State of California
The Resources Agency
DEPARTMENT OF FISH AND GAME

ANNUAL REPORT
TRINITY RIVER BASIN SALMON AND STEELHEAD MONITORING PROJECT
1994 - 1995 SEASON

authored by:

Bernard Aguilar, Lanette D. Davis,
Barry W. Collins, Larry Hanson, Wade Sinnen,
Mark Zuspan, and Michael Dean.
Inland Fisheries Division

edited by:

Robert M. Kano
Inland Fisheries Division

Inland Fisheries Division
1416 Ninth Street
Sacramento, Ca. 95814

1996

Foreword

This is the seventh annual report to the United States Bureau of Reclamation (USBR) of activities conducted under the terms of Cooperative Agreement Number 1-FG-20-09820, and covers the contract period July 1, 1994 through June 30, 1995. The field work was conducted by personnel of the California Department of Fish and Game's (CDFG) Klamath-Trinity Program, specifically its Trinity River Project (TRP), Trinity Fisheries Investigations Project (TFIP), and Natural Stocks Assessment Project (NSAP).

Trinity River Basin Salmon and Steelhead Monitoring Project
1994 - 1995 Season

Table of Contents

Trinity River Basin Salmon and Steelhead Monitoring Project
1994-1995 Season

Table of Contents
(continued)

Trinity River Basin Salmon and Steelhead Monitoring Project
1994-1995 Season

Table of Contents
(continued)

Trinity River Basin Salmon and Steelhead Monitoring Project
1994-1995 Season

Table of Contents
(continued)

Chapter IV. Job IV. (continued)

Trinity River Basin Salmon and Steelhead Monitoring Project
1994-1995 Season

Table of Contents
(continued)

Trinity River Basin Salmon and Steelhead Monitoring Project
1994-1995 Season

Table of Contents
(continued)

Trinity River Basin Salmon and Steelhead Monitoring Project
1994-1995 Season

Table of Contents
(continued)

Chapter VII. Job VII. (continued)

Trinity River Basin Salmon and Steelhead Monitoring Project
1994-1995 Season

List of Tables

Trinity River Basin Salmon and Steelhead Monitoring Project
1994-1995 Season

List of Tables
(continued)

Chapter III. Job III. Life History, Distribution, Run Size and Angler Harvest of Steelhead in the South Fork Trinity River Basin.

Trinity River Basin Salmon and Steelhead Monitoring Project
1994-1995 Season

List of Tables
(continued)

Trinity River Basin Salmon and Steelhead Monitoring Project
1994-1995 Season

List of Tables
(continued)

Trinity River Basin Salmon and Steelhead Monitoring Project
1994-1995 Season

List of Tables
(continued)

Chapter V. Job V. (continued)

Trinity River Basin Salmon and Steelhead Monitoring Project
1994-1995 Season

List of Figures

Trinity River Basin Salmon and Steelhead Monitoring Project
1994-1995 Season

List of Figures
(continued)

Chapter III. Job III. (continued)

Chapter IV. Job IV. Annual Run-size, Harvest, and Spawner Escapement Estimates for Trinity River Basin Chinook and Coho Salmon and Steelhead.

Trinity River Basin Salmon and Steelhead Monitoring Project
1994-1995 Season

List of Figures
(continued)

Chapter IV. Job IV. (continued)

Trinity River Basin Salmon and Steelhead Monitoring Project
1994-1995 Season

List of Figures
(continued)

Trinity River Basin Salmon and Steelhead Monitoring Project
1994-1995 Season

List of Figures
(continued)

Chapter VII. Job VII. (continued)

Trinity River Basin Salmon and Steelhead Monitoring Project
1994-1995 Season

List of Appendices

Trinity River Basin Salmon and Steelhead Monitoring Project
1994-1995 Season

List of Appendices
(continued)

Chapter III. Job III. (continued)

Trinity River Basin Salmon and Steelhead Monitoring Project
1994-1995 Season

List of Appendices
(continued)

Chapter IV. Job IV. (continued).

Trinity River Basin Salmon and Steelhead Monitoring Project
1994-1995 Season

List of Appendices
(continued)

Chapter IV. Job IV. (continued).

ANNUAL REPORT
TRINITY RIVER BASIN SALMON AND STEELHEAD MONITORING PROJECT
1994-1995 SEASON

CHAPTER I

JOB I
SALMON SPAWNER SURVEYS IN THE UPPER TRINITY RIVER BASIN

by

Bernard Aguilar

ABSTRACT

Staff of the California Department of Fish and Game's Trinity Fisheries Investigations Project conducted a mark-and-recovery, salmon spawner survey of the mid-Trinity River basin from 19 September through 18 December 1994. We surveyed the mainstem Trinity River from the upstream limit of anadromous migration at Lewiston Dam to the confluence of the North Fork Trinity River. Selected portions of major tributaries that were accessible to anadromous fish were also surveyed. We examined 1,720 chinook salmon (Oncorhynchus tshawytscha) carcasses and 2 coho salmon (O. kisutch) carcasses during the mainstem Trinity River survey. We found 61 chinook salmon carcasses during our tributary surveys. All chinook which spawned in the tributaries this season were assumed to be fall-run. We did not recover any coho salmon carcasses in the tributary surveys this year.

Chinook salmon spawned throughout the entire mainstem. Spawner density was highest in the uppermost 3.2 km of river, with decreased densities in downstream survey zones.

We recovered both spring-run and fall-run chinook salmon carcasses in the survey. Spring-run chinook salmon dominated recoveries in the mainstem until late October, thereafter fall-run fish became the predominant race. We observed the two coho salmon carcasses in the mainstem survey during the tenth and twelfth weeks of the survey, beginning 21 November and 5 December, respectively.

Mainstem female prespawning mortality was 1.0% for spring-run chinook salmon, and 3.1% for fall-run chinook salmon. Overall female chinook prespawning mortality was 2.3%.

Based on the recovery of adipose-fin-clipped chinook salmon carcasses, we estimated that 11.2% of the spring-run and 31.2% of the fall-run chinook salmon spawners observed in the mainstem survey were of hatchery origin.

Fork lengths of spring- and fall-run chinook salmon flagged from the mainstem Trinity River averaged 69.9 cm, and 67.3 cm, respectively. Adult spring-run chinook salmon composed 85.7% and adult fall-run composed 81.4% of the spawners from each respective run. In the tributaries, fork lengths of fall chinook carcasses averaged 64.7 cm. Flagged adult fall chinook (>59 cm) composed 74.5% of the carcasses examined in the tributaries. No coho carcasses were observed in the tributary surveys.

OBJECTIVES

1. To determine, through a system of spawning ground surveys, the distribution of naturally spawning chinook and coho salmon in the mainstem Trinity River and its tributaries upstream of, and including the North Fork Trinity River.

2. To determine the incidence of pre-spawning mortality among naturally spawning salmon in the mainstem Trinity River and its tributaries upstream of, and including the North Fork Trinity River.

3. To determine the size, sex composition, and incidence of marked and tagged individuals among the naturally spawning populations in the mainstem Trinity River and its tributaries upstream of, and including the North Fork Trinity River.

4. To determine spawner distributions within the mainstem Trinity River upstream of the North Fork Trinity River.

INTRODUCTION

This year the California Department of Fish and Game's (CDFG) Trinity Fisheries Investigations Project (TFIP) completed the twenty-seventh salmon spawner survey conducted in the mainstem Trinity River since 1942. The first three surveys (Moffett and Smith 1950, Gibbs 1956, and Weber 1965) were fishery evaluations prior to the construction of Lewiston Dam. The remaining twenty-three (La Faunce 1965; Rogers 1970, 1973, 1982; Smith 1975; Zuspan 1991, 1992a, 1992b, 1994; Aguilar and Zuspan 1995; Aguilar 1996; and works by Miller and Stempel [Appendix 1]) were designed to evaluate the effects of the existing dam on the salmon resource.

In 1984, The Trinity River Basin Fish and Wildlife Management Program was enacted by Congress (U.S. Public Law 98-541). This law appropriated approximately $57 million to be spent for fishery and wildlife restoration, and monitoring within the Trinity River basin.

This survey will help to evaluate the effectiveness of increasing spawning and holding habitat within the basin through habitat improvement efforts that are part of the restoration program.

METHODS

Mainstem Trinity River Spawner Survey

Our study area included the mainstem Trinity River from the upstream limit of anadromous fish migration at Lewiston Dam (river km 180.1) to the confluence of North Fork Trinity River, 63.4 km downstream (Figure 1). We surveyed this area once a week throughout the salmon spawning season. Previous studies have divided the river into either a four- or seven-zone system. The seven-zone system (Table 1) was used in 1987 by the United States Fish and Wildlife Service (USFWS) (Stempel, Appendix 1) and again in 1988, through 1993 by TFIP (Zuspan 1991, 1992a, 1992b, 1994; Aguilar and Zuspan 1995; Aguilar 1996). Prior to this, with the exception of Moffett and Smith (1950), all surveys were based on a system using four zones in the river reach below Lewiston Dam (Gibbs 1956; La Faunce 1965; Rogers 1970, 1973, 1982; Smith 1975; Weber 1965; and work by Miller [Appendix 1]). Our 1994 data were collected based on both zone systems. We summarized data in this report based only on the seven-zone system as it allows comparisons of different river sections in finer detail. By also recording data using the four-zone system, we will be able to compare historic and current trends in other reports.

TABLE 1. Description and lengths of river zones used in the 1994-95 mainstem Trinity River spawner survey.

River zone	Length (km)	Zone description
1	3.2	Lewiston Dam (RKM[a] 180.1) - Old Lewiston Bridge (RKM 176.9)
2	7.9	Old Lewiston Bridge (RKM 176.9) - Browns Mtn. Bridge (RKM 169.0)
3	10.2	Browns Mtn. Bridge (RKM 169.0) - Steel Bridge (RKM 158.8)
4	10.4	Steel Bridge (RKM 158.8) - Douglas City Camp (RKM 148.4)
5	11.3	Douglas City Camp (RKM 148.4) - Evans Bar (Old Junction City Weir site) (RKM 136.4)
6	13.2	Evans Bar (RKM 136.4) - McCartney Pond (RKM 123.9)
7	7.2	McCartney Pond (RKM 123.9) - mouth of North Fork Trinity (RKM 116.7)

[a] RKM = distance from the mouth of the river in km.

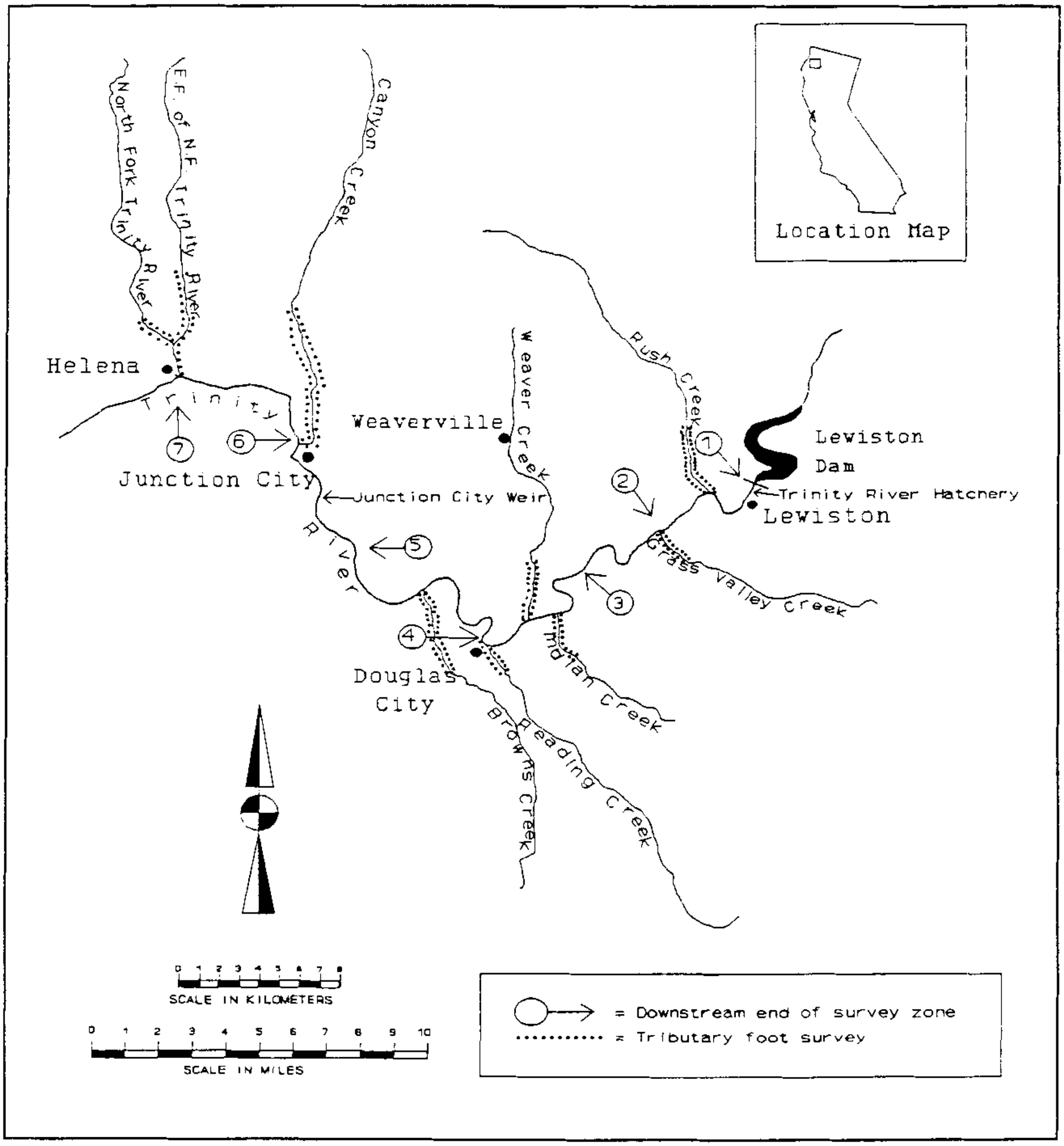


FIGURE 1. Map of the Trinity River basin showing the mainstem spawner survey zones and areas of the tributaries surveyed in the 1994-95 spawner survey.

River kilometers (RKM) for location references were taken from a series of 7.5-minute United States Geological Survey topographic maps, and refer to distances upstream from the mouth of the Trinity River (Appendix 2).

TFIP staff conducted the survey using 12-ft Avon[1/] inflatable rafts equipped with rowing frames. Raft crews consisted of a rower, and one or two personnel to recover carcasses. To increase coverage of the highly productive upper zones, two rafts were used simultaneously, with one covering each side of the river. Carcasses were recovered on-foot along the shore or, in deep water, from the rafts with long-handled gigs.

All carcasses that we observed were identified by species and examined for an adipose fin-clip (Ad-clip) indicating the possible presence of a coded-wire tag (CWT) in their snout. To minimize the number of Ad-clipped fish missed during the spawner survey, all carcasses we recovered were passed through a CWT detector. Fish which produced a positive reading with the detector, regardless of the condition of their adipose fin, were considered Ad-clipped.

Carcasses were further examined for the presence of an external tag (spaghetti tag), applied as part of an ongoing study by Trinity River Project (TRP) of the CDFG's Klamath-Trinity Program. Spaghetti tags (Program marks) were placed on returning adult fish at two trapping and tagging stations for estimating escapement and harvest of adults. Spaghetti-tagged salmon did not receive any secondary marks (operculum punches) this season. The furthest downstream trapping site was the Willow Creek Weir (WCW), located at RKM 32.2 on the mainstem Trinity River. The other trapping site, the Junction City Weir (JCW), was located in the spawner survey area at RKM 132.7. Spring-run and fall-run chinook salmon, coho salmon, and steelhead were trapped and tagged at both WCW and JCW.

We determined spawning condition in female salmon by direct examination of their ovaries and each was classified as either spawned or unspawned based on egg retention. Females which retained over 50% of their eggs were classified as unspawned. We did not assess male spawning condition, as its determination was considered to be too subjective.

[1/] The use of brand or trade names is for identification purposes only, and does not imply the endorsement of any product by the CDFG.

Chinook Salmon

All recovered chinook salmon carcasses were further classified into four categories for data collection purposes: 1) Ad-clipped fish; 2) Program-marked fish; 3) unmarked (no Ad-clip or Program-mark), condition-one fish; and 4) unmarked, condition-two fish. The category assigned determined the subsequent processing of each carcass.

We designated chinook salmon carcasses as either condition-one or -two, based on the extent of body deterioration. Condition-one carcasses were the freshest, having at least one clear eye and a relatively firm body and were assumed to have died within one week prior to recovery. Condition-two fish were in various advanced stages of decomposition and were assumed to have died more than one week prior to recovery. We did not count partially intact fish skeletons because they could have represented Program-marked or condition-two fish which had already been counted and chopped in half during a previous week's survey.

Program-marked carcasses were sexed and the females' spawning condition assessed. We removed any spaghetti tags, then cut the carcass in half to prevent recounting in future weeks. Spaghetti tags had a unique number which allowed determination of the date and location of tagging.

Unmarked condition-one carcasses were flagged and returned to moving water for subsequent recovery. We flagged and measured the first 30 condition-one chinook carcasses from each zone and tallied the remainder. Flags consisted of plastic surveyor's tape wrapped tightly around a colored hog ring and affixed to the left mandible of the carcass. The surveyor's tape was wrapped so tightly around the hog ring, that it amounted to no more than a colored coating, with less than 2.5 cm of tape extending from the hog ring. Flag colors were changed weekly, so that upon recovery, the week of flagging could be determined. The hog rings used to attach the flagging were also color-coded to indicate in which zone they were affixed, so that we could determine the incidence of carcasses drifting into another recovery zone. A systematically collected sample of carcasses was measured to the nearest cm of fork length (FL). Chinook $\leq$ 55 cm were preliminarily classified as grilse during the carcass surveys. Actual grilse to adult ratios for the whole population of chinook salmon in this year's run were determined from post-season evaluations of length frequency and CWT data. Adult and grilse salmon analysis in this report is based on the post-season size determinations.

Unmarked condition-two carcasses were checked for the presence of a flag and, if possible, the sex and females' spawning condition were assessed. If a flag was present, the color of the flagging tape and the underlying ring were recorded. All carcasses were then cut in half to prevent future recovery and recounting.

Coho Salmon

All coho salmon (coho) carcasses recovered were measured (cm FL) and checked for the presence of Ad-clips or Program-marks. When possible, sex and females' spawning condition were determined and then they were cut in half to prevent future recounting. Coho carcasses were not flagged because they would have required a separate series of flag colors to differentiate them from the flagged chinook salmon. Condition-one or -two was recorded only for Program-marked and Ad-clipped coho.

Distinguishing Between Spring and Fall Chinook Salmon Runs

Since both spring and fall runs of chinook salmon usually occur in the mainstem Trinity River, we subjectively determined a date to separate the two races based upon CWTed and Program-marked chinook salmon recovered from our spawner survey.

Tributary Spawner Surveys

Tributaries to the mainstem Trinity River, specifically Rush Creek, Grass Valley Creek, Indian Creek, Reading Creek, Browns Creek, Weaver Creek, Canyon Creek, East Fork of the North Fork Trinity River, and the mainstem North Fork Trinity River, were surveyed on foot once a week throughout the chinook salmon spawning season (Figure 1). Sections surveyed for each tributary ranged in length from 0.5 to 2.5 km, and were chosen based on accessibility and their historic use by chinook salmon spawners. The surveys began with the onset of chinook salmon spawning in each tributary and continued until spawning ended.

We designated all identifiable chinook salmon carcasses found in the tributaries into the four categories used in the mainstem spawner survey and handled them accordingly. Spawning condition was not assessed for tributary carcasses. In past surveys, too few fish were observed in the tributaries to make up a representative sample, and most of those observed were condition-one fish which we needed to flag for spawner estimates. Coho, if observed, were measured, counted and cut in half upon recovery. Chinook salmon redds, when observed for the first time, were counted and recorded.

Aerial flights and ground-truthing surveys were made of each tributary to determine the percentage of the total available spawning area within each tributary that was represented by the length of stream we surveyed. Flights were made during the peak of spawning activity to observe redds and locate the upstream limit of spawning. Follow-up ground-truthing surveys were made, when necessary, to make total redd counts for both the whole tributary and its spawner survey zone. The proportion of redds present in a survey zone was assumed to represent the percentage of a tributary's total spawning taking place within the zone.

RESULTS AND DISCUSSION

Numbers Observed

Mainstem Trinity River Spawner Surveys

Chinook Salmon. We examined 1,720 chinook salmon carcasses during the mainstem spawner survey. These included 55 Ad-clipped fish, 115 Program-marked fish, 8 which were Ad-clipped and Program marked, 569 unmarked condition-one carcasses which we flagged, and 964 unmarked condition-two carcasses. We recovered 211 (37.1%) carcasses which we had flagged in previous weeks (Appendix 3). No whole chinook skeletons were observed.

Coho Salmon. We observed only two coho carcasses during the survey; one during the tenth week, and one during the twelfth week. We did not find any whole coho skeletons (Appendix 4).

Tributary Spawner Surveys

Chinook Salmon. We found 61 chinook salmon carcasses in the nine tributaries surveyed this season. These consisted of 51 condition-one carcasses which we flagged, eight Program-marked carcasses, and two Ad-clipped carcasses. We also counted 19 whole chinook skeletons. We recovered 26 (51.0%) chinook carcasses which we had flagged in prior weeks (Appendix 5).

Coho Salmon. We did not observe any coho carcasses or skeletons in the tributaries this season (Appendix 5).

Spring and Fall Chinook Salmon Runs

Both spring- and fall-run chinook were present throughout the survey period. Spring chinook dominated our recoveries through the sixth week of the survey ending 30 October 1994. Fall chinook became predominate by the seventh week which began 31 October 1994. For the purposes of this report, and with the exception of Ad-clipped and Program-marked fish, all unmarked condition-one carcasses which we flagged and all unmarked condition-two carcasses recovered prior to 31 October were considered spring-run, while those recovered from that date onward were considered fall-run (Figure 2).

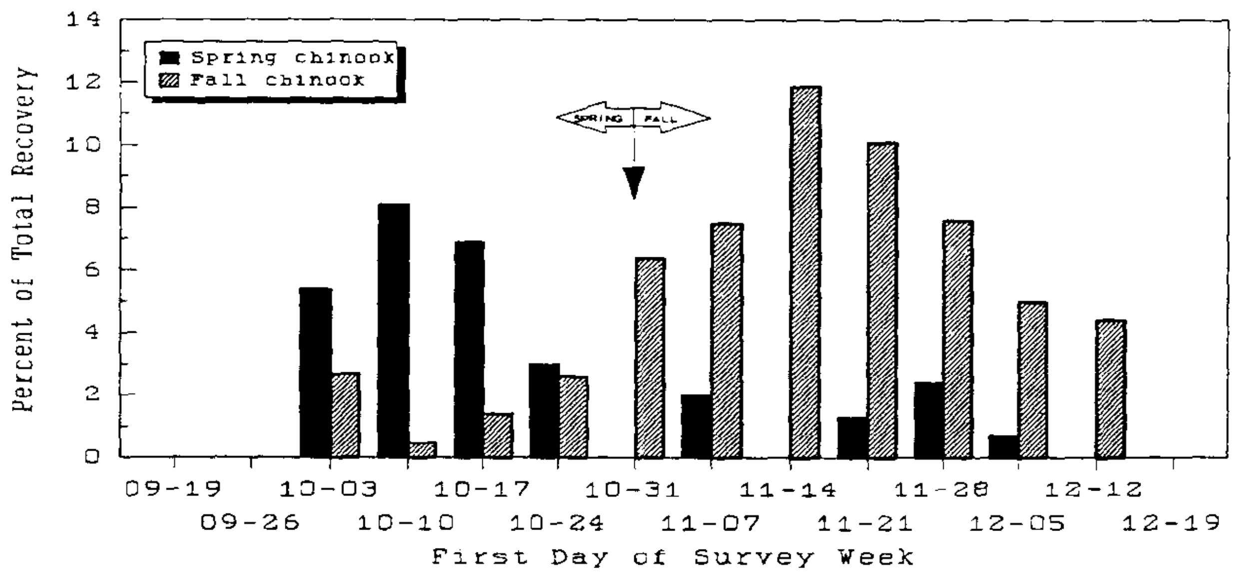


FIGURE 2. Weekly proportions of coded-wire tagged and Program-marked spring- and fall- run chinook salmon observed in the 1994-95 Trinity River spawner survey. The arrow indicates the designated separation between the spring and the fall runs.

Size Composition

Unmarked condition-two carcasses were not measured and FLs are reported only for those condition-one carcasses which were both flagged and measured (538 of the 569 condition-one flagged carcasses were measured).

Spring-run Chinook Salmon

We measured 301 spring chinook during the mainstem survey which we determined to be spring run. Adults (fish >56 cm FL[2/]), composed 85.7% of the spring chinook observed, while grilse made up the remaining 14.3%. For comparison, the percentages of spring chinook grilse sampled at JCW, and Trinity River Hatchery (TRH [RKM 180.1]) were 26.4% and 32.7%, respectively (Table 2). Data from WCW was not included in this comparison as only a small portion of the late spring chinook population (123 fish) was sampled there. There was not a significant statistical difference between the percentages of grilse sampled in the survey and at the two fixed sites (X^2=51.8, df=2, P<0.0001). Mainstem spring chinook ranged in size from 37 to

[2/] Determined from post-season analysis of length frequency and coded-wire tag recoveries. The data used for the analysis were those collected during run-size estimate studies (Chapter IV).

100 cm FL, and averaged 69.9 cm FL (Figure 3).

In past tributary surveys, all chinook carcasses were recovered during the designated fall-run periods (Zuspan 1991, 1992a, 1992b, 1994, Aguilar and Zuspan 1995). Last season (Aguilar 1996), and again during this season, we recovered a few chinook carcasses in the tributaries during the designated spring-run period; however, we assumed these fish also to be fall run.

Fall-run Chinook Salmon

We measured 237 condition-one carcasses during the mainstem survey which we determined to be fall run. Based on a minimum size of 60 cm FL[3/] for adults, 81.4% of the fall chinook measured were adults and 18.6% were grilse (Table 3). Mainstem fall chinook ranged in size from 41 to 94 cm FL, averaging 67.3 cm FL (Figure 4). The percentages of fall chinook grilse at the different sampling sites, including the tributary survey, ranged from 18.6% to 57.6%, and when tested for independence, the difference in grilse proportions between sites was statistically significant (X^2= 498.2, df=4, P=0).

We measured 51 fall chinook carcasses in the tributaries this year. Of these, 74.5% (38/51) were adults (>59 cm FL) and 25.5% (13/51) were grilse (Table 3). Tributary fall chinook ranged in size from 43 to 78 cm FL, and averaged 64.7 cm FL.

Coho Salmon

We measured two coho carcasses in the mainstem Trinity River, only one of which classified as an adult (fish >54 cm FL[3/]) (Table 4). The percentages of coho grilse at the different sampling sites ranged from 50.0% to 71.9% (Table 4), but the differences were not statistically significant (X^2= 6.4, df=3, P=0).

Sex Composition

Sex was determined for adult carcasses observed in the mainstem Trinity River surveys that were either unmarked condition-two, Program-marked, and those recovered which were previously flagged.

Chinook Salmon

We determined the sex of 964 adult chinook carcasses during the survey (382 spring-run and 582 fall-run). Of the adult spring chinook observed, 69.9% were females, while adult fall-run fish were 69.2% females. Overall, the weekly proportion of females seen in the survey was higher during the middle period of the spring run, and higher during the early and late periods of the fall run.

[3/]Determined from post-season analysis of length frequency and coded-wire tag recoveries. The data used for the analysis were those collected during run-size estimate studies (Chapter IV).

TABLE 2. Size composition of spring-run chinook salmon observed in the spawner survey and at two fixed locations in the mainstem Trinity River during the 1994-95 season.

	Junction City Weir	Trinity River Hatchery	Mainstem spawner survey
Grilse [a]	220	944	43
Adults	613	1943	258
% Grilse	26.4%	32.7%	14.3%

a/ Spring-run chinook salmon ≤ 56 cm FL were considered grilse based on a post-season analysis of length frequency and recovered coded-wire tags.

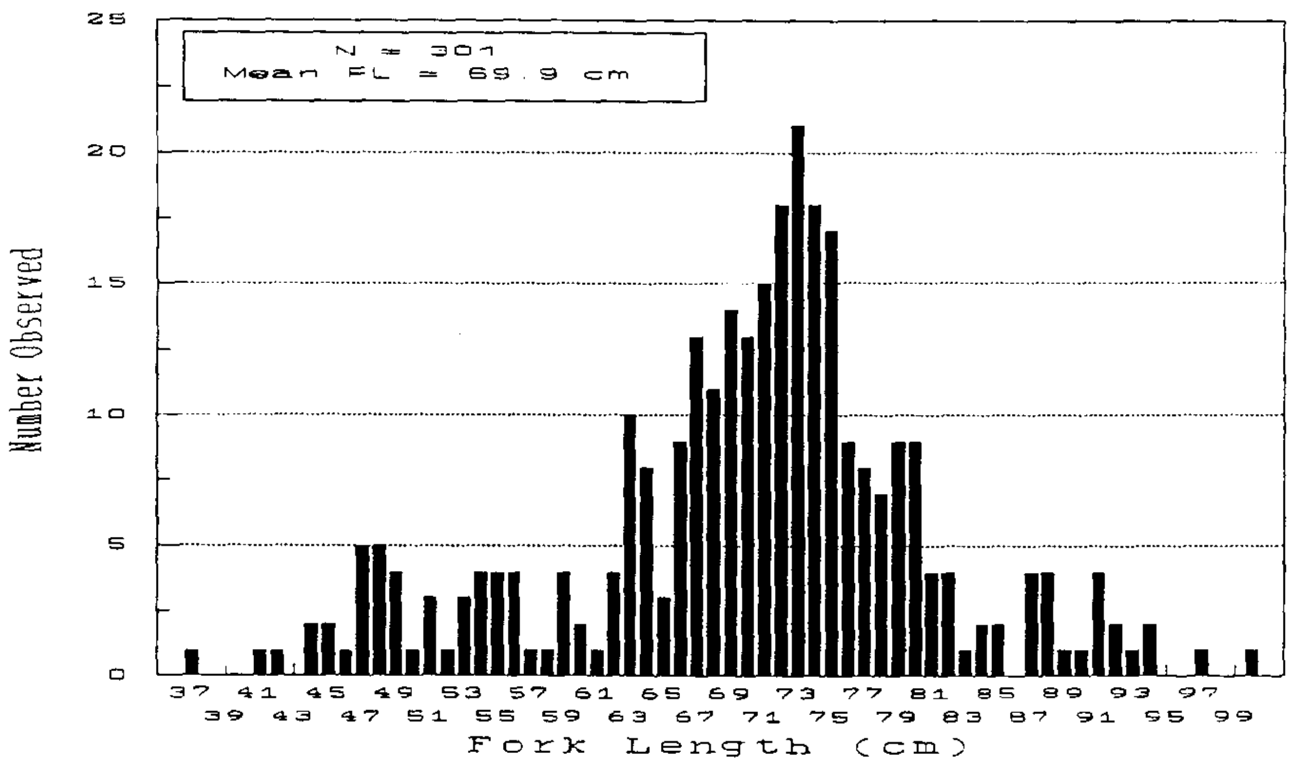


FIGURE 3. Fork length distribution, in 2-cm increments, of spring-run chinook salmon measured in the mainstem Trinity River during the 1994-1995 spawner survey.

