U.S. Fish & Wildlife Service

Arcata Fisheries Data Series Report DS 2009-16

Juvenile Salmonid Monitoring On The Mainstem Trinity River At Willow Creek, California, 2006-2007

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April 2009

Funding for this study was provided by the U.S. Fish and Wildlife Service, Arcata Fish and Wildlife Office and the Trinity River Restoration Program.

The Arcata Fish and Wildlife Office Fisheries Program reports its study findings through two publication series. The **Arcata Fisheries Data Series** was established to provide timely dissemination of data to local managers and for inclusion in agency databases. The **Arcata Fisheries Technical Reports** publishes scientific findings from single and multi-year studies that have undergone more extensive peer review and statistical testing. Additionally, some study results are published in a variety of professional fisheries journals.

Key words: Trinity River, downstream migrant trapping, salmon, Chinook salmon, coho salmon, steelhead, abundance index, juvenile salmon, rotary screw trap.

The correct citation for this report is:

Pinnix, W.D., and S. Quinn. 2009. Juvenile Salmonid Monitoring on the Mainstem Trinity River at Willow Creek, California, 2006-2007. U. S. Fish and Wildlife Service, Arcata Fish and Wildlife Office, Arcata Fisheries Data Series Report Number DS 2009-16, Arcata, California.

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Abstract Juvenile salmonid emigration from the lower mainstem Trinity River has been monitored since 1988 with rotary screw traps used as the primary gear type since 1989. This report describes monitoring conducted in 2006 and 2007; the traps fished for 151 days of the 168 possible trap days (89.9%) in 2006 and 164 days of the 172 possible trap days (95.3%) in 2007. Catch data were used to calculate abundance indices for juvenile Chinook salmon (*Oncorhynchus tshawytscha*), coho salmon (*O. kisutch*), and steelhead (*O. mykiss*) which were used to identify the duration and peak of outmigration. In addition population estimates of age-0 juvenile Chinook salmon were derived via an intensive mark-recapture procedure for periods when these could be implemented. In 2006 the estimate was 860,009 +/- 180,621 (95%CI) , and in 2007, the estimate was 2,061,366 +/- 308,749 (95% CI). Age of outmigrants, length frequency distributions, migration rates, and hatchery contributions were also estimated. Catch data of other fishes are also presented.

Introduction

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.

Past fishery investigations in the Basin have focused primarily on adult returns, due to harvest allocation and escapement objectives. Data on adult returns, however, provide an

indirect measure of restoration efforts in the Basin because adult return data are affected by ocean mortality (both juveniles entering the ocean, and adult mortality), harvest at sea, and a number of other factors. Monitoring emigrating juvenile salmonid populations in conjunction with habitat availability and suitability studies may permit for the evaluation of restoration efforts because these studies focus on the freshwater life-history phase, which is directly affected by instream conditions and not influenced by oceanic conditions and harvest.

Intermittent juvenile salmonid investigations have been conducted in the Klamath River Basin by the U.S. Fish and Wildlife Service, Arcata Fish and Wildlife Office since 1981 (USFWS 1982). In 1988, a substantial monitoring effort was undertaken in both the mainstem Klamath and Trinity rivers utilizing frame nets (USFWS 1989) and then rotary screw traps in 1989 (USFWS 1991). The purpose of this project was to monitor the abundance, timing, hatchery contribution, and biological parameters of emigrating anadromous salmonids in the mainstem Klamath and Trinity rivers. The effort on the Trinity River has continued since initiated in 1989 (USFWS 1991, 1992, 1994, 1998, 1999, 2001; Pinnix et al. 2007).

Information obtained from the salmonid outmigrant monitoring effort was critical in the development of salmonid outmigrant temperature components of the hydrographs recommended in the Trinity River Flow Evaluation (USFWS and Hoopa Valley Tribe 1999). One component of the restoration strategy employed by the Trinity River Restoration Program is to provide improved thermal regimes for rearing and emigrating juvenile salmonids. This objective is linked to the water temperature objectives for the lower Trinity River (USFWS and Hoopa Valley Tribe 1999, Table 5.11) and the timing of salmonid emigration (USFWS and Hoopa Valley Tribe 1999, Figure 5.46). Water-year specific hydrographs were developed to achieve optimum emigration temperatures throughout the majority of the spring/early summer outmigration period in normal and wetter years and marginal temperatures in dry and critically dry water years (USFWS and Hoopa Valley Tribe 1999, Appendix K). To evaluate the influence of the modified spring hydrographs on the salmonid production, including outmigration timing and the "health" of the outmigrants, the salmonid monitoring program implemented in the lower Trinity River was continued and expanded. Additionally, increases in spawning and rearing habitat should result in increased production of healthier salmonids, which can be assessed through the information collected by the outmigrant monitoring 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 (DOI 2000), in restoring the fishery resources of the Trinity River.

Study Area

The Klamath River is the second largest river system in California, draining about 26,000 square kilometers (km^2) in California, and 14,400 km^2 in Oregon. The Trinity River is the largest tributary to the Klamath River, draining approximately 7,690 km^2 in California. Two dams, Iron Gate Dam on the Klamath River (river kilometer (rkm) 306)

and Lewiston Dam on the Trinity River (rkm 144), are the upper limits of anadromous fish migration in the Basin. Two fish hatcheries, Iron Gate Hatchery (IGH) on the Klamath River and Trinity River Hatchery (TRH), were constructed to mitigate for losses of anadromous fish habitat and juvenile salmon production upstream of Iron Gate and Lewiston dams.

Trinity River juvenile salmonid outmigrant trapping was conducted at the Riverdale Campground (rkm 34) near Willow Creek, California (Figure 1). This location has been used since 1991 because the channel configuration is fairly consistent from year to year, allows for multiple trap operation over a wide range of flows, and it has private access.

Methods

Trap Design and Operation

Outmigrant sampling was conducted by deploying one to three 2.44 m diameter rotary screw traps at the trapping site. In 2006, the first trap was installed on March 22, 2006, the second trap installed May 18, 2006, and the third trap installed June 10, 2006. In 2007, the first trap was installed on March 6, 2007, the second trap installed March 16, 2007, and the third trap installed April 5, 2007. River conditions ultimately dictated when traps were deployed, and due to the high flows during the spring of 2006 and 2007, the second and third traps were not installed until flows receded. An effort was made to place rotary traps in the river early in the spring so that portions of the coho salmon and steelhead smolt outmigration could be sampled, and prior to the emigration of age-0 Chinook salmon so that emigration patterns and the relative abundance of natural and hatchery Chinook salmon could be more fully evaluated.

Traps were anchored with 0.64 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 trap out from the bank. Cone revolutions were used to determine where and when the trap could be operated without inducing unnecessary risk to the trap. 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 stream 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. Trap checks usually occurred during late morning or early afternoon. During peak emigration periods, fish were removed from traps several times during the sampling day with the frequency dictated by water temperatures, fish numbers, and mortality rates.

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

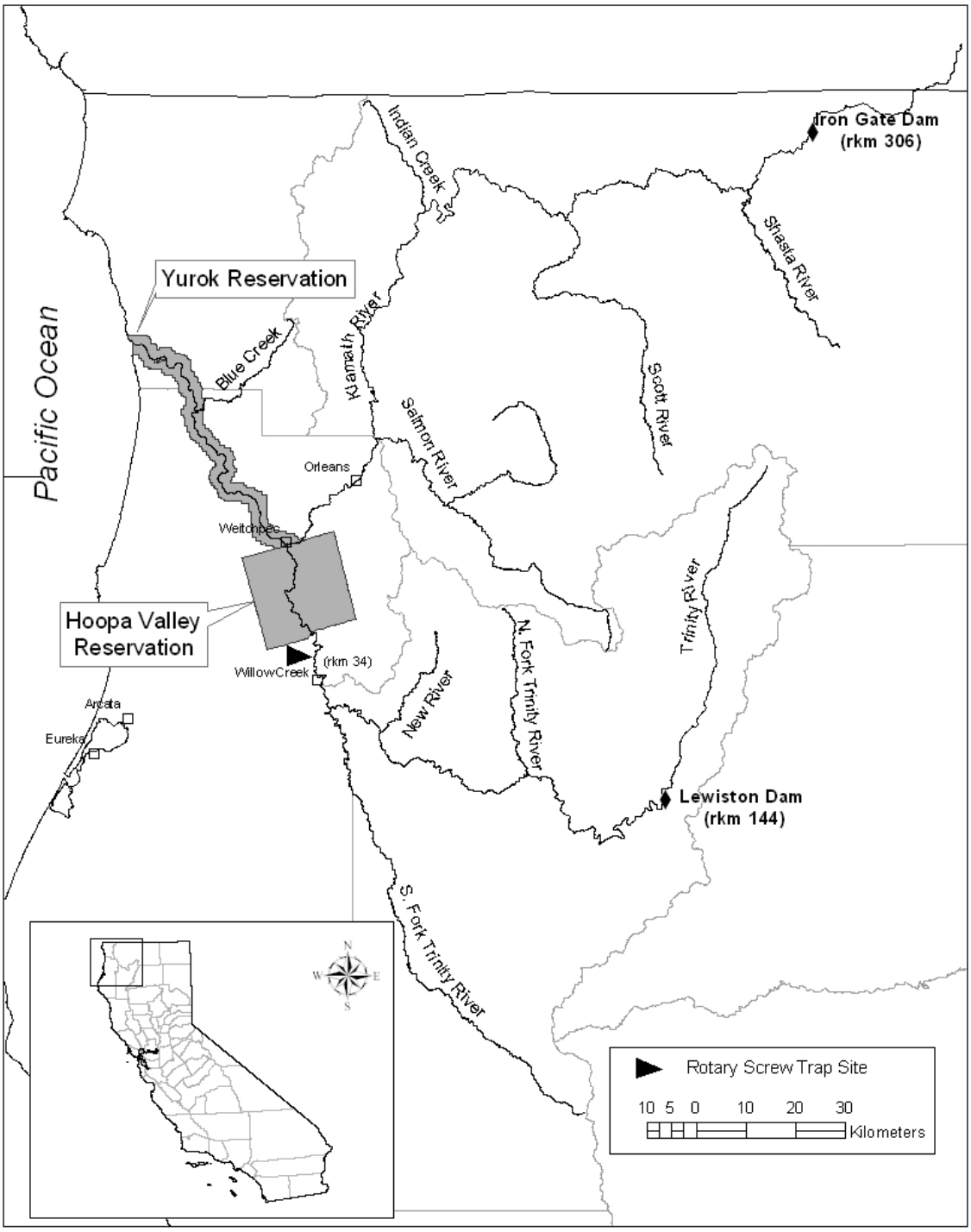

Figure 1. Location of the Trinity River rotary screw trap site near Willow Creek (river kilometer 34), California, operated by the United States Fish and Wildlife Service, Arcata Fish and Wildlife Office and the Yurok Tribal Fisheries Program.

Table 1. Julian week and corresponding first calendar date.

Julian Week	Week beginning	Julian Week	Week beginning	Julian Week	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

Water Flow and Temperature Measurements

Normal cone operating depth was 1.07 m. 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 cell area (ft^2) was calculated, then 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 (ft^3/s). Discharge data from U.S. Geological Survey Water Resource gauge station at Hoopa (#11-530000 at rkm 19.9) on the Trinity River was used as a surrogate measure of mean daily river discharge (Q) at the trap site.

An Acoustic Doppler Current Profiler was used to estimate discharge at the trap site in 2005 and 2006. The 2005 data is presented in this report as it did not get included in the 2005 report, and the combined 2005-2006 data was used to test the assumption that the Hoopa gage is an adequate indicator of discharge at the trap site.

Water temperature data were collected using an Onset Stow Away Tidbit® temperature logger attached to the outside bottom edge of each trap live box. Water temperature was recorded once per hour for the entire sampling season. Mean daily water temperatures were calculated by averaging over 24-hour periods.

Biological Sampling Procedures

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

All anesthetized fish not retained 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. Adult salmonids were not anesthetized. Fork lengths of adult salmonids were either measured or approximated before release. Any salmonid mortality in the live box was checked for a fin clip and, if included in the subsample, measured. If a salmonid escaped during netting or handling before it could be identified to species or checked for a hatchery mark (i.e. fin or maxillary clip), it was counted in the sample tally as an "unknown". Based on the probability of occurrence, unknown fish were redistributed into the most likely marked or unmarked species categories.

When present, daily subsamples of marked hatchery Chinook salmon were collected. A missing adipose fin (ad-clip) was the external marker depicting Chinook salmon with a coded wire tag (CWT) embedded in the snout. A maximum of five ad-clipped Chinook salmon from each trap 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 CWT's were removed.

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. 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 30 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 being either of hatchery or natural origin based on external marks, coded wire tag data, and hatchery marking rates. Hatchery release strategies for Chinook salmon consist of fingerling (age-0) releases in the spring and yearling (age-1) 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 JW 1 through 39 and the fall period JW 40 through 52 in years when extended sampling had been

conducted. 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 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 detected, 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 JW.

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

$$E = (C/MS)(AD/H)(T/TR)$$

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 CWT's recovered and decoded after processing.

To account for unmarked hatchery fish in the catch over a JW, the expanded estimates for each CWT code were multiplied by a production multiplier (PM) specific to each CWT code. Each PM was calculated from hatchery release data (Pacific States Marine Fisheries Commission 2006), using the following formula:

$$PM = (\#\ Tagged + \#\ Poor\ Tagged + \#\ Unmarked)/\ \#\ Tagged$$

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 JW, was calculated by the following formula:

$$\#\ Hatchery_{code(i)} = (\#\ recovered_{code(i)}) * (E_{JW}) * (PM_{code(i)})$$

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.

Towards the end of each emigration period, when catch rates were low, it is possible that juveniles of hatchery origin were captured but not represented by ad-clipped fish. If no hatchery fish captured within a given time period were marked, the hatchery contribution for that period could not be differentiated from the natural component. Thus, all fish captured during that period were considered of natural origin. The hatchery and natural stock estimates assume no differential mortality between tagged and untagged fish of the same release group, equal vulnerability to capture, and accurate estimates of the numbers of marked, unmarked, and poor tagged fish released from the hatchery. The estimate does not account for ad-clipped or non-ad-clipped hatchery fish removed from the river upstream during other juvenile monitoring operations.

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 and right-maxillary 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 JW 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 Hoopa

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

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

Where: nt_i = Number of days in the JW with at least one trap fishing

TD_i = Sum of the days in the JW

The estimated proportion of hatchery produced fish, based on catches of marked fish and

marking rates, was used to apportion the abundance indices into production attributable to hatchery or natural production. The usefulness of this index as an estimator of abundance is contingent upon the 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 beginning the first Julian week that a particular species and life stage are present in the catch and ending the last Julian week that a particular species is present in the catch. This definition applies strictly to the sampling period, and is potentially longer for species and life stages that are present prior to and after the sampling period. Emigration peaks are defined as the largest weekly abundance index for a particular species and life stage.

Abundance indices are greatly influenced by river discharge and one must use caution in comparing 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 sampling period and encompasses the temporal duration of the outmigration based on the specific species and life stage.

Migration Rate

Maximum migration rates for hatchery produced salmonids were estimated by dividing the distance (rkm) traveled by the number of days elapsed between the initial hatchery release date and initial capture date 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

When capture numbers were adequate at the Willow Creek trap site (generally after TRH releases), an intensive mark-recapture sampling technique was employed to generate population estimates for combined natural and hatchery age-0 Chinook salmon. Population estimates were generated using the modified 1-site version of the Rawson model as described by Carlson et al. (1998), stratified by Julian week. Catch from non-mark-recapture periods were not included in population totals; therefore, the estimates will be underestimates of true population size sampled during the entire trapping period. Efforts to estimate trap efficiency based on flow (and possible other ancillary variables) for periods when mark-recapture efforts were not possible to develop season-wide population estimates are currently under development.

