	209.5	163	258	44.4
4/16/09	16	465	61.2	35	93	10.8	17	106.1	92	128	12.1	14	37.6	29	48	5.1	7	99.6	86	109	8.7	4	201.0	186	220	15.2
4/23/09	17	555	61.5	39	88	9.6	14	108.4	93	130	9.0	7	41.3	37	47	3.5	5	134.8	115	175	23.6	15	181.3	158	212	19.0
4/30/09	18	136	56.3	41	88	10.3	1	120.0	120	120	----	3	54.0	38	74	18.3	1	103.0	103	103	----	1	158.0	158	158	0.0
5/7/09	19	280	61.2	39	88	10.0	1	153.0	153	153	----	1	56.0	56	56	----	6	139.0	104	182	34.0	3	177.7	160	198	19.1
5/14/09	20	442	63.1	41	94	10.2	0	----	----	----	----	0	----	----	----	----	5	110.2	93	125	15.3	4	155.8	140	165	11.4
5/21/09	21	263	64.3	42	96	11.1	0	----	----	----	----	1	59.0	59	59	----	4	111.3	93	125	13.4	3	165.0	140	185	22.9
5/28/09	22	294	66.3	43	107	10.7	0	----	----	----	----	8	64.6	55	77	7.0	5	124.2	105	150	16.9	2	180.5	173	188	10.6
6/4/09	23	709	86.4	45	152	17.6	0	----	----	----	----	3	69.0	56	87	16.1	15	135.3	108	195	26.5	7	156.7	121	187	20.4
6/11/09	24	677	86.6	51	172	14.4	1	168.0	168	168	----	8	71.8	56	90	13.0	5	117.0	104	140	14.1	1	153.0	153	153	----
6/18/09	25	740	86.3	45	125	12.6	0	----	----	----	----	9	73.0	60	107	14.2	0	----	----	----	----	0	----	----	----	----
6/25/09	26	767	85.5	53	120	10.0	0	----	----	----	----	7	77.3	61	102	14.9	1	109.0	109	109	----	0	----	----	----	----
7/2/09	27	541	86.7	55	112	8.1	0	----	----	----	----	5	73.4	58	96	14.9	0	----	----	----	----	0	----	----	----	----
7/9/09	28	803	86.9	61	118	8.0	0	----	----	----	----	20	92.7	69	119	16.1	0	----	----	----	----	0	150	150	150	----
7/16/09	29	748	86.9	57	110	7.4	0	----	----	----	----	55	103.7	77	125	10.8	1	145.0	145	145	----	0	----	----	----	----
7/23/09	30	649	87.4	60	119	8.0	0	----	----	----	----	62	110.3	71	136	13.3	4	170.0	142	211	32.1	0	----	----	----	----
7/30/09	31	584	88.0	65	122	6.9	0	----	----	----	----	35	109.7	84	125	9.2	0	----	----	----	----	0	----	----	----	----
8/6/09	32	266	90.2	68	123	7.3	0	----	----	----	----	15	108.5	76	133	14.2	1	142.0	142	142	----	0	----	----	----	----
8/13/09	33	255	91.6	74	131	6.5	0	----	----	----	----	7	118.4	110	145	12.0	4	156.0	151	165	6.2	0	----	----	----	----
8/20/09	34	172	92.4	75	137	8.8	0	----	----	----	----	5	93.8	80	105	12.3	0	----	----	----	----	0	----	----	----	----
8/27/09	35	98	97.0	79	140	12.1	0	----	----	----	----	6	84.7	75	92	6.5	0	----	----	----	----	0	----	----	----	----

Appendix 10. Trinity River at WCRST weekly Chinook salmon and coho salmon fork lengths, 2009.