TABLE 3. Size composition of fall-run chinook salmon observed in the spawner surveys and at three fixed locations in the Trinity River basin during the 1994-95 season.

	Willow Creek Weir	Junction City Weir	Trinity River Hatchery	Mainstem spawner survey	Tributary spawner survey
Grilse a/	740	239	4442	44	13
Adults	1425	180	3264	193	38
% Grilse	33.9%	57.0%	57.6%	18.6%	25.5%

a/ Fall-run chinook salmon ≤ 60 cm FL were considered grilse based on a post-season analysis of length frequency and coded-wire tag recoveries.

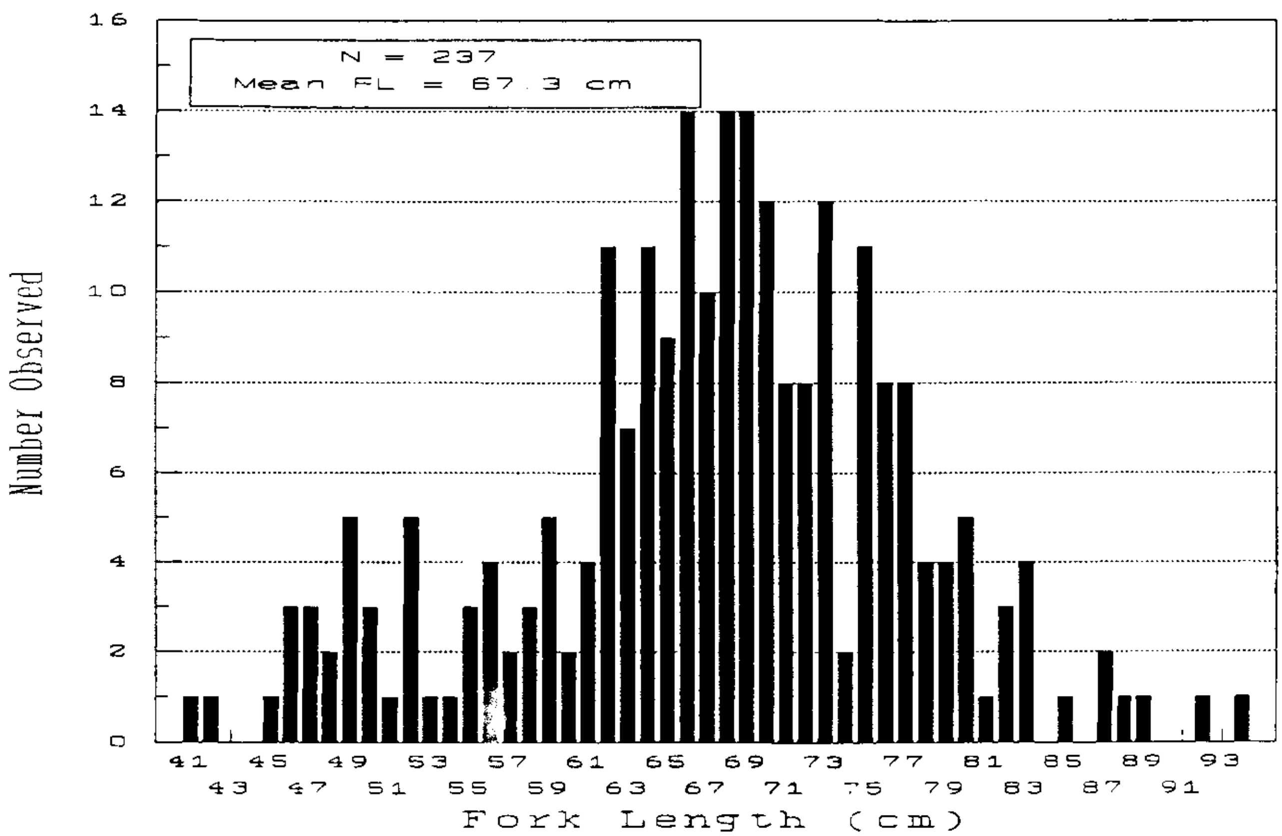


FIGURE 4. Fork length distribution, of fall-run chinook salmon measured in the mainstem Trinity River during the 1994-95 spawner survey.

TABLE 4. Size composition of coho salmon observed in the mainstem spawner survey and at three fixed locations in the Trinity River basin during the 1994-95 season.

	Willow Creek Weir	Junction City Weir	Trinity River Hatchery	Mainstem spawner survey
Grilse [a]	41	19	160	1
Adults	16	13	134	1
% Grilse	71.9%	59.4%	54.4%	50.0%

a/ Coho salmon ≤ 54 cm FL were considered grilse based on post-season analysis of length frequency and coded-wire tag recoveries.

(Figure 5). The preponderance of adult females in the chinook run has been noted in all but two of the previous surveys and has ranged from 73.6% to 25.8% (Appendix 6). Increased numbers of females among adult spawners results when males return earlier as grilse, thereby decreasing the number of males returning as older spawners.

Coho Salmon

We determined the sex of two coho, one of which was a female. For comparison, during the past six seasons females constituted between 33.3% and 80.0% of the adult spawners examined (Zuspan 1991, 1992a, 1992b, 1994; Aguilar and Zuspan 1995; Aguilar 1996).

Prespawning Mortality

Prespawning mortality was determined only for carcasses observed during surveys in the mainstem Trinity River that were either unmarked condition-two, Program-marked, or flagged recoveries.

Chinook Salmon

We determined the spawning condition of 596 female chinook salmon, including 204 spring-run and 392 fall-run fish. Prespawning mortality was 1.0% (2/204) and 3.1% (12/392) for female spring and fall chinook, respectively. The overall female prespawning mortality of both races (spring and fall runs) of chinook salmon was 2.3%.

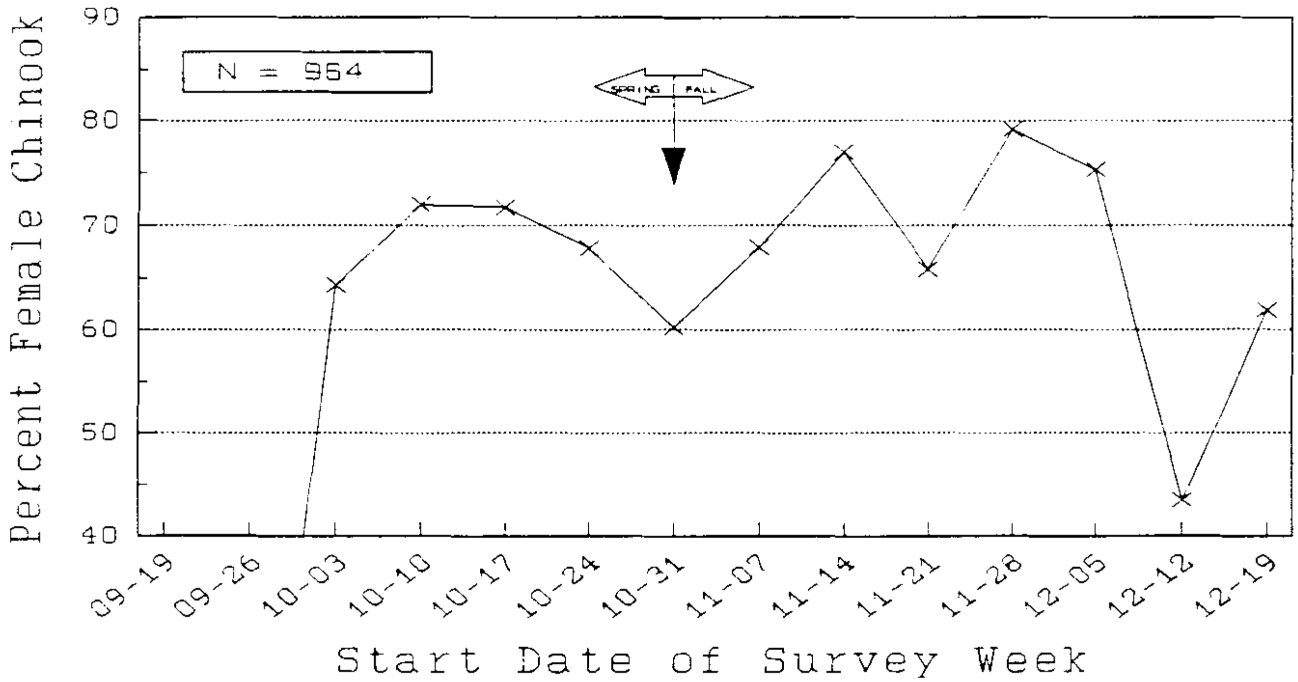


FIGURE 5. Proportion of female adult chinook salmon carcasses observed weekly in the mainstem Trinity River during the 1994-95 spawner survey. The arrow indicates the estimated separation between the spring and the fall runs.

Prespawning mortality of chinook in the Trinity River basin appears to be correlated to spawner escapement. Specifically, as spawner escapement increases so does prespawning mortality. The CDFG's Trinity River Project has developed chinook salmon escapement estimates for both runs of salmon in the Trinity River basin since 1978. Prespawning mortality was determined for the periods 1978 through 1982, and for 1987 to the present (Appendix 7). During those periods, escapement has ranged from 6,135 to 100,913 while prespawning mortality rates have ranged from 1.1% to 44.9%. With the exception of 1980, prespawning mortality generally increased with increasing escapement (Figure 6). The high prespawning mortality noted in 1980 may have been due to a sampling deficiency, when only a total of 63 female chinook were checked for spawning condition.

Coho Salmon

Only one adult female coho carcass was examined for spawning condition during this year's survey and it had spawned before dying (Appendix 4). However, this sample size is not adequate to

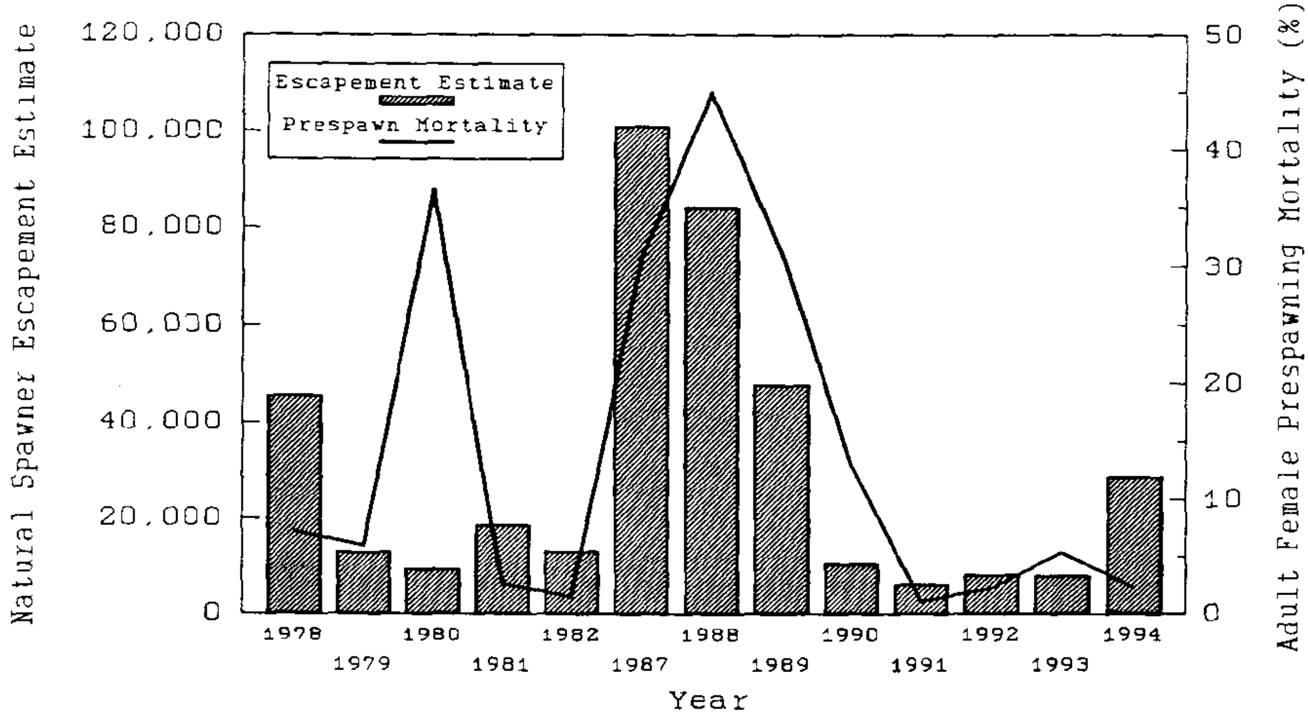


FIGURE 6. Comparison of adult chinook salmon natural spawner escapement and adult female chinook salmon prespawning mortality for the mainstem Trinity River, 1978-1982, and 1987-1994.

accurately represent prespawning mortality for this species this season.

Salmon Spawner Distribution

Salmon spawner distribution in the mainstem Trinity River is presented based on the seven-zone system first used in 1987 (Stempel, Appendix 1). Distribution estimates are for adult fish only.

Chinook Salmon

Mainstem Trinity River. We examined 1,509 adult chinook salmon carcasses in the mainstem this season, excluding flag recoveries. The densities of chinook salmon spawners ranged between 27.7 fish/km in Zone 7, to 167.1 fish/km in Zone 1 (Table 5). We recognized that carcass counts alone could not accurately describe distribution, because carcass recovery can vary from zone to zone, due to differences in stream morphology. Therefore, a recovery efficiency was calculated for each zone based on the ratio of flagged carcasses recovered to total carcasses flagged. This efficiency was used to expand the numbers of unflagged carcasses found in the respective zone, and obtain an overall weighted

TABLE 5. Adult chinook salmon spawner distribution and estimated density by river zone during the 1994-95 Trinity River spawner survey.

Zone [a]	Zone length (km)	Number carcasses flagged	Flagged carcasses recovered	Recovery efficiency	Total unflagged observed [b]	Expanded total [c]	Percent distribution	Spawner density (fish/km) [d]
1	3.2	83	34	41.0%	219	535	12.8%	167.1
2	7.9	94	46	48.9%	318	650	15.6%	82.3
3	10.2	97	38	39.2%	261	666	16.0%	65.3
4	10.4	56	10	17.9%	164	918	22.0%	88.3
5	11.3	37	13	35.1%	123	350	8.4%	31.0
6	13.2	105	40	38.1%	324	850	20.4%	64.4
7	7.2	27	13	48.1%	96	199	4.8%	27.7
Totals:	63.4	499	194		1,505	4,168	100.0%	
Overall:				38.9%				65.8

a/ Zones described in Figure 1 and Table 1.
b/ Total adult salmon observed, excluding flagged recoveries.
c/ Computed as: Total unflagged observed / (% flagged recovered/100).
d/ Computed as: Expanded total / zone length in km.

distribution and proportions of spawners in the entire survey area.

Based on the number of chinook salmon recovered in each zone, divided by the recovery efficiency rate for the respective zone, the percent distribution of chinook salmon spawners generally increased in a downstream direction, and the distribution was similar to those during the last three years' spawner surveys (Zuspan, 1994; Aguilar and Zuspan 1995; Aguilar 1996).

Spawner density, based on expanded totals of unflagged carcasses in a zone and the length of the zone, was highest in Zone 1 and lowest in Zone 7 (Table 5, Figure 7).

It is possible that increases in river flow during the late summer and fall were responsible for the more even distribution of spawners. The flows averaged about 150 CFS higher during the last four years (450 compared to 300 CFS) in an attempt to keep river temperatures within specified criteria; although temperatures were not significantly lower than in years prior to 1991. However, higher flows probably increased holding and spawning habitats, allowing chinook salmon to spawn farther downstream. It should be noted that decreases in spawner escapement, and habitat restoration projects constructed over the last few years in the downstream zones, may also have caused spawners to distribute themselves more evenly.

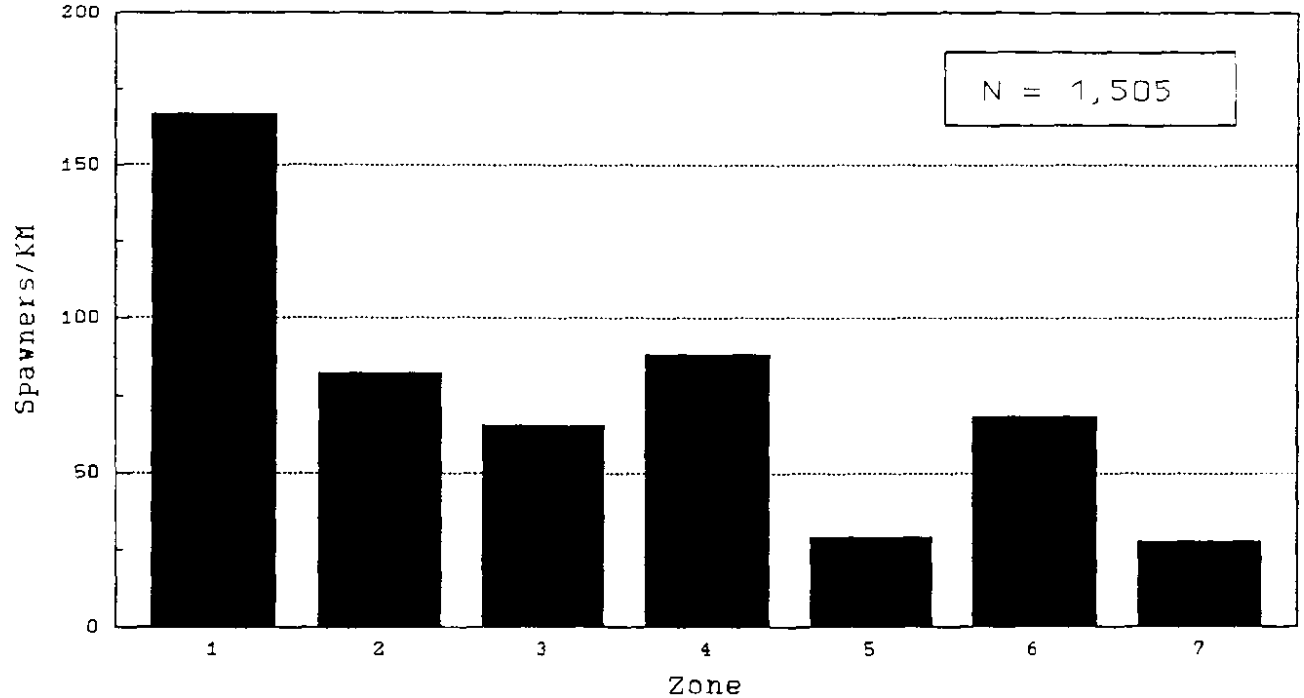


FIGURE 7. Estimated adult chinook salmon spawner density by zones during the 1994-95 mainstem Trinity River spawner surveys.

A potential source of error in the estimates was the assumption that flagged chinook salmon carcasses were recovered only in the zone that they were originally flagged. Flagged carcasses recovered downstream of the zone in which they were originally flagged would tend to increase the efficiency estimate in the recovery zone while decreasing the estimate in the flagging zone.

To determine the extent that carcasses drifted from one zone to another, fish flagged in each zone were given a distinct hog ring color. Recoveries that were originally flagged in another zone would be recognized as such. This season, all flags were recovered in the same zone in which they were originally flagged. This indicated that carcass drifting had no effect on our chinook distribution estimates, similar to results in the 1990-91 through 1993-94 seasons (Zuspan 1992b, 1994; Aguilar and Zuspan 1995; Aguilar 1996). Even during the 1989-90 season, the proportion of flagged carcasses that drifted into other zones was still less than 1% (Zuspan 1992a).

Tributaries. Spawning adult chinook salmon made very limited use of tributaries this year. Few chinook salmon carcasses were observed this season, so we used redd counts to describe spawner distribution, as was the case during 1990-91 through 1993-94 surveys (Zuspan 1992b, 1994; Aguilar and Zuspan 1995; Aguilar 1996).

We located salmon redds in five of the nine tributaries surveyed this season. We could not differentiate a chinook redd from a coho redd during the surveys, but because there were only two coho carcasses recovered in the mainstem, and none in the tributaries, we assumed all the redds we located in the tributaries this season to be from chinook. Based on this, we counted 95 chinook salmon redds overall this season, with individual tributary distributions ranging from 49 redds in the North Fork of the Trinity River to none in Indian, Reading, Browns, and Weaver creeks (Table 6, Appendix 5).

Coho salmon

Mainstem Trinity River. We observed only one adult coho carcass in the mainstem spawner survey this season, in Zone 4. Since coho were not flagged, in the past we estimated the numbers of coho which spawned in each zone using the recovery efficiency for that zone developed from chinook salmon flag recoveries. However, one carcass was not an adequate sample to determine spawner density this season.

Tributaries. We did not observe any coho carcasses during the tributary surveys. This was the second year that no coho were observed in the nine tributaries that we surveyed.

Marked Salmon Recovery

Incidence of Program-marked Salmon

We observed Program-marks (spaghetti tags only) on 43 spring-run and 80 fall-run chinook carcasses (including adult and grilse) in the mainstem Trinity River spawner survey. Program-marked spring-run and fall-run chinook from both JCW and WCW were recovered (Table 7). Of the 123 Program-marked chinook salmon we observed, 64 were condition-one carcasses and 49 were condition-two carcasses.

We used only adult condition-one chinook salmon carcasses observed to determine the proportion of Program-marked chinook salmon in the spawner survey. This was because we were more likely to correctly identify a Program-mark on a fresh (i.e. condition-one) fish than one in an advanced state of decomposition.

Recovery of fall-run condition-one Program-marked chinook was over one-and-a-half times (12.1%) that of similar spring-run fish. Spring chinook Program-marked at JCW made up a larger percentage (5.8%) of observed carcasses than those from WCW. Program-marked fall chinook from WCW (10.4%) were recovered at over six times the occurrence of those from JCW (Table 7).

We did not record the condition of coho during the survey so we could not separate out the proportion of Program-marked condition-

TABLE 6. Observed salmon redd numbers and distribution for the 1994-95 Trinity River tributary spawner survey.

Tributary	Number observed			Proportional redd distribution [a]	
	Chinook carcasses	Coho carcasses	Redds	Chinook	Coho
Rush Creek	0	0	1	1	0
Grass Valley Creek	13	0	27	27	0
Indian Creek	1	0	0	0	0
Reading Creek	0	0	0	0	0
Browns Creek	0	0	0	0	0
Weaver Creek	0	0	0	0	0
Canyon Creek	1	0	4	4	0
N. Fork Trinity R. (NFTR)	34	0	49	49	0
E. Fork of the NFTR	2	0	14	14	0
Totals:	51	0	95		
Overall:				95	0

a/ Since no coho salmon spawners were observed, all redds were assumed to be from chinook salmon.

TABLE 7. Proportions of recovered Program-marked (spaghetti tagged) condition-one, adult salmon carcasses in the 1994-95 mainstem Trinity River spawner survey.

Tag site	Spring-run chinook			Fall-run chinook			Coho Salmon		
	Program marks [a/b]	Total observed	% Program marks	Program marks [a/b]	Total observed	% Program marks	Program marks	Total observed	% Program marks
Willow Creek Weir	7	363	1.9	31	297	10.4	1	1	100.0
Junction City Weir	21	363	5.8	5	297	1.7	0	1	0
Totals:	28	301	7.7	36	297	12.1	1	1	100.0

a/ Program marks include spaghetti-tagged fish.

b/ There were also two spring- and one fall-run chinook that had weir scars only, and not included in the total. We were unable to determine if they were from WCW or JCW.

one fish. Only one Program-marked coho (marked at WCW) was recovered in the mainstem Trinity River (Table 7).

Estimation of Adipose Fin-clipped Salmon Proportions

We recovered 63 chinook salmon carcasses in the mainstem spawner survey and two chinook carcasses in the tributary survey, which appeared to be Ad-clipped. Of the 63 chinook carcasses in the mainstem, only 40 (63.5%) actually contained CWTs, while in the tributary survey, only one carcass actually contained a CWT. Based on CWTs recovered from mainstem chinook carcasses, nine were spring-run and 12 were fall-run from TRH, and 19 were from naturally produced chinook (both spring- and fall-run) (Appendix 8). This is the second year in which we recovered such a high number of naturally-produced chinook. There were 23 other carcasses which were Ad-clipped but whose CWTs were either unreadable, shed, or lost while decoding. The one tributary CWTed chinook carcass was recovered in Grass Valley Creek, and was from the 1991 brood year TRH fall-run. The majority (45.0%) of Ad+CWT chinook recovered were three-year-olds, from the 1991 brood year (Appendix 8).

The proportion of Ad-clipped chinook salmon in the spawner survey was estimated by analyzing only those Ad-clipped fish that had CWTs (Ad+CWT) and were condition-one carcasses. Carcasses in advanced decomposition (i.e. condition-two fish) were more likely to have shed their CWT. The percentage of Ad+CWTs observed in fall chinook condition-two carcasses was only 0.8% (1/125) while for condition-one carcasses, it was 6.9% (15/217). The percentage of Ad+CWTs observed in spring chinook condition-two carcasses was only 1.6% (5/312) while for condition-one carcasses, it was 6.4% (19/299). Our estimates of the Ad-clipped proportion in the spawner survey, however, are not comparable to the proportions of Ad-clipped fish observed returning to JCW, WCW, and TRH. This was because in the spawner survey we considered as Ad-clipped only those carcasses that had CWTs, while at the other sites all Ad-clipped fish even without CWTs were counted. To make our estimated proportions more comparable, we expanded the numbers of condition-one Ad+CWT carcasses observed in the spawner survey by a CWT shedding rate for Ad-clipped chinook salmon observed at TRH[4/]. Based on CWT shedding rates developed by the Trinity River Project, (12.1% for spring chinook and 9.9% for fall chinook, Chapter IV), 2.5 % of the spring, and 4.0 % of the fall chinook observed in the spawner survey were Ad-clipped.

[4/] The expanded number of Ad-clipped chinook in spawner survey = condition-one Ad+CWT carcasses/(1-TRH CWT shedding rate).

Incidence of Hatchery-produced Chinook Salmon

We determined the incidence of hatchery-produced chinook salmon among the carcasses seen in the spawner survey by comparing the ratios of Ad-clipped (hatchery-marked) chinook salmon at various locations within the river.

The proportions of Ad-clipped spring and fall chinook varied at the different recovery sites, probably as the result of hatchery-produced fish homing to the hatchery. Since naturally produced chinook salmon would become less abundant as they spawned in the lower mainstem or its tributaries, we would expect that the percentage of hatchery-produced chinook in the population would increase progressively at each upstream sampling site, and would be highest at the hatchery. This season the Ad-clipped chinook salmon relative occurrence was highest at the hatchery, intermediate at the weirs, and lowest in the mainstem Trinity River spawner survey (Table 8). The Ad-clip ratio seen in the spawner survey may have been less than at the weirs, since the weirs captured both hatchery and natural upstream migrants, while the spawner survey emphasized in-river spawners which would be more likely to be naturally produced fish.

TABLE 8. Comparison of the estimated proportion of adipose fin-clipped (Ad-clip) chinook salmon in the mainstem spawner survey to proportions observed at the three fixed locations in the Trinity River basin during the 1994-95 season.

	Spring-run chinook			Fall-run chinook		
Site	Ad-clips [a]	Total	% Ad-clips	Ad-clips [a]	Total	% Ad-clips
Willow Creek Weir [b]	23	319	7.2	181	2,165	8.4
Junction City Weir	141	833	16.9	31	419	7.4
Trinity River Hatchery	644	2,887[c]	22.3	989	7,706[c]	12.8
Mainstem Trinity River survey	9	363	2.5	12	297	4.0

[a] All Ad-clipped fish were counted at the weirs and hatchery. Only condition-1 carcasses with coded-wire tags were considered Ad-clipped for the spawner survey.
[b] Only a small portion of the late spring-run chinook salmon population was sampled at this site.
[c] TRH total is an estimate based on coded-wire tag recoveries.

Spring-run Chinook Salmon

The Ad-clip proportion of spring run chinook at WCW, JCW, TRH, and the spawner survey ranged from 2.5% to 22.3% (Table 8). The differences in chinook salmon Ad-clip proportions among the four sites was statistically significant (X^2= 86.64, df=3, P=0.0006).

Following the methodology of the past four seasons (Zuspan 1992b, 1994; Aguilar and Zuspan 1995; Aguilar 1996) we assumed that the 22.3% Ad-clip ratio for spring-run fish observed at TRH represented a population of 100% TRH-origin chinook salmon. Since only 2.5% of the spring-run chinook salmon carcasses in the spawner survey were Ad-clipped, we estimated that 11.2% (2.5/22.3) were of hatchery origin, while the remaining 88.8% were naturally produced.

Fall-run Chinook Salmon

The Ad-clip percentage of fall-run chinook ranged from 4.0% to 12.8% at the four sampling sites this season (Table 8). The differences in chinook salmon Ad-clip proportions among the four sites was statistically significant (X^2=47.88, df=3, P=0).

Since most of the fall-run chinook recovered at TRH were estimated to be of hatchery origin (based on expansions of CWT recoveries), we assumed that the 12.8% Ad-clip ratio for fall-run fish observed at TRH represented a population of 100% hatchery-produced chinook salmon. Since only 4.0% of the fall-run chinook salmon in the survey were Ad-clipped, we estimated that 31.2% (4.0/12.8) were of hatchery origin, while the remaining 68.8% were naturally produced.

Computational Assumptions

There were several assumptions which could be potential sources of error in using the above methods to determine the incidence of hatchery fish spawning in the river. We assumed that field personnel actually observed all possible Ad-clips (according to our criteria). Using the strict protocol similar to past years (i.e. using a CWT detector on all carcasses, and by considering only condition-one carcasses), we presumed we were successful at accounting for essentially all Ad+CWT fish during our survey. We also assumed that the probability of observing and recovering an Ad-clipped fish was the same in the survey as at the hatchery, and, most importantly, that the ratios of Ad-clipped to unmarked hatchery fish were the same in the spawner survey as at TRH. Since different chinook salmon release groups were Ad-clipped at different ratios, this last assumption is only valid if the various CWT groups occurred in the spawner survey in the same proportions as among the fish recovered at TRH.

RECOMMENDATIONS

This is the seventh, and tentatively final year of a multi-year effort of spawner surveys in the Trinity River basin. The following recommendations should be considered:

1. Spawner survey activities should be continued, with current objectives, in FY 1995-96 and beyond.

2. To maintain accuracy of Ad-clipped salmon recoveries, all salmon carcasses should continue to be passed through a tag detector. This allows more reliable estimates of proportions between hatchery- and naturally produced fish spawning in the wild.

3. Flows from Lewiston Dam should continue to be increased during the late summer to mid-fall period from the base 300 CFS to approximately 450 CFS, which would allow a more even chinook salmon spawner distribution between zones in the mainstem Trinity River.