In 2007, juvenile Chinook salmon were obtained from the TRH for the purpose of estimating trap efficiency early in the season when abundance of natural fish was too low to obtain sample sizes needed for accurate calculations of trap efficiency. In addition, when abundance of natural fish was high enough to conduct mark-recapture estimates,

paired mark-recapture efficiency tests were used to compare trap efficiency between natural and hatchery fish.

Population estimates were not calculated for coho salmon and steelhead because too few steelhead and coho salmon were captured to generate valid mark-recapture based population estimates.

Mark-Recapture Technique

A mark unique to each sampling week was applied to anesthetized individuals utilizing a BMX 1000 POW'R-Jet marking unit with photonic marking formula manufactured by NewWest Technologies®. The mark was made by subcutaneously injecting the photonic solution at the base of various fins specific to the color and fin mark designated for that week. After marking, the fish were allowed to recover in containers filled with river water that was aerated and iced to remain within 1.7°C of ambient river temperatures.

Upon recovery, marked fish were immediately transported upstream 0.4 km by boat and released into a large, still pool to mix with the population that had yet to pass the sampling site. Recaptures were identified and recorded during normal trapping operations, but were not counted as part of the catch for that day.

In the early portion of the sampling season juvenile Chinook salmon from TRH were obtained for the purpose of estimating trap efficiency during high flows and/or low abundance. Fish to be marked and released were netted out of raceways at the TRH and soaked in a buffered solution of Bismarck Brown (0.03 g l^{-1}) for approximately 1 hour. Marked fish were then transported in bait tanks supplied with oxygen to the trap site. Fish were transported upstream 0.4 km by boat and released into a large, still pool to mix with the population that had yet to pass the sampling site. Recaptures were identified and recorded during normal trapping operations, but were not counted as part of the catch for that day.

Testing of Trap Efficiency Assumptions

As funding permits, evaluations assessing the assumptions utilized in various aspects of implementing mark-recapture trap efficiency estimates are implemented.

Comparison of Day and Night Releases

Comparison of trapping efficiency between day and night releases of marked juvenile Chinook salmon were conducted at the Willow Creek trap site during the spring emigration monitoring period in 2005. Roughly equal size batches of differentially marked juvenile Chinook salmon were released from the same release site approximately 6 hours apart; day releases at approximately 16:00 and night releases at approximately 22:00.

Comparisons of Hatchery and Naturally Produced Fish

When catches of natural juvenile Chinook salmon were large enough, paired releases were done with Bismarck Brown died hatchery Chinook salmon and photonically marked natural Chinook salmon.

Results

Sampling Season Overview

Trapping duration at the Willow Creek trap site (WCT) was determined both by river conditions and funding levels. In years when the project was fully funded trapping was generally conducted from early spring (March-April) to late fall (November). In 2006 and 2007, the project was funded only to operate during the spring/summer emigration period. Spring monitoring at the WCT was conducted from March 22 to September 6, a 168 day period, in 2006 and from March 6 to August 25, a 172 day period, in 2007 (Table 2).

2006

The Willow Creek traps, in combination, were effectively fished for 151 days of the 168 possible trap days (89.9%) during the 2006 monitoring period (Table 2), while individual trap rates ranged from 82.7% to 91.9%. 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 Julian weeks during the sampling period.

Table 2. Period and duration of spring/summer monitoring, and percent of time trapping was conducted during 2006 and 2007 near Willow Creek (river kilometer [rkm] 34), California, operated by the United States Fish and Wildlife Service, Arcata Fish and Wildlife Office and the Yurok Tribal Fisheries Program. Combined value is total number of days sampled with at least one trap.

Year	Trap	Start-End dates	Days Trapped	Days possible	Trapping Rate
2006	1	22 Mar- 6 Sep	139	168	82.7%
2006	2	18 May – 6 Sep	102	111	91.9%
2006	3	10 Jun – 6 Sep	76	88	86.3%
2006	Combined	22 Mar – 6 Sep	151	168	89.9%
2007	1	6 Mar – 25 Aug	154	172	89.5%
2007	2	16 Mar – 25 Aug	146	162	90.1%
2007	3	5 Apr – 24 Aug	120	141	85.1%
2007	Combined	6 Mar – 25 Aug	164	172	95.3%

Maximum daily discharge during the 2006 sampling period, as recorded at Hoopa,

California US Geological Survey Water Resource gauge station #11-530000, was 22,500 ft^3/s and minimum daily discharge was 837 ft^3/s (Figure 2). Maximum mean daily water temperature during the 2006 sampling period, as recorded at the trap site, was 24.6 ^oC and minimum mean daily water temperature was 6.8 ^oC (Figure 2).

2007

The Willow Creek traps combined were effectively fished for 164 days of the 172 possible trap days (95.3%) during the 2007 monitoring period (Table 2), while individual trap rates ranged from 85.1% to 90.1%. 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 Julian weeks during the sampling period.

Maximum daily discharge during the 2007 sampling period, as recorded at Hoopa, California US Geological Survey Water Resource gauge station #11-530000, was 12,300 ft^3/s and minimum daily discharge was 633 ft^3/s (Figure 2). Maximum mean daily water temperature during the 2007 sampling period, as recorded at the trap site, was 25.0 ^oC and minimum mean daily water temperature was 8.1^oC.

Flow Sampled Assumption

An Acoustic Doppler Current Profiler (ADCP) was used to calculate discharge over a range of flows at the trap site six times in 2005 and four times in 2006 (Table 3). Discharge at the trap site was significantly correlated ($p < 0.001$, $r^2 = 0.996$) with discharge measured at the Hoopa gage (Figure 3); in addition, the slope was not significantly different ($p=0.2243$) than 1, and the intercept was not significantly different ($p=0.4062$) than 0 suggesting that the Hoopa gage is a suitable surrogate for discharge at the trap site.

Table 3. Acoustic Doppler Current Profiler (ADCP) estimates of discharge at Willow Creek trap site and discharge as measured at Hoopa, California US Geological Survey Water Resource gage station #11-530000. Values are in ft^3/s.

Date	ADCP	Hoopa Gage
2/17/05	4814	4560
2/24/05	5166	4770
4/13/05	9597	9530
4/21/05	5945	5870
5/05/05	8940	8590
7/20/05	1838	1840
7/11/06	2796	3170
8/03/06	1057	1170
8/30/06	812	849
9/13/06	791	833

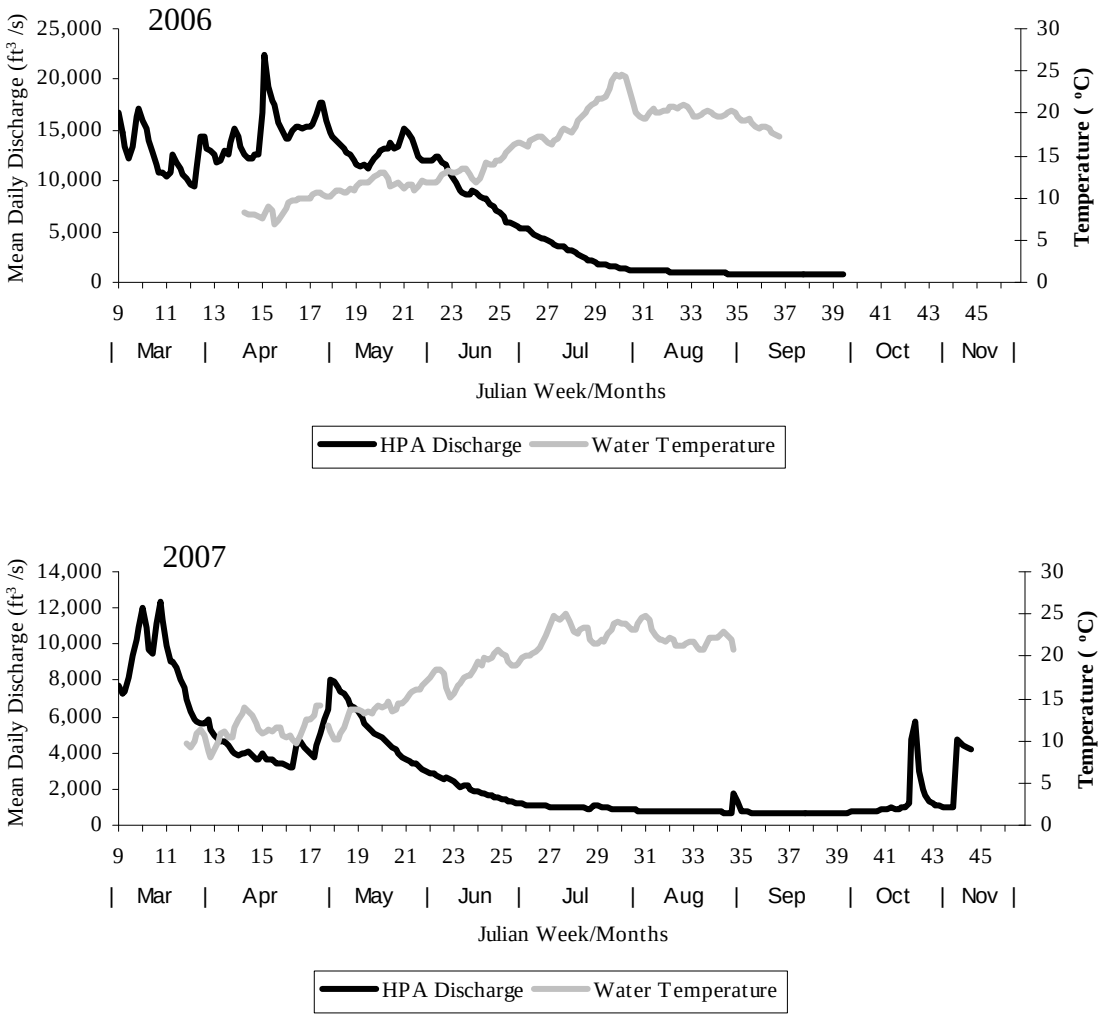

Figure 2. Mean daily discharge (ft^3/s) as recorded at Hoopa (HPA), California (US Geological Survey Water Resource gauge station #11-530000) and mean daily water temperature (^oC) during 2006 and 2007 sampling seasons at the Trinity River rotary screw trap site near Willow Creek (rkm 34), California.

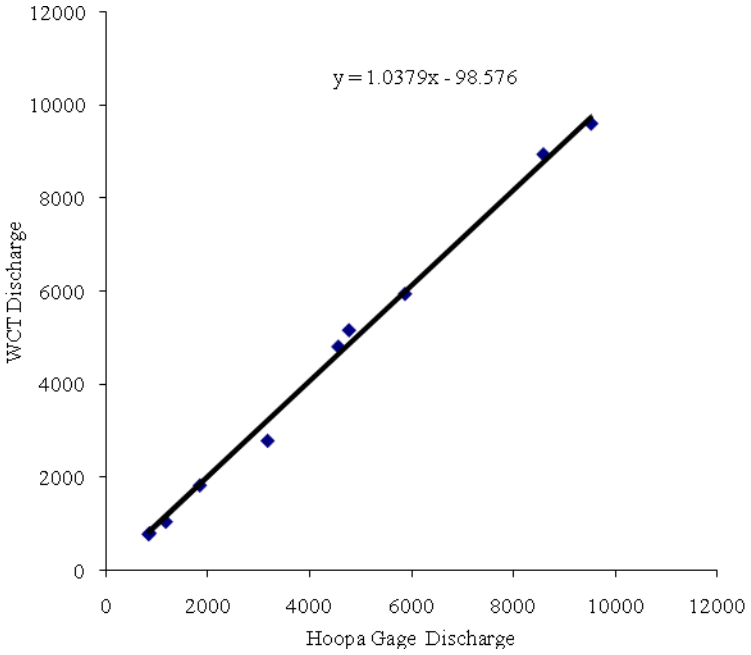

Figure 3. Regression of WCT Discharge as measured by Acoustic Doppler Current Profiler vs. Hoopa Gage Discharge (n = 10, r = 0.999).

Catch Totals

Chinook salmon

2006

Catches of Chinook salmon in 2006 were predominately hatchery fish with a catch of 12,328 comprising 76.6% of the total age-0 (Table 4, Appendix 1). A total of 3,765 natural age-0 fish were captured during the monitoring period, comprising 23.4% of the total catch. Additionally, two age-1 Chinook salmon were captured.

Table 4. Juvenile salmonid catch totals for 2006 and 2007 at the Trinity River rotary screw traps near Willow Creek (river kilometer [rkm] 34), California, operated by the United States Fish and Wildlife Service, Arcata Fish and Wildlife Office and the Yurok Tribal Fisheries Program. Hatchery and natural catches for Chinook salmon are estimated from coded wire tag expansions; age-1+ fish includes all juveniles 1 year old and older.

Year	Species	Hatchery	Natural Age-0	Natural Age-1+	Total	% Hatchery
2006	Chinook salmon	12,328	3,765	2*	16,095	76.6
2006	coho salmon	395	89	126	610	64.8
2006	steelhead	141	807	299	1,247	11.3
2007	Chinook salmon	8,115	45,212	8*	53,335	15.2
2007	coho salmon	1,992	314	203	2,509	79.4
2007	steelhead	1,766	795	4,418	6,979	25.3

*Due to low catch numbers, the possibility exists that these could be hatchery origin fish.

Natural age-0 Chinook salmon were captured throughout the sampling period (mid-March through early September), although very few (<10 fish per week) natural age-0 Chinook salmon were captured from the last week in April through the end of May, the time period that also coincided with high stream discharges (>10,000 ft^3/s). The majority of hatchery produced Chinook salmon, were captured from early June through end of August (Appendix 1). While trapping was initiated the second week of March, catches of age-0 Chinook salmon during the first week of sampling indicate 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.

The TRH released approximately 3.2 million age-0 Chinook salmon (spring- and fall-run) in the spring of 2006 (Table 5). Spring releases included AD-clipped Coded Wire Tagged groups, representing 23.5% of released Chinook salmon. TRH released approximately 1.4 million age-0 Chinook salmon in the fall of 2006 (Table 5). Fall releases, which occurred after trapping operations were ended, included AD-clipped Coded Wire Tagged groups, representing 24.0% of released Chinook salmon.

Table 5. California Department of Fish and Game, Trinity River Hatchery juvenile salmonid releases, 2006-2007.

Year	Species	Release Season	Number Released	Percentage AD-clipped	Release Dates
2006	Chinook salmon	Spring	3,199,954	23.5%	06/01/2006-06/07/2006
2006	Chinook salmon	Fall	1,396,705	24.0%	10/02/2006-10/16/2006
2006	coho salmon	Spring	545,851	100%	03/15/2006-03/24/2006
2006	steelhead	Spring	824,888	100%	03/15/2006-03/24/2006
2007	Chinook salmon	Spring	2,968,557	24.0%	06/01/2007-06/08/2007
2007	Chinook salmon	Fall	965,516	25.0%	10/01/2007-10/8/2007
2007	coho salmon	Spring	514,592	100%	03/15/2007-03/27/2007
2007	steelhead	Spring	823,373	100%	03/15/2007-03/27/2007

2007

Catches of Chinook salmon were predominately natural fish with a catch of 45,212, comprising 84.8% of the age-0 total (Table 4, Appendix 2). A total of 8,115 hatchery age-0 fish were captured, comprising 15.2% of the total age-0 catch. Additionally, eight age-1 Chinook salmon were captured.

Natural age-0 Chinook salmon were captured throughout the sampling period (mid-March through late August). The majority of hatchery produced Chinook salmon were captured from early June through the end of July (Appendix 2). While trapping was initiated the second week of March, catches of age-0 Chinook salmon during the first week of sampling indicate 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.

The TRH released approximately 3.0 million age-0 Chinook salmon (spring- and fall-run) in the spring of 2007 (Table 5). Spring releases included AD-clipped Coded Wire Tagged groups, representing 24.0% of released Chinook salmon. The TRH released approximately 1.0 million age-0 Chinook salmon in the fall of 2007 (Table 5). Fall releases, which occurred after trapping operations were ended, included AD-clipped Coded Wire Tagged groups, representing 25.0% of released Chinook salmon.