Week	of the	Chinook salmon										Natural coho salmon										Hatchery coho salmon				
		Age-0					Age-1					Age-0					Age-1					Age-1				
Starting	Year	n	mean	min	max	SD	n	mean	min	max	SD	n	mean	min	max	SD	n	mean	min	max	SD	n	mean	min	max	SD
03/12/09	11	90	42	34	63	5.46	99	99	70	120	10.34	0	----	----	----	----	10	101	91	106	5.24	0	----	---	---	---
03/19/09	12	185	42	34	63	4.39	24	101	78	158	18.81	1	37	37	37	----	16	117	60	175	40.10	61	157	120	213	17.39
03/26/09	13	257	42	35	71	5.52	22	98	75	117	10.76	3	33	32	36	2.31	13	93	69	120	16.20	10	154	137	176	11.55
04/02/09	14	265	43	34	74	6.75	7	89	78	103	7.39	2	37	34	40	4.24	9	97	71	115	16.92	2	169	158	179	14.85
04/09/09	15	262	44	35	72	7.30	8	119	95	150	20.94	1	38	38	38	----	47	175	82	228	32.29	0	----	---	---	---
04/16/09	16	386	48	34	93	12.34	0	----	----	----	----	3	46	34	54	10.79	1	117	117	117	----	0	----	---	---	---
04/23/09	17	428	53	33	83	10.84	0	----	----	----	----	3	48	47	49	1.00	3	164	152	170	10.39	10	181	162	220	21.75
04/30/09	18	157	56	37	80	10.35	3	126	120	134	7.09	2	37	32	41	6.36	8	156	75	238	50.38	35	175	142	248	19.39
05/07/09	19	308	54	37	84	8.56	3	119	113	124	5.57	1	67	67	67	----	5	115	105	137	13.90	22	180	142	232	19.05
05/14/09	20	331	56	39	93	9.13	0	----	----	----	----	1	68	68	68	----	6	116	91	137	15.61	21	168	141	222	16.99
05/21/09	21	326	62	37	98	13.00	0	----	----	----	----	5	50	41	59	6.91	9	121	108	135	9.57	16	167	143	212	20.02
05/28/09	22	462	63	37	100	12.34	0	----	----	----	----	13	59	52	65	3.93	30	118	100	136	10.20	23	159	136	199	16.82
06/04/09	23	471	79	40	130	14.23	0	----	----	----	----	3	69	56	88	16.65	17	126	112	157	11.34	5	163	152	171	7.91
06/11/09	24	840	86	44	125	15.89	0	----	----	----	----	1	65	65	65	----	7	121	107	140	11.76	7	158	138	171	12.51
06/18/09	25	833	86	47	122	14.50	0	----	----	----	----	1	80	80	80	----	2	132	130	133	2.12	0	----	---	---	---
06/25/09	26	718	83	48	178	9.64	0	----	----	----	----	2	67	66	68	1.41	1	102	102	102	----	1	159	159	159	---
07/02/09	27	583	80	50	120	9.93	0	----	----	----	----	3	83	60	101	20.95	0	----	----	----	----	0	----	---	---	---
07/09/09	28	1019	82	51	114	8.06	0	----	----	----	----	0	----	----	----	----	1	125	125	125	----	0	----	---	---	---
07/16/09	29	837	81	51	102	7.08	0	----	----	----	----	1	99	99	99	----	5	109	95	125	10.96	1	102	102	102	---
07/23/09	30	567	80	49	107	8.42	0	----	----	----	----	0	----	----	----	----	2	104	102	105	2.12	1	107	107	107	---
07/30/09	31	290	76	46	112	9.09	0	----	----	----	----	1	70	70	70	----	2	111	104	117	9.19	0	----	---	---	---
08/06/09	32	128	77	55	95	7.51	0	----	----	----	----	0	----	----	----	----	10	101	91	106	5.24	0	----	---	---	---
08/13/09	33	78	81	53	122	10.12	0	----	----	----	----	1	37	37	37	----	16	117	60	175	40.10	61	157	120	213	17.39
08/20/09	34	36	83	57	124	16.67	0	----	----	----	----	3	33	32	36	2.31	13	93	69	120	16.20	10	154	137	176	11.55
08/27/09	35	141	89	43	130	13.24	0	----	----	----	----	2	37	34	40	4.24	9	97	71	115	16.92	2	169	158	179	14.85

Appendix 11. Trinity River at PTRST weekly steelhead fork lengths, 2009.