LITERATURE CITED

Aguilar, B. 1996. Salmon spawner surveys in the upper Trinity River Basin. Chapter I. Job I. pp. 1-33. In: R. M. Kano (ed.), Annual Report of the Trinity River Basin Salmon and Steelhead Monitoring Project, 1993-1994 Season. February 1996. 266 p. Available from Calif. Dept. Fish and Game, Inland Fish. Div., 1416 9th St., Sacramento, CA 95814.

Aguilar, B., and M. Zuspan. 1995. Salmon spawner surveys in the upper Trinity River Basin. Chapter I. Job I. pp. 1-34. In: R. M. Kano (ed.), Annual Report of the Trinity River Basin Salmon and Steelhead Monitoring Project, 1992-1993 Season. March 1995. 235p. Available from Calif. Dept. Fish and Game, Inland Fish. Div., 1416 9th St., Sacramento, CA 95814.

Gibbs, E. D. 1956. A report on king salmon, *Oncorhynchus tshawytscha*, in the upper Trinity River, 1955. Calif. Dept. Fish and Game, Inland Fish. Admin. Rep. No. 56-10. 14 p.

La Faunce, D. A. 1965. King (chinook) salmon spawning escapement in the upper Trinity River, 1963. Calif. Dept. Fish and Game, Mar. Res. Admin. Rep. No. 65-3. 10 p.

Moffett, J. W., and S. H. Smith. 1950. Biological investigations of the fishery resources of the Trinity River, Calif. USFWS Spec. Sci. Rep., Fish. Bull. No. 12. 71 p.

Rogers, D. W. 1970. A king salmon spawning escapement and spawning habitat survey in the upper Trinity River and its tributaries, 1968. Calif. Dept. Fish and Game, Anad. Fish. Admin. Rep. No. 70-16. 13 p.

_____________ 1973. King salmon, Oncorhynchus tshawytscha, and silver salmon, Oncorhynchus kisutch, spawning escapement and spawning habitat in the upper Trinity River, 1970. Calif. Dept. Fish and Game, Anad. Fish. Admin. Rep. No. 73-10. 14 p.

_____________ 1982. A spawning escapement survey of anadromous salmonids in the upper Trinity River, 1971. Calif. Dept. Fish and Game, Anad. Fish. Admin. Rep. No. 82-2. 11 p.

Smith, G. E. 1975. Anadromous salmonid spawning escapements in the upper Trinity River, 1969. Calif. Dept. Fish and Game, Anad. Fish. Admin. Rep. No. 75-7. 17 p.

Weber, G. 1965. North coast king salmon spawning stock survey 1956-57 season. Calif. Dept. Fish and Game, Mar. Res. Admin. Rep. No. 65-1. 34 p.

Zuspan, M. 1991. Salmon spawner surveys in the upper Trinity River Basin. Chapter I. Job I. pp. 1-23. In: R. Carpenter, and K. Urquhart (eds.), Annual Report of the Trinity River Basin Salmon and Steelhead Monitoring Project, 1988-1989 Season. August 1991. 51 p. Available from Calif. Dept. Fish and Game, Inland Fish. Div., 1416 9th St., Sacramento, CA 95814.

Zuspan, M. 1992a. Salmon spawner surveys in the upper Trinity River basin. Chapter I. Job I. pp. 1-29. In: K. Urquhart (ed.), Annual Report of the Trinity River Basin Salmon and Steelhead Monitoring Project, 1989-1990 Season. June 1992. 140 p. Available from Calif. Dept. Fish and Game, Inland Fish. Div., 1416 9th St., Sacramento, CA 95814.

__________ 1992b. Salmon spawner surveys in the upper Trinity River basin. Chapter I. Job I. pp. 1-31. In: K. Urquhart (ed.), Annual Report of the Trinity River Basin Salmon and Steelhead Monitoring Project, 1990-1991 Season. December 1992. 186 p. Available from Calif. Dept. Fish and Game, Inland Fish. Div., 1416 9th St., Sacramento, CA 95814.

__________ 1994. Salmon spawner surveys in the upper Trinity River basin. Chapter I. Job I. pp. 1-37. In: K. Urquhart and R. M. Kano (eds.), Annual Report of the Trinity River Basin Salmon and Steelhead Monitoring Project, 1991-1992 Season. February 1994. 235 p. Available from Calif. Dept. Fish and Game, Inland Fish. Div., 1416 9th St., Sacramento, CA 95814.

APPENDIX 1. Other sources of data.

Researcher:	Edward Miller
File report title:	Untitled
Study years:	1972-1974, 1976, 1978-1982, 1984, 1985
Available from:	Calif. Dept. Fish and Game - Region I, 601 Locust St., Redding, CA. 96001.

Researcher:	Mike Stempel
File report title:	Chinook Salmon Spawning Survey in the Upper Trinity River During the Fall of 1987
Study year:	1987 (published 1988)
Available from:	USFWS F.A.O., P.O. Box 1450, Weaverville, CA 96093

APPENDIX 2. List of maps used to identify the river km of locations used during the 1994-95 Trinity River spawner survey.

---

1. Lewiston Quadrangle, California-Trinity Co.; 7.5 Minute Series (Topographic). N4037.5-W12245/7.5, Ref. 649-1C, U.S. Dept. of the Interior, Geological Survey; modified for USDA Forest Service; Provisional Edition 1982, Revised 1983; 1:24,000; 71 X 56 cm; b/w.

2. Weaverville Quadrangle, California-Trinity Co.; 7.5 Minute Series (Topographic). N4037.5-W12252.5/7.5, Ref. 649-2C, U.S. Dept. of the Interior, Geological Survey; modified for USDA Forest Service; Provisional Edition 1982, Revised 1983; 1:24,000; 71 X 56 cm; b/w.

3. Junction City Quadrangle, California-Trinity Co.; 7.5 Minute Series (Topographic). N4037.5-W12300/7.5, Ref. 650-1C, U.S. Dept. of the Interior, Geological Survey; modified for USDA Forest Service; Provisional Edition 1982, Revised 1984; 1:24,000; 71 X 56 cm; b/w.

4. Dedrick Quadrangle, California-Trinity Co.; 7.5 Minute Series (Topographic). N4045-W12300/7.5, Ref. 668-4C, U.S. Dept. of the Interior; Geological Survey; modified for USDA Forest Service; Provisional Edition 1982, Revised 1984; 1:24,000; 71 X 56 cm; b/w.

5. Helena Quadrangle, California-Trinity Co.; 7.5 Minute Series (Topographic). N4045-W12307.5/7.5, Ref. 668-3C, U.S. Dept. of the Interior, Geological Survey; modified for USDA Forest Service; Provisional Edition 1982, Revised 1984; 1:24,000; 71 X 56 cm; b/w.

APPENDIX 3. Summary of all chinook salmon carcasses recovered during the 1994–95 mainstem Trinity River spawner survey.

Survey week	Beginning of survey week	Adipose fin–clips	Program marks a/	Program–marked + Ad–clipped b/	Chinook flagged c/ f/ Adults	Chinook flagged c/ f/ Grilse	Flags recovered d/ f/ Adults	Flags recovered d/ f/ Grilse	Unmarked chinook e/ Males	Unmarked chinook e/ Females	Unmarked chinook e/ Unknown g/	Weekly total h/
1	19–Sep–94	0	0	0	1	1	0	0	0	0	0	2
2	26–Sep–94	0	0	0	5	0	0	0	1	0	0	6
3	03–Oct–94	5	2	0	21	1	1	0	5	0	3	37
4	10–Oct–94	17	9	2	109	19	1	1	21	31	2	210
5	17–Oct–94	11	16	0	83	10	29	2	34	55	8	217
6	24–Oct–94	6	12	2	73	9	24	5	52	68	8	230
7	31–Oct–94	1	9	0	53	3	15	2	34	35	6	141
8	07–Nov–94	1	19	0	56	8	26	3	43	52	21	200
9	14–Nov–94	7	9	2	43	2	24	0	27	37	6	133
10	21–Nov–94	4	12	2	26	9	20	2	41	33	20	147
11	28–Nov–94	3	17	0	22	4	29	0	26	57	41	170
12	05–Dec–94	0	8	0	5	4	16	1	25	49	47	138
13	12–Dec–94	0	2	0	2	0	3	1	16	9	16	45
14	19–Dec–94	0	0	0	0	0	6	0	9	13	22	44
Totals:		55	115	8	499	70	194	17	334	439	200	1,720

a/ Chinook salmon which were previously marked (spaghetti–tagged) downstream of the survey area.
b/ Chinook salmon which were Program–marked and Adipose–clipped.
c/ Chinook salmon which were flagged that week for later recovery.
d/ All recoveries that week which had been flagged during previous weeks.
e/ Condition–two chinook salmon which were not flagged, adipose fin–clipped, or Program–marked, and which were chopped in half upon recovery.
f/ During the survey, for tally purposes, chinook salmon $\leq$55 cm were initially assumed to be grilse.
g/ Chinook salmon of unknown sex.
h/ Includes all first–time observed carcasses, but does not include those which were previously flagged (Flags recovered).

APPENDIX 4. Summary of all coho salmon carcasses recovered during the 1994-95 mainstem Trinity River spawner survey.

					Unmarked				
						Females			
Survey week	Beginning of survey week	Number Ad-clipped a/	Number Program-marked b/	Program-marked + Ad-clipped c/	Males	Spawned	Unspawned	Percent spawned	Weekly total
1	19 Sep 94	0	0	0	0	0	0	-	0
2	26 Sep 94	0	0	0	0	0	0	-	0
3	03 Oct 94	0	0	0	0	0	0	-	0
4	10 Oct 94	0	0	0	0	0	0	-	0
5	17 Oct 94	0	0	0	0	0	0	-	0
6	24 Oct 94	0	0	0	0	0	0	-	0
7	31 Nov 94	0	0	0	0	0	0	-	0
8	07 Nov 94	0	0	0	0	0	0	-	0
9	14 Nov 94	0	0	0	0	0	0	-	0
10	21 Nov 94	0	0	0	1	0	0	-	1
11	28 Nov 94	0	0	0	0	0	0	-	0
12	05 Dec 94	0	1	0	0	0	0	-	1
13	12 Dec 94	0	0	0	0	0	0	-	0
14	19 Dec 94	0	0	0	0	0	0	-	0
	Totals:	0	1	0	1	0	0		2

a/ Adipose fin-clipped fish.
b/ Coho salmon which were previously marked (spaghetti-tagged) downstream of the survey area.
c/ Coho which were Program-marked and Ad-clipped.

APPENDIX 5. Summary of salmon carcasses and redds observed during the 1994–95 spawner surveys in the tributaries to the Trinity River.

Tributary	Number of weeks surveyed	Kilometers surveyed	Percent of spawning occurrance a/	Chinook: Total redds	Chinook: Adipose fin–clips	Chinook: Program marks b/	Chinook: Flagged carcasses c/ Adults	Chinook: Flagged carcasses c/ Grilse d/	Chinook: Flags recovered	Chinook: Skeletons	Chinook: Weekly total e/	Coho
Rush Creek	10	3.9	100.0	1	0	0	0	0	0	0	0	0
Grass Valley Creek	10	1.3	77.0	27	2	1	7	6	6	6	22	0
Indian Creek	10	2.1	100.0	0	0	0	0	1	0	0	1	0
Reading Creek	10	0.8	100.0	0	0	0	0	0	0	0	0	0
Browns Creek	10	4.0	100.0	0	0	0	0	0	0	0	0	0
Weaver Creek	7	2.9	100.0	0	0	0	0	0	0	0	0	0
Canyon Creek	9	3.5	80.0	4	0	0	0	1	0	0	1	0
North Fork Trinity R.	9	2.4	94.0	49	0	6	32	2	20	10	50	0
E. Fork N. Fork Trinity R.	9	2.1	100.0	14	0	1	1	1	0	3	6	0
Totals:				95	2	8	40	11	26	19	80	0

a/ Estimated percent of the total chinook spawning in that tributary which occurred in the surveyed section, as determined from ground and aerial redd surveys.
b/ Chinook salmon which had been previously marked (spaghetti–tagged) at various sites downstream of the survey area.
c/ Chinook salmon carcasses which were flagged and returned to the tributary for subsequent recovery.
d/ During the survey, for tally purposes, chinook salmon $\leq$55 cm are assumed to be grilse.
e/ Chinook weekly totals include flagged carcasses, skeletons, Ad–clipped and Program–marked carcasses, but does not include flags recovered (carcasses recovered which had been flagged and counted during a previous week).

APPENDIX 6. Sex compositions of adult chinook salmon observed during the mainstem Trinity River spawner surveys from 1942 through 1994.

Study year	Literature source	Spring-run chinook				Fall-run chinook				Total chinook			
		Males		Females		Males		Females		Males		Females	
		Number	Percent	Number	Percent	Number	Percent	Number	Percent	Number	Percent	Number	Percent
1942-1945 a/	Moffett/Smith (1950)									201	35.6	364	64.4
1955 a/	Gibbs (1956)									1769	49.7	1789	50.3
1956 a/	Weber (1965)									3149	46.3	3657	53.7
1963 a/	LaFaunce (1965)									1419	41.4	2008	58.6
1968 a/	Rogers (1970)									1244	44.5	1551	55.5
1969 a/	Smith (1975)									1054	37.0	1791	63.0
1970 a/	Rogers (1973)									527	48.7	556	51.3
1971 a/	" (1982)									1704	46.2	1987	53.8
1972 a/	Miller (1972)									499	38.7	791	61.3
1973 a/	" (1973)									404	38.7	641	61.3
1974 a/	" (1974)									706	38.6	1125	61.4
1976 a/	" (1976)									195	30.5	444	69.5
1978 a/	" (1978)									420	32.9	855	67.1
1979 a/	" (1979)									89	48.9	93	51.1
1980 a/	" (1980)									43	55.8	34	44.2
1981 a/	" (1981)									66	34.2	127	65.8
1982 a/	" (1982)									100	28.4	252	71.6
1984 a/ b/	" (1984)									276	74.2	96	25.8
1985 a/ b/	" (1985)									796	51.6	748	48.4
1987 a/	Stempel (1988)									1182	26.4	3299	73.6
1988	Zuspan (1991)	47	30.7	106	69.3	659	39.3	1016	60.7	706	38.6	1122	61.4
1989	Zuspan (1992a)	150	30.1	348	69.9	577	41.8	802	58.2	727	38.7	1150	61.3
1990	Zuspan (1992b)	39	25.7	113	74.3	50	32.9	102	67.1	89	29.3	215	70.7
1991	Zuspan (1994)	23	46.9	26	53.1	132	45.4	159	54.6	155	45.6	185	54.4
1992	Aguilar / Zuspan (1995)	71	33.5	141	66.5	128	41.3	182	58.7	199	38.1	323	61.9
1993	Aguilar (1995)	105	44.3	132	55.7	106	35.6	192	64.4	211	39.4	324	60.6
1994	Current study	115	30.1	267	69.9	179	30.8	403	69.2	294	30.5	670	69.5

a/ Spring-run and fall-run chinook salmon were not reported separately.

b/ Grilse chinook salmon were included in these counts.

APPENDIX 7. Female chinook salmon pre-spawning mortality rates observed during the mainstem Trinity River spawner surveys from 1955 through 1994.

		Spring-run chinook			Fall-run chinook			Total chinook		
Study year	Literature source	Spawned	Unspawned	Percent unspawned	Spawned	Unspawned	Percent unspawned	Spawned	Unspawned	Percent unspawned
1955 a/	Gibbs (1956)							2076	32	1.5
1956 a/	Weber (1965)							3438	219	6.0
1963 a/	LaFaunce (1965)							4953	328	6.2
1968 a/	Rogers (1970)							1494	124	7.7
1969 a/	Smith (1975)							1889	23	1.2
1970 a/	Rogers (1973)							632	34	5.1
1971 b/	" (1982)									
1972 a/	Miller (1972)							791	110	12.2
1973 a/ c/	" (1973)									12.0
1974 a/ c/	" (1974)									9.1
1976 a/ c/	" (1976)									8.4
1978 a/ c/	" (1978)									7.2
1979 a/ c/	" (1979)									6.0
1980 a/ c/	" (1980)									36.5
1981 a/ c/	" (1981)									2.6
1982 a/ c/	" (1982)									1.5
1984 b/	" (1984)									
1985 b/	" (1985)									
1987 c/	Stempel (1988)			49.9			18.8			30.8
1988	Zuspan (1991)	11	27	71.1	479	372	43.7	490	399	44.9
1989	Zuspan (1992a)	194	327	62.8	1546	464	23.1	1740	791	31.3
1990	Zuspan (1992b)	76	21	21.6	104	6	5.5	180	27	13.0
1991	Zuspan (1994)	22	0	0.0	162	2	1.2	184	2	1.1
1992	Aguilar / Zuspan (1995)	48	3	5.9	133	1	0.7	181	4	2.2
1993	Aguilar (1995)	115	5	4.2	180	12	6.3	295	17	5.4
1994	Current study	202	2	1.0	380	12	3.1	582	14	2.3

a/ Spring-run and fall-run chinook salmon were not separated during these years.
b/ Pre-spawning mortality rate was not reported during these years.
c/ Overall pre-spawning mortality rates were reported but not numbers of carcasses observed.

APPENDIX 8. Release and recovery data for coded-wire-tagged chinook salmon recovered in the 1994-95 mainstem Trinity River salmon spawner survey.

		Release data					
CWT a/	Race b/	Brood year	Location c/	Date	Number effectively tagged d/	Number recovered	% CWT recovered f/
0601080108	Wild	1989	Lewiston	3/27 - 4/6/90	26,148	3	7.5
0601080109	Wild	1989	Lewiston	4/4 - 4/18/90	21,388	2	5.0
0601040101	F-f	1989	TRH	5/18/90	201,622	1	2.5
0601080112	Wild	1990	Steelbridge	4/18 - 5/2/91	19,090	1	2.5
0601080113	Wild	1990	Sky Ranch	5/3 - 5/27/91	26,741	3	7.5
0601080114	Wild	1990	Sky Ranch	5/3 - 5/27/91	27,034	3	7.5
065636	S-y	1990	TRH	10/8/91	48,553	1	2.5
065638	F-y	1990	TRH	10/9/91	103,040	1	2.5
065640	S-y	1990	TRH	10/8/91	46,086	2	5.0
0601040103	S-f	1990	TRH	5/28/91	196,908	1	2.5
0601080301	Wild	1991	Ambrose	3/13 - 3/30/92	8,070	1	2.5
0601080304	Wild	1991	Sky Ranch	4/10 - 4/30/92	9,408	4	10.0
065732	F-y	1991	TRH	10/2/92	56,720	2	5.0
0601040104	F-f	1991	TRH	6/22/92	206,416	7	17.5
0601040105	S-f	1991	TRH	6/5/92	198,277	4	10.0
0601080402	Wild	1992	Hardhat	3/26 - 4/9/90	9,816	1	2.5
0601080405	Wild	1992	Sky Ranch	5/16 - 5/18/93	6,568	1	2.5
065733	F-f	1992	TRH	6/16/93	192,032	1	2.5
0601040106	S-f	1992	TRH	6/15/93	215,038	1	2.5
100000 e/						23	--
Totals:						63	100.0

a/ Coded-wire tag number assigned to that group of fish.
b/ S = spring, F = fall, y = yearling, f= fingerling, Wild = Naturally produced
c/ TRH = Trinity River Hatchery; release locations for wild fish (Chapter 2 in past Annual Reports).
d/ Number effectively tagged = (Total number tagged) - (tagging mortalities + estimated shed tags + estimated poor fin-clipped fish).
e/ Adipose fin-clipped recovered fish. CWTs were either unreadable, shed, or lost while decoding.
f/ Includes only those fish whose CWTs were readable.

ANNUAL REPORT
TRINITY RIVER BASIN SALMON AND STEELHEAD MONITORING PROJECT
1994-1995 SEASON

CHAPTER II

JOB II
CAPTURE AND CODED-WIRE TAGGING OF NATURALLY PRODUCED CHINOOK SALMON IN THE TRINITY RIVER BASIN

by

Lanette Davis

ABSTRACT

From 1989 to 1994, the California Department of Fish and Game's Trinity Fisheries Investigations Project personnel trapped and coded-wire tagged naturally produced juvenile chinook salmon in the mainstem Trinity River. Trapping and tagging were not conducted in 1995. However, returns of chinook previously tagged by this Project were monitored and are reported in this Chapter.

Ninety-two adult chinook salmon (Oncorhynchus tshawytscha), coded-wire-tagged as Trinity River naturally produced juveniles, were recovered this season from the in-river and ocean sport fishery, Trinity River Hatchery, Indian gill-net fishery, and the mainstem salmon spawner surveys. These included five from the 1989 brood year (five-year-olds), thirty-eight from the 1990 brood year (four-year-olds), forty-four from the 1991 brood year (three-year-olds), and five from the 1992 brood year (two-year-olds).

JOB OBJECTIVE

To capture, mark (adipose fin-clip), tag (binary-coded-wire), and release representative groups (up to 100,000 fish/group) of naturally produced chinook salmon fry/fingerlings in the mainstem Trinity River, for use in subsequent determinations of their survival and contributions as adults to the ocean and river fisheries and spawning escapements.

INTRODUCTION

The Trinity River system in northern California is a major producer of chinook salmon (hereafter called chinook) for the Klamath River basin. Knowledge of fry- or fingerling-to-adult survival, harvest, and spawner escapement of these stocks is crucial to wise management of chinook in the basin.

Legislation (U. S. Public Law 98-541) enacted in 1984, resulted in a major effort to restore the fishery resources in the Trinity River basin to pre-Trinity-Project conditions. Emphasis for this effort is placed on naturally produced chinook. Survival, catch, and escapement data for these fish will help to evaluate the effectiveness of these restoration efforts.

Previous coded-wire tagging studies of juvenile chinook in the Trinity River basin have focused on hatchery-produced chinook and made references to naturally produced chinook based on those results (Heubach and Hubbell 1979; Heubach 1980; Maria and Heubach 1981, 1984a, 1984b, 1984c).

From 1989 to 1994 the California Department of Fish and Game's (CDFG) Trinity Fisheries Investigations Project (TFIP) personnel trapped, adipose (Ad) fin-clipped, coded-wire tagged (CWT), and released naturally produced juvenile chinook. Subsequent studies of these fish as adults, by TFIP and other projects of the CDFG's Klamath-Trinity Program, will be used to determine survival, harvest, and spawning escapement for this important component of the Trinity River basin's chinook stocks.

METHODS

Trapping and Tagging

Trapping and tagging of mainstem Trinity River naturally produced chinook was not conducted this year. Therefore, the only results reported are recoveries of adult chinook previously tagged as naturally produced juveniles by this Project.

Coded-Wire Tag Recovery

As part of ongoing studies, CDFG recovered Ad-clipped adult salmonids from among ocean- and inland-harvested fish, and hatchery and natural spawner returns. Heads from recovered Ad-clipped fish were retained and CWTs were extracted and decoded.

RESULTS

A total of 92 CWTed adult chinook salmon were recovered this season from the 1989 through 1992 brood years (BY) tagged as naturally produced juveniles by this Project from 1990 through 1993 (Zuspan 1992a, 1992b, 1994; Aguilar 1995). The majority of recoveries were from the Indian gill-net fishery (33.7%) and the ocean harvest (32.6%). Adult chinook from the 1989 BY were only recovered from the mainstem Trinity River spawner surveys, while the in-river sport fishery recoveries were only from the 1992 BY (Table 1).

TABLE 1. Adult recoveries of coded-wire-tagged (CWT) naturally produced chinook during the 1994-95 season.

		Number of fish recovered					
CWT group	Brood year	Indian gill-net fishery	In-river sport harvest	Spawner survey	Trinity River Hatchery	Ocean harvest	Age (years)
0601080108	1989			3			5
0601080109	1989			2			5
0601080112	1990			1			4
0601080113	1990	12		3	1	8	4
0601080114	1990			3	1	9	4
0601080301	1991			1	2		3
0601080304	1991	12		4	2		3
0601080306	1991	7			1		3
0601080307	1991					13	3
0601080309	1991				1		3
0601080310	1991				1		3
0601080402	1992			1			2
0601080403	1992				1		2
0601080405	1992			1			2
0601080407	1992		2				2
Totals:		31	2	19	10	30	

Three-year-olds (1991 BY) made up the largest proportion (47.8%) of naturally produced CWTed fish recoveries this year, and four-year-olds (1990 BY) constituted 41.3%. Two-year-olds (1992 BY) and five-year-olds (1989 BY) each made up 5.4% of the recoveries this season. For comparison, hatchery-produced three-year-olds (47.6%) and two-year-olds (43.0%) made up the largest proportions of the total CWTed chinook recovered this season from the Indian gill-net fishery, in-river sport fishery, mainstem Trinity River spawner surveys, Trinity River Hatchery, and ocean harvest fishery (R. Dixon, CDFG, pers. comm.).

DISCUSSION

We recovered more naturally produced CWTed chinook (92 fish) this year than in past years (Aguilar 1995, Aguilar and Davis 1996, Zuspan 1992b, 1994). For comparison, we recovered 76 in 1994, seven in 1993, seven in 1992, and one in 1991. We should expect larger returns of CWTed naturally-produced chinook in the next two years because of the greater number (>100,000) of juveniles, from the 1993 BY, which were CWTed in 1994 than during the three previous tagging years. In 1996 and 1997, we expect these fish to return as three- and four-year-olds, respectively, ages which have constituted the largest proportions of the naturally produced chinook observed in the past.

RECOMMENDATIONS

1. Job 2 activities should be continued in FY 1995-96.

2. In order to trap and tag over 100,000 1995 BY juvenile chinook in 1996, we should be prepared to sample during periods of high flow releases, which will require the purchase of additional equipment and modifications to existing trapping equipment.

3. We should continue efforts to recover coded-wire-tagged chinook harvested by anglers or returning to TRH. Efforts to recover naturally spawned code-wire-tagged fish should be increased.

LITERATURE CITED

Aguilar, B. 1995. Capture and coded-wire tagging of naturally produced chinook salmon in the Trinity River basin. Chapter II. Job II. pp. 35-52. In: R. M. Kano (ed.), Annual Report of the Trinity River Basin Salmon and Steelhead Monitoring Project, 1992-1993 Season. March 1995. 235 p. Available from Calif. Dept. of Fish and Game, Inland Fish. Div., 1416 9th St., Sacramento, CA, 95814.

Aguilar, B. and L. Davis. 1996. Capture and coded-wire tagging of naturally produced chinook salmon in the Trinity River basin. Chapter II. Job II. pp. 35-53. In: R. M. Kano (ed.), Annual Report of the Trinity River Basin Salmon and Steelhead monitoring project, 1993-1994 Season. February 1996. 266 p. Available from the Calif. Dept. of Fish and Game, Inland Fish. Div., 1416 9th St., Sacramento, CA 95814.

Heubach, B. and P. Hubbell. 1979. FY 1978 progress report. Task V. Salmon tagging and release monitoring. pp. 1-5. In: P.M. Hubbell (ed.), Evaluation Report--FY 1978. Trinity River Basin Fish and Wildlife Task Force Priority Work Item No. 5. January 1979. 65 p. Available from Calif. Dept. of Fish and Game, Inland Fish. Div., 1416 9th St., Sacramento, CA, 95814.

Heubach, B. 1980. FY 1979 progress report. Task V. Salmon tagging and release monitoring. pp. 75-79. In: P.M. Hubbell (ed.), Progress Report. Fishery Investigations - Trinity River. Trinity River Basin Fish and Wildlife Task Force Priority Work Item No. 5. September 1980. 141 p. Available from Calif. Dept. of Fish and Game, Inland Fish. Div., 1416 9th St., Sacramento, CA, 95814.

Maria, D., and B. Heubach. 1981. FY 1980 progress report. Task V. Salmon tagging and release monitoring. pp. 7-12. In: P.M. Hubbell (ed.), Progress Report. Fishery Investigations - Trinity River. Trinity River Basin Fish and Wildlife Task Force Priority Work Item No. 5. Tasks II, V, VII. December 1981. 23 p. Available from Calif. Dept. of Fish and Game, Inland Fish. Div., 1416 9th St., Sacramento, CA, 95814.

__________. 1984a. FY 1981 progress report. Task V. Salmon tagging and release monitoring. pp. 6-15. In: P.M. Hubbell (ed.), Progress Report. Fishery Investigations - Trinity River. Trinity River Basin Fish and Wildlife Task Force Priority Work Item No. 5. Tasks II, V, VII. October 1984. 24 p. Available from Calif. Dept. of Fish and Game, Inland Fish. Div., 1416 9th St., Sacramento, CA, 95814.

Maria, D., and B. Heubach 1984b. FY 1982 progress report. Task V. Salmon tagging and release monitoring. pp. 5-13. In: P.M. Hubbell (ed.), Progress Report. Fishery Investigations - Trinity River. Trinity River Basin Fish and Wildlife Task Force Priority Work Item No. 5. Tasks II, V. November 1984. 13 p. Available from Calif. Dept. of Fish and Game, Inland Fish. Div., 1416 9th St., Sacramento, CA, 95814.

________. 1984c. FY 1983 progress report. Task V. Salmon tagging and release monitoring. pp. 1-11. In: P.M. Hubbell (ed.), Progress Report. Fishery Investigations - Trinity River. Trinity River Basin Fish and Wildlife Task Force Priority Work Item No. 5. Task V. November 1984. 11 p. Available from Calif. Dept. of Fish and Game, Inland Fish. Div., 1416 9th St., Sacramento, CA, 95814.

Zuspan, M. 1992a. Capture and coded-wire tagging of naturally produced chinook in the Trinity River Basin. Chapter II. Job II. pp. 30-43. In: K. Urquhart (ed.), Annual Report of the Trinity River Basin Salmon and Steelhead Monitoring Project, 1989-1990 Season. June 1992. 140 p. Available from Calif. Dept. of Fish and Game, Inland Fish. Div., 1416 9th St., Sacramento, CA, 95814.

________. 1992b. Capture and coded-wire tagging of naturally produced chinook in the Trinity River Basin. Chapter II. Job II. pp. 32-49. In: K. Urquhart and R. Carpenter (eds.), Annual Report of the Trinity River Basin Salmon and Steelhead Monitoring Project, 1990-1991 Season. December 1992. 186 p. Available from Calif. Dept. of Fish and Game, Inland Fish. Div., 1416 9th St., Sacramento, CA, 95814.

________. 1994. Capture and coded-wire tagging of naturally produced chinook in the Trinity River Basin. Chapter II. Job II. pp. 38-50. In: K. Urquhart and R. M. Kano (eds.), Annual Report of the Trinity River Basin Salmon and Steelhead Monitoring Project, 1991-1992 Season. February 1994. 235 p. Available from Calif. Dept. of Fish and Game, Inland Fish. Div., 1416 9th St., Sacramento, CA, 95814.

ANNUAL REPORT
TRINITY RIVER BASIN SALMON AND STEELHEAD MONITORING PROJECT
1994-1995 SEASON

CHAPTER III

JOB III

LIFE HISTORY, DISTRIBUTION, RUN SIZE AND ANGLER HARVEST OF STEELHEAD IN THE SOUTH FORK TRINITY RIVER BASIN

by

Barry W. Collins and Larry Hanson

ABSTRACT

The California Department of Fish and Game's Natural Stocks Assessment Project monitored adult fall-run steelhead (Onchorynchus mykiss) immigration into the South Fork Trinity River basin during the 1994-1995 season.