Coho salmon

2006

Catches of coho salmon during 2006 were predominately hatchery age-1 fish with a catch of 395, comprising 64.8% of the total catch (Table 4, Appendix 3). A total of 126 natural age-1 and 89 natural age-0 coho salmon were captured, comprising 20.7% and 14.5%, respectively, of the total catch.

The majority of age-1 coho salmon, both hatchery and naturally produced, were captured from early May through mid-June (Appendix 3). While trapping was initiated the week following the release of hatchery produced coho salmon, the large catch of age-1 hatchery coho 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. The majority of age-0 coho salmon were captured from mid-June through mid-July.

The TRH released over 500,000 yearling coho salmon during March, 2006 (Table 5). All hatchery coho salmon were marked with a right maxillary clip and an adipose fin clip.

2007

Catches of coho salmon during 2007 were predominately hatchery age-1 fish with a catch of 1,992 comprising 79.4% of the total catch (Table 4, Appendix 4). A total of 203 natural age-1 and 314 natural age-0 coho salmon were captured during the spring monitoring period, comprising 8.1% and 12.5%, respectively, of the total spring catch.

The majority of age-1 coho salmon, both hatchery and naturally produced, were captured from late April through mid-June (Appendix 4). Trapping was initiated the week prior to the release of hatchery produced coho salmon, effectively capturing the spring emigration period for hatchery produced coho salmon. The majority of age-0 coho salmon were captured from mid-March through early-July.

The TRH released over 500,000 yearling coho salmon during March, 2007 (Table 5). All hatchery coho salmon were marked with a right maxillary clip and an adipose fin clip.

Steelhead

2006

Catches of steelhead during 2006 were predominately natural age-0 fish, with a catch of 807 comprising 64.7% of the total catch (Table 4, Appendix 5). A total of 199 natural age-1, 100 natural age-2, and 141 hatchery age-1 steelhead were captured, comprising 16.0%, 8.0%, and 11.3% of the total catch, respectively.

The majority of age-1 hatchery steelhead were captured from early May through mid-June (Appendix 5), while the majority of natural age-1+ steelhead were captured from early May through mid-July. While trapping was initiated the week following the release of hatchery produced steelhead, catches of age-1 hatchery steelhead 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. The majority of age-0 steelhead were captured from mid-May through mid-August.

The TRH released over 800,000 yearling steelhead during March of 2006 (Table 5). All hatchery steelhead were marked with an adipose fin clip.

2007

Catches of steelhead during 2007 were predominately natural age-1+ fish with a catch of 4,418 comprising 63.3% of the total catch (Table 4, Appendix 6). A total of 795 natural age-0, and 1,766 hatchery age-1 steelhead were captured, comprising 11.4%, and 25.3% of the total catch, respectively.

The majority of age-1 hatchery steelhead were captured from late March through late June (Appendix 6). The majority of natural age-1+ steelhead were captured from mid-March through the end of July, but were present in the catch every week that sampling occurred in 2007. Trapping was initiated the week prior to the release of hatchery produced steelhead, effectively capturing the spring emigration period for hatchery produced steelhead. The majority of age-0 steelhead were captured from early April through the end of August. Since age-0 steelhead were captured on the last day of sampling, it is likely that the end of the age-0 'emigration' period was not fully captured and an unknown number of fish migrated past the trap site after sampling ceased.

The TRH released over 800,000 yearling steelhead during March of 2007 (Table 5). All hatchery steelhead were marked with an adipose fin clip.

Non-Target Species

2006

Lamprey ammocetes were the most common non-target fish captured during 2006 (Table 6). Other abundant species included Klamath smallscale suckers, speckled dace, and green sturgeon (Table 6).

Table 6. Catch totals of non-target fish species captured at the Trinity River rotary screw trap, near Willow Creek (rkm 34), California, 2006-2007.

Common Name	Species	2006 Catch (n)	2007 Catch (n)
Lamprey ammocete	*Entosphenus spp.*	2,611	990
Klamath smallscale sucker	*Catostomus rimiculus*	2,411	1,533
Speckled dace	*Rhinichthys osculus*	482	909
Green sturgeon	*Acipenser medirostris*	108	43
Sculpin species	*Cottus spp.*	63	160
Brown trout	*Salmo trutta*	28	14
Threespine stickleback	*Gasterosteus aculeatus*	20	41
Sockeye salmon	*Oncorhynchus nerka*	15	19
American shad	*Alosa sapidissima*	5	2
Golden shiner	*Notemigonus crysoleucas*	3	13
Season Total		5,746	3,724

2007

Klamath smallscale sucker was the most common non-target species captured during 2007 (Table 6). Other abundant species included lamprey ammocetes, speckled dace, and sculpin (Table 6).

Abundance Indices, Emigration Timing and Duration

Chinook salmon

2006

In 2006, Chinook salmon were caught the first day trapping occurred, suggesting that juvenile Chinook salmon were present before traps were installed. The 2006 total abundance index for natural age-0 Chinook salmon was 80,311 (Table 7, Appendix 1). Natural age-0 Chinook salmon had two relatively distinct emigration periods (Figure 4), one from JW 12-19 peaking JW 14 (Table 8), and another from JW 21-36 peaking JW 26 (Table 8).

Only two natural age-1 Chinook salmon were captured, so no peak could be determined, as such, the emigration duration should be interpreted with caution. The 2006 abundance index for natural age-1 Chinook salmon was 400 (Table 7).

The 2006 abundance index total for hatchery age-0 Chinook salmon was 198,276 (Table 7, Appendix 1). Emigration duration of hatchery age-0 Chinook salmon was from JW 23-35 with a peak in JW 26 (Table 8, Appendix 1). Weekly abundance indices of hatchery age-0 Chinook salmon increased through June then decreased through the end of August (Figure 4).

Table 7. Juvenile salmonid abundance indices, Willow Creek trap site, 2006-2007.

Year	Species	Natural Age-0	Natural Age-1+	Hatchery Age-0	Hatchery Age-1	Total
2006	Chinook salmon	80,311	400	198,276	N/A	278,987
2006	coho salmon	3,918	7,820	N/A	37,748	49,449
2006	steelhead	28,578	20,713	N/A	15,681	64,972
2007	Chinook salmon	635,906	221	63,325	N/A	699,452
2007	coho salmon	8,328	3,987	N/A	46,016	58,331
2007	steelhead	6,806	72,124	N/A	30,518	109,448

Table 8. Juvenile salmonid emigration duration and peak, Willow Creek trap site, 2006-2007. Values represent Julian weeks.

		Emigration Duration			Emigration Peak		
Year	Species	Natural Age-0	Natural Age-1+	Hatchery	Natural Age-0	Natural Age-1+	Hatchery
2006	Chinook salmon	12-36	17-20	23-35	14/26*	N/A	26
2006	coho salmon	13-34	12-28	12-29	15/27*	14/21*	12/20*
2006	steelhead	18-36	12-36	12-31	22	16/20/23*	20
2007	Chinook salmon	10-34	11-21	23-32	11/19*	N/A	24
2007	coho salmon	11-27	11-25	11-27	11/18*	11/18/21*	12/18/21*
2007	steelhead	13-34	10-34	12-26	24	17	17

*Multiple Peaks

2007

In 2007, Chinook salmon were caught the first day trapping occurred, suggesting that juvenile Chinook salmon were present before traps were installed. The 2007 total abundance index for natural age-0 Chinook salmon was 635,906 (Table 7, Appendix 2). Emigration duration for natural age-0 Chinook salmon encompassed the entire sampling period, JW 10-34 (Table 8, Appendix 2). Natural age-0 Chinook salmon had two relatively distinct emigration periods (Figure 4), one from JW 10-14 peaking JW 11 (Table 8), and another from JW 15-30 peaking JW 19 (Table 8, Appendix 2).

Only eight natural age-1 Chinook salmon were captured, so no peak could be determined, as such, the emigration duration should be interpreted with caution. The 2007 abundance index for natural age-1 Chinook salmon was 221 (Table 7).

The 2007 abundance index total for hatchery age-0 Chinook salmon was 63,325 (Table 7, Appendix 2). Emigration duration of hatchery age-0 Chinook salmon was from JW 23-32 with a peak in JW 24 (Table 8, Appendix 2). Weekly abundance indices of hatchery age-0 Chinook salmon increased through mid-June, then decreased through the end of August (Figure 4).

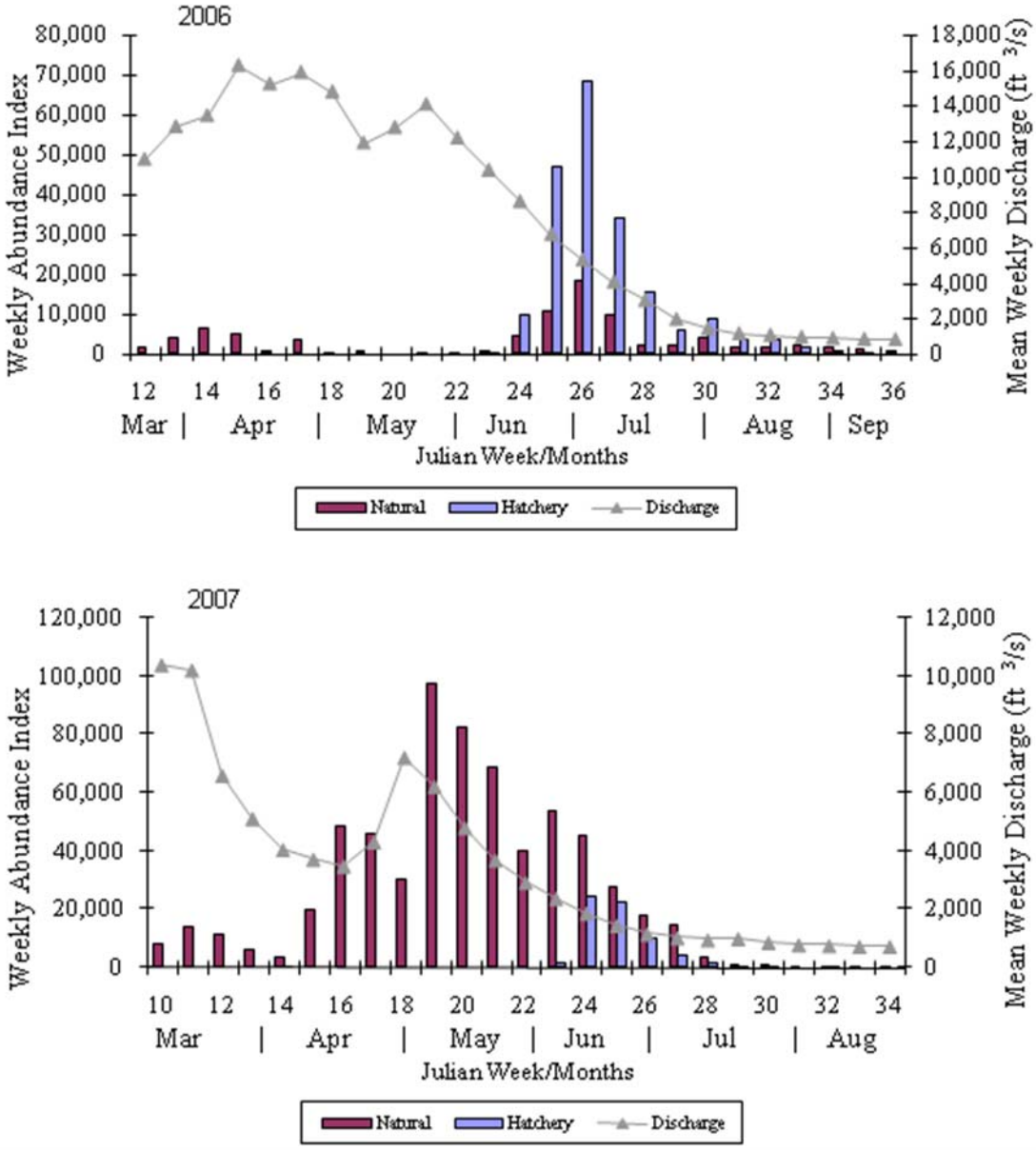

Figure 4. Weekly abundance indices for natural age-0 and hatchery age-0 Chinook salmon captured at the Trinity River rotary screw traps near Willow Creek (rkm 34), California, and mean daily discharge (ft^3/s) as recorded at Hoopa, California (US Geological Survey Water Resource streamgage station #11-530000), 2006-2007. Please note differences in scale of axes.

Coho salmon

2006

In 2006, age-0 coho salmon were captured the second week of trapping, indicating that the initiation of age-0 coho salmon emigration was adequately sampled. The 2006 abundance index total for age-0 coho salmon was 3,918 (Table 7). Emigration duration for age-0 coho salmon was from JW 13-34 (Table 8, Appendix 3). Natural age-0 coho salmon in 2006 had two distinct emigration periods (Figure 5), one from JW 13-19 peaking JW 15 (Table 8), and another from JW 23-34 peaking JW 27 (Table 8, Appendix 3).

In 2006, natural age-1 coho salmon were caught the first day trapping occurred, suggesting that natural age-1 coho salmon were present before traps were installed. The 2006 abundance index for natural age-1 coho salmon was 7,820 (Table 7). Emigration duration for natural age-1 coho salmon was from JW 12-28 (Table 8, Appendix 3) with two distinct emigration periods (Figure 5) one from JW 12-16 peaking JW 14, and another from JW 19-28 peaking JW 21 (Table 8, Appendix 3).

In 2006, hatchery age-1 coho salmon were caught the first day trapping occurred, suggesting that hatchery age-1 coho salmon were present before traps were installed. The 2006 abundance index total for hatchery age-1 coho salmon was 37,748 (Table 7). Emigration duration for hatchery age-1 coho salmon was from JW 12-29 (Table 8, Appendix 3) with two distinct emigration periods (Figure 5) one from JW 12-17 peaking JW 12, and another from JW 19-29 peaking JW 20 (Table 8, Appendix 3).

2007

In 2007, age-0 coho salmon were caught the second week of trapping, indicating that the initiation of age-0 coho salmon emigration was adequately sampled. The 2007 abundance index total for age-0 coho salmon was 8,328 (Table 7). Emigration duration for age-0 coho salmon was from JW 11-27 (Table 8, Appendix 4). Natural age-0 coho salmon had two distinct emigration periods (Figure 5), one from JW 11-16 peaking JW 11 (Table 8, Appendix 3), and another from JW 17-27 peaking JW 18 (Table 8, Appendix 4).

In 2007, natural age-1 coho salmon were caught the second week of trapping, indicating that the initiation of natural age-1 coho salmon emigration was adequately sampled. The 2007 abundance index for natural age-1 coho salmon was 3,987 (Table 7). Emigration duration for natural age-1 coho salmon was from JW 11-25 (Table 8, Appendix 4) with two distinct emigration periods (Figure 5) one from JW 11-16 peaking JW 11, and another from JW 17-25, with two peaks in JW 18 and JW 21 (Table 8, Appendix 4).

In 2007, hatchery age-1 coho salmon were caught the second week of trapping, indicating that the initiation of hatchery age-1 coho salmon emigration was adequately sampled. The 2007 abundance index total for hatchery age-1 coho salmon was 46,016 (Table 7). Emigration duration for hatchery age-1 coho salmon was from JW 11-27 (Table 8, Appendix 4) with two distinct emigration periods (Figure 5): one from JW 11-13, peaking JW 12, and another from JW 15-27 with two peaks, JW 18 and JW 21(Table 8, Appendix 4).