WOY	Natural steelhead															Hatchery steelhead				
	Age-0					Age-1					Age-2+					Age-1				
	n	mean	min	max	SD	n	mean	min	max	SD	n	mean	min	max	SD	n	mean	min	max	SD
2	0	---	---	---	---	3	100.3	91	115	12.86	1	200.0	200	200	---	0	---	---	---	---
3	0	---	---	---	---	17	99.5	59	140	23.46	5	198.4	168	230	21.9	0	---	---	---	---
4	0	---	---	---	---	27	100.4	56	152	20.99	0	---	---	---	---	0	---	---	---	---
5	0	---	---	---	---	38	93.8	56	140	20.70	3	218.7	170	310	79.2	0	---	---	---	---
6	0	---	---	---	---	33	94.4	60	139	18.67	1	198.0	198	198	---	0	---	---	---	---
7	0	---	---	---	---	56	94.2	74	140	14.93	2	178.0	175	181	4.2	0	---	---	---	---
8	0	---	---	---	---	200	85.2	50	144	17.21	0	---	---	---	---	0	---	---	---	---
9	0	---	---	---	---	240	82.6	51	143	16.90	5	171.4	162	187	11.7	0	---	---	---	---
10	0	---	---	---	---	280	84.8	47	158	19.35	5	170.2	164	187	9.6	0	---	---	---	---
11	0	---	---	---	---	145	86.3	52	150	22.05	4	170.8	162	188	11.9	0	---	---	---	---
12	2	31.5	28	35	4.95	128	89.4	58	153	23.98	1	166.0	166	166	---	198	202.5	108	245	19.85
13	0	---	---	---	---	161	91.5	57	173	24.19	3	176.3	160	209	28.3	284	198.5	100	252	20.59
14	0	---	---	---	---	95	94.1	59	157	20.48	2	185.0	180	190	0.0	283	197.2	99	255	24.29
15	0	---	---	---	---	107	97.9	65	161	23.79	4	170.0	165	173	3.6	112	204.7	140	291	21.95
16	13	28.7	27	30	1.11	227	89.0	51	158	18.62	6	179.3	170	186	5.3	88	203.1	150	236	18.62
17	16	33.3	28	44	5.26	145	94.2	60	152	17.09	6	182.8	175	195	7.4	187	195.5	118	248	20.00
18	21	28.2	25	35	2.23	4	96.8	84	120	16.52	0	---	---	---	---	4	171.5	150	195	18.45
19	20	27.3	25	30	1.59	24	86.4	62	117	17.45	0	---	---	---	---	10	175.4	132	210	22.87
20	61	29.1	23	39	2.20	26	90.5	53	157	23.70	0	---	---	---	---	6	186.7	160	210	22.54
21	58	29.0	24	37	2.28	1	120.0	120	120	---	0	---	---	---	---	11	183.4	160	221	18.59
22	28	34.5	26	64	9.42	21	100.4	64	167	31.72	6	181.8	170	206	12.6	16	185.9	153	220	19.80
23	29	37.7	27	55	7.38	19	102.5	73	169	24.80	6	196.7	173	219	16.2	44	185.0	114	290	25.60
24	50	45.2	29	83	13.73	10	114.1	82	146	20.01	3	176.7	172	185	7.2	14	186.2	106	226	29.97
25	64	45.7	26	91	12.33	8	113.9	89	138	16.17	1	189.0	189	189	---	7	202.0	175	235	21.45
26	80	47.4	6	66	9.46	13	115.5	77	164	26.78	0	---	---	---	---	0	---	---	---	---
27	35	58.8	39	84	10.04	9	124.8	112	134	8.15	0	---	---	---	---	0	---	---	---	---
28	91	62.5	39	98	12.61	20	130.7	104	160	18.96	2	184.0	178	190	8.5	1	191.0	191	191	---
29	165	58.1	33	99	11.39	19	133.6	105	164	17.11	1	202.0	202	202	---	2	227.0	178	276	69.30
30	146	58.2	39	83	8.94	10	141.5	121	172	15.67	1	188.0	188	188	---	0	---	---	---	---
31	66	63.2	42	108	11.99	9	134.3	115	160	13.28	0	---	---	---	---	0	---	---	---	---
32	30	66.1	49	95	11.44	10	142.7	107	185	27.46	0	---	---	---	---	1	158.0	158	158	---
33	17	69.0	55	83	7.12	3	133.3	125	141	8.02	0	---	---	---	---	1	150.0	150	150	---
34	39	64.6	45	90	9.38	1	148.0	148	148	---	0	---	---	---	---	0	---	---	---	---
35	106	73.8	44	104	11.11	3	145.0	120	170	25.00	0	---	---	---	---	0	---	---	---	---

Appendix 12. Trinity River at WCRST weekly steelhead fork lengths, 2009.