Based on the results of our creel survey of the sport fishery in the two major areas accessible to the public, we estimated that 1,119 anglers landed 59 adult steelhead during the 1994-1995 season. The angler harvest rate in the entire South Fork Trinity River basin during the 1994-1995 season was estimated at 10.1%.

Steelhead spawning stock surveys were conducted in 24 streams in the South Fork Trinity River basin. We surveyed 104.3 km of stream, observed 14 adult steelhead, and counted 54 redds. Steelhead were found to spawn mostly in pool tail-crests (64.8%) and runs (25.9%). The average redd area was 1.6 m^2 and the average redd depth was 32 cm.

Direct observation snorkel surveys in selected key tributaries throughout the SFTR basin found age 0+, 1+, and 2+ steelhead utilizing these areas for summer rearing; however, juvenile chinook and coho salmon were essentially only found in Madden Creek during the late summer.

JOB OBJECTIVES

1. To determine the size, composition, distribution, and timing of the adult steelhead runs in the South Fork Trinity River basin.

2. To determine the angler harvest of adult steelhead in the South Fork Trinity River basin.

3. To determine the life history patterns of the South Fork Trinity River basin steelhead stocks.

4. To determine the seasonal use made by juvenile steelhead of various habitat types within selected South Fork Trinity River tributaries.

5. To describe relationships between habitat types and seasonal juvenile steelhead standing crops.

INTRODUCTION

The life histories and current status of steelhead (*Onchorynchus mykiss*) populations within the South Fork Trinity River (SFTR) basin (Figure 1) are of concern because population numbers are believed to have dropped significantly in the last 30 years. A combination of human activities (e.g., road construction, and timber harvest), exacerbated by flooding and wildfire is believed to have limited steelhead production in the SFTR basin. Much of the spawning and rearing habitats in the basin have apparently been damaged or destroyed through excessive aggradation. Before we began our monitoring program in 1988, little data was actually available regarding juvenile steelhead life-history patterns, adult steelhead run sizes, spawning distributions, and sport fishery harvest and harvest rates.

Restoration of salmon and steelhead habitat within the basin is a high priority of the Trinity River Basin Restoration Program (overseen by the Trinity River Basin Fish and Wildlife Task Force), the U.S. Forest Service, and the California Department of Fish and Game (CDFG). Restoration and management efforts for steelhead stocks in the SFTR basin will be aided by the knowledge gained through studies of their current status, their habitat requirements, and life histories.

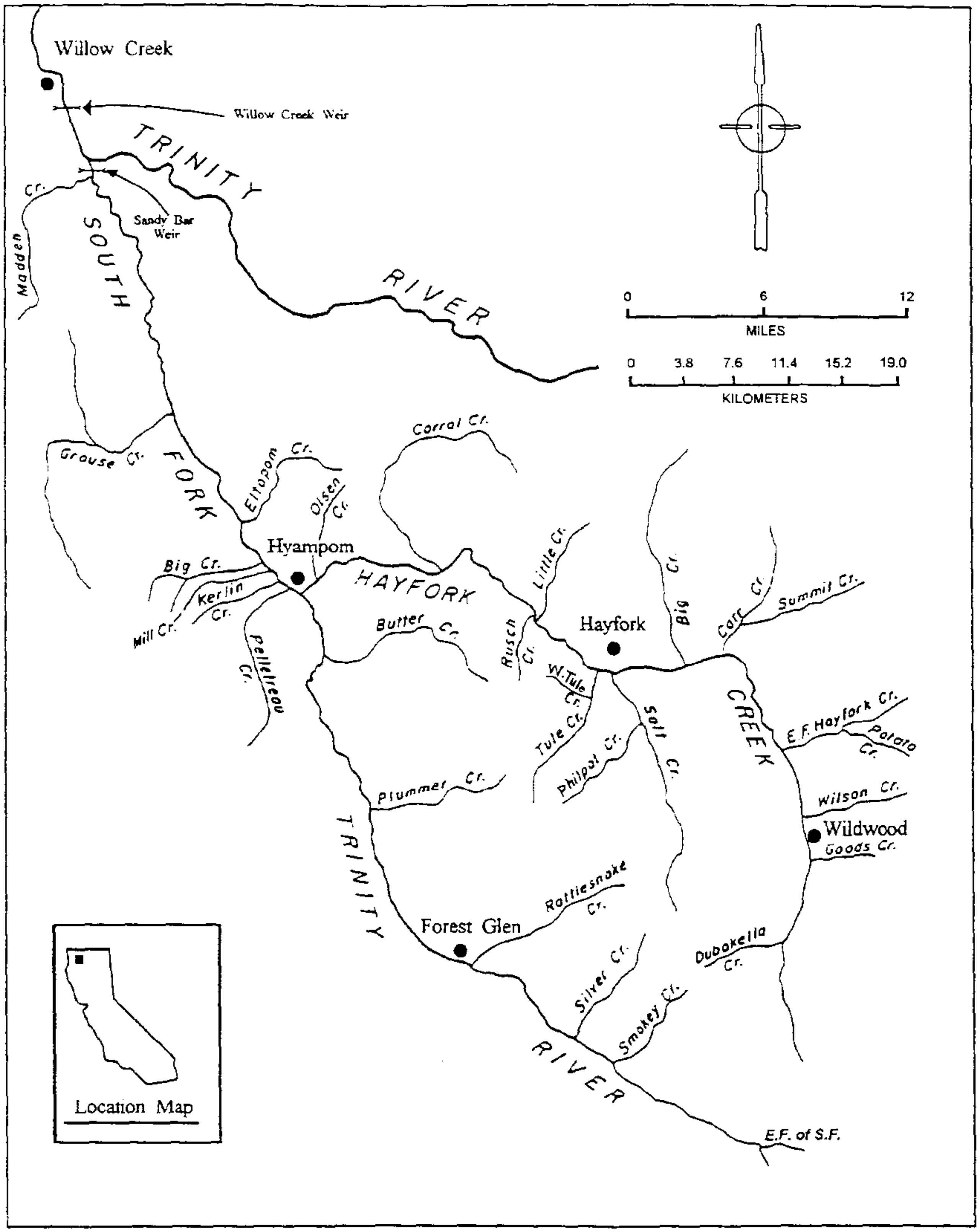


FIGURE 1. Location of the weir used to capture immigrant adult steelhead in the South Fork Trinity River basin during the 1994-1995 season.

METHODS

Use of Standard Julian Week

The Julian week (JW) format was used to compile angler harvest and juvenile salmonid sampling data collected y project personnel. A JW is a period of seven consecutive days. The calendar year consists of 52 JWs commencing on 1 January and running through 31 December. The extra day in leap years is included in the ninth week, and the last day o the year is included in the 52nd week (Appendix 1). The J format allows annual comparison of data for identical time periods.

Adult Steelhead Trapping and Tagging

An immigrant steelhead capture-weir was constructed in the SFTR at Sandy Bar, river km (RKM) 2.4 (Figure 1), to assess run timing, run composition, and population size of immigrant steelhead entering the SFTR basin. The Sandy Bar Weir has been operated at this site since 1984, initially to estimate fall-run chinook salmon (O. tshawytscha) escapement, and then steelhead escapement since 1988. Trapping during the 1994-1995 season was conducted over a period of 55 days from 1 October to 24 November 1994.

The weir consisted of a series of metal panels. Panels were fabricated from 1.9-cm diameter electrical conduit, spaced 2.5 cm apart horizontally, and welded to 2.5-cm angle iron at the ends. Individual panels measured 1.2 m high by 1.5 m wide, and were linked end-to-end across the river by securing them with wire to supporting metal fence posts driven into the streambed. Two immigrant fyke traps were installed in the channel, one in the deepest part of the thalweg on the right side of the river, looking downstream, and the other in a somewhat shallower area on the left side of the river. The sides of the traps were constructed with similar materials and horizontal spacing as the weir panels. The floors and tops of the traps were made from marine grade plywood. The traps measured 2.4 m wide x 2.4 m long x 1.2 m high. They were secured to metal fence posts and tied in to the weir with wire. Traps and weir panels were laced together with a steel cable anchored to the bank, to prevent loss during high flow events. A small mesh screen was strung above the weir to prevent fish from jumping over it.

Captured steelhead were sexed, measured to the nearest cm fork length (FL), and scale samples were collected. Fish were examined for fin-clips, external tags, and external scars (gill net, fishing-hook, and predator scars). Fishing-hook and predator scars were classified as either of salt-water (healed) or freshwater origin.

Ten-dollar reward anchor tags were applied to all unmarked steelhead, except those judged to be excessively stressed by capture and handling, or those that appeared to be in poor physical condition. Tags were discretely numbered for assessment of migration travel time of individual fish in the SFTR basin, as well as for population abundance and angler harvest rate monitoring.

Chinook and Coho Salmon Trapping

Chinook and coho salmon (O. kisutch) captured were measured and inspected in the same manner as steelhead. Chinook and coho salmon were released unmarked.

Tagged Steelhead Recovery

In past seasons we have utilized emigrant weirs in the upper SFTR basin during the spring to recover steelhead tagged at the Sandy Bar Weir for population estimates. However, due to high flows these weirs could not be installed this season, and steelhead escapement into the SFTR basin could not be estimated.

Angler Survey

A creel census was used to collect angler effort and harvest information of fall- and winter-run steelhead in the SFTR. The census was systematically stratified by JW, location (section), day type (weekday\weekend), and time periods (AM\PM). Sampling was conducted on two randomly selected weekdays per week and on both weekend days. Sampling was conducted along set routes.

Two sections of the SFTR were sampled (Figure 2). The lower section extended from the confluence of the SFTR with the mainstem Trinity River upstream to RKM 22.5. The upper section extended from RKM 32.2 to the SFTR bridge at Hyampom (RKM 49.1), the upstream limit of legal fishing. Public access is very limited elsewhere in the basin due to the lack of public roads and the rugged nature of the SFTR canyon.

Anglers were interviewed for targeted species, number of hours fished, angling method, and state and county of residence. Harvested salmonids were sexed, measured to the nearest cm FL,and scale samples were taken. Fish were examined for fin-clips, external tags, and general body condition. Steelhead were classified into age classes based on FL; juveniles (<25 cm),half-pounders (≥25 and <41 cm), and adults (≥41 cm). Salmon age classes were also based on FL; grilse (<55 cm), adults (≥55 cm).

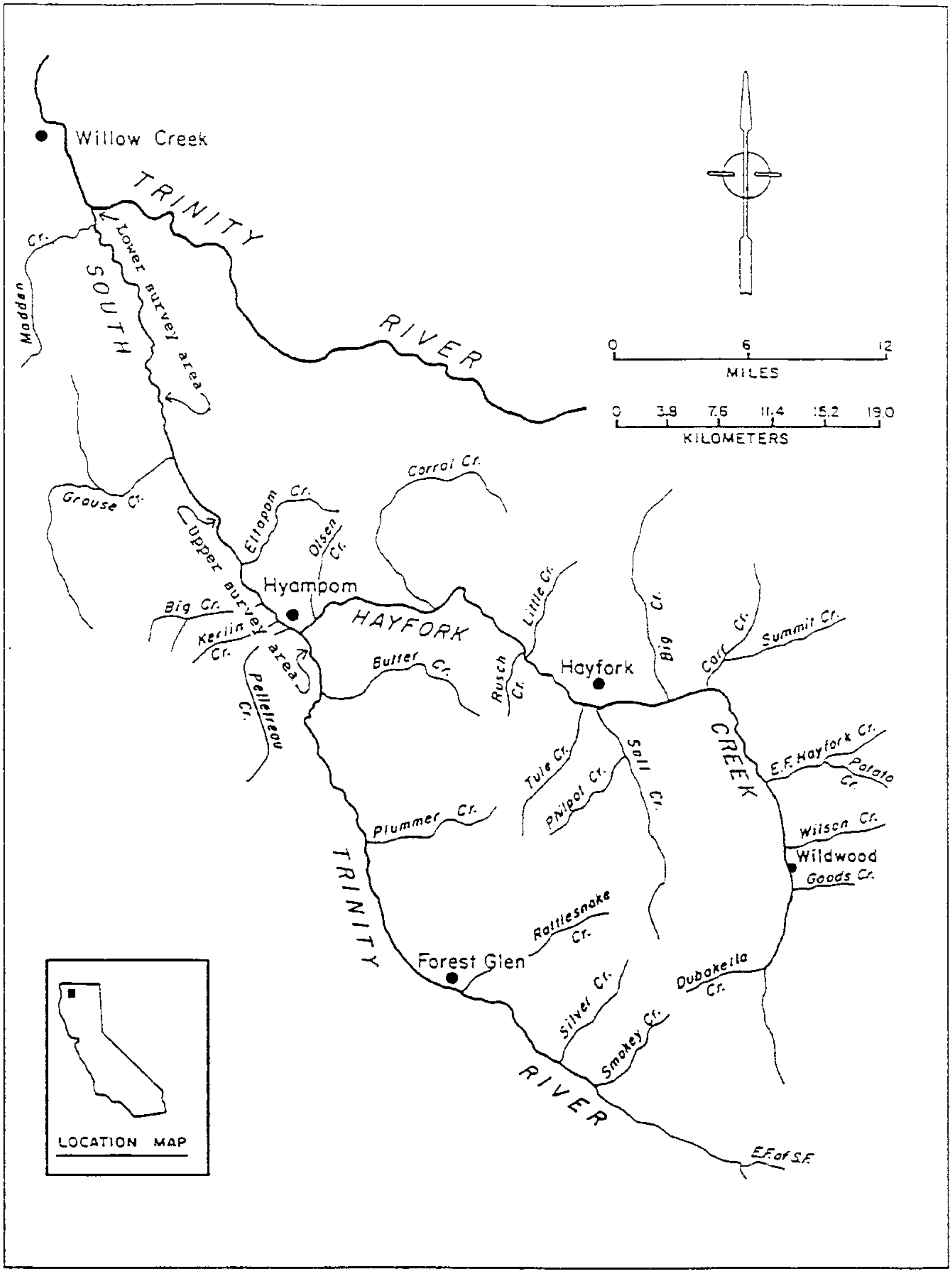


FIGURE 2. Locations of the two creel survey areas in the South Fork Trinity River basin during the 1994-1995 season.

Steelhead Sport Harvest

Data from the angler survey were expanded under the assumption that angling effort, angler numbers, and steelhead harvest were constant for the duration of each stratum sampled. A ratio of the number of legal fishing hours possible during the AM or PM stratum to the hours sampled during that stratum yielded a weighting factor which was used to expand observed angler numbers, angler hours, and steelhead harvest. Expanded estimates for strata not surveyed were calculated by using average values for strata from equivalent sampling periods (i.e., for a missing weekday evening survey, the mean of all weekday PM survey samples for that section during that JW was used). Expanded estimates and actual data were combined to give an estimate of sport harvest for the 1994-1995 season in the SFTR basin.

The sport harvest rate estimate was made with the following assumptions: 1) all tagged fish caught by sport anglers were recognized as such, 2) no tags were shed, and 3) there was no differential mortality between tagged and untagged fish. All reward tags from the Sandy Bar Weir that were observed during the angler survey were left with the individual anglers to be returned by mail. A non-response rate was estimated by dividing the number of tags observed in the angler survey by the number of tags that were returned by mail. The estimated sport harvest was then determined by dividing the number of tags returned in the mail by the number of tags applied at the Sandy Bar Weir, divided by the non-response rate.

Juvenile Salmonid Emigration

Juvenile salmonid emigration in the SFTR basin was not monitored this season because the loss of funding with the conclusion of the Trinity River Restoration Program necessitated winding down the project.

Juvenile Steelhead Habitat Utilization

Juvenile steelhead habitat utilization surveys like those made in past seasons in Eltapom Creek were not conducted this season because of the need to wind down the project. However, we did conduct limited direct observation (snorkel) surveys during the summer in selected SFTR basin tributaries mainly to assess the presence or absence of juvenile salmonids.

We conducted limited presence/absence snorkel surveys for juvenile salmonids during the summer in selected streams listed as refugia by Pacific Watershed Associates (1994; pp. XVI-2 to -8). Plummer Creek was not surveyed since this would have been a duplication of the CDFG Trinity Fisheries Investigations Project monitoring (Chapter VII). Eltapom Creek was included in the survey because of its importance as a steelhead spawning area.

A three-person crew consisting of two divers and one data recorder was used. We conducted sampling in five basic habitat types: cascade, pool, riffle, run, and step-run. The upstream and downstream ends of each discrete habitat unit was blocked off with nets. Both divers simultaneously worked their way upstream keeping cumulative counts by species and life stage. Juvenile steelhead age classes were based on FL: age 0+ (<85 mm), age 1+ (≥85 mm and <150 mm), and age 2+ (≥150 mm). Juvenile chinook age classes were also based on FL: age 0+ (<85 mm), age 1+ (≥85 mm). When possible we sampled several of each habitat type in the stream. Flow and temperature data was collected during each sampling period.

Spawning Survey

To document steelhead spawning distribution in the SFTR basin we surveyed 12 streams tributary to the SFTR, sections of Hayfork Creek, and 11 streams tributary to Hayfork Creek (Figure 1). Nineteen streams were surveyed twice, and the remaining five once. Selection of the tributaries sampled was based on historic use by spawning steelhead and replication of past surveys performed by this project. Sampling was conducted from 4 April through 6 June 1995.

Only anadromous reaches of the creeks were surveyed. Crews typically walked a 2- to 3-mile reach of each creek while searching for steelhead redds. On the initial survey, habitat types in each creek were delineated into units of five habitat types: cascade, pool, riffle, run, and step-run. In each stream surveyed the length and width of each habitat unit were measured for area calculations. The locations of redds found in each particular unit were also recorded.

Length and width measurements were taken of each redd, using a meter stick or tape measure, from the upstream end of the redd to the highest point of the tailspill, and perpendicularly across the widest point of the redd. An index of the redd's surface area was calculated as the product of the length and width. Water depths were taken using a graduated top-setting wading rod, and water velocities were measured with an electronic flow meter. Two separate water velocity measurements were taken; mean water column velocity (MWCV) and fish-nose water velocity (FNWV). MWCV measurements were taken at 60% of the depth below the water surface, and FNWV measurements were taken 0.12 m above the substrate. Redd substrate composition was characterized by assessing the average size of the dominant and subdominant components (Table 1) and the percent embeddedness of its gravel/cobble components (Hampton 1988). The water velocity measurements and the substrate assessments were made 0.15 m upstream from the redd to reflect the hydraulic and substrate conditions before the redd was constructed. Distance to the closest cover, escape, or resting place was noted, as well as the dominant habitat type in which the redd was located.

RESULTS AND DISCUSSION

Immigrant Steelhead Trapping

The Sandy Bar Weir was operated from 1 October through 24 November 1994. On 10 November an intense Pacific weather system dropped over 3.5 inches of rain at the weir site. To prevent mortalities to fish trapped in the weir, we opened the traps and the weir that afternoon. High flows and debris load later over-topped the weir, and knocked down some of its panels. It was not until 20 November that we were able to make repairs and put the weir back into operation. However, we were only able to trap for an additional four days before the weir was again knocked down by high flows on 25 November, marking the end of operations for this season. As a side note, flows remained high throughout much of the 1994-1995 season. It was not until the following summer that we were able to retrieve the weir panels and traps from the river.

In 45 days of trapping we captured 87 immigrant steelhead (25 males, 60 females, 2 half-pounders) and 1 juvenile steelhead. Peak migration of steelhead at the weir occurred after the first major flow increase on the evening of 5 November. During the

TABLE 1. Criteria used to describe the size of dominant and subdominant spawning gravel substrate.

Data code	Substrate type	Substrate size range (mm)
0	Fines	< 4
1	Small gravel	4 - 25
2	Medium gravel	25 - 50
3	Large gravel	50 - 75
4	Small cobble	75 -150
5	Medium cobble	150 -225
6	Large cobble	225 - 300
7	Small boulder	300 - 600
8	Large boulder	> 600
9	Bedrock	

following six-day period (5-10 November) 64 steelhead (73.6% of the season's total) were captured (Figure 3).

Monitoring the escapement of fall/winter run steelhead into the SFTR basin through a weir operation is only effective at low-to-moderate river-stage levels, and the weir cannot be operated at all after higher levels are reached. Even during periods of an average lower stage level, the SFTR is extremely prone to sudden flow increases since its watershed encompasses 2,585 km^2. The weir cannot be operated during these events, and when they are anticipated we leave the traps open to allow fish passage. Since the peak upstream migrations of steelhead occur during higher flows, it is often difficult to capture and mark enough fish for a Peterson-type population estimate. Therefore, an alternative means of monitoring the escapement of adult fall/winter steelhead into the basin should be considered. It may be more practical to abandon attempts to monitor adult escapement into the basin and concentrate on monitoring the status of this stock through adult spawner and juvenile distribution and emigration surveys conducted in tributaries and mainstem areas throughout the basin.

Tags were applied to 68 adults and one half-pounder steelhead, and five fish were released unmarked. Mean FL of immigrant steelhead captured at the Sandy Bar Weir was 56.8 cm; range: 34-76 cm (Figure 4). Thirteen of the adult steelhead we caught carried tags applied at the CDFG Willow Creek Weir, located in the Trinity River 48.4 km upstream from its confluence with the Klamath River and 3.7 km downstream from its confluence with the SFTR. These fish were examined and released and were not tagged a second time with a Sandy Bar Weir tag. The average time between the release of steelhead from the Willow Creek Weir to their capture at the Sandy Bar Weir was 49.8 days; range 5-97 days (Appendix 2).

Gill-net and predator scars were the most common types of scars (14.9% and 11.5%, respectively) observed on steelhead trapped this year at the Sandy Bar Weir (Table 2). This was the second year in a row that we observed an increase in the proportion of gill-net scars among the steelhead captured at the weir. Between the 1992-93 and 1993-94 seasons the incidence of gill-net scars increased from 2.3% to 7.0%. The proportion of gill-net scars were also relatively high in the 1990-91 and 1991-92 seasons (30.1% and 11.3%, respectively) (Wilson and Collins 1992, 1994). However, only 1.6% of steelhead captured at the Willow Creek Weir during the 1994-95 were scarred by gill-nets, a decrease from the 4.5% observed during the 1993-94 season (M. Zuspan, personal communication). This suggests that the Indian gill-net fishery

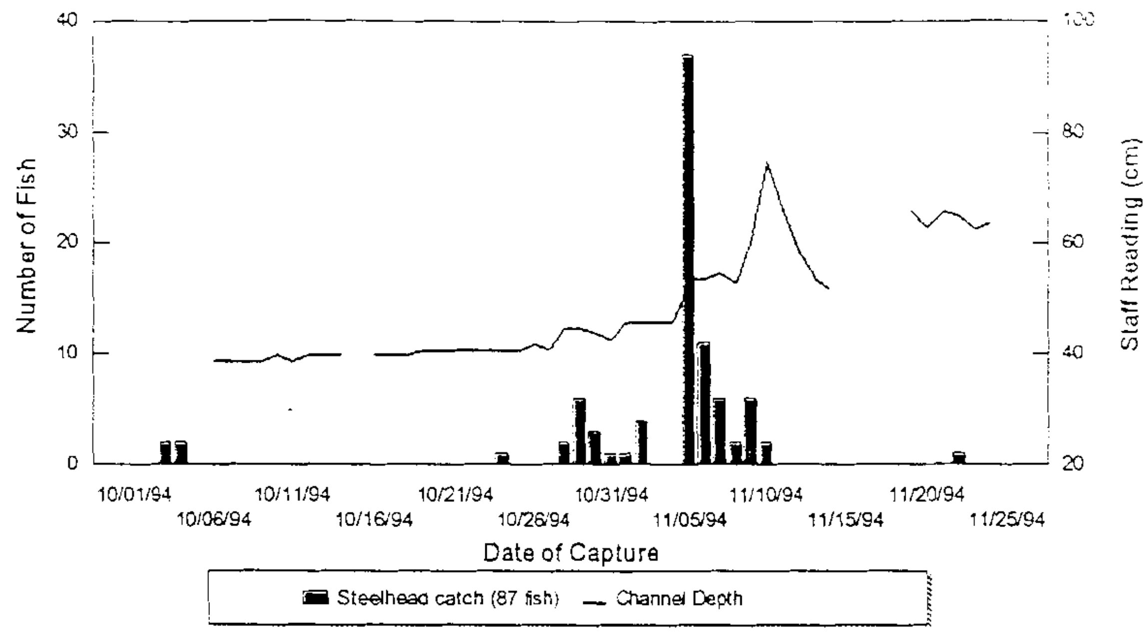


FIGURE 3. Daily catch of immigrant steelhead and river levels at the Sandy Bar Weir in the South Fork Trinity River from 1 October through 24 November 1994.

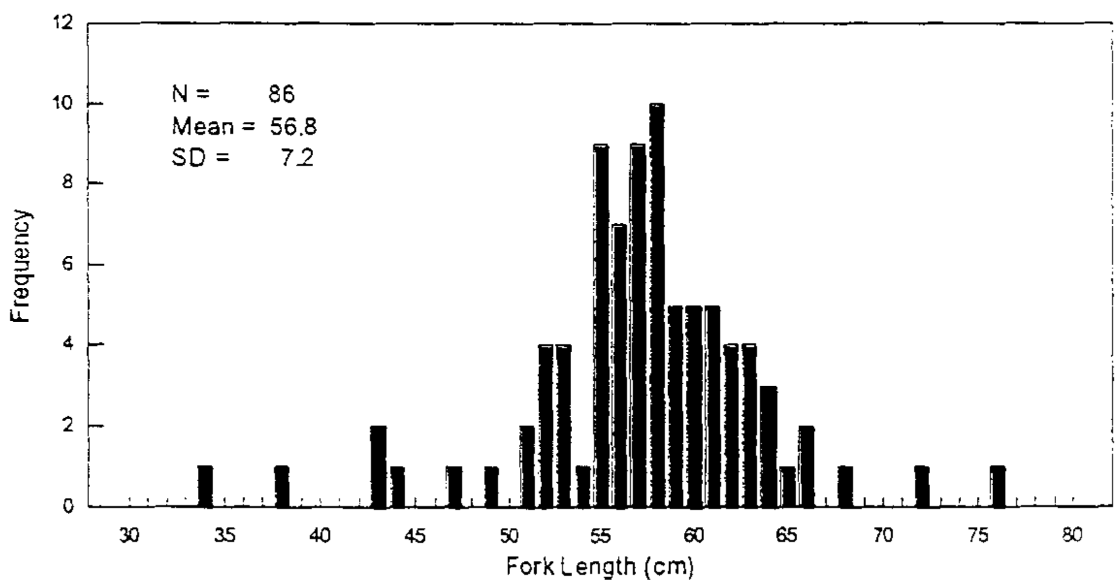


FIGURE 4. Length frequency distribution of immigrant steelhead captured at the Sandy Bar Weir in the South Fork Trinity River during the 1994-1995 season.

TABLE 2. Scars observed on steelhead captured at the Sandy Bar Weir in the South Fork Trinity River between 1 October and 24 November 1994.

Scar type	Number of fish with scars	Percent of fish with scars	Percent of total fish captured
Gill-net	13	48.2	14.9
Freshwater hook	3	11.1	3.4
Ocean hook	0	0.0	0.0
Predator	10	37.0	11.5
Unknown origin	1	3.7	1.1
Total:	27		

may be having a relatively greater impact on the natural stock of SFTR fall/winter steelhead than on the mainstem run which is composed of both natural and hatchery stocks.

Immigrant Chinook and Coho Salmon Trapping

A total of 404 chinook salmon were captured at the Sandy Bar Weir (257 males, including 107 grilse, and 146 females) (Figure 5). Chinook salmon migration timing showed some response to flow increases, but were not as pronounced as for steelhead. We measured 403 of the fish captured. The mean FL for males was 59.6 cm (range: 38-89 cm); while females averaged 66.8 cm (range: 38-88 cm)(Figure 6). Thirty-one chinook carried tags applied at the Willow Creek Weir. The average time between the release of chinook salmon from the Willow Creek Weir to their capture at the Sandy Bar Weir was 10.9 days; range 1-51 days (Appendix 2).

Only two female coho salmon were captured at the Sandy Bar Weir, measuring 65 cm and 71 cm FL.

Angler Survey

The creel census in the SFTR, 1 November 1994 to 8 March 1995 (131 days), consisted of 103 angler surveys. The lower section was surveyed 50 times, and the upper section 53 times. Creel surveys were not conducted between 7 January and 13 February 1995 due to extremely high flow conditions. Surface water temperatures taken during the surveys ranged from 4.4° to 13.9 °C.

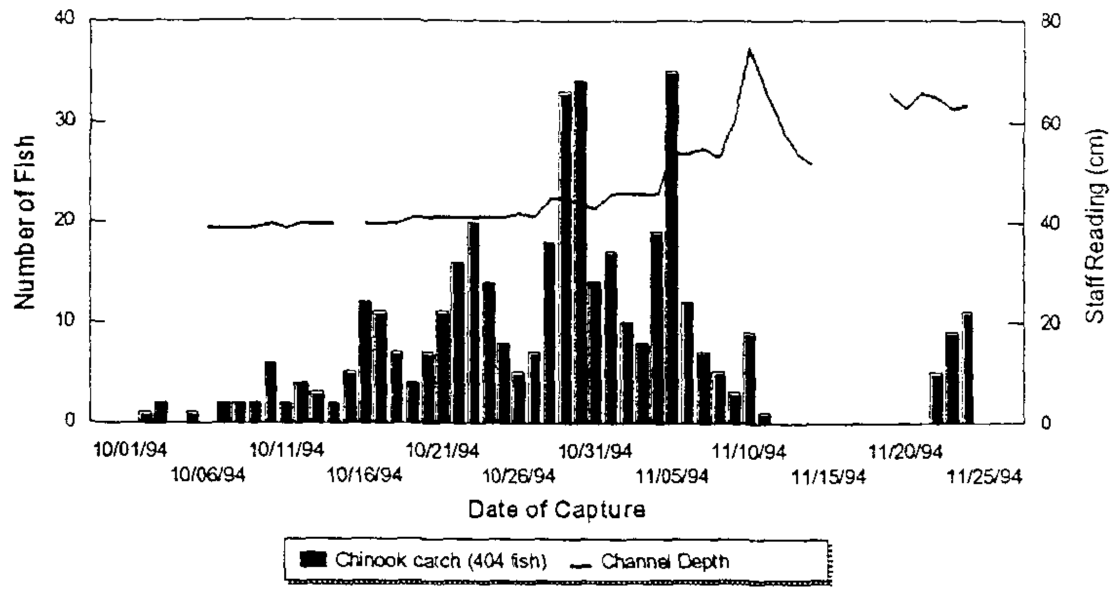


FIGURE 5. Daily catch of immigrant chinook salmon captured at the Sandy Bar Weir in the South Fork Trinity River from 1 October through 24 November 1994.