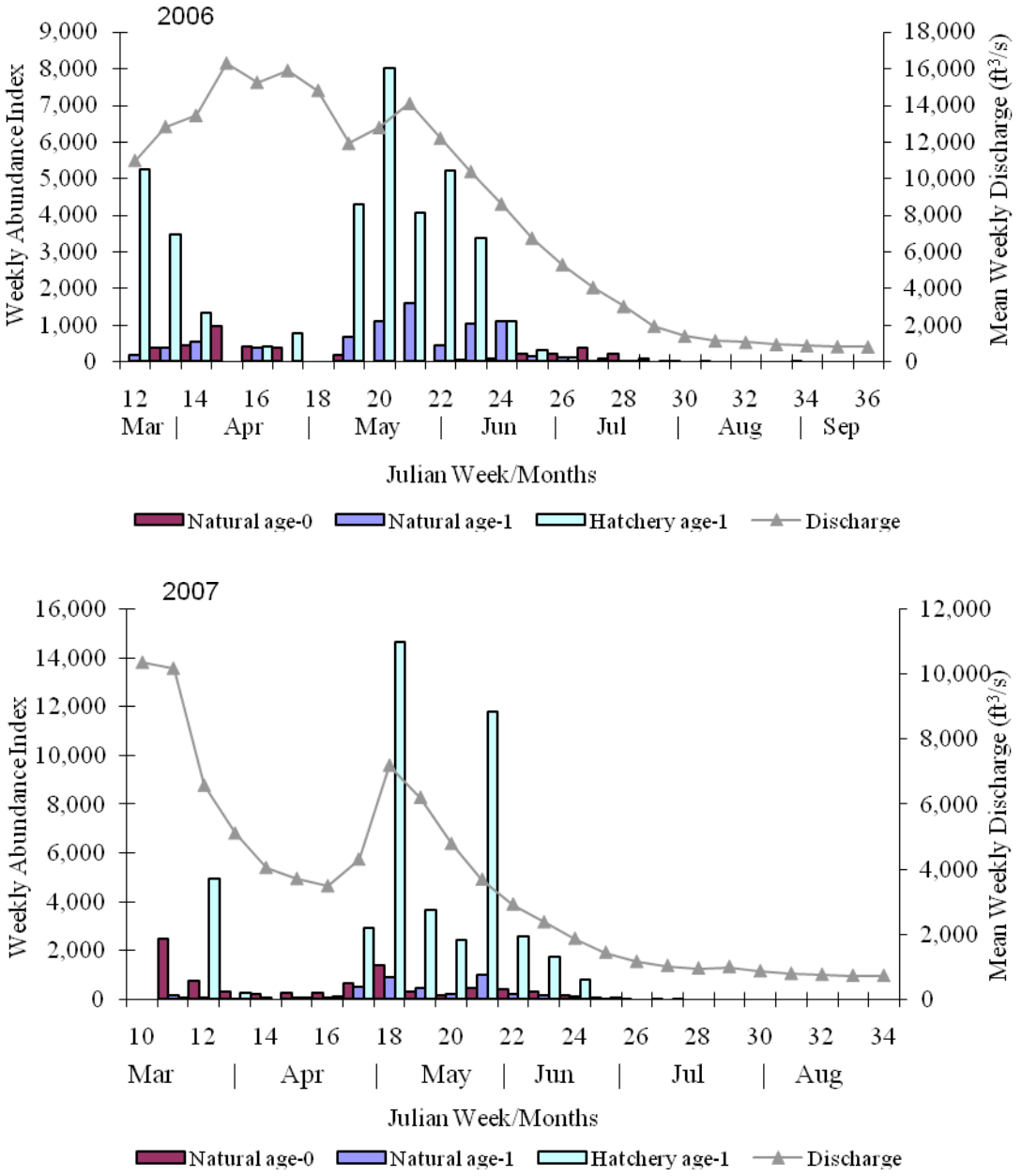

Figure 5. Weekly abundance indices for natural age-0 natural age-1 and hatchery age-1 coho salmon captured at the Trinity River rotary screw traps near Willow Creek (rkm 34), California, and mean daily discharge (ft^3/s) as recorded at Hoopa, California (US Geological Survey Water Resource streamgage station #11-530000), 2006-2007. Please note differences in scale of axes.

Steelhead

2006

In 2006, age-0 steelhead were not caught until the seventh week of trapping, indicating that the initiation of age-0 steelhead emigration was adequately sampled. The 2006 abundance index total for age-0 steelhead was 28,578 (Table 7). Emigration duration had one period from JW 18-36, peaking JW 22 (Table 8, Figure 6, Appendix 5).

In 2006, natural age-1 or older (age-1+) steelhead were caught the first week trapping occurred, suggesting that natural age-1+ steelhead were present before traps were installed. The 2006 abundance index for natural age-1+ steelhead was 20,713. The duration of the natural age-1+ steelhead emigration from the Trinity River had one distinct period (JW 12-36) with multiple peaks (JW 16, 20, and 23) (Figure 6, Table 8, Appendix 5).

In 2006, hatchery age-1 steelhead were caught the first week trapping occurred, suggesting that hatchery age-1 steelhead were present before traps were installed. The 2006 index for hatchery age-1 steelhead was 15,681. The emigration duration of hatchery age-1+ steelhead had one distinct period (JW 12-31) with a peak in JW 20 (Figure 6, Table 8, Appendix 5).

2007

In 2007, age-0 steelhead were first caught the fourth week of trapping, indicating that the initiation of age-0 steelhead emigration was adequately sampled. The 2007 abundance index for age-0 steelhead was 6,806 (Table 7). The emigration duration had one period from JW 13-34 peaking JW 24 (Table 8, Figure 6, Appendix 6).

In 2007, natural age-1+ steelhead were caught the first week trapping occurred, suggesting that natural age-1+ steelhead were present before traps were installed. The 2007 abundance index for natural age-1+ steelhead was 72,124. The emigration duration of natural age-1+ steelhead had one distinct period (JW 10-34) with a peak in JW 17 (Figure 6, Table 8, Appendix 6).

In 2007, hatchery age-1+ steelhead were first caught the third week of trapping indicating that the beginning of the hatchery age-1+ steelhead emigration period was adequately sampled. The 2007 abundance index for hatchery age-1+ steelhead was 30,518. The emigration duration of natural age-1+ steelhead had one distinct period (JW 12-26) with a peak in JW 17 (Figure 6, Table 8, Appendix 6).

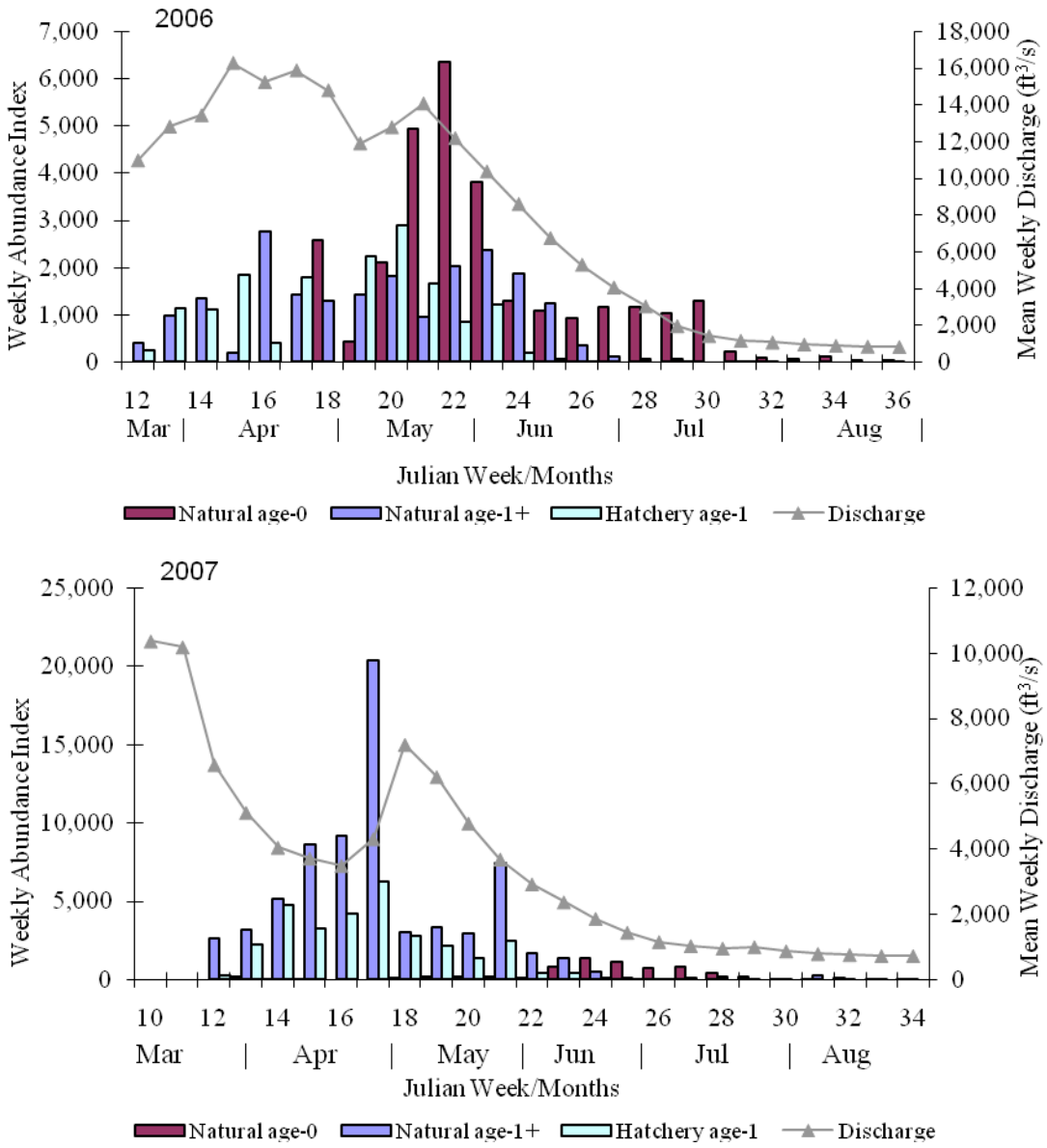

Figure 6. Weekly abundance indices for natural age-0, natural age-1+, and hatchery age-1 steelhead captured at the Trinity River rotary screw traps near Willow Creek (rkm 34), California, and mean daily discharge (ft^3/s) as recorded at Hoopa, California (US Geological Survey Water Resource streamgage station #11-530000), 2006-2007. Please note differences in scale of axes.

Migration Rates

Trinity River Hatchery Chinook salmon

2006
Juvenile Chinook salmon were released from TRH on June 1, 2006, and first captured at the trap site on June 10, 2006. The initial/maximum migration rate for hatchery Chinook salmon calculated from the initial release date and first ad-clip captured was 16.0 rkm/day (Table 9).

2007
Juvenile Chinook salmon were released from TRH on June 1, 2007, and first captured at the trap site on June 6, 2007. The initial/maximum migration rate for hatchery Chinook salmon calculated from the initial release date and first ad-clip captured was 27.0 rkm/day (Table 9).

Table 9. Juvenile salmonid maximum migration rate from Trinity River Hatchery to the rotary screw trap site near Willow Creek (rkm 34), California, operated by the United States Fish and Wildlife Service, Arcata Fish and Wildlife Office and the Yurok Tribal Fisheries Program, 2006-2007.

Year	Species	Date First Released	Date First Captured	# of Days	Maximum Migration Rate
2006	Chinook salmon	6/01/2006	6/10/2006	9	16.0 rkm/day
2006	coho salmon	3/15/2006	3/22/2006*	7*	19.3 rkm/day*
2006	steelhead	3/15/2006	3/25/2006*	10*	13.5 rkm/day*
2007	Chinook salmon	6/01/2007	6/06/2007	5	27.0 rkm/day
2007	coho salmon	3/15/2007	3/17/2007	2	67.5 rkm/day**
	coho salmon	3/15/2007	3/19/2007	4	33.8 rkm/day
2007	steelhead	3/15/2007	3/22/2007	7	19.3 rkm/day

*Values should be interpreted with caution because the hatchery release occurred prior to trap installation.
**The first arrival was marked with a fluorescent orange elastomer mark behind the left eye, origin unknown. It is assumed this fish was released prior to the hatchery release.

Coho salmon

2006
Coho salmon yearlings released from TRH on March 15, 2006, were first captured at the trap site on March 22, 2006. The migration rate calculated from the initial release date and first max-clip captured was 19.3 rkm/day (Table 9); however, this value should be interpreted with caution because the traps were installed after the hatchery release. It is possible that the initial/maximum migration rate for hatchery yearling coho salmon was faster than that presented in this report.

2007
Coho salmon yearlings released from Trinity River Hatchery on March 15, 2007, were first captured at the trap site on the first day of sampling, March 17, 2007. Although the migration rate calculated from the initial release date and first max-clip captured was 67.5 rkm/day (Table 9), the first max-clip captured was marked with a fluorescent orange elastomer mark behind the left eye and assumed to have been released prior to the hatchery release. The migration rate calculated from the initial release date and the second max-clip captured was 33.8 rkm/day (Table 9).

Steelhead

2006
Steelhead yearlings released from TRH on March 15, 2006, were first captured at the trap site on March 25, 2006. The migration rate calculated from the initial release date and first ad-clip captured was 13.5 rkm/day (Table 9); however, this value should be interpreted with caution because the traps were installed after the hatchery release. It is possible that the initial/maximum migration rate for hatchery yearling steelhead was faster than that presented in this report, even though three days elapsed before catching a yearling hatchery steelhead after installation of the traps.

2007
Steelhead yearlings released from Trinity River Hatchery on March 15, 2007, were first captured at the trap site on March 22, 2007. The migration rate calculated from the initial release date and first ad-clip captured was 19.3 rkm/day (Table 9).

Population Estimate

Only age-0 Chinook salmon were captured in quantities sufficient for conducting mark-recapture population estimates. Population estimates include both natural and hatchery age-0 Chinook salmon because of the inability to distinguish between naturally produced and unmarked hatchery produced Chinook salmon.

2006
Mark-recapture tests in 2006 were conducted from JW 24 to JW 31 (Appendix 7). Season-wide marking rate was 70.6% (Table 10) with over 11,000 fish marked, and the recapture rate was 2.11% with 240 recaptures. The age-0 Chinook salmon population estimate and 95% confidence interval for the period from JW 24 – 31 was 860,009 +/- 180,621 (Appendix 7) with the 95% confidence interval equal to +/-21.0% of the population estimate.

Table 10. Chinook salmon age-0 season total catch, numbers marked and recaptured, and season-wide marking and recapture rates, Willow Creek trap site, in 2006 and 2007.

Year	Catch	# Marked	Marking Rate	# Recaps	Recapture Rate
2006	16,082	11,351	70.6%	240	2.11%
2007	53,327	19,427	36.4%	661	3.40%

2007

Mark-recapture tests in 2007 were conducted from JW 16 to JW 26 (Appendix 8), except no marking was conducted JW 18 due to high flows. For this period the marking rate was 36.4% (Table 10) with over 19,000 fish marked, and the recapture rate was 3.40% with 661 recaptures (Appendix 8). The age-0 Chinook salmon population estimate and 95% confidence interval for the period from JW 16 – 26 was 2,061,366 +/- 308,749, however, this value is an underestimate due to no mark-recapture tests during JW 18. The 95% confidence interval equals +/-15.0% of the population estimate.

Testing of Trap Efficiency Assumptions

Comparison of Day and Night Releases (2005)

Comparison of trapping efficiency between day and night releases of marked juvenile Chinook salmon indicated that there was no significant difference (paired t-test, $t = -0.857$, $n = 6$, $p = 0.431$) in trap efficiency between day and night releases. In addition, the efficiency of day and night releases were positively correlated ($r = 0.888$, $n = 6$, $p = 0.018$; Figure 7). Thus it appears that time of day does not significantly affect trap efficiency at the Willow Creek trap site. However, as the day releases were made during the late afternoon not during morning hours, it is unknown what effect earlier release might have on the relationship. In addition, it is quite possible that the particular hydrographics of 2005 were such that no detectable difference in efficiency between day and night could be detected. It is recommended that the relationship between release time be further investigated in future years.