WOY	Natural steelhead																				Hatchery steelhead				
	Age-0					Age-1					Age-2					Age-3					Age-1				
	n	mean	min	max	SD	n	mean	min	max	SD	n	mean	min	max	SD	n	mean	min	max	SD	n	mean	min	max	SD
11	0	0	----	----	0	229	90	63	150	15.79	2	198	190	205	10.61	0	0	0	0	----	0	0	----	----	0
12	23	39	36	42	1.97	172	89	63	150	14.73	0	0	0	0	----	0	0	0	0	----	0	0	----	----	0
13	5	40	38	42	1.48	276	90	60	149	14.11	4	209	186	240	24.25	0	0	0	0	----	67	204	143	255	19.84
14	0	0	----	----	0	325	89	54	150	13.85	2	233	231	234	2.12	0	0	0	0	----	243	202	120	250	20.24
15	0	0	----	----	0	205	91	63	141	13.14	1	253	253	253	----	0	0	0	0	----	261	209	161	253	15.45
16	0	0	----	----	0	174	91	66	153	14.43	1	237	237	237	----	0	0	0	0	----	280	208	158	250	14.99
17	0	0	----	----	0	158	95	65	153	17.13	0	0	0	0	----	0	0	0	0	----	245	205	120	270	18.10
18	0	0	----	----	0	60	96	72	148	17.19	9	207	195	222	8.93	0	0	0	0	----	186	189	98	239	24.70
19	0	0	----	----	0	37	107	80	145	17.58	16	186	167	212	14.66	0	0	0	0	----	118	186	128	232	18.73
20	0	0	----	----	0	43	107	72	147	19.05	8	192	181	200	6.04	0	0	0	0	----	75	184	95	226	23.05
21	0	0	----	----	0	22	117	84	148	19.81	11	186	176	205	9.22	0	0	0	0	----	74	193	132	250	20.97
22	1	49	49	49	0	71	113	80	154	19.81	26	186	172	218	12.99	0	0	0	0	----	93	187	151	230	17.36
23	4	42	30	52	9.25	41	122	87	154	19.80	9	218	186	293	42.63	0	0	0	0	----	77	182	93	215	26.26
24	12	46	36	58	7.49	16	118	98	154	16.94	8	208	185	290	36.52	0	0	0	0	----	55	188	96	230	19.61
25	20	46	31	55	5.75	2	110	99	120	14.85	2	175	169	180	7.78	0	0	0	0	----	10	193	175	218	13.49
26	29	49	29	67	7.89	5	113	108	125	6.80	0	0	0	0	----	0	0	0	0	----	3	172	163	190	15.31
27	10	57	50	62	3.92	1	113	113	113	0.00	0	0	0	0	----	0	0	0	0	----	0	0	----	----	0
28	11	60	46	73	7.05	4	123	109	128	9.50	0	0	0	0	----	0	0	0	0	----	0	0	----	----	0
29	22	57	41	69	5.58	5	118	101	148	18.10	0	0	0	0	----	0	0	0	0	----	1	154	154	154	0
30	24	55	40	77	9.48	9	125	106	148	13.18	1	184	184	184	----	0	0	0	0	----	0	0	----	----	0
31	4	54	49	58	3.87	11	126	113	142	9.17	0	0	0	0	----	0	0	0	0	----	0	0	----	----	0
32	1	74	74	74	0	3	114	101	130	14.64	0	0	0	0	----	0	0	0	0	----	0	0	----	----	0
33	3	52	41	59	9.64	3	124	116	130	7.09	0	0	0	0	----	0	0	0	0	----	0	0	----	----	0
34	0	0	----	----	0	1	142	142	142	0.00	0	0	0	0	----	0	0	0	0	----	0	0	----	----	0
35	12	54	33	70	12.35	2	125	121	128	4.95	0	0	0	0	----	0	0	0	0	----	0	0	----	----	0