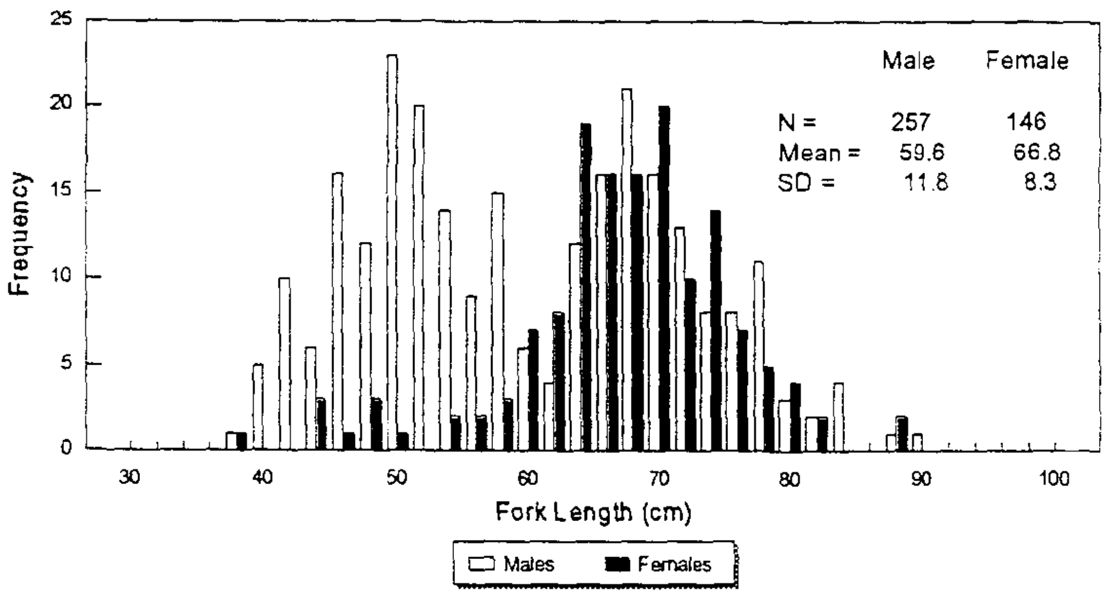


FIGURE 6. Length frequency distribution of immigrant chinook salmon captured at the Sandy Bar Weir in the South Fork Trinity River during the 1994-1995 season.

We interviewed a total of 212 anglers (14 of them [6.6%] in the lower section, and 198 [93.4%] in the upper section) (Table 3). Forty-two of the anglers interviewed were observed fishing at multiple locations on the same day. These anglers were not recounted, but their total expended effort was included in calculating the total hours fished at all locations. Most of the fishing occurred in the Hyampom Valley in the upper section and at Sandy Bar in the lower section.

We observed 8 adult steelhead and no half-pounders or juveniles in the catch. All fish were caught in the upper section (Tables 4 and 5). Five of the steelhead creeled carried tags, one applied at the Sandy Bar Weir and four applied at the Willow Creek Weir.

Based on extrapolations of the angler survey data, an estimated 868 anglers fished for 872.9 hours to land 59 adult steelhead (CPUE 0.07 fish/hr) in the upper section (Table 5).

The majority of the anglers interviewed (90.6%) lived in Trinity County. Humboldt County residents accounted for 8.2% of the anglers, with the remaining 1.2% coming from only two other California counties (Table 6).

Steelhead Sport Harvest

Seven of the 69 reward tags applied at the Sandy Bar Weir were returned by anglers through the mail indicating a harvest rate of only 10.1%. Since a population estimate could not be calculated this year, we also could not estimate total steelhead harvest in the SFTR basin based on the observed harvest rate.

Juvenile Steelhead Habitat Utilization

An action plan for the restoration of the SFTR watershed and its fisheries, submitted to the U.S. Bureau of Reclamation and the Trinity River Task Force (Pacific Watershed Associates 1994), attempted to identify the factors limiting the recovery of anadromous salmonid stocks in the basin. The plan listed projects and actions needed for the recovery of stream habitat and fish populations including: water management, watershed (land) management, forest management, fisheries habitat improvement, and bioenhancement. The highest priority was given to tasks necessary to protect and retain viable native stocks, to ensure their presence when long-term restoration efforts have improved conditions necessary for full recovery. These tasks included changes in land use, in-stream and watershed treatments, and the delineation and protection of critical habitat refugia.

In this context, we understand "refugia" to mean tributaries or the reaches of tributaries and the mainstem which provide critical spawning and rearing habitat for the continued survival

TABLE 3. Angler occurrence at access sites surveyed during the creel survey of the South Fork Trinity River basin, 1994-1995 season.

	Location		Anglers observed a/	
Angling access site	River km	River mile	Number	Percent
Lower Survey Section				
Sandy Bar	1.6	1.0	12	5.6
Madden Creek	2.1	1.3	2	0.9
Holmes Farm/Bridge	13.2	8.2	0	---
Todd Ranch	18.8	11.7	0	---
Surprise Creek area	22.2	13.8	0	---
Upper Survey Section				
Swinging Bridge (Gates Rd.)	32.7	20.3	3	1.4
Big Slide Campground	40.2	25.0	39	18.4
Eltapom Creek area	40.9	25.4	21	10.0
Upper Slide Creek access	40.1	25.5	3	1.4
Salmon Rock area	41.7	25.9	7	3.3
Little Rock Campground	42.0	26.1	23	10.8
Mortensen property	42.6	26.5	6	2.8
Saw Mill site	43.4	27.0	3	1.4
Way property	45.1	28.0	5	2.4
Hyampom airstrip	46.0	28.6	27	12.7
Pelletreau Creek mouth	46.3	28.8	4	1.9
Old Bridge site	47.3	29.4	5	2.4
Church access	47.9	29.8	22	10.4
County maintenance yard	48.3	30.0	12	5.7
Hayfork Creek mouth	48.8	30.3	18	8.5
Totals:			212	100.0

a/ A total of 170 individual anglers were observed. Numbers shown include multiple observations of the same angler on the same day.

TABLE 4. Observed and estimated angler use and steelhead harvest for the South Fork Trinity River lower section creel survey during the 1994-1995 season.

Dates	Julian week	Angler effort: Angler numbers Observed	Angler numbers Estimated	Angler hours Observed	Angler hours Estimated
10/22-11/04/94	43-44	1	38.7	4.0	154.8
11/05-11/18/94	45-46	10	181.3	16.5	264.7
11/19-12/02/94	47-48	1	11.7	0.5	5.9
12/03-12/16/94	49-50	1	3.9	0.5	1.9
12/17-12/31/94	51-52	0	0.0	0.0	0.0
01/01-01/14/95	01-02	1	15.3	2.0	30.6
01/15-01/28/95	03-04	---	---	---	---
01/29-02/11/95	05-06	---	---	---	---
02/12-02/25/95	07-08	0	0.0	0.0	0.0
02/26-03/11/95	09-10	0	0.0	0.0	0.0
	Totals:	14	250.9	23.5	457.9

Dates	Julian week	Steelhead harvest: Adults a/ Obsrvd.	Adults a/ Estmtd.	Half-pounders b/ Obsrvd.	Half-pounders b/ Estmtd.	Juveniles c/ Obsrvd.	Juveniles c/ Estmtd.
10/22-11/04/94	43-44	0	0	0	0	0	0
11/05-11/18/94	45-46	0	0	0	0	0	0
11/19-12/02/94	47-48	0	0	0	0	0	0
12/03-12/16/94	49-50	0	0	0	0	0	0
12/17-12/31/94	51-52	0	0	0	0	0	0
01/01-01/14/95	01-02	0	0	0	0	0	0
01/15-01/28/95	03-04	---	---	---	---	---	---
01/29-02/11/95	05-06	---	---	---	---	---	---
02/12-02/25/95	07-08	0	0	0	0	0	0
02/26-03/11/95	09-10	0	0	0	0	0	0
	Totals:	0	0	0	0	0	0

a/ Adult steelhead were $\geq$ 41 cm FL.
b/ Half-pounder steelhead were $\geq$ 25 cm and < 41 cm, FL.
c/ Juvenile steelhead were < 25 cm, FL.

TABLE 5. Observed and estimated angler use and steelhead harvest for the South Fork Trinity River upper section creel survey during the 1994-1995 season.

Dates	Julian week	Angler effort: Angler numbers Observed	Angler numbers Estimated	Angler hours Observed	Angler hours Estimated
10/22-11/04/94	43-44	0	0.0	0.0	0.0
11/05-11/18/94	45-46	11	56.5	11.0	53.9
11/19-12/02/94	47-48	34	203.1	30.0	184.8
12/03-12/16/94	49-50	24	99.3	20.0	90.2
12/17-12/31/94	51-52	29	165.7	24.0	138.6
01/01-01/14/95	01-02	14	126.9	19.0	163.6
01/15-01/28/95	03-04	---	---	---	---
01/29-02/11/95	05-06	---	---	---	---
02/12-02/25/95	07-08	32	163.3	40.0	189.7
02/26-03/11/95	09-10	12	53.2	12.0	52.1
	Totals:	156	868.0	156.0	872.9

Dates	Julian week	Steelhead harvest: Adults a/ Obsrvd.	Adults a/ Estmtd.	Half-pounders b/ Obsrvd.	Half-pounders b/ Estmtd.	Juveniles c/ Obsrvd.	Juveniles c/ Estmtd.
10/22-11/04/94	43-44	0	0.0	0	0	0	0
11/05-11/18/94	45-46	1	2.2	0	0	0	0
11/19-12/02/94	47-48	5	33.0	0	0	0	0
12/03-12/16/94	49-50	0	0.0	0	0	0	0
12/17-12/31/94	51-52	1	8.1	0	0	0	0
01/01-01/14/95	01-02	1	15.3	0	0	0	0
01/15-01/28/95	03-04	---	---	---	---	---	---
01/29-02/11/95	05-06	---	---	---	---	---	---
02/12-02/25/95	07-08	0	0.0	0	0	0	0
02/26-03/11/95	09-10	0	0.0	0	0	0	0
	Totals:	8	58.6	0	0	0	0

a/ Adult steelhead were ≥ 41 cm FL.
b/ Half-pounder steelhead were ≥ 25 cm and < 41 cm, FL.
c/ Juvenile steelhead were < 25 cm, FL.

TABLE 6. County of residence for anglers interviewed within the South Fork Trinity River basin during the 1994-1995 creel survey.

County of origin	Number of anglers interviewed	Percent of total anglers interviewed
Alameda	1	0.6
Humboldt	14	8.2
Tehama	1	0.6
Trinity	154	90.6
Total:	170	100.0

of specific stocks from year to year. This is indeed a basic need for the restoration efforts in the SFTR basin. However, it is important that the delineation of refugia be based on accurate information and its correct interpretation. The action plan identified Plummer Creek as harboring the only substantial population of juvenile spring chinook in the South Fork Trinity River basin during the summer. However, over the past three years, CDFG surveys in Plummer Creek have not found either spring chinook adults spawning or juveniles rearing there (M. Dean, CDFG; personal communication). With only limited funding available to protect native stocks in refugia or other key basin areas, we must be certain that those areas are properly identified and that the status of stocks utilizing them is adequately monitored. This information is necessary to prioritize the restoration efforts needed to ensure the survival of native stocks in the basin, and also to evaluate the success of those efforts.

Although fall/winter run steelhead are not at the depressed levels of other stocks in the SFTR basin (i.e., spring [summer] steelhead, coho salmon, and spring and fall chinook salmon), it is nevertheless important to know which areas in the basin are being used by this stock for spawning and juvenile rearing.

Seven SFTR basin tributaries were sampled in the summer of 1994 to determine the presence or absence of juvenile salmonid species and their life stages. Observed water temperatures ranged from 13.3 to 18.9 °C, and stream flows ranged from 0.1 to 4.8 cfs (Table 7). Juvenile steelhead ages 0+, 1+, and 2+ were found in all streams sampled. However, juvenile chinook and coho salmon were essential only found in Madden Creek and their densities were comparable or higher than those for age 1+ and 2+ steelhead

TABLE 7. Juvenile salmonid presence/absence direct observation snorkel surveys conducted in South Fork Trinity River (SFTR) basin tributaries during the 1994-1995 season.

Location	Survey date	Water temperature (°C)	Stream flow (cfs)
Willow Creek area			
Madden Creek	25-Aug-94	---	4.8
Hyampom Valley area			
Butter Creek	02-Aug-94	16.7	1.8
Eltapom Creek	13-Jul-94	17.2	1.8
Hayfork-Wildwood area			
Big Creek	07-Jul-94	---	2.2
	20-Jul-94	18.9	0.1
	03-Aug-94	13.3	1.0
Forest Glen area			
E. Fork SFTR	28-Jul-94	17.2	3.3
	10-Jul-94	14.4	2.3
Rattlesnake Creek	18-Jul-94	17.2	1.2
	22-Jul-94	16.7	0.2
Smokey Creek	15-Aug-94	16.7	0.3

observed anywhere in the basin (Table 8, Figure 7).

The highest densities of age 0+ steelhead (>1.0 fish/m^2) were found in the runs and riffles of Eltapom Creek, and the East Fork SFTR. Densities of age 0+ steelhead were generally lowest in Big Creek. Age 0+ steelhead were most commonly found in run habitat (Figure 7), with some indication that their densities in pools and riffles increased as the summer progressed. However, this latter observation is made across streams sampled at different times during the summer. To assess their habitat requirements, sampling is needed periodically throughout their rearing period in the same stream.

TABLE 8. Densities of juvenile salmonids observed in different habitat type during direct observation snorkel surveys in selected South Fork Trinity Ri (SFTR) basin tributaries during the 1994-1995 season.

		Mean densitiy (fish/m^2)				
		Steelhead			Chinook	Coho
Location	N	Age 0+	Age 1+	Age 2+	salmon	salmon
Willow Creek area						
		Madden Creek / 25-Aug-94				
Cascade	0	---	---	---	---	---
Pool	5	0.669	0.705	0.545	0.287	0.530
Riffle	1	0.192	0.000	0.000	0.000	0.000
Run	4	0.236	0.057	0.054	0.109	0.281
Step-run	2	0.424	0.123	0.178	0.030	0.098
Hyampom Valley area						
		Butter Creek / 02-Aug-94				
Cascade	1	0.179	0.179	0.000	0.000	0.000
Pool	3	0.438	0.187	0.218	0.012	0.000
Riffle	1	0.792	0.140	0.000	0.000	0.000
Run	4	0.647	0.073	0.058	0.000	0.000
Step-run	1	0.752	0.059	0.020	0.000	0.000
		Eltapom Creek / 13-Jul-94				
Cascade	0	---	---	---	---	---
Pool	4	0.867	0.107	0.007	0.000	0.000
Riffle	3	0.397	0.027	0.000	0.000	0.000
Run	2	1.286	0.009	0.000	0.000	0.000
Step-run	2	0.996	0.070	0.047	0.000	0.000
Hayfork-Wildwood area						
		Big Creek / 07-Jul-94				
Cascade	0	---	---	---	---	---
Pool	5	0.194	0.102	0.074	0.000	0.000
Riffle	3	0.030	0.033	0.043	0.000	0.000
Run	3	0.223	0.097	0.024	0.000	0.000
Step-run	1	0.212	0.099	0.028	0.000	0.000
		Big Creek / 20-Jul-94				
Cascade	0	---	---	---	---	---
Pool	8	0.075	0.018	0.040	0.000	0.000
Riffle	0	---	---	---	---	---
Run	2	0.179	0.026	0.013	0.000	0.000
Step-run	2	0.099	0.062	0.086	0.000	0.000
		Big Creek / 03-Aug-94				
Cascade	0	---	---	---	---	---
Pool	4	0.073	0.203	0.063	0.000	0.000
Riffle	1	0.349	0.000	0.000	0.000	0.000
Run	1	0.101	0.090	0.034	0.000	0.000
Step-run	2	0.209	0.091	0.017	0.000	0.000

continued.

TABLE 8 (continued). Densities of juvenile salmonids observed in different habitat types during direct observation snorkel surveys in selected South Fork Trinity River (SFTR) basin tributaries during the 1994-1995 season.

		Mean densitiy (fish/m^2)				
		Steelhead			Chinook	Coho
Location	N	Age 0+	Age 1+	Age 2+	salmon	salmon
Forest Glen area						
		East Fork of the South Fork Trinity River / 28-Jul-94				
Cascade	0	---	---	---	---	---
Pool	2	0.682	0.087	0.030	0.000	0.000
Riffle	4	0.347	0.027	0.073	0.000	0.000
Run	4	1.118	0.152	0.083	0.000	0.000
Step-run	0	---	---	---	---	---
		East Fork of the South Fork Trinity River / 10-Aug-94				
Cascade	1	0.000	0.000	0.000	0.000	0.000
Pool	5	0.709	0.206	0.079	0.000	0.000
Riffle	2	1.119	0.120	0.024	0.000	0.000
Run	2	1.436	0.195	0.078	0.000	0.000
Step-run	2	0.799	0.111	0.000	0.000	0.000
		Rattlesnake Creek / 18-Jul-94				
Cascade	0	---	---	---	---	---
Pool	1	0.217	0.071	0.023	0.000	0.000
Riffle	4	0.589	0.032	0.000	0.014	0.000
Run	4	0.246	0.093	0.034	0.000	0.000
Step-run	0	---	---	---	---	---
		Rattlesnake Creek / 22-Jul-94				
Cascade	0	---	---	---	---	---
Pool	5	0.092	0.184	0.039	0.000	0.000
Riffle	0	---	---	---	---	---
Run	7	0.102	0.051	0.018	0.000	0.000
Step-run	0	---	---	---	---	---
		Smokey Creek / 15-Aug-94				
Cascade	0	---	---	---	---	---
Pool	4	0.388	0.347	0.123	0.000	0.000
Riffle	0	---	---	---	---	---
Run	7	0.439	0.077	0.030	0.000	0.000
Step-run	1	0.265	0.044	0.022	0.000	0.000

TABLE 9. Steelhead spawning survey data for the South Fork Trinity River (SFTR) basin from 4 April to 6 June 1995.

Location	Survey dates: First	Survey dates: Last	Number of surveys	Stream length (km)	Total redds observed	Redds per km	Live steelhead observed
Willow Creek area							
Madden Creek	June 2	—	1	1.3	0	0	0
Hyampom Valley area							
Big Creek	May 24	—	1	0.4	0	0	0
Butter Creek	May 16	May 29	2	2.6	1	0.4	0
Eltapom Creek	April 24	May 19	2	1.2	3	2.5	3
Kerlin Creek	April 11	May 17	2	1.8	0	0	0
Mill Creek	April 10	May 24	2	0.5	0	0	0
Olsen Creek / Hay Fork	April 25	May 22	2	1.5	2	1.3	1
Pelletreau Creek	April 14	May 17	2	1.1	1	0.9	3
	Subtotals:		13	9.1	7	—	7
		Overall density:				0.8	
Hayfork-Wildwood area							
Big Creek	April 17	May 24	2	14.0	16	1.1	1
Dubakella Creek	April 10	May 05	2	1.4	0	0	0
E.F. Hayfork Creek	April 12	May 10	2	7.7	2	0.3	0
Goods Creek	April 10	May 03	2	1.1	0	0	0
Hayfork Creek	May 17	May 30	2	11.6	0	0	0
Little Creek	April 19	May 18	2	2.0	0	0	0
Philpot Creek	April 05	May 16	2	2.1	0	0	0
Potato Creek	April 04	May 16	2	2.4	0	0	0
Rusch Creek	April 11	May 09	2	6.0	1	0.2	0
Salt Creek	April 18	May 26	2	16.7	2	0.1	0
Tule Creek	April 18	May 19	2	5.0	2	0.4	2
	Subtotals:		22	70.0	23	—	3
		Overall density:				0.3	
Forest Glen area							
E.F. SFTR	May 15	June 06	2	5.3	8	1.5	2
Plummer Creek	May 18	—	1	3.3	7	2.1	2
Rattlesnake Creek	May 29	June 01	2	10.6	1	0.1	0
Silver Creek	May 16	—	1	1.9	2	1.1	0
Smokey Creek	May 17	—	1	2.8	6	2.1	0
	Subtotals:		7	23.9	24	—	4
		Overall density:				1.0	—
Grand totals:			43	104.3	54	—	14
		Overall density:				0.52	

Upper SFTR Basin Near Forest Glen

Five tributaries of the SFTR were surveyed. Twenty-four redds and four live fish were observed in the 23.9 km surveyed. A mean density of 1.0 redds/km was observed in this area.

Redd Characteristics

We observed the physical and hydraulic characteristics of steelhead redds throughout the SFTR basin (Appendix 3). The average redd area index from 54 redds measured was 1.6 m^2. Depth and mean water column velocities at redd sites were measured only for 18 redds. The average water depth, measured 0.15 m upstream from the redd depression, was 32 cm. Average fish-nose water velocity and mean water column velocity were both 0.5 m/sec.

Substrate composition, embeddedness, and relationship to cover were assessed for all of the 54 redds observed during the survey. In 96.3% of the redds the dominant substrate type ranged in size from small gravel to small cobble (Table 10). The substrates in 94.4% of the redds observed were less than 40% embedded, and over half (53.7%) were less than 10% embedded (Table 10). One-third of the redds observed were associated with dominant cover in the form of large woody debris, while whitewater and boulders each constituted 18.5% of the dominant cover types (Table 11).

Steelhead Life-history Patterns

Steelhead scale analysis was not conducted this year because of a lack of time and trained personnel. We have continued to collect scale samples each season so that this material will be available at a later time for analysis. We believe that emphasis should be placed on the juvenile freshwater phase to assess that age-structure in the basin and to determine if distinctive scale circuli patterns exist. Comparison to the freshwater portions on adult scales will allow a better understanding of the total life-history patterns of steelhead within the SFTR basin.

TABLE 10. Dominant and subdominant substrate composition, a: embeddedness of substrate components in steelhead redds observed in the South Fork Trinity River basin during the 1994-1995 season.

Substrate code	Substrate type	Dominant substrate		Subdominant substrate	
		Number observed	Percent	Number observed	Percent
0	Fines	0	0	1	1.8
1	Small gravel	6	11.1	10	18.5
2	Medium gravel	13	24.1	21	38.9
3	Large gravel	27	50.0	11	20.4
4	Small cobble	6	11.1	4	7.4
5	Medium cobble	2	3.7	7	13.0
6	Large cobble	0	0	0	0
7	Small boulder	0	0	0	0
8	Large boulder	0	0	0	0
9	Bedrock	0	0	0	0
	Totals:	54	100.0	54	10(

Embeddedness code	Level of embeddedness	Number observed	Percent
0	0% - 9%	29	53.7
1	10% - 19%	11	20.3
2	20% - 29%	3	5.6
3	30% - 39%	8	14.8
4	40% - 49%	3	5.6
5	50% - 59%	0	0
6	60% - 69%	0	0
7	70% - 79%	0	0
8	80% - 89%	0	0
9	90% - 100%	0	0
	Totals:	54	100.0

TABLE 11. Dominant and subdominant cover habitat or vegetation associated with steelhead redd sites examined in the South Fork Trinity River basin during the 1994-1995 season.

		Dominant cover		Subdominant cover	
Cover code	Cover type	Number observed	Percent	Number observed	Percent
0	No cover	0	0	1	1.9
1	Cobble	1	1.9	2	3.7
2	Boulders	10	18.5	12	22.2
3	Small woody debris	1	1.9	14	25.9
4	Large woody debris	18	33.3	5	9.2
5	Undercut bank	8	14.8	9	16.7
6	Overhanging vegetation	6	11.1	0	0
7	Aquatic vegetation	0	0	2	3.7
8	Whitewater	10	18.5	9	16.7
	Totals:	54	100.0	54	100.0

Quality of cover	Number observed	Percent
Poor	5	9.3
Fair	18	33.3
Good	20	37.0
Excellent	11	20.4
Totals:	54	100.0

RECOMMENDATIONS

1. Our creel surveys in the SFTR basin and reward tags applied during the Sandy Bar Weir operations have shown that harvest and harvest rates vary considerably from year to year. Angler harvest of fall/winter steelhead in the basin is largely a function of flow levels. However, even during the drought years of 1989-90 and 1991-92, harvest rates did not exceed 20%. Angler harvest should be periodically monitored in the basin, especially during low flow conditions, to assess its impact on steelhead stocks; however, we do not believe annual creel surveys are warranted.

2. Adult steelhead spawning surveys should begin by 15 February, weather permitting. Habitat types should be quantified during these surveys to help assess the production potential of the basin.

3. Annual juvenile steelhead habitat utilization studies should be conducted. A direct observation (snorkel) survey, with comparison counts by electrofishing, should be conducted on various tributaries of the SFTR and Hayfork Creek. Juvenile salmonid densities in relation to habitat, brood year production, and reari conditions can be assessed throughout the basin this way.

4. Juvenile migration should also be monitored farther downstream in the SFTR basin in conjunction with monitoring at the previously used trapping locations. A portion of the fish captured upstream should be marked. This would provide a better estimate of the actual emigration of juveniles from the SFTR basin, and allow for an analysis of travel time, in-river growth, and an assessment of the relative level of production of juvenile salmonids.

5. Steelhead life-history studies through scale analysis should be conducted. Although we have collected scale samples from both adults and juveniles for the last three seasons, we have not had the time or personnel available to conduct these analyzes.

ACKNOWLEDGMENTS

The authors thank Judith Jackson for her assistance in preparing the tables for this report. The authors also thank D. Ammon, D.& M. Arey, C. Carrigan, J. Ferguson, D. Fisher, C. Glase, L. Harpham, B. Huber, J. Jackson, L. Peak, J. Rice, B. St. John P. Taylor, and R. Wood for fieldwork and data collection.

LITERATURE CITED

Hampton, M. 1988. Development of habitat preference criteria for anadromous salmonids of the Trinity River. Available from U.S. Dept. Int., Fish Wildl. Serv., Div. Ecol. Serv., Sacramento, California. 93 p.

Hanson, L. and B. W. Collins. 1996. Life history, distribution, run size, and angler harvest of steelhead in the South Fork Trinity River basin. Chapter III. Job III. pp. 55-96. In: R.M. Kano (ed.), Annual Report of the Trinity River Basin Salmon and Steelhead Monitoring Project, 1993-1994 Season. February 1994. 266 p. Available from Calif. Dept. of Fish and Game, Inland Fish. Div., 1416 9th St., Sacramento, CA 95814.

Pacific Watershed Associates. 1994. Action plan for the restoration of the South Fork Trinity River watershed and its fisheries. Prepared for U.S. Bureau of Reclamation and the Trinity River Task Force, Contract No. 2-CS-20-01100. February 1994.

Wilson, C. E. and B. W. Collins. 1992. Life history, distribution, run size, and angler harvest of steelhead in the South Fork Trinity River basin. Chapter III. Job III. pp. 50-92. In: K. Urquhart and R. Carpenter (eds.), Annual Report of the Trinity River Basin Salmon and Steelhead Monitoring Project, 1990-1991 Season. December 1992. 186 p. Available from Calif. Dept. of Fish and Game, Inland Fish. Div., 1416 9th St., Sacramento, CA 95814.

Wilson, C. E. and B. W. Collins. 1994. Life history, distribution, run size, and angler harvest of steelhead in the South Fork Trinity River basin. Chapter III. Job III. pp. 56-102. In: K. Urquhart and R.M. Kano (eds.), Annual Report of the Trinity River Basin Salmon and Steelhead Monitoring Project, 1991-1992 Season. February 1994. 235 p. Available from Calif. Dept. of Fish and Game, Inland Fish. Div., 1416 9th St., Sacramento, CA 95814.

APPENDIX 1. List of Julian weeks and their calendar date equivalents.

Julian week	Calendar dates Start	Finish	Julian week	Calendar dates Start	Finish
1	01-Jan	07-Jan	27	02-Jul	08-Jul
2	08-Jan	14-Jan	28	09-Jul	15-Jul
3	15-Jan	21-Jan	29	16-Jul	22-Jul
4	22-Jan	28-Jan	30	23-Jul	29-Jul
5	29-Jan	04-Feb	31	30-Jul	05-Aug
6	05-Feb	11-Feb	32	06-Aug	12-Aug
7	12-Feb	18-Feb	33	13-Aug	19-Aug
8	19-Feb	25-Feb	34	20-Aug	26-Aug
9 a/	26-Feb	04-Mar	35	27-Aug	02-Sep
10	05-Mar	11-Mar	36	03-Sep	09-Sep
11	12-Mar	18-Mar	37	10-Sep	16-Sep
12	19-Mar	25-Mar	38	17-Sep	23-Sep
13	26-Mar	01-Apr	39	24-Sep	30-Sep
14	02-Apr	08-Apr	40	01-Oct	07-Oct
15	09-Apr	15-Apr	41	08-Oct	14-Oct
16	16-Apr	22-Apr	42	15-Oct	21-Oct
17	23-Apr	29-Apr	43	22-Oct	28-Oct
18	30-Apr	06-May	44	29-Oct	04-Nov
19	07-May	13-May	45	05-Nov	11-Nov
20	14-May	20-May	46	12-Nov	18-Nov
21	21-May	27-May	47	19-Nov	25-Nov
22	28-May	03-Jun	48	26-Nov	02-Dec
23	04-Jun	10-Jun	49	03-Dec	09-Dec
24	11-Jun	17-Jun	50	10-Dec	16-Dec
25	18-Jun	24-Jun	51	17-Dec	23-Dec
26	25-Jun	01-Jul	52 b/	24-Dec	31-Dec

a/ Eight-day week in each year divisible by 4.
b/ Eight-day week every year.

APPENDIX 2. Length of time between capture for salmonids tagged and released at the Willow Creek Weir in the Trinity River, and their recapture at the Sandy Bar Weir in the South Fork Trinity River during the 1994-1995 season.

Tag number	Date tagged/released at Willow Creek Weir	Date recaptured at Sandy Bar Weir	Elapsed time between captures (days)
Steelhead			
R006518	08/04/94	11/09/94	97
R006560	08/08/94	11/05/94	89
R006581	08/10/94	11/05/94	87
R006714	08/23/94	11/05/94	74
R006887	09/06/94	11/05/94	60
R006878	09/06/94	11/06/94	61
R006980	09/14/94	11/05/94	52
R007019	09/19/94	11/05/94	47
R004988	09/26/94	10/28/94	32
R007348	10/04/94	11/05/94	32
R007693	10/31/94	11/05/94	5
R007744	11/02/94	11/07/94	5
R007775	11/02/94	11/09/94	7
		Mean:	49.8
Chinook salmon			
R006847	09/05/94	10/07/94	32
W005858	09/06/94	10/24/94	48
W005978	09/12/94	10/16/94	34
W006031	09/16/94	11/06/94	51
W006272	09/22/94	10/25/94	33
W006316	09/23/94	10/29/94	36
R007426	10/10/94	10/16/94	6
W006816	10/12/94	10/13/94	1
W006818	10/12/94	10/25/94	13
W006878	10/14/94	10/15/94	1
W006855	10/14/94	10/17/94	3
W006899	10/17/94	10/18/94	1
W006898	10/17/94	10/21/94	4
R007513	10/17/94	10/29/94	12
W006921	10/18/94	10/22/94	4
R007530	10/19/94	10/20/94	1
R007531	10/19/94	10/22/94	3
W006963	10/19/94	10/22/94	3
W006995	10/20/94	10/22/94	2
R007578	10/21/94	10/22/94	1
W004420	10/21/94	10/28/94	7
W004461	10/25/94	10/26/94	1
W004473	10/26/94	11/03/94	8
R007626	10/27/94	10/29/94	2
R007672	10/28/94	10/29/94	1
W004516	10/28/94	10/29/94	1
W004530	10/28/94	10/29/94	1
R007642	10/28/94	10/29/94	1
W004523	10/28/94	10/29/94	1
R007648	10/28/94	11/23/94	26
R007737	11/01/94	11/02/94	1
		Mean:	10.9

APPENDIX 3. Physical and hydraulic characteristics of steelhead redds observed during the spawning survey in the South Fork Trinity River between 4 April and 6 June 1995.