Comparisons of Recapture Rates of Hatchery and Naturally Produced Fish (2007)

A total of four paired releases of distinctively marked natural and hatchery age-0 Chinook salmon at the trap site early in the season were conducted from JW 15 -21 (Table 11), with recapture rates of marked hatchery fish ranging from 2.19% to 7.49%, while recapture rates of natural age-0 Chinook salmon for the same time periods ranged from 4.09% to 6.86% (Table 11). Although hatchery recapture rates were higher than natural recapture rates ($n = 4$, $p = 0.0475$, paired t-test; Table 11), they were positively correlated ($n = 4$, $r = 0.941$, $p = 0.0586$; Figure 8). The comparison of hatchery to natural fish during the first release period compares hatchery fish released late in JW 15 (HPA discharge 3,650 ft^3/s) to natural fish released early in JW 16 (HPA discharge 3,490); it is assumed that there is little flow effect on the relationship, but should be noted.

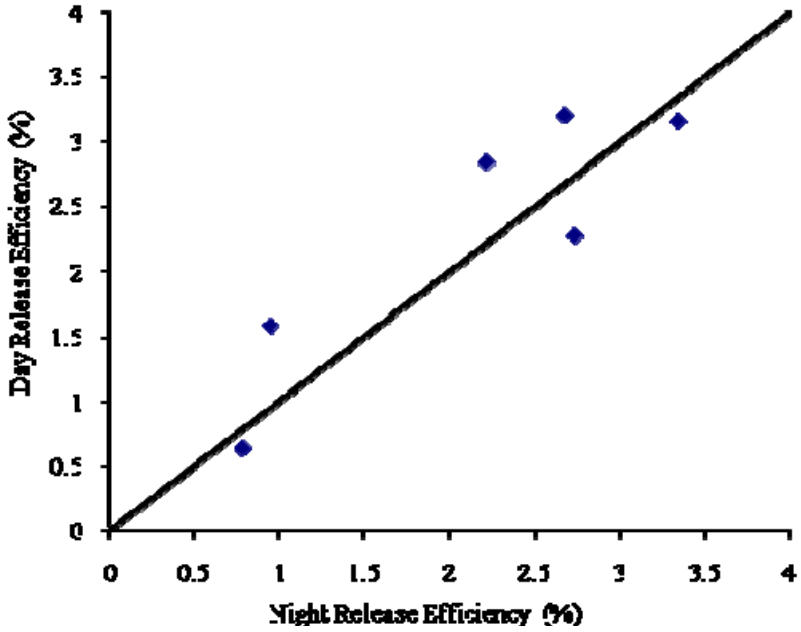

Figure 7. Comparison of trapping efficiency between night and day releases of marked juvenile Chinook salmon at the Trinity River rotary screw traps near Willow Creek (rkm 34), California, 2005. Solid line represents a 1:1 relationship.

Table 11. Marked hatchery Chinook salmon age-0 release numbers and recapture rate, Willow Creek Trap Site, in 2007.

JW	# Released Hatchery	# Recaps Hatchery	# Released Natural	# Recaps Natural	Hatchery Recapture Rate	Natural Recapture Rate
15	2,043	153	2,961*	203*	7.5%	6.9%*
17	2,040	149	294	17	7.3%	5.8%
19	1,798	82	2,577	110	4.6%	4.3%
21	2,023	102	978	40	5.0%	4.1%

*JW 16 Data

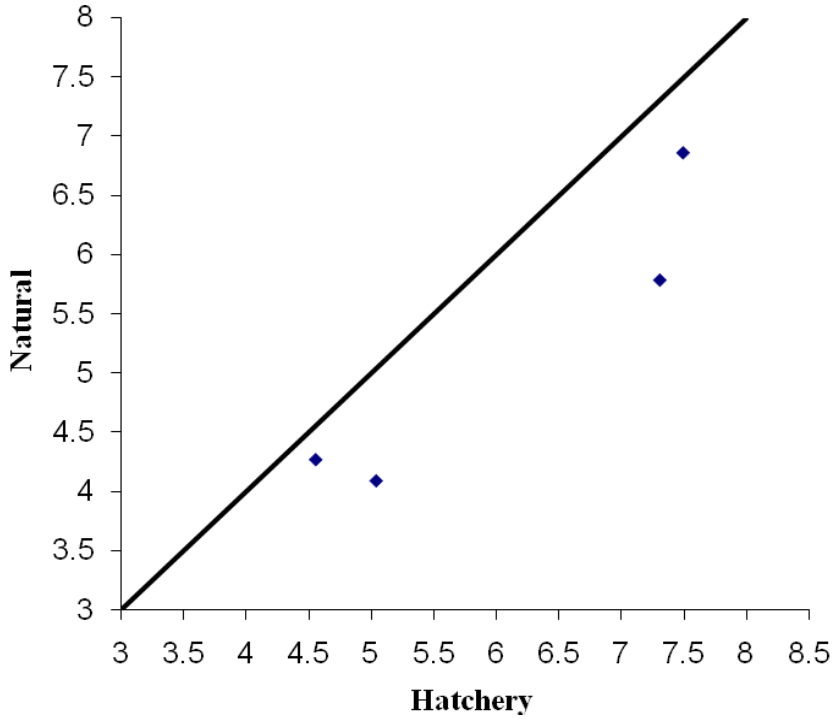

Figure 8. Comparison of Natural and Hatchery recapture rates (%) of age-0 Chinook salmon at the Trinity River rotary screw traps near Willow Creek (rkm 34), California, 2007. Solid line represents a 1:1 relationship.

Fork Lengths

Chinook salmon

2006
Mean FL of age-0 Chinook salmon was fairly stable during the beginning of sampling in 2006 (Figure 9, Appendix 9) then increased noticeably in Julian week 22 with the arrival of hatchery fish. This increase in mean FL was followed by a small decrease and then an increase through the end of sampling.

2007
Mean FL of age-0 Chinook salmon in 2007 gradually increased through the first part of the season (Figure 9, Appendix 10) then increased slightly in Julian week 24 with the arrival of hatchery fish. This increase in mean FL was followed by a small decrease and then a leveling off through the end of sampling.

Coho salmon

2006
Mean FL of age-0 coho salmon generally increased over the 2006 sampling season (Figure 10, Appendix 9). Mean FL of hatchery age-1 coho salmon generally decreased through the 2006 sampling season, while mean FL of natural age-1 coho salmon generally increased.

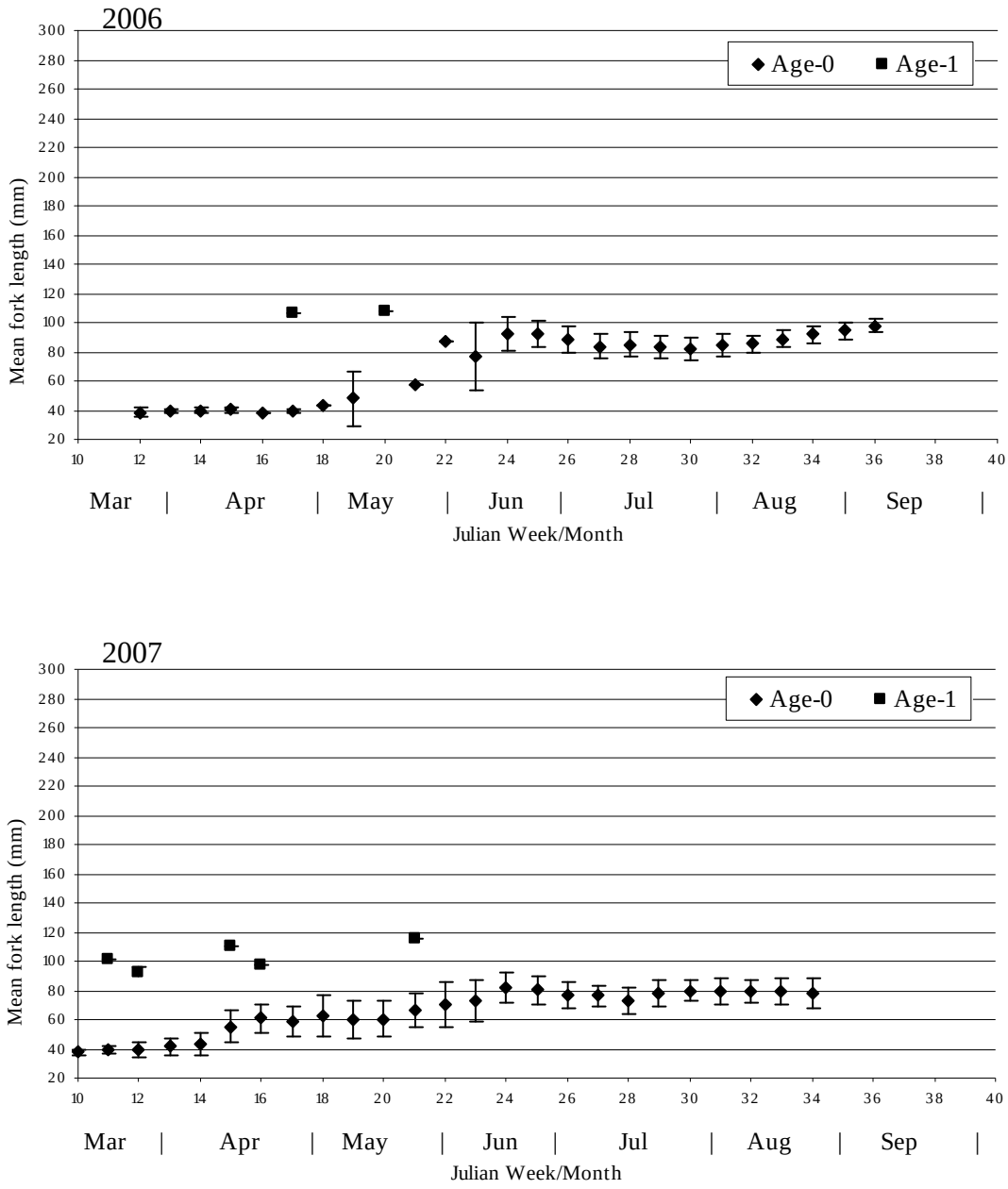

Figure 9. Weekly mean fork lengths for age-0 (natural and hatchery combined) and natural age-1 Chinook salmon captured at the Trinity River rotary screw traps near Willow Creek (rkm 34), California, 2006-2007. Error bars represent one standard deviation of the mean.

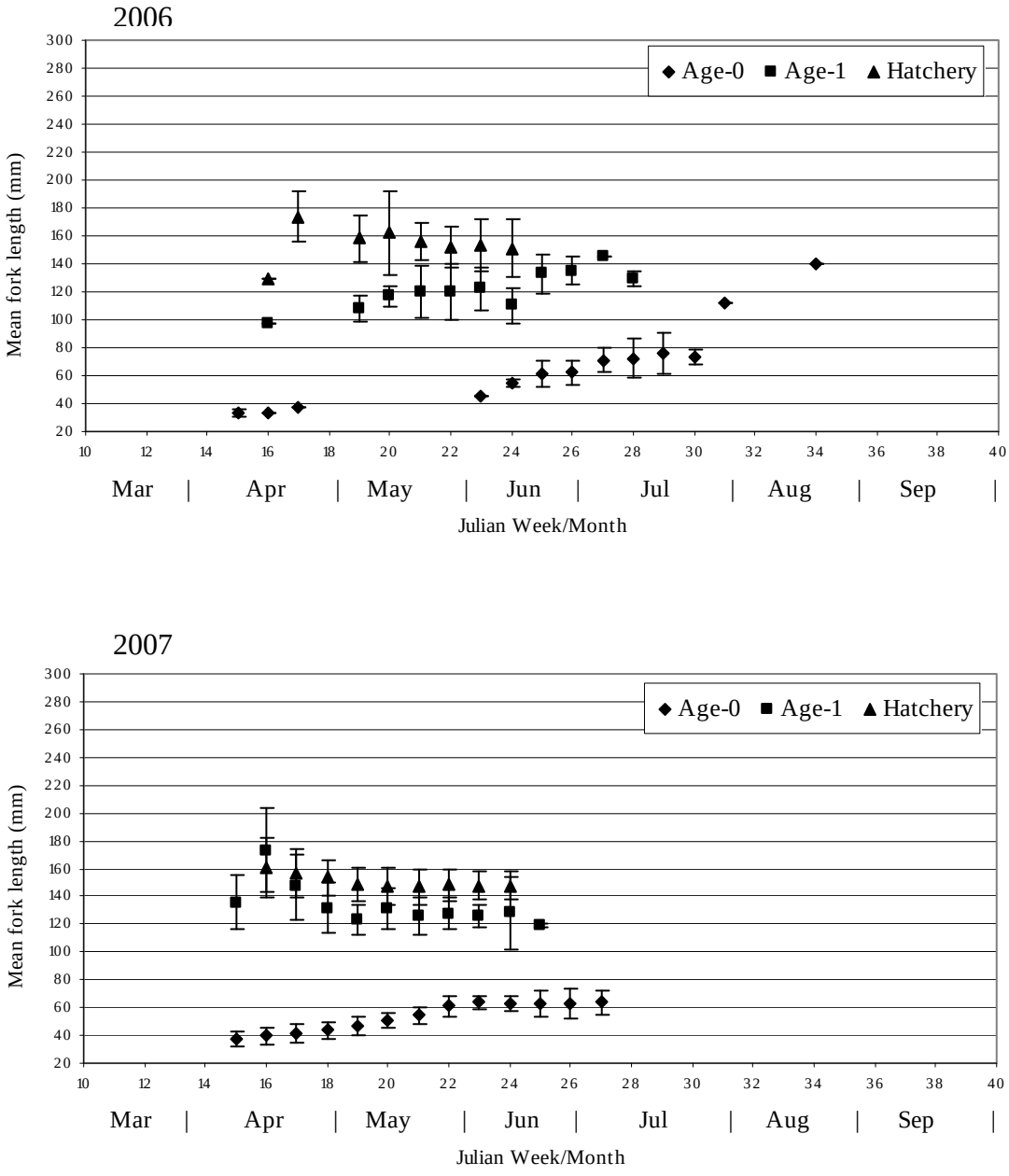

Figure 10. Weekly mean fork lengths for natural age-0, natural age-1, and hatchery coho salmon captured at the Trinity River rotary screw traps near Willow Creek (rkm 34), California, 2006-2007. Error bars represent one standard deviation of the mean.

2007
Mean FL of age-0 coho salmon generally increased through the 2007 sampling season (Figure 10, Appendix 10). Mean FL of hatchery age-1 coho salmon generally decreased through the sampling season, while mean FL of natural age-1 coho salmon initially increased then decreased.

Steelhead

2006
Mean FL of age-0 steelhead generally increased through the 2006 sampling season (Figure 11, Appendix 11). Mean FL of hatchery age-1 and natural age-2 steelhead generally decreased while mean FL of natural age-1 steelhead generally increased.

2007
Mean FL of age-0 steelhead generally increased although was quite variable through the 2007 sampling season (Figure 11, Appendix 12). Mean FL of hatchery age-1 and natural age-2 steelhead generally decreased while mean FL of natural age-1 steelhead generally increased but was variable later in the season.

Summary

Juvenile salmonid emigration from the mainstem Trinity River has been monitored at the Willow Creek site since 1989 with rotary screw traps. This data series report summarizes the outmigrant monitoring data collected in 2006 and 2007 cooperatively by the Arcata Fish and Wildlife Office 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 at the site and prevents the loss of 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 the lower Trinity River trap site. While trapping operations have been refined to operate the traps at higher flows (>12,000 ft^3/s), high and highly variable flows during the beginning of the trapping seasons create challenges in maintaining effective sampling.

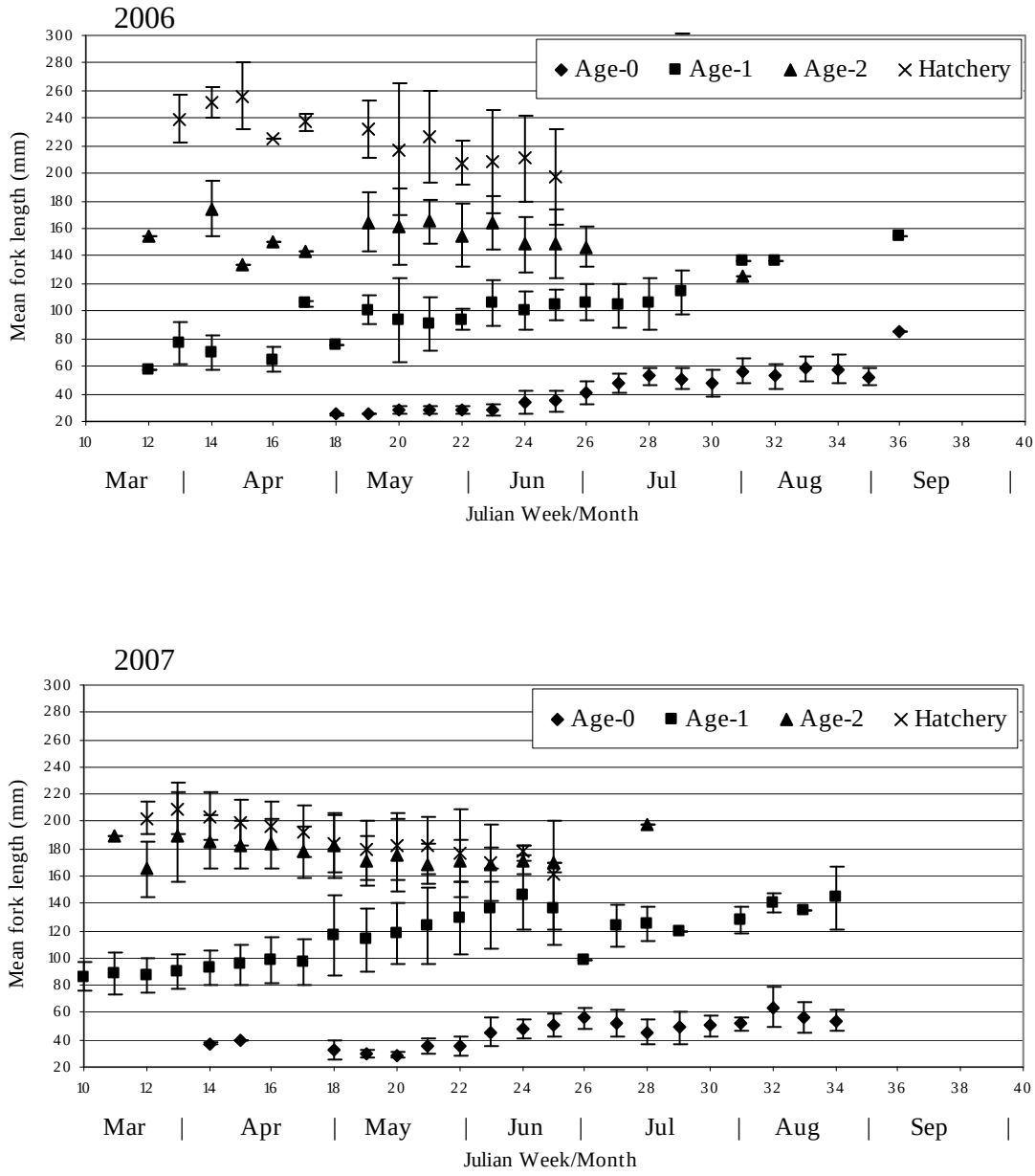

Figure 11. Weekly mean fork lengths for natural age-0, age-1, age-2, and hatchery age-1 steelhead captured at the Trinity River rotary screw traps near Willow Creek (rkm 34), California, 2006-2007. Error bars represent one standard deviation of the mean.

In 2006, trapping was initiated in the third week of March, while in 2007 trapping was initiated in the second week of March. To ensure that the early peak of the natural Chinook salmon emigration, as well as the hatchery and natural coho salmon and steelhead smolt emigration is sufficiently sampled, efforts were made to install the traps as early as possible. It is important to initiate sampling as early as possible and continue as late as possible so that comparable data sets, especially similar time periods, are collected to allow between year 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 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 fish. 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 throughout the 2006 and 2007 sampling seasons with the spring/summer emigration dominated by hatchery produced fish (71%) in 2006 and dominated by naturally produced fish (91%) in 2007 based on abundance indices. From mid-August to early September (2006) or late August (2007), very few Chinook salmon were captured .

The coho salmon population in the Trinity River is composed of both naturally produced and hatchery fish. The vast majority of coho salmon emigrate to the ocean as age-1 smolts while the emigration of age-0 fish is presumably a redistribution of rearing juveniles. Natural and hatchery produced age-1 coho salmon emigrated through the lower Trinity River beginning in mid-March through early July in both 2006 and 2007. Emigration of natural age-1 coho salmon may have occurred earlier but trapping was initiated in mid-March. Based on abundance indices, the age-1 coho salmon emigration is composed primarily of hatchery produced fish, comprising 76% of the total index in 2006 and 79% of the total index in 2007.

The steelhead population in the Trinity River is 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. Steelhead, especially age-0 and age-1 natural steelhead, were generally captured throughout the sampling season, with peaks in abundance occurring during the early portion of sampling effort. Age-0 steelhead were captured throughout the sampling season with peaks in abundance occurring in late-May (2006) to mid-June (2007). The majority of age-1 or older natural steelhead emigrated by the end of June in 2006 but were present in the catch through the end of August in 2007. The majority of hatchery produced age-1 steelhead emigrated by the end of June in both years. Steelhead mean length data was highly variable, most likely due to the various populations and races being sampled at the Willow Creek trapping site. Based on abundance indices, the age-1+ steelhead emigration is composed of less hatchery produced fish compared to naturally produced fish, comprising 24.1% and 31.9% respectively of the total steelhead abundance index in 2006, and 27.9% and 65.9% respectively of the total steelhead abundance index in 2007.

Abundance Indices

The total spring season 2006 abundance index for age-0 natural Chinook salmon (Table 7) was very low compared to indices calculated since 1992 over comparable time periods (USFWS 1992, 1994, 1998, 1999, 2001; Pinnix et al. 2007), while all the other 2006 spring/summer season juvenile salmon (age-1 natural and age-0 hatchery Chinook salmon, age-0 and age-1 natural coho salmon, and all ages of natural and hatchery steelhead) abundance indices were within the range of values calculated since 1992 over comparable time periods. The low abundance index for age-0 natural Chinook salmon mirrors the low catch numbers, and likely reflects a true low abundance for the 2006 spring sampling season, not just low catches due to low trap efficiencies. Since natural age-0 Chinook salmon were captured on the first day of trap operation in 2006, it is possible that a portion of the early spring natural age-0 Chinook salmon emigrated prior to trap installation.

The total spring season 2007 abundance index for age-0 natural Chinook salmon, age-1 natural Chinook salmon, age-0 hatchery Chinook salmon, age-0 coho salmon, age-1 natural coho salmon, age-1 hatchery coho salmon, age-0 steelhead, and age-1 hatchery steelhead (Table 7) were within the range of values calculated since 1992 over comparable time periods (USFWS 1992, 1994, 1998, 1999, 2001; Pinnix et al. 2007). The total spring season 2007 abundance index for age-1 natural steelhead was the highest on record since 1992 over comparable time periods (USFWS 1992, 1994, 1998, 1999, 2001; Pinnix et al. 2007). Since natural age-0 Chinook salmon were captured on the first day of trap operation in 2007, 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, intensive 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. Previous efforts to implement mark-recapture techniques into the trapping efforts were limited due to lack of sufficient funding. Abundance indices based on catches and the proportion of flow sampled by the trap(s) have been the quantification method employed for many years (USFWS 1991, 1994, 1995, 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 accuracy of the indices and make inter-year comparisons questionable. Mark-recapture efforts employed since 2002 (Pinnix et al. 2007) indicate that precise population estimates can be obtained (95% confidence intervals ranging from +/- 8.9% to 54.9% of the estimate) depending on the proportion of the population marked (marking rate), and capture efficiency (recapture rate).

Low catches of Chinook salmon early in the sampling season of both 2006 and 2007 precluded conducting mark-recapture efforts on natural age-0 Chinook salmon during these periods, therefore the generated estimates only represent times when mark-

recapture efforts were conducted. During the 2007 sampling season, marked hatchery Chinook salmon were released to estimate capture efficiency early in the season and to compare hatchery to natural capture efficiencies. These tests showed that the capture efficiency for hatchery Chinook salmon was on average 0.89% higher ($n = 4$, $p = 0.0475$, range 0.29-1.52%) than natural Chinook salmon, and that the two were positively correlated ($r = 0.941$, $p = 0.0586$; Figure 8). This first year of paired releases was implemented to determine if hatchery produced fish could be used to conduct mark-recapture tests during periods when insufficient numbers of naturally produced fish are available. It is anticipated that following an upcoming monitoring workshop, a statistically rigorous formula will be developed to account for periods when mark-recapture is not being conducted by using marked hatchery fish releases to estimate trapping efficiency. An initial test of the differences in recapture rates of day and night releases, implemented in 2005, indicated that there was no significant difference in trap efficiency ($p= 0.431$, $n=6$, Figure 7) and the trap efficiency of day and night releases were positively correlated ($r=0.888$, $p=0.018$; Figure 7).

The weakness of the abundance indices is that precision of the estimates cannot be assessed which limits the ability to make between year comparisons of populations estimates. At this time the only measure of coho salmon and steelhead population size are the flow-based abundance indices. While the relationship between the Chinook salmon mark-recapture populations estimates and flow based abundance indices suggest that the indices may be an acceptable surrogate (Pinnix et al. 2007), it is unknown if this strong correlation applies to coho salmon and steelhead smolts. This is especially important for assessing the magnitude and emigration timing of coho salmon and steelhead populations because there are not sufficient numbers of these species captured to conduct mark-recapture efforts. Additional efforts are needed to assess how a mark-recapture based estimate correlates with a flow based abundance index for these two species.

Future Efforts and Products

The USFWS and YTFP, in cooperation with other TRRP partners, will continue to refine trapping efforts to provide salmonid outmigrant data for use in evaluating the effectiveness of restoration efforts in the Trinity River Basin. Additional reports that are currently under development from data collected by this project include: evaluating the accuracy and precision of population estimates, including addressing periods when mark-recapture techniques cannot be employed; evaluate the relationship between mark-recapture population estimates and abundance indices; evaluate outmigrant timing in relation to thermal regimes, and evaluate outmigrant condition in relation to thermal regimes.

Acknowledgements

Special thanks to Al Andreoli, for allowing access through his property at the Trinity River trap site.

The U.S. Fish and Wildlife Service and Yurok Tribe Fisheries Program acknowledges the following persons integral to the efforts of this project:

Michael Long
Randy Brown
Nicholas Hetrick
Joe Polos
Mike Cunanan
Tim Hayden
Dave Hillemeyer

We also appreciate the contributions of the following individuals who worked as crew members on this project:
Kirsten Acker
Hank Alameda
Jeremy Alameda
Heather Ambrose
Adam Frimodig
Anthony Heacock
Anthony Scheiff
Aaron Johnson
Isaac Kinney
Tim Ulrich

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Appendices

Appendix 1. Trinity River at Willow Creek weekly Chinook salmon catches, and abundance indices, 2006. NC = no clip, AD = adipose fin clip.

		Mean		Weekly Chinook Catch					Weekly Chinook Index Totals				
Week	Julian	Daily	Days	Hatchery		Natural		Catch	Hatchery		Natural		Index
Starting	Week	Discharge	Sampled	NC	AD	Age-0	Age-1	Total	NC	AD	Age-0	Age-1	Total
03/19/06	12	10,987	4	0	0	7	0	7	0	0	1,523	0	1,523
03/26/06	13	12,829	4	0	0	19	0	19	0	0	3,689	0	3,689
04/02/06	14	13,443	4	0	0	30	0	30	0	0	6,157	0	6,157
04/09/06	15	16,286	4	0	0	24	0	24	0	0	4,890	0	4,890
04/16/06	16	15,243	2	0	0	1	0	1	0	0	392	0	392
04/23/06	17	15,886	5	0	0	9	1	10	0	0	3,280	333	3,613
04/30/06	18	14,800	3	0	0	1	0	1	0	0	313	0	313
05/07/06	19	11,914	7	0	0	3	0	3	0	0	420	0	420
05/14/06	20	12,786	10	0	0	0	1	1	0	0	0	67	67
05/21/06	21	14,086	12	0	0	1	0	1	0	0	77	0	77
05/28/06	22	12,200	8	0	0	1	0	1	0	0	112	0	112
06/04/06	23	10,383	15	7	2	1	0	10	57	18	371	0	446
06/11/06	24	8,614	19	309	95	179	0	583	7,489	2,301	4,487	0	14,277
06/18/06	25	6,764	21	1,673	514	438	0	2,625	35,861	11,016	10,757	0	57,634
06/25/06	26	5,311	21	2,747	844	850	0	4,441	52,376	16,090	18,379	0	86,845
07/02/06	27	4,074	21	1,758	540	591	0	2,889	26,129	8,026	9,544	0	43,699
07/09/06	28	3,039	21	1,029	316	117	0	1,462	11,862	3,644	2,148	0	17,654
07/16/06	29	1,970	21	439	135	201	0	775	4,398	1,351	2,074	0	7,823
07/23/06	30	1,426	19	605	186	317	0	1,108	6,685	2,053	3,975	0	12,713
07/30/06	31	1,174	18	254	78	134	0	466	2,479	761	1,360	0	4,600
08/06/06	32	1,084	20	326	100	151	0	577	2,583	793	1,305	0	4,681
08/13/06	33	967	21	186	57	316	0	559	1,093	336	1,939	0	3,368
08/20/06	34	899	21	85	26	240	0	351	560	172	1,562	0	2,294
08/27/06	35	855	14	13	4	110	0	127	109	34	1,091	0	1,234
09/03/06	36	832	5	0	0	24	0	24	0	0	466	0	466
Total			320	9,431	2,897	3,765	2	16,095	151,681	46,595	80,311	400	278,987

Appendix 2. Trinity River at Willow Creek weekly Chinook salmon catches, and abundance indices, 2007. NC = no clip, AD = adipose fin clip.