Habitat Type	Redd area index (m^2)	Redd depth (cm)	Fish-nose water velocity (m/s)	Mean water column velocity (m/s)
Pools				
N	35	11	11	11
Min	0.4	18.3	0.1	0.1
Max	3.9	48.8	0.9	1.0
Mean	1.6	31.3	0.5	0.5
SD	0.77	9.94	0.26	0.28
Riffles				
N	3	2	2	2
Min	0.8	27.4	0.5	0.4
Max	1.6	54.9	0.6	0.7
Mean	1.2	41.2	0.6	0.5
SD	0.40	19.40	0.11	0.17
Runs				
N	14	4	4	4
Min	0.2	24.4	0.3	0.3
Max	4.2	36.6	0.7	0.7
Mean	1.7	32.0	0.4	0.4
SD	1.15	5.28	0.20	0.19
Step-runs				
N	2	1	1	1
Min	0.7	18.3	0.5	0.5
Max	1.5	18.3	0.5	0.5
Mean	1.1	18.3	0.5	0.5
SD	0.53			

ANNUAL REPORT
TRINITY RIVER BASIN SALMON AND STEELHEAD MONITORING PROJECT
1994-1995 SEASON

CHAPTER IV

JOB IV
ANNUAL RUN-SIZE, HARVEST, AND SPAWNER ESCAPEMENT ESTIMATES FOR TRINITY RIVER BASIN CHINOOK AND COHO SALMON AND STEELHEAD

by

Wade Sinnen and Larry Hanson

ABSTRACT

The California Department of Fish and Game's Trinity River Project conducted tagging and recapture operations from May 1994 through April 1995 to obtain chinook salmon (Oncorhynchus tshawytscha), coho salmon (O. kisutch), and adult fall-run steelhead (O. mykiss) run-size, angler harvest, and spawner escapement estimates in the Trinity River basin. We placed weirs in the Trinity River near the towns of Junction City and Willow Creek, and trapped 1,152 spring-run and 2,584 fall-run chinook salmon, 89 coho salmon and 720 fall-run steelhead.

Based on tagged fish recovered at Trinity River Hatchery and on the return of reward tags by anglers, we estimated that 6,788 spring-run chinook salmon migrated into the Trinity River basin upstream of Junction City Weir and that 454 (6.7%) of these were caught by anglers, leaving 6,334 fish as potential spawners. We estimated 21,924 fall-run chinook salmon migrated past Willow Creek Weir and that 16,937 of these fish continued up the Trinity River past Junction City Weir. Anglers harvested an estimated 807 (3.7%) of the fall-run chinook salmon that passed Willow Creek Weir, leaving 21,117 fish as potential spawners.

The coho salmon run in the Trinity River basin upstream of Willow Creek Weir was 852 fish. None of the coho salmon that migrated past Willow Creek Weir were harvested.

An estimated 4,244 adult fall-run steelhead entered the Trinity River basin upstream of Willow Creek, of which 1,373 continued past Junction City Weir. Anglers harvested 545 (12.8%) of the adult fall-run steelhead that migrated past Willow Creek Weir, leaving 3,699 fish as potential spawners.

JOB OBJECTIVES

1. To determine the size, composition, distribution and timing of adult chinook and coho salmon, and steelhead runs in the Trinity River basin.

2. To determine the angler harvest and spawner escapements of Trinity River chinook and coho salmon, and steelhead.

INTRODUCTION

The California Department of Fish and Game's (CDFG) Trinity River Project (TRP) conducts annual tagging and recapture operations for adult chinook and coho salmon, and fall-run steelhead in the mainstem Trinity River. This effort determines the composition (race and proportion of hatchery-marked[1/] or Project-tagged[2/] fish), distribution, and timing of the chinook and coho salmon, and fall-run steelhead runs in the Trinity River basin. Recaptures of hatchery-marked or Project-tagged fish are used to develop run-size, angler harvest, and spawner escapement estimates for each chinook and coho salmon, and steelhead run.

This is a continuation of studies that began in 1977 with the trapping, tagging, and recapture of fall-run chinook salmon (fa chinook), coho salmon (coho), and fall-run steelhead (steelhead, in the Trinity River in order to determine run-size and angler harvest rates. In 1978, similar studies were added to include spring-run chinook salmon (spring chinook). Steelhead were dropped from the program in 1985 through 1989 and reinstated in 1990. Results of these studies are available from California Department of Fish and Game (Heubach 1984a, 1984b; Heubach and Hubbell 1980; Heubach et al. 1992a, 1992b; Lau et al. 1994; Zuspan et al. 1985; Zuspan et al. 1995; Zuspan and Sinnen 1996.

The earlier studies were funded variously by the U.S. Bureau of Reclamation (USBR), and with Anadromous Fish Act funds administered by the U.S. Fish and Wildlife Service and National Marine Fisheries Service. The USBR (P.L. 98-541) has funded the program from 1 October 1989 through the present.

Prior to the current program, all efforts to measure salmon and steelhead populations in the Trinity River basin had been restricted to portions of the upper mainstem Trinity River and certain of its tributaries, or the South Fork Trinity River and

---

1/ Adipose fin-clipped and coded-wire-tagged (Ad+CWT), hatchery-produced chinook and coho salmon.

2/ Spaghetti tags applied by CDFG personnel to returning sea-r fish.

some of its tributaries (Gibbs 1956; La Faunce 1965a, 1965b, 1967; Miller 1975; Moffett and Smith 1950; Rogers 1970, 1972, 1973a, 1973b, 1982; Smith 1975; Weber 1965). These earlier efforts did not include fish which used the mainstem and tributaries of the lower Trinity River, nor attempt to determine the proportion of hatchery fish in the runs and the rates at which various runs contributed to the fisheries. To develop a comprehensive management plan for the Trinity River basin, all salmon stocks utilizing the basin must be considered.

METHODS

Trapping and Tagging

Trapping Locations and Periods

Trapping and tagging operations were conducted by TRP personnel from May through December 1994 at temporary weir sites near the towns of Willow Creek and Junction City in the mainstem Trinity River (Figure 1). The downstream site, Willow Creek Weir (WCW), was located 8.4 km upstream from the town of Willow Creek, 48.4 km upstream from the Trinity River's confluence with the Klamath River, and 131.4 km downstream from Trinity River Hatchery (TRH). The upstream site, Junction City Weir (JCW), was located 5.4 km upstream from the town of Junction City, 132.7 km upstream from the Klamath River confluence, and 47.1 km downstream from TRH[3/].

The WCW is used to obtain Trinity River run size and angler harvest estimates for fall chinook, coho, and steelhead as far downstream as possible. The JCW is used to obtain run size and angler harvest estimates of spring chinook as far downstream as is feasible during periods of high spring flows. We operated the JCW into December to obtain run-size estimates of fall chinook, coho and steelhead in the upper Trinity River basin.

We trapped at the WCW from 3 August through 11 December 1994. We trapped at the JCW from 24 May through 13 December 1994.

At the JCW site, we tried to trap continuously through a four-day period beginning mid-afternoon on Monday and going through Friday morning. At the WCW, in response to the public perception that the weir was "stacking up" fish, making them more susceptible to harvest, we altered the trapping schedule. In the past, the schedule was similar to that described for the JCW. This year we trapped during a five-day period beginning mid-afternoon on

---

3/ Due to changes in river morphology which necessitated a new trapping site, the Junction City Weir was moved 4.4 km downstream from the historical location used since 1983.

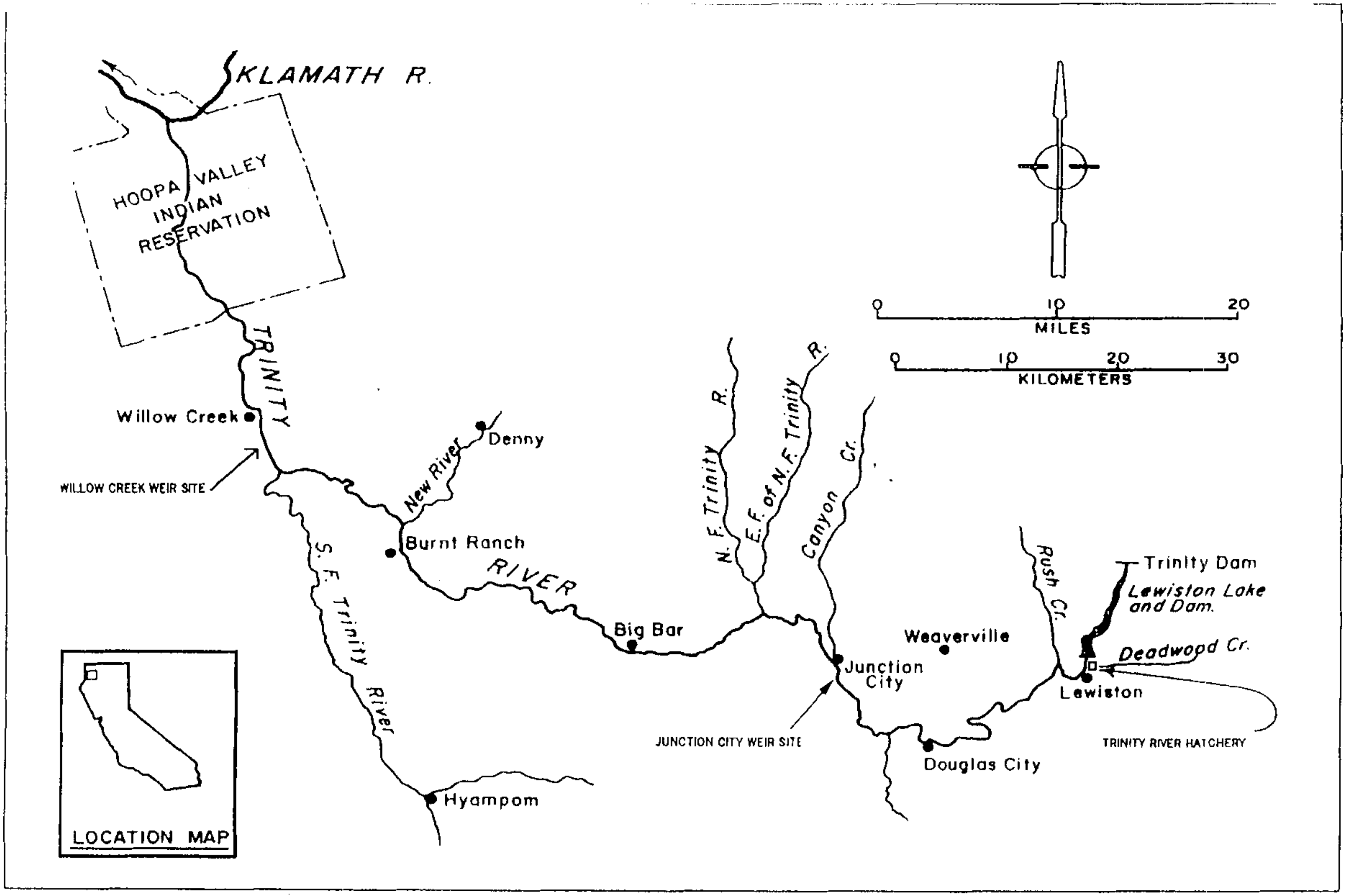


FIGURE 1. Locations of trapping and tagging weirs for anadromous salmonids near Willow Creek and Junction City in the mainstem Trinity River during the 1994-95 season.

Sunday and ending mid-afternoon on Friday. We opened the weir each trapping day for approximately four hours allowing fish to pass unimpeded.

We trapped and tagged fish only at water temperatures <21°C to avoid severely stressing the fish. High river flows forced us to make changes in the trapping schedule at both weirs during portions of the season.

Weir and Trap Design

Since 1989, we have used the Bertoni (Alaskan) weir design at both sites (Figure 2). The weir was supported by wooden tripods set 2.5 m apart. Weir panels consisted of 3.0-m X 1.9-cm (10-ft X ¾-in) electrical conduit spaced 5.1 cm apart on center, leaving a gap of 3.2 cm between conduits. Conduits were supported by three pieces of aluminum channel arranged 0.92 m apart, that connected to the supporting tripods.

We anchored the tripods with cable attached to 1.8-m stakes driven into the stream bottom. The weir panels were angled, with the top of the weir standing 1.8 m above the river bottom (Figure 2).

The trap was made of 1.9-cm electrical conduit spaced 2.5 cm apart and welded into panels. The panels were wired together at the corners to produce a 2.4-m square box which was bolted to a plywood floor and covered with plywood to prevent fish from jumping out. A fyke, also made of conduit panels, was installed in the trap. Its purpose was to guide the fish into the trap and prevent their escape.

The trap was placed on the upstream side of the weir. About 12 weir conduits were raised to allow fish to pass through the weir and into the trap.

A gate, inserted between two weir panels, allowed boat passage at both weirs. The gate was made of welded conduit panels with 2.5-cm spacing between conduits.

Processing of Fish

At both weirs, we identified all trapped salmonids to species, measured them to the nearest cm fork length (FL), and examined them for hook and gill-net scars, fin clips, and tags. Each untagged salmonid judged in good condition or unspawned was tagged with a serially numbered FT-4[4/] spaghetti tag (Project-

---

4/ The use of brand or trade names is for identification purposes only, and does not imply the endorsement of any product by the CDFG.

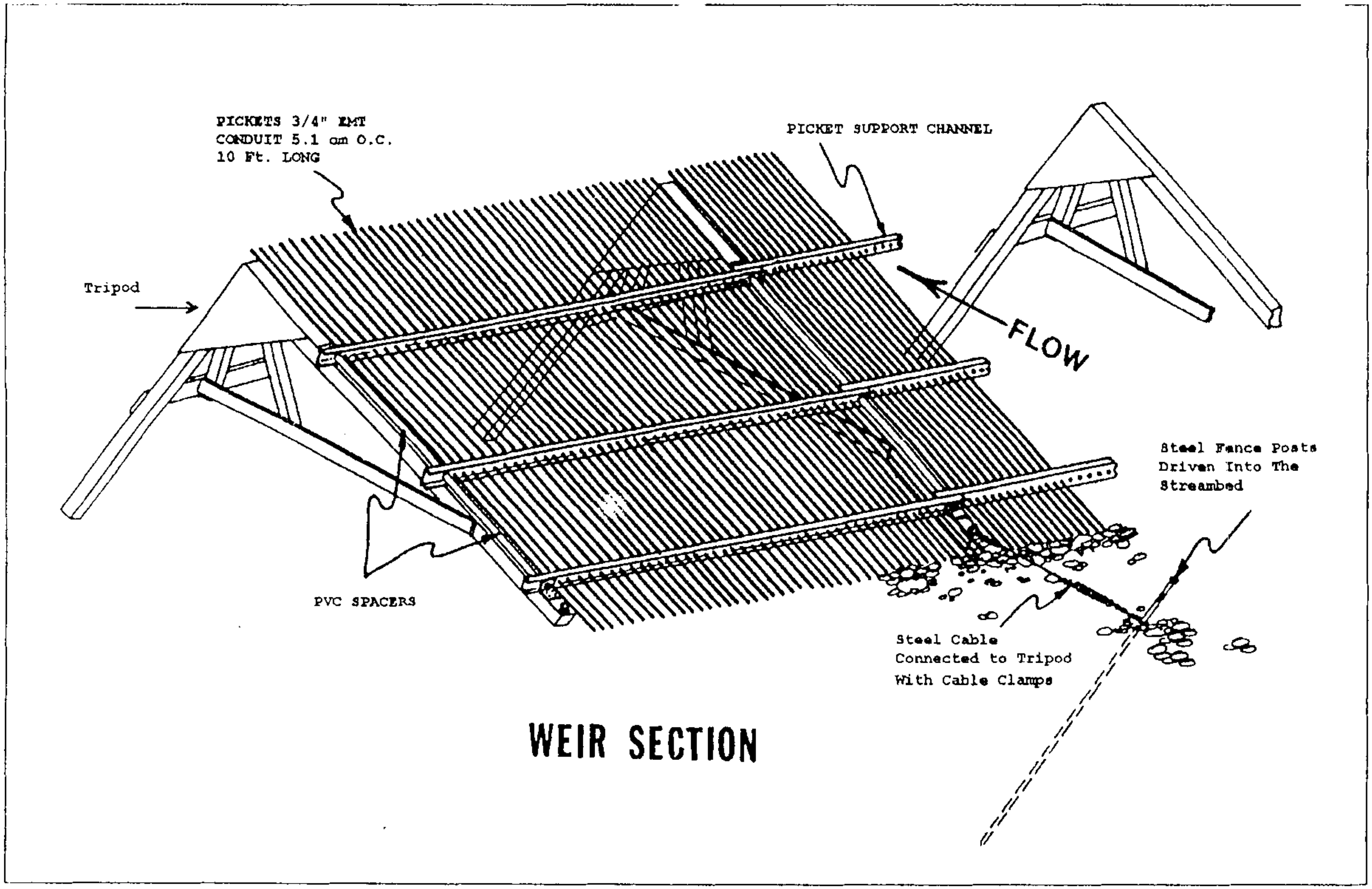


FIGURE 2. Schematic diagram of an Alaskan weir section, showing the arrangement of the tripod and weir paneling, as used in the mainstem Trinity River during the 1994-95 season.

tagged). To determine angler harvest and catch-and-release rates upstream of the weirs, one-third of the chinook salmon, approximately 55% of the coho salmon[5/], and all of the steelhead received $10-reward tags, while the remaining tags were non-reward.

Following last year's recommendation (Zuspan and Sinnen 1996), this year we discontinued the secondary-marking of salmon caught at the weirs, which was intended for determining tag-shedding rates. We felt secondary-marks placed an unnecessary stress on fish during the tagging process, and that angler tag-return data indicated that tag loss probably resulted more from anglers removing tags while catching and releasing fish. We accounted for this loss by subtracting angler-removed tags from the effectively tagged fish totals. We released all fish at the respective capture sites immediately after processing.

Determining the Separation Between Spring and Fall Chinook Salmon Runs at the Weirs

Each year there is a temporal overlap in the spring and fall chinook runs in the Trinity River. Since the timing of runs varies between years, each season we assigned new dates separating the two runs so that numbers of spring and fall chinook used to estimate the run size and angler harvest could be determined. To make this separation, we compared the proportions of known spring and fall chinook trapped at the weirs each week. The week at which the proportion of fall chinook exceeded spring chinook was designated as the first week of the fall-run at that weir. A recovered tagged chinook was identified as either a spring or fall chinook based on two separate criteria. First, some chinook tagged at the weirs carried coded-wire tags (CWT), placed in their snouts as juveniles at the hatchery. If these fish were recovered at the hatchery or during spawning surveys, the CWT code indicated whether they were spring or fall fish. Secondly, non-CWTed chinook tagged at the weir and recovered at the hatchery were classified as either spring or fall fish based on the date they entered the hatchery. If they entered the hatchery during the period associated with the spring run (based on CWT recoveries at the hatchery) they were considered spring chinook. Those chinook entering the hatchery during the period associated with the fall run (again, based on CWT recoveries) were considered fall chinook.

5/ Reward-tagged proportion of coho salmon was increased this year in order to more fully assess angler harvest rates of this species.

Estimating Numbers of Spring and Fall Chinook Salmon at Trinity River Hatchery

As at the weirs, there is an overlap in the migration of spring and fall chinook into TRH. To estimate the respective numbers of spring and fall chinook without CWTs entering TRH, we expanded the numbers of tags recovered from each returning CWT group by the ratio of tagged to untagged chinook salmon when they were originally released (same strain, brood year [BY], release site and date). For example, 103,040 fall chinook of CWT group 065638 plus 540,870 unmarked fall chinook were released directly from TRH in October 1991. Since there were 5.2 unmarked chinook salmon released for every CWTed chinook salmon released (540,870 unmarked/103,040 marked = 5.2), we multiplied the total number of CWTed chinook salmon of code group 065638 by 5.2 to estimate the number of unmarked chinook of that release group that returned to TRH. In doing so, we assumed that return rates to TRH of both CWTed fish and their unmarked counterparts were the same.

If more chinook salmon entered the hatchery on a particular sorting day than could be accounted for by the expansion of all of the CWT groups, we assumed the additional fish were naturally produced. We designated these fish as spring or fall run in the same proportions that were determined by the expansion of the CWT groups on that day.

Size Discrimination Between Adult and Grilse Salmon

We designated the size separating an adult fish from a grilse for spring and fall chinook, and coho based on length frequency data obtained at the two trapping sites and at TRH, compared against length data obtained from groups of CWTed fish that entered TRH whose exact age was known. Daily chinook salmon FL data from TRH were assigned to either spring or fall chinook only when the expansion of the number of CWTs indicated ≥90% of the chinook salmon entering TRH were from either spring or fall runs.

The length data collected at the weirs and TRH were smoothed with a moving average of five, 1-cm increments to determine the nadir separating grilse and adults.

Size Discrimination Between Adult and Immature Steelhead

All steelhead >41 cm FL were considered adults, and steelhead ≤41 cm FL captured at the weirs were assumed to be half-pounders (assumed to have migrated to the ocean). Steelhead ≤41 cm FL that entered TRH were classified as sub-adults, since we did not know whether they had migrated to the ocean or were resident steelhead.

Recovery of Tagged Fish

Weir Recovery

We examined dead salmonids recovered against the weir for tags, fin clips, and spawning condition, and measured them to the nearest cm FL. Heads of adipose fin-clipped (Ad-clipped) (potentially hatchery-marked) fish were removed for the recovery of the CWT. After examination, the carcasses were cut in half to prevent recounting and returned to the river downstream of the weir.

Tagging Mortalities

We defined all tagged salmonids recovered dead at the weir or reported dead by anglers as tagging mortalities, if there was no evidence they had spawned and they were recovered dead ≤30 days after tagging. Tagged fish recovered dead more than 30 days after tagging, or those that had spawned, regardless of the number days after tagging, were not considered tagging mortalities.

Angler Tag Returns

We used the information from Project-tags returned by anglers to assess sport harvest. All the tags placed on fish at the weirs were inscribed with our address so anglers could return the tags to us. All anglers that returned tags were sent questionnaires requesting the date and location of their catch and whether they harvested (killed) or released their catch. The questionnaire informed them of the fish's tagging date and location.

Tags returned to us through 30 April 1995 were used to assess harvest and catch-and-release rates. Tags returned after that date were processed for payment but not used for analysis. This date was chosen due to time constraints associated with the completion of this report.

Trinity River Hatchery

The TRH fish ladder was open from 6 September 1994 through 13 April 1995. Hatchery personnel conducted fish sorting and spawning operations generally two days per week. We considered the initial day a fish was observed during sorting as the day it entered the hatchery.

On all sorting days, salmon and steelhead entering TRH were identified to species, sexed, and examined for tags and fin clips. We measured all salmon to the nearest cm FL, except those that were Project-tagged fish from the weirs. Project-tagged salmon and steelhead recovered at TRH were assigned the FL recorded for them at the weir where they were originally tagged.

During each sorting week, we gave a distinguishing fin-clip to chinook that were placed in ponds to ripen, so the week they initially entered the hatchery (i.e., were sorted) could be determined when they were spawned.

On the day they were spawned, we removed the heads of all Ad-clipped salmon and placed each in a plastic bag with a serially numbered tab noting the date and location of recovery, species, sex, and FL. Project personnel later performed CWT extraction and decoding.

Statistical Analyses

Effectively Tagged Fish

We estimated the number of effectively tagged fish by subtracting from the total tagged, those fish we classified as tagging mortalities, tagged-fish recovered downstream of the tagging site, and angler-caught-and-released fish.

Run-size Estimates

We determined the run-size estimates in 1994-95 by using Chapman's version[6/] of the Petersen Single Census Method:

$$N = \frac{(M+1)\ (C+1)}{(R+1)}, \quad \text{where}$$

N = estimated run-size, M = the number of effectively tagged fish, C = the number of fish examined at TRH, and R = the number of Project-marked fish recovered in the hatchery sample.

We attempted to tag and recover enough fish to obtain 95% confidence limits within $\pm$10% of the run-size estimate. We used criteria established by Chapman (1948) to select the type of confidence interval estimator.

We examined the grilse and adult composition of the effectively tagged salmon, the sample of Project-tagged salmon recovered at TRH, and the untagged sample of salmon at TRH to determine if the run-size estimate should be stratified by grilse and adults. Run-size estimates were stratified by grilse and adult salmon when: 1) the proportions of grilse and adult salmon in each of the above samples were significantly different statistically; and 2) there were sufficient grilse and adult salmon recovered in the Project-tagged sample at TRH to obtain 95% confidence limits of $\pm$10% of each of the stratified portions of the run-size estimate.

6/ Chapman, D. G. 1951. Some properties of the hypergeometric distribution with applications to zoological census. Univ. Cali Publ. Stat. 1:131-160, As cited in Ricker (1975).

If we were not able to stratify the salmon run-size estimate by grilse and adults, we used the proportions of grilse and adult salmon trapped at each weir to estimate the numbers of grilse and adults comprising the run upstream of that respective weir.

All steelhead run-size estimates were for adults only. This year, we made independent estimates of naturally- and hatchery-produced steelhead. Since the 1989 BY, all TRH-produced steelhead have been fin-clipped. This allowed us to distinguish naturally produced (non-fin-clipped) from hatchery-produced (fin-clipped) steelhead at the weirs. We used the proportion of non-fin-clipped and fin-clipped steelhead observed at each weir to estimate the numbers of naturally and hatchery-produced steelhead in the run upstream of that respective weir.

For the run-size estimates, we assumed that: 1) fish trapped and released from the weir were a random sample representative of the population; 2) tagged and untagged fish were equally vulnerable to recapture at TRH; 3) all Project tags were recognized upon recovery; 4) tagged and untagged fish were randomly mixed throughout the population and among the fish recovered at TRH; and 5) we accounted for all tagging mortalities.

Angler Harvest and Catch-and-Release Rates and Harvest Estimates

Generally, anglers will return reward tags at a rate higher or nearly equal to that of non-reward tags. When this was the case, we used only reward tag returns to determine harvest rates. When non-reward tags were returned at higher rates than reward tags, we combined the two to determine harvest rates.

We computed the harvest rate for each species (and race of chinook) by dividing the number of angler-returned tags from harvested fish by the number of fish we effectively tagged. We calculated independent harvest rates for grilse and adult salmon.

The assumptions for the numbers of effectively reward- and non-reward-tagged fish released were the same as those for determining the run-size estimate (See "Run-size Estimates" above).

We computed the catch-and-release rate for each species (and race of chinook) by dividing the number of angler-returned reward tags from caught and released fish by the number of fish effectively reward-tagged plus the number of fish reported as released.

We estimated the numbers of fish harvested upstream of each weir by multiplying the harvest rates (for each species and race) by their respective run sizes upstream of each weir.

Other Analyses

The mean FLs of samples were compared statistically using a Student's t-test with the assumption of unequal variances (Dixon and Massey 196 . We did not conduct comparisons for sample sizes <20 fish and differences in such cases were not considered statistically different.

Use of Standard Julian Week

Weekly sampling data collected by Project personnel at the weirs are presented in Julian week (JW) format. Each JW is defined as one of a consecutive set of 52 weekly periods, beginning 1 January, regardless of the day of the week on which 1 January falls. The extra day in leap years is included in the ninth week (Appendix 1). This procedure allows inter-annual comparisons of identical weekly periods.

RESULTS AND DISCUSSION

Trapping and Tagging

Chinook Salmon

Spring-Fall Chinook Separation. Analysis of known-race WCW-tagged chinook showed that beginning JW 36 (3-9 Sept 1994) and continuing thereafter, the proportion of fall chinook exceeded that of spring chinook. Therefore, for the purposes of this report, the 319 chinook trapped prior to JW 36 at WCW were considered spring-run while the 2,165 chinook trapped that week and after were considered fall chinook (Table 1, Figure 3).

Spring chinook were the predominant race at JCW through JW 38 (17-23 Sept 1994) after which fall chinook became predominant. The 833 chinook trapped through JW 38 at JCW were considered spring chinook while the 419 chinook trapped after JW 38 were considered fall chinook for the purposes of this report (Table 2, Figure 3).

Run Timing. The spring chinook run at WCW was limited to the first five weeks of trapping. Fall chinook average weekly catch at WCW peaked (90.4 fish/night) during JW 38 (17-23 Sept 1994), remained relatively high (>35 fish/night) through JW 43 (22-28 Oct), and then rapidly decreased following JW 44 (29 Oct - 4 Nov) to less than 2.0 fish/night for the remainder of the season (Table 1, Figure 4).

At JCW, spring chinook average weekly catch peaked (44.5 fish/night) during JW 26 (25 Jun - 1 Jul 1994), decreased to 14. fish/night during JW 28 (9-15 Jul), then leveled off to between 1.5 and 11.0 fish/night through JW 38 (17-23 Sept). Fall chinook

TABLE 1. Weekly summary of spring and fall chinook trapped in the Trinity River at Willow Creek Weir during the 1994-95 season. a/

Julian week	Inclusive dates	Nights trapped	Number trapped: Grilse b/	Adults	Total	Average catch (fish/night)
Spring-Run Chinook c/						
31	07/30 - 08/05	3	16	19	35	11.7
32	08/06 - 08/12	5	17	24	41	8.2
33	08/13 - 08/19	5	29	41	70	14.0
34	08/20 - 08/26	5	19	50	69	13.8
35	08/27 - 09/02	5	38	66	104	20.8
	Sub-total:	23	119	200	319	
	Sub-mean:					13.9
Fall-Run Chinook c/						
36	09/03 - 09/09	5	56	244	300	60.0
37	09/10 - 09/16	5	30	91	121	24.2
38	09/17 - 09/23	5	188	264	452	90.4
39	09/24 - 09/30	5	146	222	368	73.6
40	10/01 - 10/07	5	103	121	224	44.8
41	10/08 - 10/14	5	91	117	208	41.6
42	10/15 - 10/21	5	57	176	233	46.6
43	10/22 - 10/28	5	55	124	179	35.8
44	10/29 - 11/04	5	12	61	73	14.6
45	11/05 - 11/11	3	2	2	4	1.3
46	11/12 - 11/18	3	0	2	2	0.7
47	11/19 - 11/25	5	0	0	0	0.0
48	11/26 - 12/02 d/	0	- -	- -	- -	- -
49	12/03 - 12/09	2	0	1	1	0.5
50	12/10 - 12/16	2	0	0	0	0.0
	Sub-total:	60	740	1,425	2,165	
	Sub-mean:					36.1
	Grand Total:	83	859	1,625	2,484	
	Combined Mean:					29.9

a/ Trapping at Willow Creek Weir took place from 3 August (Julian week 31) through 11 December (Julian week 50) of 1994.

b/ Spring-run chinook less than or equal to 56 cm FL were considered grilse; fall-run chinook less than or equal to 59 cm FL were considered grilse.

c/ There was actually a temporal overlap of spring- and fall-run chinook during Julian weeks 32 through 39. For the purpose of analysis, all chinook caught through Julian week 35 were considered spring-run chinook; those caught after that were considered fall-run chinook.

d/ No trapping was attempted during Julian week 48 due to high flows.