		Mean	Trap	Weekly Chinook Catch					Weekly Chinook Index Totals				
Week	Julian	Daily	Days	Hatchery		Natural		Catch	Hatchery		Natural		Index
Starting	Week	Discharge	Sampled	NC	AD	Age-0	Age-1	Total	NC	AD	Age-0	Age-1	Total
03/05/07	10	10,373	4	0	0	27	0	27	0	0	7,991	0	7,991
03/12/07	11	10,191	10	0	0	129	1	130	0	0	13,727	57	13,784
03/19/07	12	6,587	14	0	0	248	3	251	0	0	10,825	109	10,934
03/26/07	13	5,117	14	0	0	191	0	191	0	0	6,000	0	6,000
04/02/07	14	4,053	17	3	1	198	0	202	46	15	3,401	0	3,462
04/09/07	15	3,719	20	0	0	1,398	2	1,400	0	0	19,508	28	19,536
04/16/07	16	3,493	21	0	0	3,651	1	3,652	0	0	48,487	12	48,499
04/23/07	17	4,313	21	0	0	3,002	0	3,002	0	0	45,569	0	45,569
04/30/07	18	7,206	8	0	0	670	0	670	0	0	30,034	0	30,034
05/07/07	19	6,216	19	0	0	5,103	0	5,103	0	0	97,425	0	97,425
05/14/07	20	4,796	19	0	0	4,663	0	4,663	0	0	82,223	0	82,223
05/21/07	21	3,691	14	0	0	3,509	1	3,510	0	0	68,211	15	68,226
05/28/07	22	2,929	18	0	0	2,945	0	2,945	0	0	39,569	0	39,569
06/04/07	23	2,380	20	98	31	5,165	0	5,294	993	313	53,729	0	55,035
06/11/07	24	1,871	21	2,220	701	5,369	0	8,290	18,378	5,803	44,938	0	69,119
06/18/07	25	1,447	21	2,144	677	3,494	0	6,315	16,926	5,345	27,170	0	49,441
06/25/07	26	1,166	21	1,096	346	2,527	0	3,969	7,652	2,416	17,481	0	27,549
07/02/07	27	1,040	21	405	128	2,178	0	2,711	2,789	881	14,692	0	18,362
07/09/07	28	962	21	127	40	551	0	718	876	277	3,581	0	4,734
07/16/07	29	1,007	21	41	13	68	0	122	273	86	477	0	836
07/23/07	30	875	17	24	8	55	0	87	143	45	385	0	573
07/30/07	31	796	21	0	0	38	0	38	0	0	243	0	243
08/06/07	32	767	15	10	3	19	0	31	52	16	140	0	208
08/13/07	33	736	12	0	0	8	0	8	0	0	54	0	54
08/20/07	34	732	10	0	0	6	0	6	0	0	46	0	46
Total			420	6,167	1,948	45,212	8	53,335	48,127	15,198	635,906	221	699,452

Appendix 3. Trinity River at Willow Creek weekly coho salmon catches, and abundance indices, 2006. R-MAX = right maxillary clip.

		Man	Trap	Weekly coho catches				Weekly coho indices			
Week	Julian	Daily	Days	Hatchery	Natural		Catch	Hatchery	Natural		Index
Starting	Week	Discharge	Sampled	R-MAX	Age-0	Age-1	Total	R-MAX	Age-0	Age-1	Total
03/19/06	12	10,987	4	26	0	1	27	5,243	0	194	5,437
03/26/06	13	12,829	4	18	2	2	22	3,477	378	378	4,233
04/02/06	14	13,443	4	6	2	3	11	1,316	438	551	2,305
04/09/06	15	16,286	4	0	5	0	5	0	973	0	973
04/16/06	16	15,243	2	1	1	1	3	392	392	392	1,176
04/23/06	17	15,886	5	2	1	0	3	756	384	0	1,140
04/30/06	18	14,800	3	0	0	0	0	0	0	0	0
05/07/06	19	11,914	7	32	1	5	38	4,291	158	676	5,125
05/14/06	20	12,786	10	84	0	12	96	8,010	0	1,114	9,124
05/21/06	21	14,086	12	50	0	19	69	4,057	0	1,600	5,657
05/28/06	22	12,200	8	45	0	4	49	5,224	0	457	5,681
06/04/06	23	10,383	15	65	1	23	89	3,378	45	1,037	4,460
06/11/06	24	8,614	19	40	3	40	83	1,092	70	1,112	2,274
06/18/06	25	6,764	21	13	9	7	29	294	191	154	639
06/25/06	26	5,311	21	6	10	6	22	120	199	114	433
07/02/06	27	4,074	21	5	24	1	30	74	358	16	448
07/09/06	28	3,039	21	1	18	2	21	14	215	25	254
07/16/06	29	1,970	21	1	8	0	9	10	80	0	90
07/23/06	30	1,426	19	0	2	0	2	0	21	0	0
07/30/06	31	1,174	18	0	1	0	1	0	8	0	0
08/06/06	32	1,084	20	0	0	0	0	0	0	0	0
08/13/06	33	967	21	0	0	0	0	0	0	0	0
08/20/06	34	899	21	0	1	0	1	0	8	0	0
08/27/06	35	855	14	0	0	0	0	0	0	0	0
09/03/06	36	832	5	0	0	0	0	0	0	0	0
Total			320	395	89	126	610	37,748	3,918	7,820	49,449

Appendix 4. Trinity River at Willow Creek weekly coho salmon catches, and abundance indices, 2007. R-MAX = right maxillary clip.

Week Starting	Julian Week	Mean Daily Discharge	Trap Days Sampled	Weekly coho catches				Weekly coho indices			
				Hatchery	Natural		Catch	Hatchery	Natural		Index
				R-MAX	Age-0	Age-1	Total	R-MAX	Age-0	Age-1	Total
03/05/07	10	10,373	4	0	0	0	0	0	0	0	0
03/12/07	11	10,191	10	1	23	2	26	62	2,478	169	2,709
03/19/07	12	6,587	14	120	18	1	139	4,960	740	55	5,755
03/26/07	13	5,117	14	8	9	1	18	252	303	36	591
04/02/07	14	4,053	17	0	12	3	15	0	207	46	253
04/09/07	15	3,719	20	3	19	4	26	50	277	55	382
04/16/07	16	3,493	21	7	20	4	31	96	280	61	437
04/23/07	17	4,313	21	189	40	35	264	2,900	648	513	4,061
04/30/07	18	7,206	8	291	28	19	338	14,659	1,415	908	16,982
05/07/07	19	6,216	19	162	15	22	199	3,640	327	436	4,403
05/14/07	20	4,796	19	140	8	11	159	2,418	179	197	2,794
05/21/07	21	3,691	14	607	24	53	684	11,809	456	984	13,249
05/28/07	22	2,929	18	193	31	18	242	2,566	418	238	3,222
06/04/07	23	2,380	20	167	28	16	211	1,721	292	168	2,181
06/11/07	24	1,871	21	93	20	12	125	799	167	105	1,071
06/18/07	25	1,447	21	10	12	2	24	77	94	16	187
06/25/07	26	1,166	21	0	3	0	3	0	20	0	20
07/02/07	27	1,040	21	1	4	0	5	7	27	0	34
07/09/07	28	962	21	0	0	0	0	0	0	0	0
07/16/07	29	1,007	21	0	0	0	0	0	0	0	0
07/23/07	30	875	17	0	0	0	0	0	0	0	0
07/30/07	31	796	21	0	0	0	0	0	0	0	0
08/06/07	32	767	15	0	0	0	0	0	0	0	0
08/13/07	33	736	12	0	0	0	0	0	0	0	0
08/20/07	34	732	10	0	0	0	0	0	0	0	0
Total			420	1,992	314	203	2,509	46,016	8,328	3,987	58,331

Appendix 5. Trinity River at Willow Creek weekly steelhead catches, and abundance indices, 2006. AD = adipose fin clip.

			Trap	Steelhead Weekly Catch					Steelhead Weekly Abundance Indices				
Week	Julian	Mean	Days	Hatchery		Natural		Catch	Hatchery		Natural		Index
Starting	Week	Flow	Sampled	AD	Age-0	Age-1	Age-2+	Total	AD	Age-0	Age-1	Age-2+	Total
03/19/06	12	10,987	4	1	0	1	2	4	235	0	194	194	623
03/26/06	13	12,829	4	6	0	5	0	11	1,148	0	966	0	2,114
04/02/06	14	13,443	4	6	0	4	4	14	1,120	0	749	593	2,462
04/09/06	15	16,286	4	9	0	0	2	11	1,836	0	0	203	2,039
04/16/06	16	15,243	2	1	0	3	1	5	392	0	2,373	392	3,157
04/23/06	17	15,886	5	5	0	3	1	9	1,785	0	1,051	384	3,220
04/30/06	18	14,800	3	0	2	1	0	3	0	2,574	1,288	0	3,862
05/07/06	19	11,914	7	18	3	2	9	32	2,236	432	334	1,088	4,090
05/14/06	20	12,786	10	32	27	7	16	82	2,895	2,100	726	1,100	6,821
05/21/06	21	14,086	12	21	58	5	8	92	1,667	4,932	431	518	7,548
05/28/06	22	12,200	8	7	51	7	11	76	851	6,340	837	1,188	9,216
06/04/06	23	10,383	15	22	61	18	26	127	1,212	3,805	1,001	1,371	7,389
06/11/06	24	8,614	19	7	51	61	9	128	187	1,272	1,672	208	3,339
06/18/06	25	6,764	21	3	47	46	8	104	73	1,068	1,049	186	2,376
06/25/06	26	5,311	21	1	46	16	2	65	21	925	313	38	1,297
07/02/06	27	4,074	21	0	77	8	0	85	0	1,145	120	0	1,265
07/09/06	28	3,039	21	0	98	4	0	102	0	1,144	50	0	1,194
07/16/06	29	1,970	21	1	102	5	0	108	10	1,021	50	0	1,081
07/23/06	30	1,426	19	0	120	0	0	120	0	1,280	0	0	1,280
07/30/06	31	1,174	18	1	21	1	1	24	13	213	12	8	246
08/06/06	32	1,084	20	0	11	1	0	12	0	91	8	0	99
08/13/06	33	967	21	0	10	0	0	10	0	60	0	0	60
08/20/06	34	899	21	0	17	0	0	17	0	106	0	0	106
08/27/06	35	855	14	0	3	0	0	3	0	31	0	0	31
09/03/06	36	832	5	0	2	1	0	3	0	39	18	0	57
Total			320	141	807	199	100	1,247	15,681	28,578	13,242	7,471	64,972

Appendix 6. Trinity River at Willow Creek weekly steelhead catches, and abundance indices, 2007. AD = adipose fin clip.

			Trap	Steelhead Weekly Catch				Steelhead Weekly Abundance Indices			
Week	Julian	Mean	Days	Hatchery	Natural		Catch	Hatchery	Natural		Index
Starting	Week	Flow	Sampled	AD	Age-0	Age-1+	Total	AD	Age-0	Age-1+	Total
03/05/07	10	10,373	4	0	0	3	3	0	0	863	863
03/12/07	11	10,191	10	0	0	12	12	0	0	1,280	1,280
03/19/07	12	6,587	14	7	0	62	69	254	0	2,594	2,848
03/26/07	13	5,117	14	67	6	93	166	2,206	193	3,135	5,534
04/02/07	14	4,053	17	274	3	312	589	4,720	51	5,123	9,894
04/09/07	15	3,719	20	210	3	584	797	3,206	50	8,621	11,877
04/16/07	16	3,493	21	329	0	711	1,040	4,222	0	9,141	13,363
04/23/07	17	4,313	21	425	0	1,405	1,830	6,234	0	20,317	26,551
04/30/07	18	7,206	8	56	2	63	121	2,781	93	3,014	5,888
05/07/07	19	6,216	19	107	10	180	297	2,136	226	3,359	5,721
05/14/07	20	4,796	19	79	9	171	259	1,342	153	2,946	4,441
05/21/07	21	3,691	14	127	11	398	536	2,482	223	7,447	10,152
05/28/07	22	2,929	18	29	8	126	163	389	107	1,685	2,181
06/04/07	23	2,380	20	38	79	134	251	395	810	1,390	2,595
06/11/07	24	1,871	21	13	166	56	235	113	1,372	484	1,969
06/18/07	25	1,447	21	4	144	14	162	31	1,115	109	1,255
06/25/07	26	1,166	21	1	106	4	111	7	733	36	776
07/02/07	27	1,040	21	0	121	10	131	0	816	62	878
07/09/07	28	962	21	0	61	20	81	0	408	134	542
07/16/07	29	1,007	21	0	29	3	32	0	211	13	224
07/23/07	30	875	17	0	7	7	14	0	43	43	86
07/30/07	31	796	21	0	9	34	43	0	58	215	273
08/06/07	32	767	15	0	11	6	17	0	75	42	117
08/13/07	33	736	12	0	5	4	9	0	34	28	62
08/20/07	34	732	10	0	5	6	11	0	35	43	78
Total			420	1,766	795	4,418	6,979	30,518	6,806	72,124	109,448

Appendix 7. Trinity River at Willow Creek weekly Chinook salmon population estimates, 2006.

Julian	Smolts captured	Recaps	Marks Released	Population Size	Confidence Interval		Variance
Week	u_{h*}	m_h	M_h	U_h	95% LCL	95% UCL	$V(U_h)$
24	583	1	390	113,977	(14,890)	242,843	4,322,843,704
25	2,625	20	1,929	241,250	140,588	341,912	2,637,673,977
26	4,430	72	3,992	242,315	187,163	297,467	791,796,560
27	2,889	47	2,759	166,118	119,629	212,606	562,563,694
28	1,462	49	1,212	35,468	25,775	45,161	24,458,482
29	775	28	485	12,988	8,398	17,578	5,485,206
30	1,108	11	475	43,951	20,234	67,667	146,412,067
31	466	12	109	3,943	1,977	5,910	1,006,633
Total:	14,338	240	11,351				
		Stratified Estimator		860,009	679,388	1,040,629	8,492,240,323

* Note - Captured column does not include recaps.

Appendix 8. Trinity River at Willow Creek weekly Chinook salmon population estimates, 2007. (No mark-recapture on JW 18)

Julian Week	Smolts captured u_{h*}	Recaps m_h	Marks Released M_h	Population Size U_h	Confidence Interval 95% LCL	95% UCL	Variance $V(U_h)$
16	3,652	203	2,961	53,026	45,828	60,223	13,484,440
17	3,002	17	294	49,199	27,698	70,701	120,342,992
18	N/A	N/A	N/A	N/A	N/A	N/A	N/A
19	5,103	110	2,577	118,518	96,814	140,223	122,626,597
20	4,663	100	2,444	112,882	91,201	134,562	122,357,535
21	3,510	40	978	83,812	58,856	108,768	162,116,163
22	2,945	37	1,748	135,548	93,200	177,895	466,816,901
23	5,294	68	2,228	171,019	131,324	210,714	410,165,693
24	8,290	25	2,058	656,504	410,052	902,956	15,810,742,891
25	6,315	30	2,098	427,587	280,173	575,000	5,656,698,475
26	3,969	31	2,041	253,272	167,192	339,351	1,928,801,561
Total:	46,743	661	19,427				
		Stratified Estimator		2,061,366	1,752,617	2,370,115	24,814,153,247

* Note - Captured column does not include recaps.

Appendix 9. Trinity River at Willow Creek weekly Chinook salmon and coho salmon fork lengths, 2006.