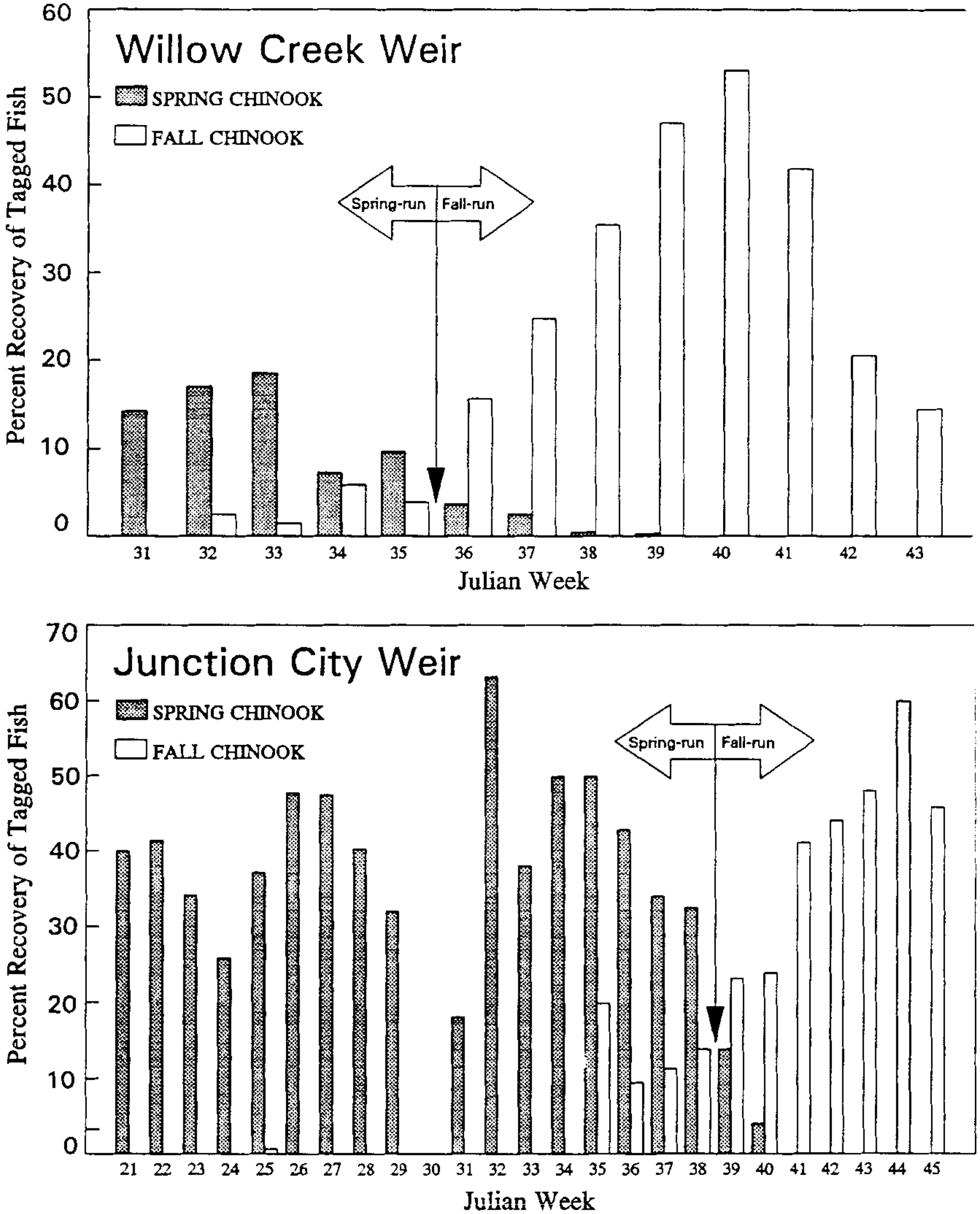


FIGURE 3. Weekly proportions of spring- and fall-run chinook salmon at the weirs during the 1994-1995 season. The arrow denotes separation of the s for analysis. Percentages were calculated using recoveries of known spring or fall-run tagged fish.

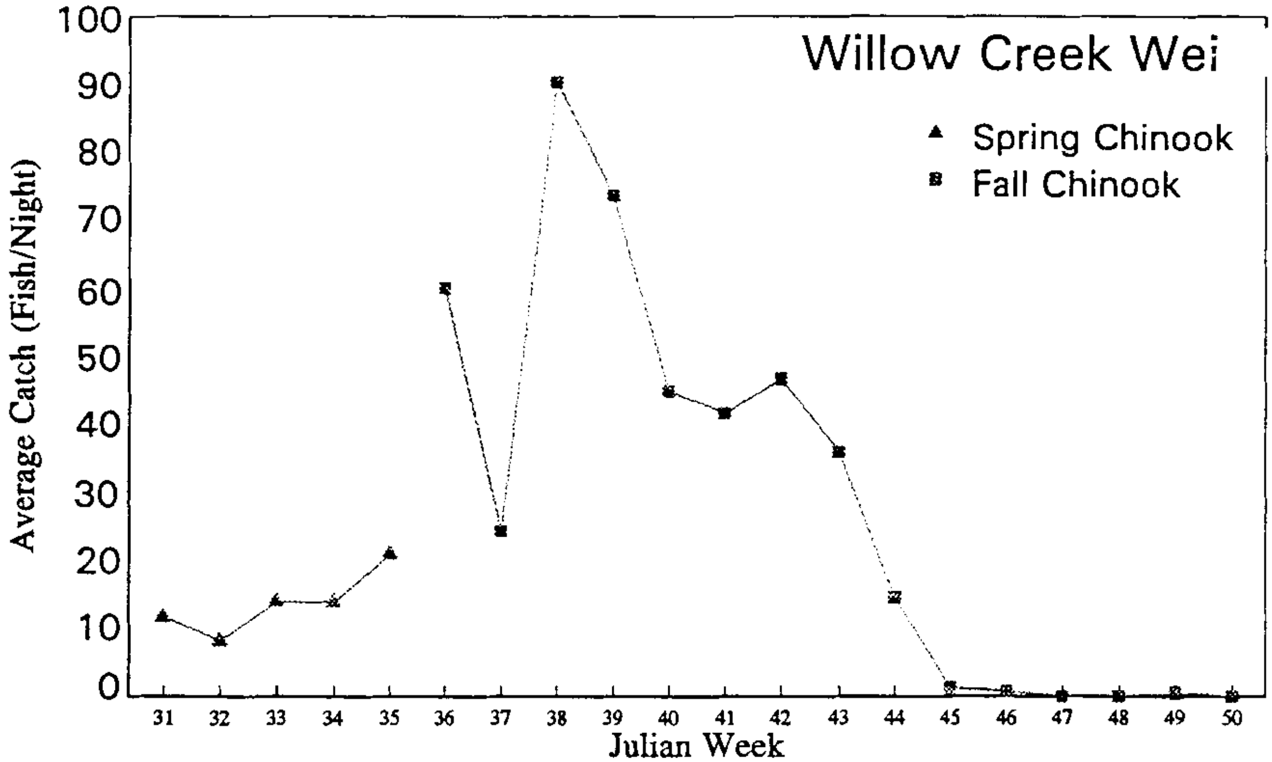
TABLE 2. Weekly summary of spring and fall chinook trapped in the Trinity River at Junction City Weir during the 1994-95 season. a/

Julian week	Inclusive dates	Nights trapped	Number trapped: Grilse b/	Adults	Total	Average catch (fish/night)
Spring-Run Chinook c/						
21	05/21 - 05/27	4	0	15	15	3.8
22	05/28 - 06/03	4	0	58	58	14.5
23	06/04 - 06/10	4	0	35	35	8.8
24	06/11 - 06/17	4	0	27	27	6.8
25	06/18 - 06/24	4	22	139	161	40.3
26	06/25 - 07/01	4	25	153	178	44.5
27	07/02 - 07/08	4	24	58	82	20.5
28	07/09 - 07/15	4	29	28	57	14.3
29	07/16 - 07/22	4	24	4	28	7.0
30	07/23 - 07/29	4	4	2	6	1.5
31	07/30 - 08/05	4	18	4	22	5.5
32	08/06 - 08/12	4	13	6	19	4.8
33	08/13 - 08/19	4	9	12	21	5.3
34	08/20 - 08/26	4	3	3	6	1.5
35	08/27 - 09/02	4	5	5	10	2.5
36	09/03 - 09/09	4	12	9	21	5.3
37	09/10 - 09/16	4	14	30	44	11.0
38	09/17 - 09/23	4	18	25	43	10.8
	Sub-total:	72	220	613	833	
	Sub-mean:					11.6
Fall-Run Chinook c/						
39	09/24 - 09/30	4	15	28	43	10.8
40	10/01 - 10/07	4	13	12	25	6.3
41	10/08 - 10/14	4	59	60	119	29.8
42	10/15 - 10/21	4	63	30	93	23.3
43	10/22 - 10/28	3	51	28	79	26.3
44	10/29 - 11/04	3	3	2	5	1.7
45	11/05 - 11/11	4	19	18	37	9.3
46	11/12 - 11/18	4	7	2	9	2.3
47	11/19 - 11/25	3	3	0	3	1.0
48	11/26 - 12/02	3	3	0	3	1.0
49	12/03 - 12/09	4	2	0	2	0.5
50	12/10 - 12/16	2	1	0	1	0.5
	Sub-total:	42	239	180	419	
	Sub-mean:					10.0
	Grand Total:	114	459	793	1,252	
	Combined Mean:					11.0

a/ Trapping at Junction City Weir took place from 24 May (Julian week 21) through 13 December (Julian week 50) of 1994.

b/ Spring-run chinook grilse were less than or equal to 56 cm FL; fall-run chinook grilse were less than or equal to 59 cm FL.

c/ There was actually a temporal overlap of spring- and fall-run chinook during Julian weeks 35 through 40. For the purpose of analysis, all chinook caught through Julian week 38 were considered spring-run chinook; those caught after that were considered fall-run chinook.



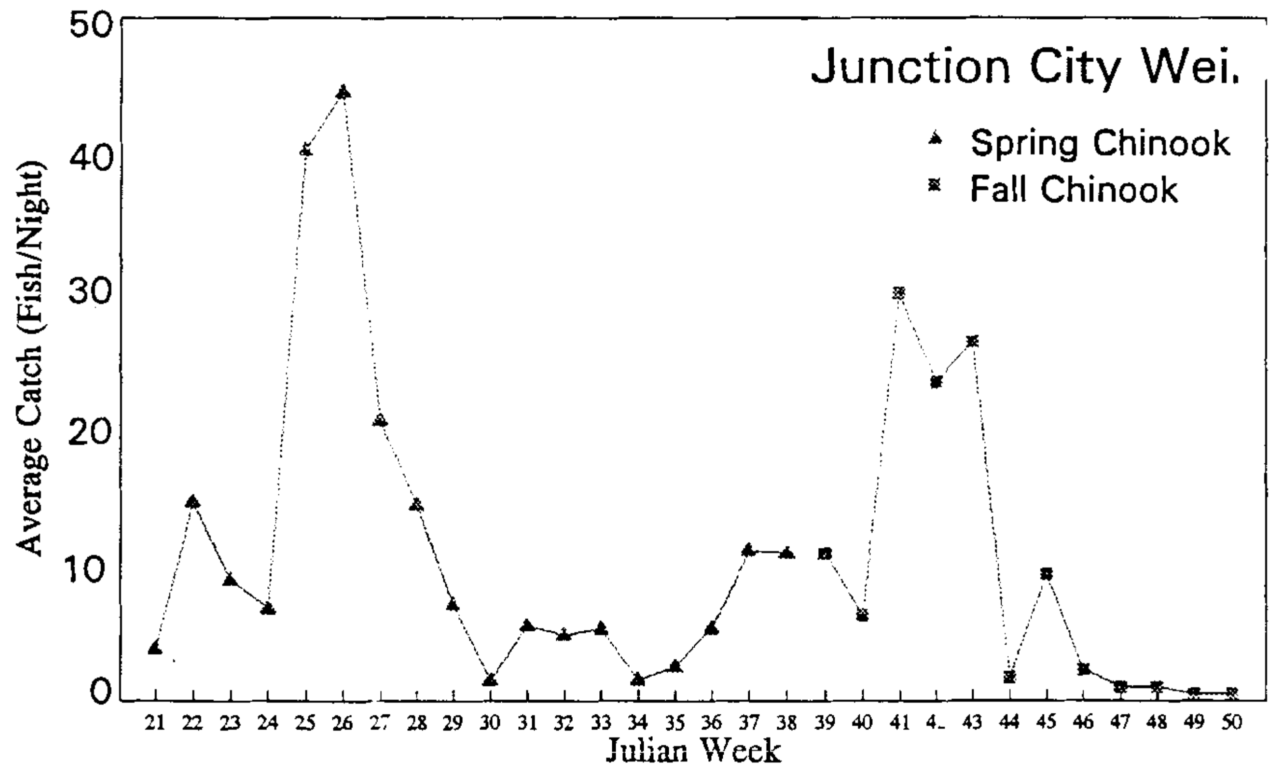


FIGURE 4. Average catch of spring- and fall-run chinook salmon each Julian week in the Trinity River at Willow Creek and Junction City weirs during the 1994-1995 season.

average weekly catch peaked at 29.8 fish/night during JW 41 (8-14 Oct), remained near that level for two weeks and decreased to less than 9.4 fish/night thereafter (Table 2, Figure 4).

Sizes of Trapped Fish. The average sizes of the spring chinook trapped at WCW and JCW, and that entered TRH varied between 62.3 and 63.6 cm FL. Based on the analysis of combined FL distribution at JCW and TRH, the size separating grilse from adult spring chinook was 56 cm (Figure 5). Limited information from known-age, hatchery-marked spring chinook that entered TRH supported the 56 cm FL separation of adults and grilse (Appendix 2). Therefore, this season, we considered spring chinook in the Trinity River basin ≤56 cm FL to be grilse, while adults were >56 cm FL.

Grilse comprised 37.3%, 26.4%, and 32.7% of the spring chinook observed at WCW, JCW, and TRH, respectively.

The average sizes of fall chinook trapped at WCW and JCW and that entered TRH ranged between 57.6 and 62.8 cm FL. Analysis of the combined FL distribution for the three sites indicated the size separation between grilse and adult fall chinook at 59 cm (Figure 6). Size data of known-age, hatchery-marked fall chinook entering TRH also supported the 59 cm FL size separation (Appendix 3). Therefore, this season, we considered fall chinook in the Trinity River basin ≤59 cm FL to be grilse, while adults were >59 cm FL.

Fall chinook grilse comprised 34.2%, 57.0%, and 57.6% of the run observed at WCW, JCW, and TRH, respectively.

Effectively Tagged Fish. We trapped 833 spring chinook at JCW, of which 824 (217 grilse and 607 adults) were effectively tagged (Appendix 4). The number effectively tagged was adjusted to account for tagging mortalities (one fish), poor-condition untagged fish (four fish) and fish from which anglers reported removing tags (four fish). The effectively tagged number included 267 (32.4%) reward-tagged fish (71 grilse and 196 adults).

We trapped 2,165 fall chinook at WCW, 122 of which were released untagged, 29 from which anglers had removed the tags and one which was a tagging mortality. We effectively tagged 2,013 fall chinook (685 grilse and 1,328 adults) at WCW this season (Appendix 5). We placed reward tags on 669 (233 grilse and 436 adults), or 33.2%, of the effectively tagged fall chinook at WCW.

We trapped 419 fall chinook at JCW, of which 377 (211 grilse and 166 adults) were effectively tagged (Appendix 5). The fish not effectively tagged included 42 fish released untagged. Reward tags were placed on 125 (65 grilse and 60 adults), or 33.2%, of the effectively tagged fall chinook at JCW.

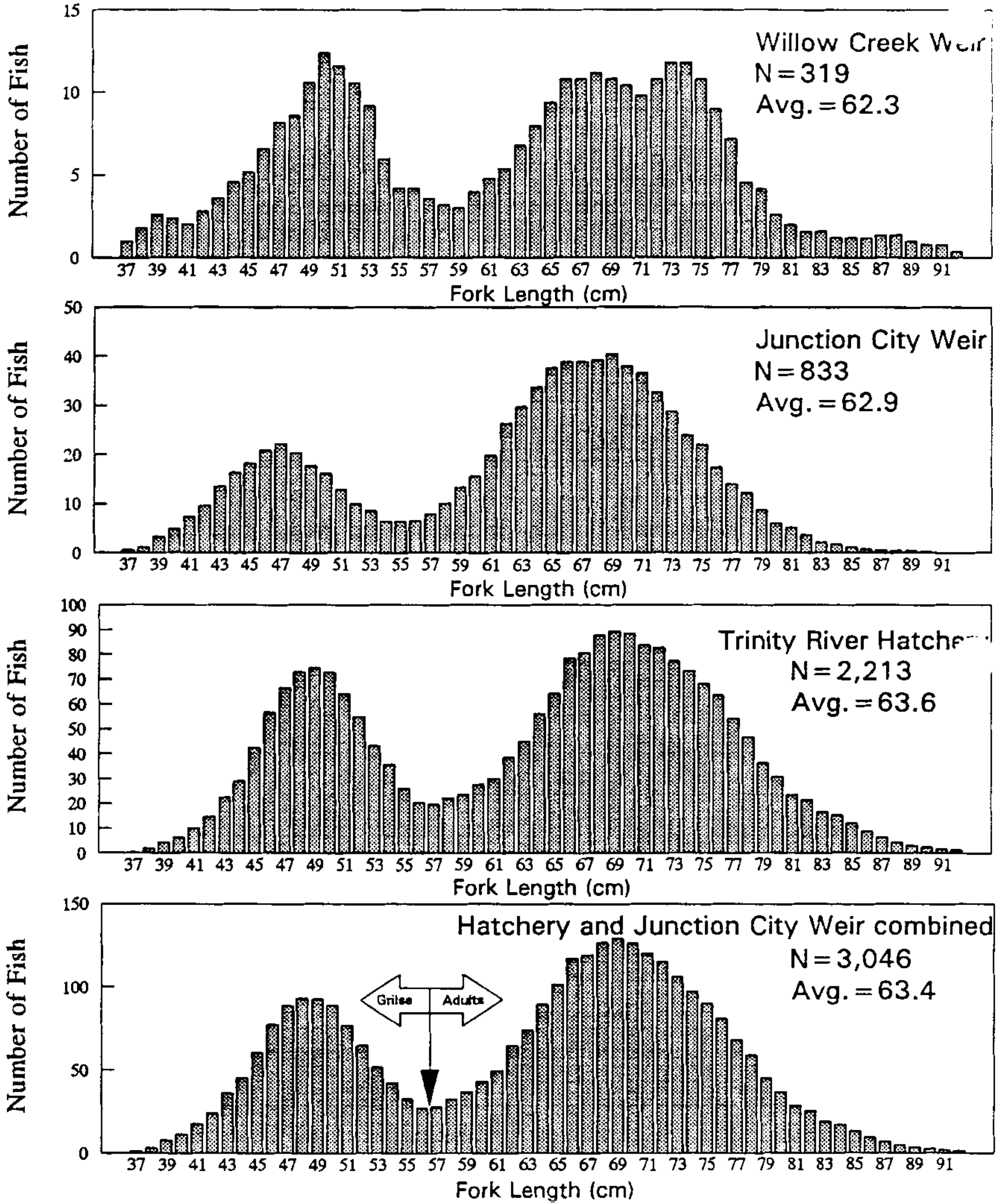


FIGURE 5. Analysis of spring-run chinook lengths observed at the Trinity River weirs and Trinity River Hatchery during the 1994-1995 season. The number of fish at each fork length is shown as a moving average of five, 1-cm increments. The arrow denotes the size used to separate grilse from adults for analysis.

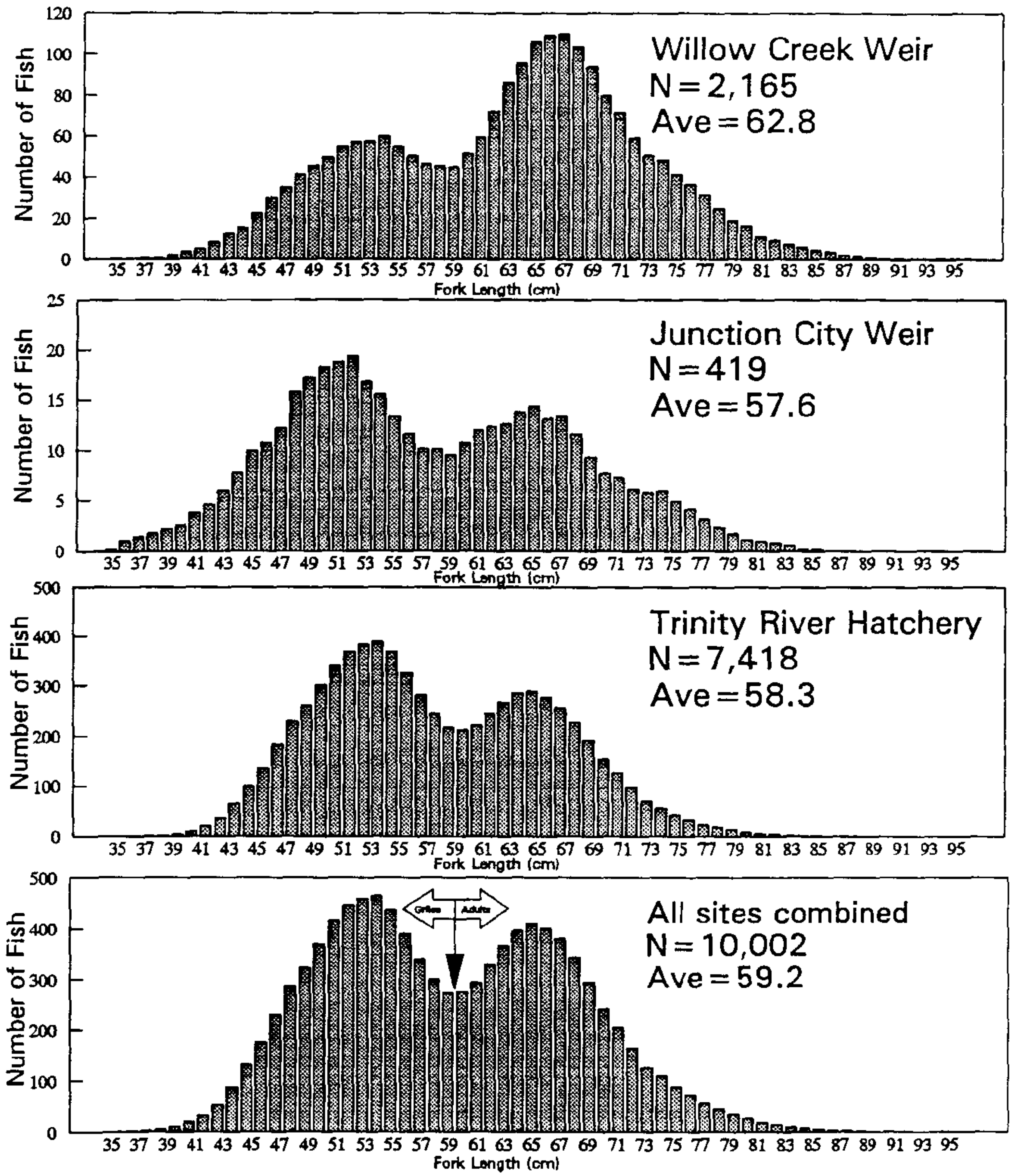


FIGURE 6. Analysis of fall-run chinook salmon lengths observed at the Trinity River weirs and Trinity River Hatchery during the 1994-1995 season. The number fish at each fork length is shown as a moving average of five, 1-cm increments. The arrow denotes the size used to separate grilse and adults for analysis.

Incidence of Tags and Fin Clips. Twelve of the 286 (4.2%) spring chinook salmon effectively tagged at WCW were recaptured at JCW. Length of time for migration between the weirs for these fish ranged from 10 to 61 d, averaging 31 d. Thirty-three (1.6%) of the 2,013 fall chinook effectively tagged at WCW were recovered at JCW. Length of time to travel between the weirs for these fish ranged from 7 to 51 d, averaging 24 d.

Ad-clipped fish comprised 7.2% (23/319) of the spring chinook seen at WCW and 16.9% (141/833) at JCW (Appendix 4).

Nine (39.1%) of the 23 Ad-clipped spring chinook tagged at WCW were recovered at TRH. Of these, seven were spring chinook from TRH and two had shed their CWTs (Table 3). Seventy-nine (56%) of the 141 Ad-clipped JCW-tagged spring chinook were recovered at TRH. These included one naturally produced chinook of unknown race, 64 spring chinook of TRH origin and 14 which had shed their CWTs.

Ad-clipped fish comprised 8.4% (181/2165) of the fall chinook seen at WCW and 7.4% (31/419) at JCW (Appendix 5). One hundred-seven (59.1%) of the 181 Ad-clipped fall chinook tagged at WCW were recovered at TRH. Of these, 98 were fall chinook from TRH and nine had shed their CWTs (Table 3). Eighteen (58.1%) of the 31 Ad-clipped fall chinook which were tagged at JCW were recovered at TRH. Of these, 15 were fall chinook from TRH and three had shed their tags (Table 3).

Incidence of Gill-net Wounds and Hook Scars. Seventy-three (8.8%) of the 833 spring chinook trapped at JCW had gill-net wounds. The average size of gill-net-wounded vs. non-wounded spring chinook was 67.6 and 62.4 cm FL, respectively. The size difference between the two was statistically significant ($T=4.599$, $P<0.005$, d.f.=130). At WCW, 52 (16.3%) of the spring chinook bore gillnet wounds. The size difference between wounded and non-wounded fish at WCW was also statistically significant ($T=3.277$, $P<0.005$, df=110).

For fall chinook, 10.5% (228/2165) and 4.5% (19/419) of the fish trapped at WCW and JCW, respectively, were gill-net-wounded. As with spring chinook, gill-net-wounded fish were larger on average than non-wounded fish. At both weirs the difference between sizes of wounded and non-wounded fish was statistically significant (JCW: $T=4.45$, $P<0.005$, d.f.=29; WCW: $T=9.23$, $P<0.005$, d.f.=380).

One of the 833 (0.12%) spring chinook and one of the 419 (0.24%) fall chinook trapped at JCW had ocean-hook scars. At WCW, one (0.31%) of the 319 spring chinook and three (0.14%) of the 2,165 fall chinook trapped bore ocean-hook scars. Fresh hooking-wounds were observed on three (0.36%) and two (0.63%) of the spring chinook observed at JCW and WCW, respectively. Four fall

TABLE 3. Release data and recoveries for coded-wire tagged salmon that were trapped in the Trinity River at Willow Creek and Junction City weirs, and recovered at Trinity River Hatchery during the 1994-95 season.

Release data							Numbers recovered from tagging site: b/	
CWT a/ number	Species	Race	Brood year	Date	Number of fish	Site c/	WCW	JCW
0601040103	chinook	spring	1990	05/28/91	196,908	TRH	1	12
065636	chinook	spring	1990	10/08/91	48,553	TRH	1	1
065640	chinook	spring	1990	10/08/91	46,086	TRH		3
0601040105	chinook	spring	1991	06/05/92	198,277	TRH		18
0601080304 d/	chinook	spring	1991	04/10/92	9,408	TR		1
065658	chinook	spring	1991	10/02/92	110,797	TRH		4
0601040106	chinook	spring	1992	06/15/93	215,038	TRH	1	24
065734	chinook	spring	1992	10/01-07/93	53,675	TRH	3	1
065735	chinook	spring	1992	10/01-07/93	56,281	TRH	1	1
shed tag e/	chinook						2	14
Total spring-run chinook:							9	79
065638	chinook	fall	1990	10/09/91	103,040	TRH	8	1
0601040104	chinook	fall	1991	06/22/92	206,416	TRH	44	3
065731	chinook	fall	1991	10/02/92	58,580	TRH	13	1
065732	chinook	fall	1991	10/02/92	56,720	TRH	14	2
065733	chinook	fall	1992	06/16/93	192,032	TRH	13	5
065748	chinook	fall	1992	10/01-07/93	54,586	TRH	5	3
065749	chinook	fall	1992	10/01-07/93	54,308	TRH	1	
shed tag e/	chinook						9	3
Total fall-run chinook:							107	18
065760	coho		1992	03/28/94	54,723	TRH	1	
shed tag	coho							1
Total coho:							1	1

a/ CWT=coded-wire tag.

b/ Tagging site: WCW=Willow Creek Weir; JCW=Junction City Weir.

c/ Release site: TRH=Trinity River Hatchery; TR=mainstem Trinity River between Lewiston Dam and the North Fork Trinity River.

d/ The fish with this CWT was a naturally-produced chinook of unknown race. It was considered a spring-run fish because it was trapped during the time associated with the spring-run.

e/ Fish with shed CWTs were designated as spring- or fall-race based on the date they were trapped at the weirs.

chinook at JCW (0.95%) and 42 (1.9%) fall chinook at WCW bore fresh hooking-wounds. There was no significant size difference between hook-wounded and non-hook-wounded fall chinook at WCW ($T=1.36$, $p>0.005$, d.f.$=43$).

Coho Salmon

Run timing. We trapped the first coho at WCW on 30 September 1994 (JW 39). The average weekly catch peaked (6.2 fish/night) two weeks later during JW 41 (8-14 Oct) and then decreased to less than 2.0 fish/night through JW 45 (5-11 Nov) when the last coho was trapped (Figure 7). We trapped 57 coho salmon (41 grilse and 16 adults) at WCW during the 1994-95 season (Table 4).