		Chinook*										Natural coho										Hatchery coho				
Week	Julian	Age-0					Age-1					Age-0					Age-1					Age-1				
Starting	Week	n	$\bar{X}$	min	max	SD	n	$\bar{X}$	min	max	SD	n	$\bar{X}$	min	max	SD	n	$\bar{X}$	min	max	SD	n	$\bar{X}$	min	max	SD
3/19/06	12	7	39	32	42	3.15	0	0	0	0	----	0	0	0	0	----	1	103	103	103	----	26	165	126	206	16.97
3/26/06	13	19	39	37	44	1.61	0	0	0	0	----	2	34	33	35	1.41	2	94	88	99	7.78	18	154	140	178	12.55
4/2/06	14	29	40	34	44	2.05	0	0	0	0	----	2	36	35	36	0.71	3	101	84	110	14.73	6	144	130	158	11.37
4/9/06	15	22	40	37	45	2.02	0	0	0	0	----	5	33	28	34	2.68	0	0	0	0	----	0	0	0	0	----
4/16/06	16	1	38	38	38	----	0	0	0	0	----	1	33	33	33	----	1	98	98	98	----	1	130	130	130	----
4/23/06	17	9	39	37	41	1.41	1	107	107	107	----	1	37	37	37	----	0	0	0	0	----	2	174	161	187	18.38
4/30/06	18	1	43	43	43	----	0	0	0	0	----	0	0	0	0	----	0	0	0	0	----	0	0	0	0	----
5/7/06	19	3	48	36	70	19.08	0	0	0	0	----	0	0	0	0	----	5	108	95	119	9.00	32	158	132	203	16.31
5/14/06	20	0	0	0	0	----	1	108	108	108	----	0	0	0	0	----	12	117	104	130	7.83	84	162	115	301	30.21
5/21/06	21	1	57	57	57	----	0	0	0	0	----	0	0	0	0	----	19	120	101	170	18.37	50	156	136	189	13.32
5/28/06	22	1	87	87	87	----	0	0	0	0	----	0	0	0	0	----	4	120	105	149	19.85	45	151	112	180	14.56
6/4/06	23	9	77	51	115	23.34	0	0	0	0	----	1	45	45	45	----	23	122	96	151	14.94	65	153	114	210	18.46
6/11/06	24	419	92	38	119	11.89	0	0	0	0	----	3	55	53	58	2.65	40	110	83	144	12.81	39	151	78	190	20.43
6/18/06	25	1060	93	50	114	8.80	0	0	0	0	----	8	61	49	73	9.56	7	133	105	148	13.86	13	155	119	183	20.17
6/25/06	26	1031	89	59	110	8.78	0	0	0	0	----	11	62	52	84	9.03	6	135	118	147	9.84	6	148	132	162	10.23
7/2/06	27	859	84	60	115	8.80	0	0	0	0	----	24	71	57	91	8.83	1	145	145	145	----	5	144	133	156	9.18
7/9/06	28	929	85	60	122	8.14	0	0	0	0	----	18	73	50	102	13.43	2	129	125	133	5.66	1	154	154	154	----
7/16/06	29	638	83	46	111	7.71	0	0	0	0	----	8	77	61	105	14.59	0	0	0	0	----	1	170	170	170	----
7/23/06	30	641	82	60	123	8.19	0	0	0	0	----	2	74	70	77	4.95	0	0	0	0	----	0	0	0	0	----
7/30/06	31	373	84	58	104	7.39	0	0	0	0	----	1	112	112	112	----	0	0	0	0	----	0	0	0	0	----
8/6/06	32	466	85	63	111	5.96	0	0	0	0	----	0	0	0	0	----	0	0	0	0	----	0	0	0	0	----
8/13/06	33	520	89	71	105	5.47	0	0	0	0	----	0	0	0	0	----	0	0	0	0	----	0	0	0	0	----
8/20/06	34	330	92	70	107	5.70	0	0	0	0	----	1	140	140	140	----	0	0	0	0	----	0	0	0	0	----
8/27/06	35	126	95	75	106	6.03	0	0	0	0	----	0	0	0	0	----	0	0	0	0	----	0	0	0	0	----
9/3/06	36	23	98	86	104	4.34	0	0	0	0	----	0	0	0	0	----	0	0	0	0	----	0	0	0	0	----

* Includes Hatchery Releases

Appendix 10. Trinity River at Willow Creek weekly Chinook salmon and coho salmon fork lengths, 2007.

		Chinook*										Natural coho										Hatchery coho				
Week	Julian	Age-0					Age-1					Age-0					Age-1					Age-1				
Starting	Week	n	$\bar{X}$	min	max	SD	n	$\bar{X}$	min	max	SD	n	$\bar{X}$	min	max	SD	n	$\bar{X}$	min	max	SD	n	$\bar{X}$	min	max	SD
3/5/07	10	27	38	34	41	1.84	0	0	0	0	----	0	0	0	0	----	0	0	0	0	----	0	0	0	0	----
3/12/07	11	128	39	33	46	2.45	1	101	101	101	----	23	35	30	39	1.77	2	108	105	110	3.54	1	155	155	155	----
3/19/07	12	233	39	32	69	4.79	3	93	89	96	3.51	18	36	31	42	2.43	2	117	112	121	6.36	120	138	95	168	12.45
3/26/07	13	205	41	33	68	6.43	0	0	0	0	----	9	37	33	40	1.94	1	182	182	182	----	8	138	130	150	8.16
4/2/07	14	178	43	34	74	8.02	0	0	0	0	----	12	36	32	42	2.95	3	131	108	162	28.02	0	0	0	0	----
4/9/07	15	580	55	34	91	10.43	2	110	110	110	----	18	38	32	50	5.33	4	136	117	158	19.33	3	153	117	210	49.93
4/16/07	16	724	61	33	87	9.90	1	98	98	98	----	20	40	33	58	6.34	4	173	136	205	30.10	7	160	124	183	21.24
4/23/07	17	586	59	35	86	10.61	0	0	0	0	----	40	42	32	60	6.72	35	147	109	184	23.72	92	157	106	202	17.08
4/30/07	18	194	63	37	95	13.75	0	0	0	0	----	25	44	35	56	5.81	18	132	109	172	18.08	149	154	122	200	12.71
5/7/07	19	594	60	36	95	12.63	0	0	0	0	----	13	47	36	61	6.24	19	123	101	141	10.79	128	149	117	187	11.77
5/14/07	20	520	60	37	97	11.85	0	0	0	0	----	7	51	44	58	5.03	3	131	116	145	14.57	96	147	112	192	13.48
5/21/07	21	492	66	33	102	11.61	1	115	115	115	----	17	54	40	62	6.11	52	126	102	165	13.26	211	147	120	244	13.36
5/28/07	22	400	70	39	101	15.44	0	0	0	0	----	22	61	52	88	7.76	15	128	105	142	11.23	154	148	125	195	11.31
6/4/07	23	520	73	38	101	13.93	0	0	0	0	----	15	64	54	70	4.69	16	126	112	140	8.47	148	148	125	179	10.11
6/11/07	24	749	82	48	110	10.51	0	0	0	0	----	16	63	50	70	5.19	5	128	98	156	26.04	67	148	128	185	10.24
6/18/07	25	818	80	43	112	9.47	0	0	0	0	----	7	63	51	74	9.13	2	119	118	120	1.41	6	147	136	167	12.19
6/25/07	26	664	77	43	100	8.64	0	0	0	0	----	2	63	55	70	10.61	0	0	0	0	----	0	0	0	0	----
7/2/07	27	763	77	43	104	7.16	0	0	0	0	----	4	64	54	76	9.11	0	0	0	0	----	1	118	118	118	----
7/9/07	28	467	73	45	99	8.92	0	0	0	0	----	0	0	0	0	----	0	0	0	0	----	0	0	0	0	----
7/16/07	29	116	78	44	95	8.51	0	0	0	0	----	0	0	0	0	----	0	0	0	0	----	0	0	0	0	----
7/23/07	30	66	80	62	93	6.77	0	0	0	0	----	0	0	0	0	----	0	0	0	0	----	0	0	0	0	----
7/30/07	31	33	79	64	95	8.87	0	0	0	0	----	0	0	0	0	----	0	0	0	0	----	0	0	0	0	----
8/6/07	32	29	80	66	95	8.03	0	0	0	0	----	0	0	0	0	----	0	0	0	0	----	0	0	0	0	----
8/13/07	33	5	79	67	89	9.10	0	0	0	0	----	0	0	0	0	----	0	0	0	0	----	0	0	0	0	----
8/20/07	34	6	78	69	95	10.28	0	0	0	0	----	0	0	0	0	----	0	0	0	0	----	0	0	0	0	----

*Includes Hatchery Releases

Appendix 11. Trinity River at Willow Creek weekly steelhead fork lengths, 2006.

		Natural steelhead																				Hatchery steelhead				
Week	Julian	Age-0					Age-1					Age-2					Age-3					Age-1				
Starting	Week	n	$\bar{X}$	min	max	SD	n	$\bar{X}$	min	max	SD	n	$\bar{X}$	min	max	SD	n	$\bar{X}$	min	max	SD	n	$\bar{X}$	min	max	SD
3/5/06	10	0	0	0	0	----	0	0	0	0	----	0	0	0	0	----	0	0	0	0	----	0	0	0	0	----
3/12/06	11	0	0	0	0	----	0	0	0	0	----	0	0	0	0	----	0	0	0	0	----	0	0	0	0	----
3/19/06	12	0	0	0	0	----	1	57	57	57	----	1	154	154	154	----	1	172	172	172	----	0	0	0	0	----
3/26/06	13	0	0	0	0	----	5	77	60	100	15.11	0	0	0	0	----	0	0	0	0	----	6	239	215	255	17.65
4/2/06	14	0	0	0	0	----	4	70	60	88	12.36	3	174	154	195	20.50	1	233	233	233	----	6	252	237	270	11.32
4/9/06	15	0	0	0	0	----	0	0	0	0	----	1	134	134	134	----	1	219	219	219	----	9	256	221	284	24.20
4/16/06	16	0	0	0	0	----	3	65	58	75	8.89	1	150	150	150	----	0	0	0	0	----	1	225	225	225	----
4/23/06	17	0	0	0	0	----	3	105	103	107	2.08	1	143	143	143	----	0	0	0	0	----	5	237	230	247	6.67
4/30/06	18	2	26	25	26	0.71	1	76	76	76	----	0	0	0	0	----	0	0	0	0	----	0	0	0	0	----
5/7/06	19	1	26	26	26	----	2	101	94	108	9.90	9	165	132	193	20.98	0	0	0	0	----	18	232	190	276	20.76
5/14/06	20	26	28	21	36	2.77	7	94	70	155	30.77	14	162	119	238	28.08	2	182	169	195	18.38	31	217	120	291	47.82
5/21/06	21	57	28	22	36	2.79	5	91	67	119	19.40	7	165	142	189	16.29	1	274	274	274	----	19	227	152	290	33.15
5/28/06	22	51	28	23	40	2.70	7	94	83	107	8.00	10	155	107	183	22.45	1	195	195	195	----	7	208	187	236	15.88
6/4/06	23	59	28	24	51	4.18	18	106	74	130	16.03	24	164	122	210	19.34	2	217	215	218	2.12	22	208	133	261	37.62
6/11/06	24	50	34	25	53	8.27	61	100	76	138	13.93	8	149	118	181	20.20	1	255	255	255	----	7	211	157	250	31.51
6/18/06	25	42	35	20	53	7.39	46	104	84	132	10.92	8	149	108	178	25.09	0	0	0	0	----	3	198	178	238	34.64
6/25/06	26	45	41	25	60	8.25	16	107	84	136	13.04	2	147	136	157	14.85	0	0	0	0	----	0	0	0	0	----
7/2/06	27	72	47	30	71	7.05	8	104	85	125	15.98	0	0	0	0	----	0	0	0	0	----	0	0	0	0	----
7/9/06	28	93	53	38	68	6.46	4	105	80	124	18.39	0	0	0	0	----	0	0	0	0	----	0	0	0	0	----
7/16/06	29	91	51	35	69	7.51	5	114	97	140	16.08	0	0	0	0	----	0	0	0	0	----	1	302	302	302	----
7/23/06	30	59	47	32	72	9.56	0	0	0	0	----	0	0	0	0	----	0	0	0	0	----	0	0	0	0	----
7/30/06	31	9	57	39	68	9.11	1	136	136	136	----	1	126	126	126	----	0	0	0	0	----	0	0	0	0	----
8/6/06	32	3	53	43	60	8.74	1	137	137	137	----	0	0	0	0	----	0	0	0	0	----	0	0	0	0	----
8/13/06	33	8	58	48	73	8.94	0	0	0	0	----	0	0	0	0	----	0	0	0	0	----	0	0	0	0	----
8/20/06	34	14	58	45	80	10.00	0	0	0	0	----	0	0	0	0	----	0	0	0	0	----	0	0	0	0	----
8/27/06	35	2	53	48	57	6.36	0	0	0	0	----	0	0	0	0	----	0	0	0	0	----	0	0	0	0	----
9/3/06	36	1	85	85	85	----	1	155	155	155	----	0	0	0	0	----	0	0	0	0	----	0	0	0	0	----

Appendix 12. Trinity River at Willow Creek weekly steelhead fork lengths, 2007.

		Natural steelhead																				Hatchery steelhead				
Week	Julian	Age-0					Age-1					Age-2					Age-3					Age-1				
Starting	Week	n	$\bar{X}$	min	max	SD	n	$\bar{X}$	min	max	SD	n	$\bar{X}$	min	max	SD	n	$\bar{X}$	min	max	SD	n	$\bar{X}$	min	max	SD
3/5/07	10	0	0	0	0	----	3	86	77	98	10.69	0	0	0	0	----	0	0	0	0	----	0	0	0	0	----
3/12/07	11	0	0	0	0	----	10	89	71	115	14.89	1	190	190	190	----	0	0	0	0	----	0	0	0	0	----
3/19/07	12	0	0	0	0	----	57	87	68	135	13.13	4	165	148	193	20.38	0	0	0	0	----	6	202	185	218	11.99
3/26/07	13	0	0	0	0	----	84	90	64	124	12.26	5	189	153	232	32.70	0	0	0	0	----	55	210	156	254	19.10
4/2/07	14	2	38	37	38	0.71	208	93	66	137	12.51	12	185	150	228	19.61	4	221	210	235	10.44	241	204	124	250	17.79
4/9/07	15	1	40	40	40	----	324	95	66	168	14.94	33	183	153	225	17.96	1	229	229	229	----	183	199	155	240	16.70
4/16/07	16	0	0	0	0	----	254	98	68	158	17.25	40	184	153	240	18.30	0	0	0	0	----	211	197	101	250	18.12
4/23/07	17	0	0	0	0	----	264	97	66	158	16.60	44	178	150	226	18.56	0	0	0	0	----	219	192	121	241	19.03
4/30/07	18	2	33	28	38	7.07	40	117	75	200	29.64	20	182	136	230	23.64	0	0	0	0	----	56	184	116	233	20.54
5/7/07	19	7	30	27	35	2.75	92	113	80	178	22.81	43	171	142	210	18.12	0	0	0	0	----	104	179	124	254	21.20
5/14/07	20	7	29	27	31	1.91	40	118	88	171	21.93	31	175	140	285	26.62	0	0	0	0	----	38	182	115	251	24.54
5/21/07	21	9	35	28	45	5.88	95	123	76	189	28.25	102	169	140	205	14.34	0	0	0	0	----	112	182	140	250	21.12
5/28/07	22	7	35	28	44	6.99	47	129	92	186	27.15	43	172	150	210	15.64	0	0	0	0	----	21	177	117	253	31.94
6/4/07	23	56	46	31	105	10.80	45	136	80	187	29.06	71	169	140	202	12.80	0	0	0	0	----	30	170	92	210	28.13
6/11/07	24	81	49	31	70	6.89	24	147	97	178	25.01	11	171	156	190	10.32	0	0	0	0	----	7	179	175	186	3.73
6/18/07	25	91	51	37	75	8.81	9	136	99	180	26.97	1	170	170	170	----	0	0	0	0	----	3	161	115	185	39.85
6/25/07	26	71	56	34	74	8.26	1	99	99	99	----	0	0	0	0	----	0	0	0	0	----	0	0	0	0	----
7/2/07	27	121	52	30	78	9.64	4	124	106	144	15.80	0	0	0	0	----	0	0	0	0	----	0	0	0	0	----
7/9/07	28	60	46	25	81	9.09	5	125	112	146	12.76	1	198	198	198	----	0	0	0	0	----	0	0	0	0	----
7/16/07	29	29	49	27	84	12.03	1	120	120	120	----	0	0	0	0	----	0	0	0	0	----	0	0	0	0	----
7/23/07	30	6	50	40	63	7.39	0	0	0	0	----	0	0	0	0	----	0	0	0	0	----	0	0	0	0	----
7/30/07	31	9	52	44	60	5.24	8	128	110	140	10.09	0	0	0	0	----	0	0	0	0	----	0	0	0	0	----
8/6/07	32	7	64	51	84	14.61	2	140	135	145	7.07	0	0	0	0	----	0	0	0	0	----	0	0	0	0	----
8/13/07	33	5	56	44	72	11.34	1	135	135	135	----	0	0	0	0	----	0	0	0	0	----	0	0	0	0	----
8/20/07	34	4	54	44	62	7.76	3	144	125	169	22.61	0	0	0	0	----	0	0	0	0	----	0	0	0	0	----