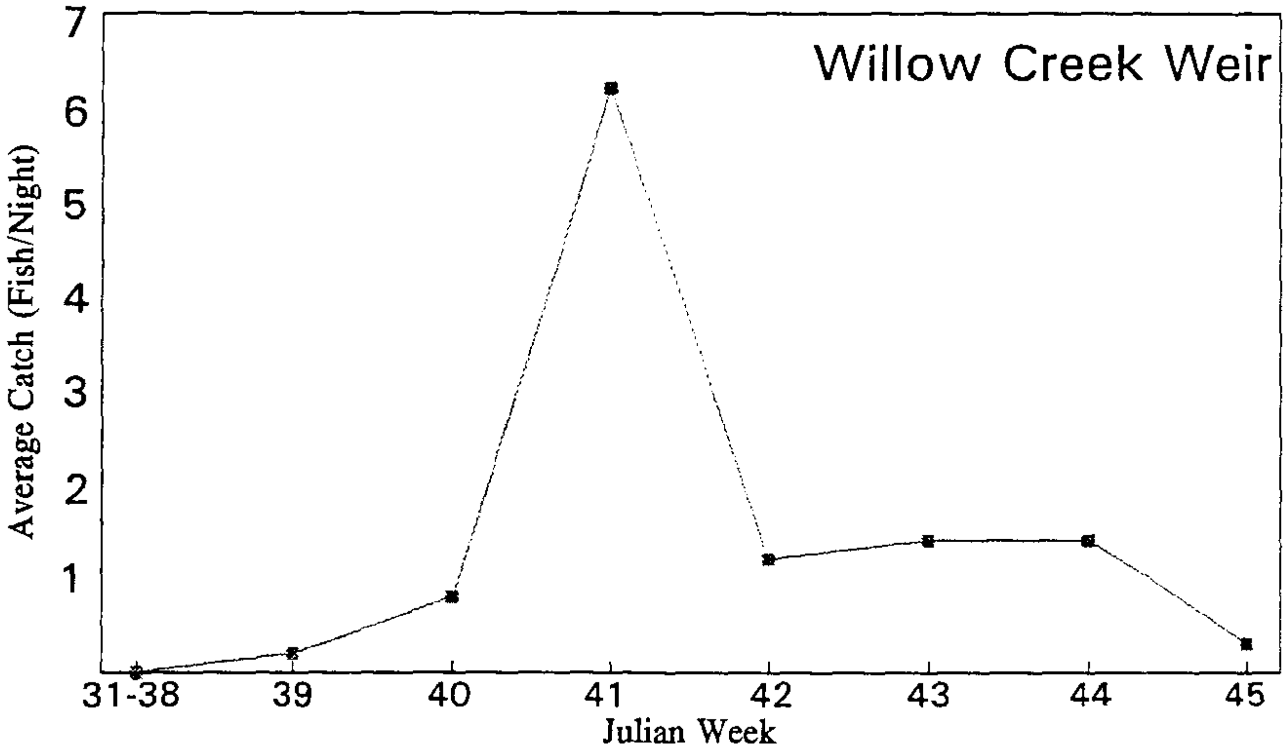
We trapped our first coho at JCW on 24 October 1994 (JW 43), about 24 days after coho first appeared at the WCW. The peak of the coho run at JCW (4.0 fish/night) was observed during the same week they were first trapped, after which average weekly catch was less than 2.0 fish/night through the last week of trapping. We trapped 32 coho (19 grilse and 13 adults) at JCW during the 1994-95 season (Table 5).

Size of Fish Trapped. The size ranges and mean FLs of coho trapped at WCW and JCW were similar (Figure 8, Appendix 6). The size separating grilse and adult coho was based on the combined length data from coho trapped at WCW, JCW and that entered TRH. The combined data showed the size separation between grilse and adults was 54 cm (Figure 8). Limited length data from CWTed coho recovered at TRH generally supported the length of 54 cm to separate grilse from adults (Appendix 7). This year all coho ≤54 cm FL were considered grilse, while larger coho were adults.

Grilse comprised 71.9%, 59.4%, and 54.4% of the coho trapped at WCW, JCW, and TRH, respectively.

Effectively Tagged Fish. We trapped 57 coho salmon at WCW, of which 51 (35 grilse and 16 adults) were effectively tagged (Appendix 6). Six coho (all grilse) were considered too small to tag. The effectively tagged coho included 28 (54.9%) reward-tagged fish (15 grilse and 13 adults).

Thirty-two coho salmon were trapped at JCW, of which three were released untagged because they were in poor condition. Thus, 29 coho (17 grilse and 12 adults) were effectively tagged. The effectively tagged fish included 17 (58.6%) that were reward-tagged (nine grilse and eight adults).



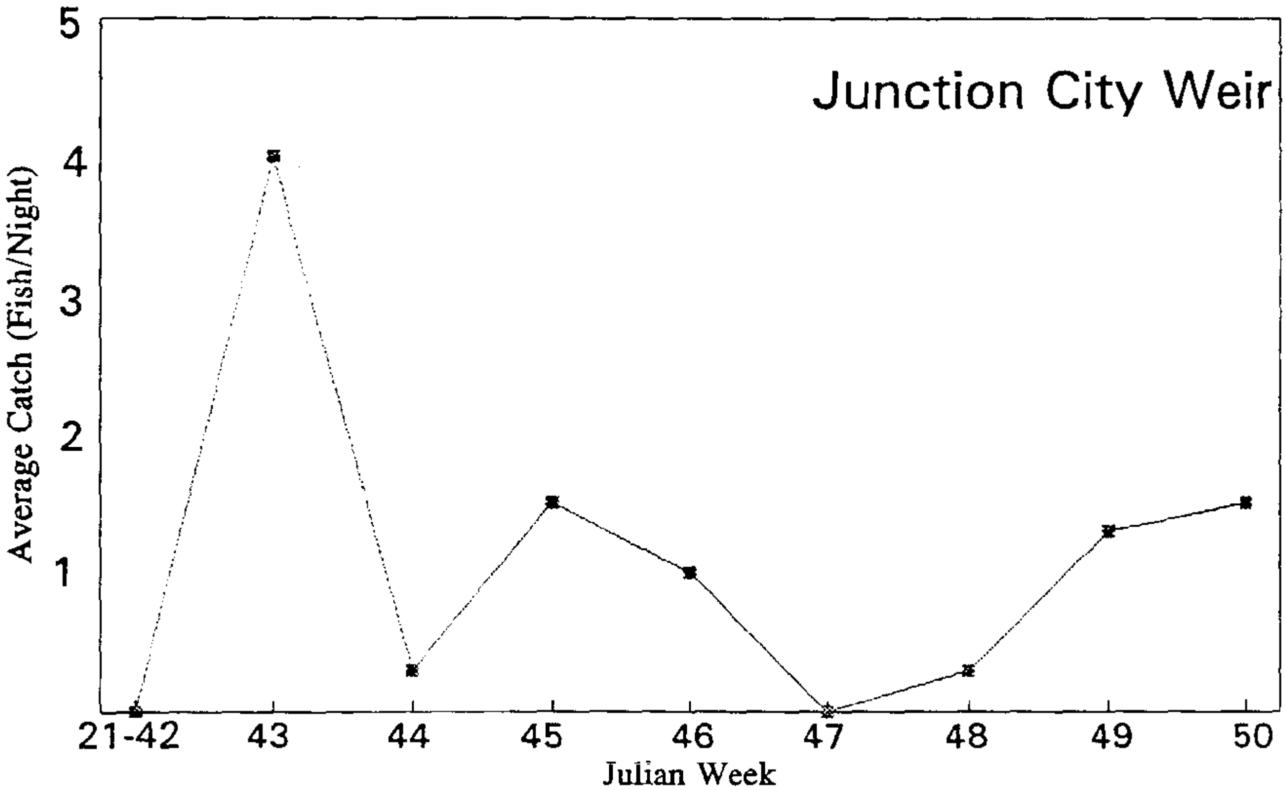


FIGURE 7. Average catch of coho salmon each Julian week in the Trinity River at Willow Creek and Junction City weirs during the 1994-1995 season.

TABLE 4. Weekly summary of coho salmon trapped in the Trinity River at Willow Cre^k Weir during the 1994-95 season. a/

Julian week	Inclusive dates	Nights trapped	Number trapped: Grilse b/	Adults	Total	Averag catch (fish/nigh
31-38	07/30 - 09/23	38	0	0	0	0.0
39	09/24 - 09/30	5	1	0	1	0.2
40	10/01 - 10/07	5	3	1	4	0.8
41	10/08 - 10/14	5	27	4	31	6.2
42	10/15 - 10/21	5	5	1	6	1.2
43	10/22 - 10/28	5	5	2	7	1.4
44	10/29 - 11/04	5	0	7	7	1.4
45	11/05 - 11/11	3	0	1	1	0.3
	Totals: c/	33	41	16	57	
	Mean: c/					1.7

a/ Trapping at Willow Creek weir took place from 3 August (Julian week 31) through 11 December (Julian week 50) of 1994.
b/ Coho grilse were less than or equal to 54 cm FL; larger fish were adults.
c/ Based on trapping data from Julian weeks 39 through 45.

TABLE 5. Weekly summary of coho salmon trapped in the Trinity River at Junction City Weir during the 1994-95 season. a/

Julian week	Inclusive dates	Nights trapped	Number trapped: Grilse b/	Adults	Total	Average catch (fish/night
21-42	05/21 - 10/21	88	0	0	0	0.0
43	10/22 - 10/28	3	10	2	12	4.0
44	10/29 - 11/04	3	0	1	1	0.3
45	11/05 - 11/11	4	4	2	6	1.5
46	11/12 - 11/18	4	1	3	4	1.0
47	11/19 - 11/25	3	0	0	0	0.0
48	11/26 - 12/02	3	1	0	1	0.3
49	12/03 - 12/09	4	2	3	5	1.3
50	12/10 - 12/16	2	1	2	3	1.5
	Totals: c/	26	19	13	32	
	Mean: c/					1.2

a/ Trapping at Junction City Weir took place from 24 May (Julian week 21) through 13 December (Julian week 50) of 1994.
b/ Coho grilse were less than or equal to 54 cm FL; larger fish were adults.
c/ Based on trapping data from Julian weeks 43 through 50.

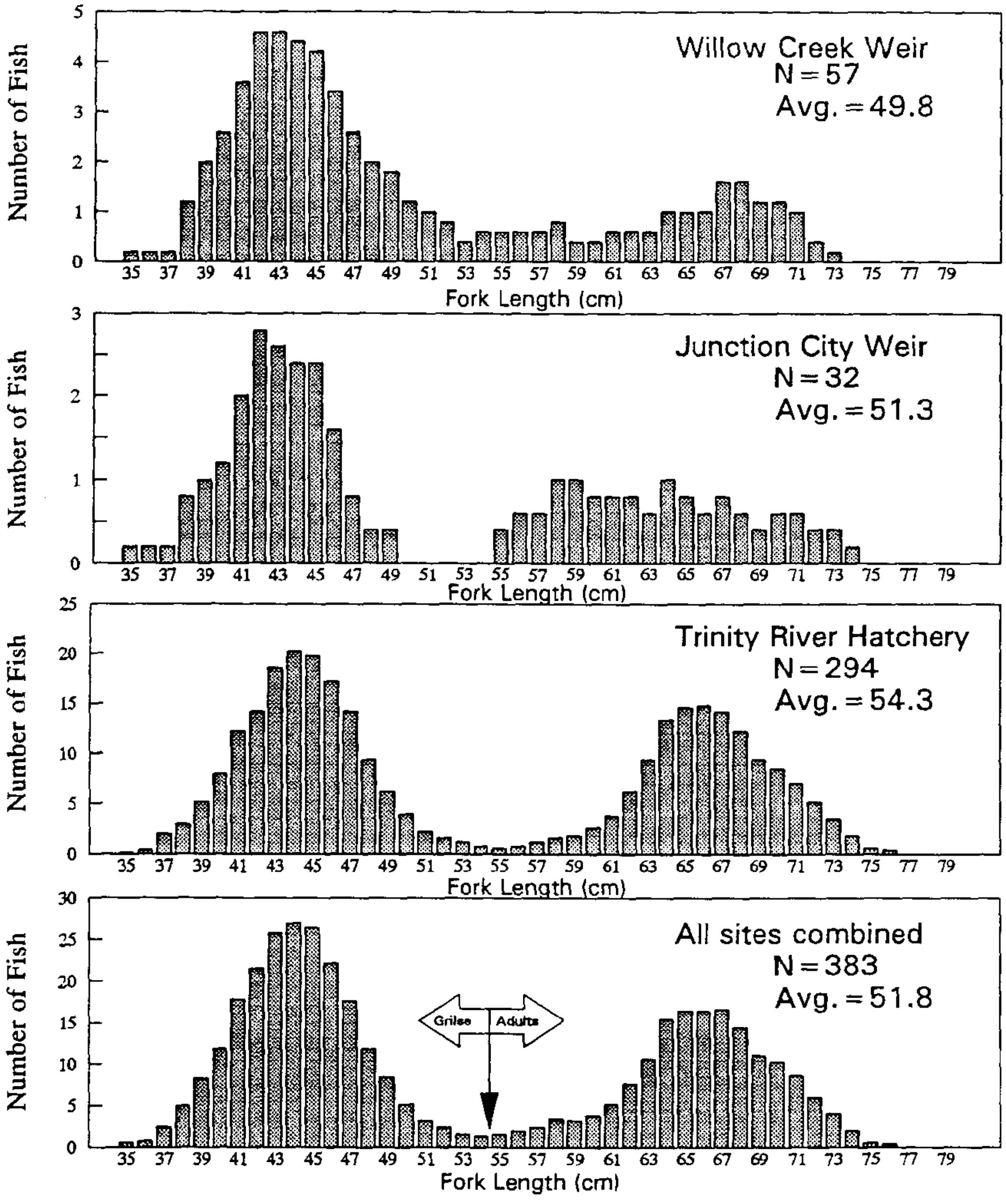


FIGURE 8. Analysis of coho salmon lengths observed at the Trinity River weirs and Trinity River Hatchery during the 1994-1995 season. The number of fish at each fork length is shown as a moving average of five, 1-cm increments. The arrow denotes the size used to separate grilse from adults for analysis.

Incidence of Tags and Fin Clips. None of the coho trapped at JCW had originally been tagged at WCW.

We trapped four Ad-clipped coho at WCW (three grilse and one adult) which comprised 7.0% of the total WCW coho catch (Appendix 6). At JCW, 9.4% (3/32) of the coho trapped were Ad-clipped (two grilse and one adult). One Ad-clipped coho tagged at each weir was recovered at TRH; the one WCW Ad-clipped coho was of TRH origin, while the Ad-clipped coho tagged at JCW had shed its CWT (Table 3).

Incidence of Gill-net Wounds and Hook Scars. None of the coho observed at either WCW or JCW were gill-net-wounded or hook-scarred.

Fall-run Steelhead

Run Timing. With the exception of JW 48 (26 Nov-2 Dec 1994), when no trapping was attempted, we caught steelhead every week of trapping at WCW (Figure 9). Two major peaks of immigration were observed, occurring during JW 31 and 32 (30 Jul-12 Aug), and again during JW 44 (29 Oct-4 Nov). Average weekly catches exceeded 15.0 fish/night in both instances. We trapped 631 steelhead (603 adults and 28 half-pounders) at WCW this season (Table 6). We caught steelhead intermittently and in relativel low numbers at JCW this season. Average weekly catch peaked JW 45 (5-11 Nov 1994) at 3.8 fish/night (Figure 9). We trapped 89 steelhead, including 82 adults and seven half-pounders at JCW during the 1994-95 season (Table 7).

Size of Fish Trapped. Steelhead caught at WCW, JCW, and TRH averaged 56.8, 54.4 and 56.6 cm FL, respectively (Figure 10). Sub-adult steelhead ($\leq$ 41 cm FL) made up 4.4%, 7.9% and 5.7% of the steelhead trapped at WCW, JCW and TRH respectively.

Effectively Tagged Fish. We trapped 603 adult steelhead at WCW of which 545 were effectively tagged (Appendix 8). There were no tagging mortalities, 11 fish were not tagged, and anglers reported removing tags from 47 fish. All of the effectively tagged adults were reward-tagged.

We trapped and reward-tagged 82 adult steelhead at JCW this season. There were no tagging mortalities and three tags were removed by anglers, leaving 79 effectively tagged steelhead (Appendix 8).

Incidence of Tags and Fin Clips. Nine of the 545 (1.7%) adult steelhead that were originally tagged at the WCW were recaptured at the JCW. Migration time ranged from 11 to 63 d, averaging 37 d.

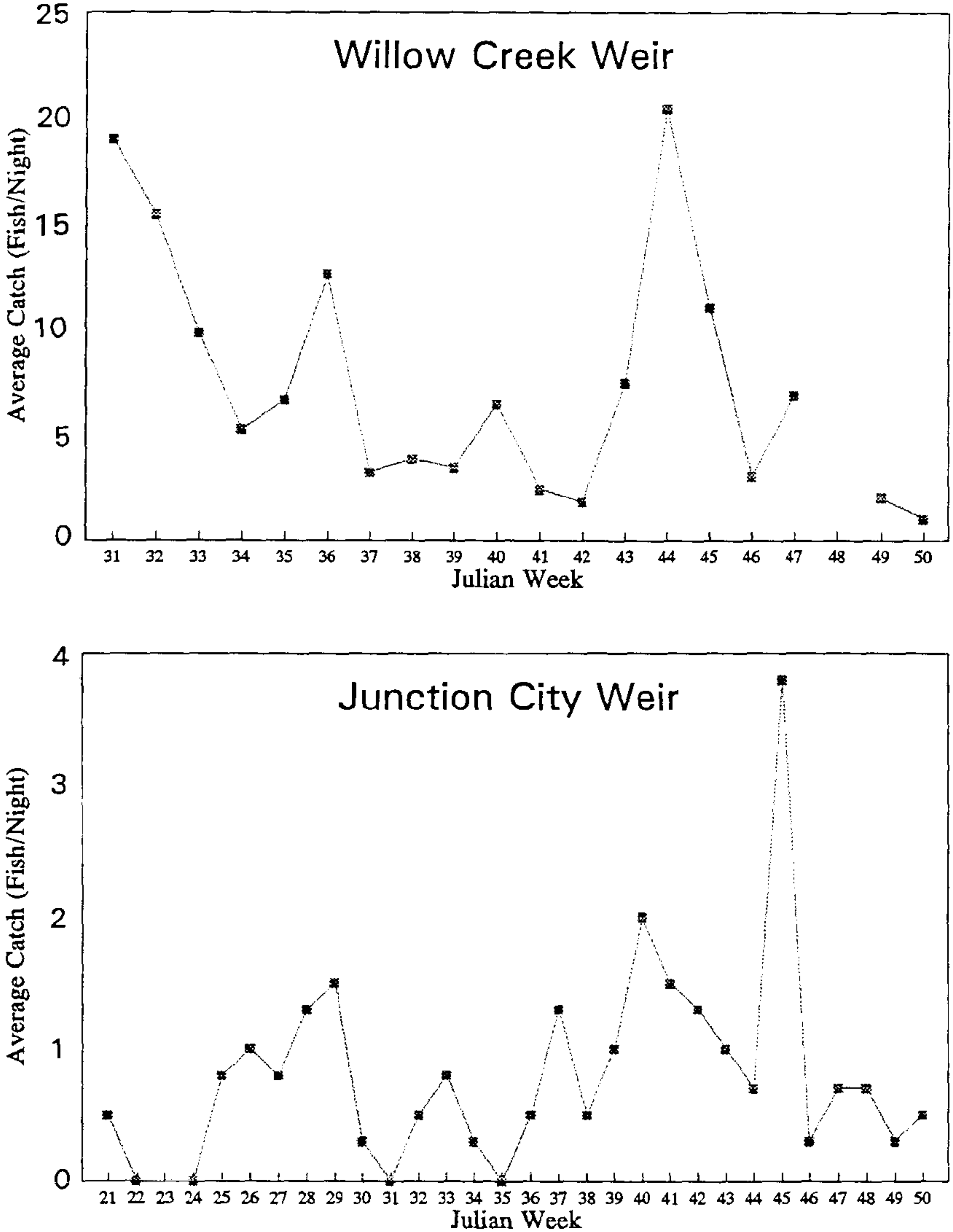


FIGURE 9. Average catch of fall-run steelhead each Julian week in the Trinity River at Willow Creek and Junction City weirs during the 1994-1995 season.

Table 6. Weekly summary of steelhead trapped in the Trinity River at Willow Creek Weir during the 1994-95 season. a/

Julian week	Inclusive dates	Nights trapped	Number trapped: Half-pounders b/	Number trapped: Adults	Number trapped: Total	Average catch (fish/night)
31	07/30 - 08/05	3	2	55	57	19.0
32	08/06 - 08/12	5	0	77	77	15.4
33	08/13 - 08/19	5	2	47	49	9.[illegible]
34	08/20 - 08/26	5	2	24	26	5.[illegible]
35	08/27 - 09/02	5	5	28	33	6.6
36	09/03 - 09/09	5	4	59	63	12.6
37	09/10 - 09/16	5	4	12	16	3.2
38	09/17 - 09/23	5	0	19	19	3.8
39	09/24 - 09/30	5	1	16	17	3.4
40	10/01 - 10/07	5	3	29	32	6.4
41	10/08 - 10/14	5	0	12	12	2.4
42	10/15 - 10/21	5	1	8	9	1.8
43	10/22 - 10/28	5	1	36	37	7.4
44	10/29 - 11/04	5	1	101	102	20.4
45	11/05 - 11/11	3	1	32	33	11.0
46	11/12 - 11/18	3	0	9	9	3.0
47	11/19 - 11/25	5	1	33	34	6.8
48	11/26 - 12/02 /c	--	--	--	--	--
49	12/03 - 12/09	2	0	4	4	2.0
50	12/10 - 12/16	2	0	2	2	1.0
	Totals:	83	28	603	631	
	Mean:					7.6

a/ Trapping at Willow Creek weir took place from 3 August (Julian week 31) through 11 December (Julian week 50) of 1994.
b/ Half-pounder steelhead were less than or equal to 41 cm FL; larger fish were adults.
c/ No trapping was attempted during Julian week 48 due to high flows.

Table 7. Weekly summary of steelhead trapped in the Trinity River at Junction City Weir during the 1994-95 season.

Julian week	Inclusive dates	Nights trapped	Number trapped: Half-pounders b/	Number trapped: Adults	Number trapped: Total	Average catch (fish/night)
21	05/21 - 05/27	4	2	0	2	0.5
22	05/28 - 06/03	4	0	0	0	0.0
23	06/04 - 06/10	4	0	0	0	0.0
24	06/11 - 06/17	4	0	0	0	0.0
25	06/18 - 06/24	4	1	2	3	0.8
26	06/25 - 07/01	4	0	4	4	1.0
27	07/02 - 07/08	4	0	3	3	0.8
28	07/09 - 07/15	4	0	5	5	1.3
29	07/16 - 07/22	4	0	6	6	1.5
30	07/23 - 07/29	4	0	1	1	0.3
31	07/30 - 08/05	4	0	0	0	0.0
32	08/06 - 08/12	4	0	2	2	0.5
33	08/13 - 08/19	4	0	3	3	0.8
34	08/20 - 08/26	4	0	1	1	0.3
35	08/27 - 09/02	4	0	0	0	0.0
36	09/03 - 09/09	4	0	2	2	0.5
37	09/10 - 09/16	4	1	4	5	1.3
38	09/17 - 09/23	4	0	2	2	0.5
39	09/24 - 09/30	4	0	4	4	1.0
40	10/01 - 10/07	4	0	8	8	2.0
41	10/08 - 10/14	4	0	6	6	1.5
42	10/15 - 10/21	4	0	5	5	1.3
43	10/22 - 10/28	3	0	3	3	1.0
44	10/29 - 11/04	3	0	2	2	0.7
45	11/05 - 11/11	4	2	13	15	3.8
46	11/12 - 11/18	4	0	1	1	0.3
47	11/19 - 11/25	3	0	2	2	0.7
48	11/26 - 12/02	3	0	2	2	0.7
49	12/03 - 12/09	4	1	0	1	0.3
50	12/10 - 12/16	2		1	1	0.5
	Totals:	114	7	82	89	
	Mean:					0.8

a/ Trapping at Junction City Weir took place from 24 May (Julian week 21) through 13 December (Julian week 50) of 1994.
b/ Half-pounder steelhead were less than or equal to 41 cm FL; larger fish were adults.

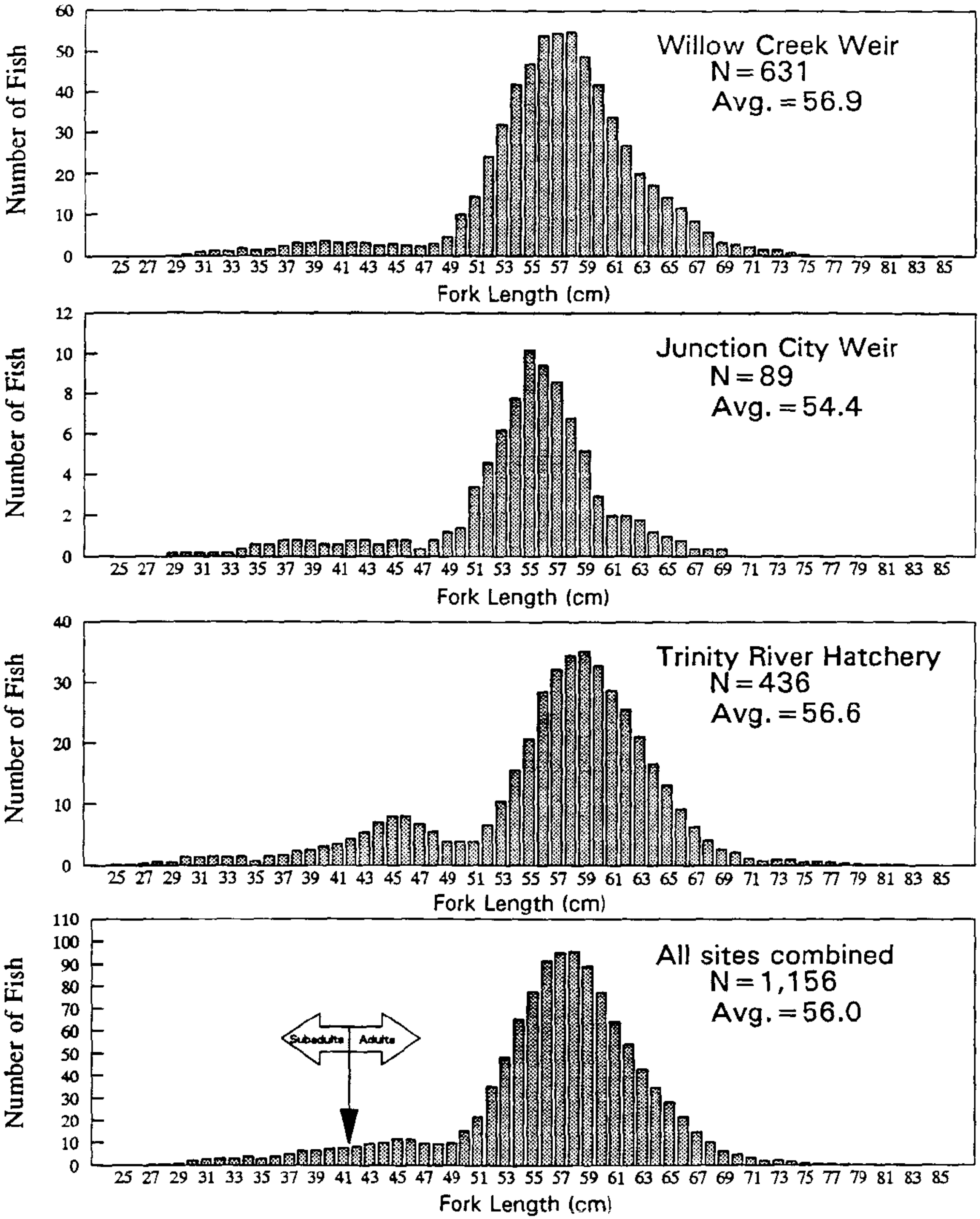


FIGURE 10. Analysis of fall-run steelhead lengths observed at the Trinity River weirs and the Trinity River Hatchery during the 1994-1995 season. The number of fish at each fork length is shown as a moving average of five, 1-cm increments. The arrow denotes the size used to separate subadults and adults for analysis.

We observed fin-clips on 210 adult and three subadult steelhead at WCW, and 69 adults and three subadults at JCW (Appendix 8). The majority of adult, fin-clipped steelhead (88.1% at WCW and 89.9% at JCW), were from the 1990 or 1992 brood year released from TRH in April 1993 (Appendix 9). Assuming that all the TRH-produced steelhead captured at the weirs were fin-clipped[7], 34.8% (210/603) and 84.1% (69/82) of the adults observed at WCW and JCW, respectively, were TRH-produced.

Incidence of Gill-net Wounds and Hook Scars. Ten (1.6%) of the steelhead trapped at WCW and one (1.1%) of the steelhead trapped at JCW had gill-net wounds.

Three (0.48%) of the steelhead at WCW and four (4.5%) of the steelhead at JCW bore fresh hook-scars.

Recovery of Tagged Fish

Tag Returns by Anglers

Angler Harvest Regulations. Department of Fish and Game fishing regulations can affect the return of tags each year by limiting harvest. Special quota restrictions were in place during the 1994-95 season which served to decreased the number of adult chinook caught by anglers (Appendix 10).

Spring Chinook. Anglers returned 37 tags from harvested spring chinook tagged at JCW (23 grilse and 14 adults). These included 18 reward and 19 non-reward tags. We estimated the harvest rate, based on the return of reward tags, at 3.1% (6/196) for adults and 16.7% (12/72) for grilse.

Anglers returned four additional tags from spring chinook (two grilse and two adults) that were caught and released. We estimated that the catch-and-release rate for spring chinook upstream of JCW, based on the return of reward tags, was 0.5% (1/197) for adults and 2.7% (2/74) for grilse.

Fall Chinook. Anglers returned 50 tags (25 reward and 25 non-reward) from harvested fall chinook salmon (34 grilse and 16 adults) tagged at WCW. Based on the return of the reward tags (from eight adults and 17 grilse) the estimated harvest rate of fall chinook upstream of WCW was 1.8% for adults and 7.3% for grilse.

Anglers returned an additional 13 reward tags (six adults and seven grilse) from fish that were caught and released. We

---

7/ This seems a safe assumption since 97.7% of the steelhead recovered at TRH bore fin-clips indicating they were of TRH origin (see p.107).

estimated that the catch-and-release rate of fall chinook upstream of WCW was 1.4% (6/442) and 2.9% (7/240) for adults and grilse, respectively.

Only one tag (non-reward) was returned from a JCW-tagged fall chinook grilse that was harvested. Based on the returns of both reward and nonreward tags, we estimated that the harvest of fall chinook upstream of JCW was 0.5% (1/211) for grilse. We concluded that no adult fall chinook (tagged at JCW) were harvested.

Based on tag returns, anglers did not catch and release any of the fall chinook that had been originally tagged at JCW.

Coho Salmon. None of the tags placed on coho salmon at WCW or JCW were returned by anglers. We therefore concluded that no coho salmon were harvested, or caught and released, upstream of the WCW in the Trinity River basin during the 1994-95 season.

Fall-run Steelhead. Anglers returned 70 tags from harvested WCW-tagged steelhead. Based on the reward tags returned (only reward tags were used on steelhead), we estimated that anglers harvested 12.8% of the steelhead migrating upstream of WCW. There was little difference in the harvest of unmarked and fin-clipped steelhead. Twenty-five (13.3%) of the 188 tags applied to fin-clipped steelhead were reported harvested by anglers, while 45 (12.6%) of the 357 tags applied to unmarked steelhead were reported as harvested.

There apparently was a substantial catch-and-release fishery for steelhead in the Trinity River. Based on the return of tags by anglers who reported releasing their fish, 7.9% of the steelhead migrating upstream of WCW were caught and released at least once[8/].

Anglers returned seven tags from harvested JCW-tagged steelhead. We estimated that the harvest rate was 8.9% for steelhead upstream of JCW.

Three of the steelhead (3.7%) tagged at JCW were reported caught and released by anglers.

Trinity River Hatchery

Spring Chinook. Based on CWT recoveries, spring chinook began entering TRH during JW 36 (3-9 Sept 1994) and continued through JW 43 (22-28 Oct) (Figure 11, Table 8). We estimated that 2,887

8/ Since the anglers removed the tags from caught-and-released fish we had no way to determine if these fish were caught again.

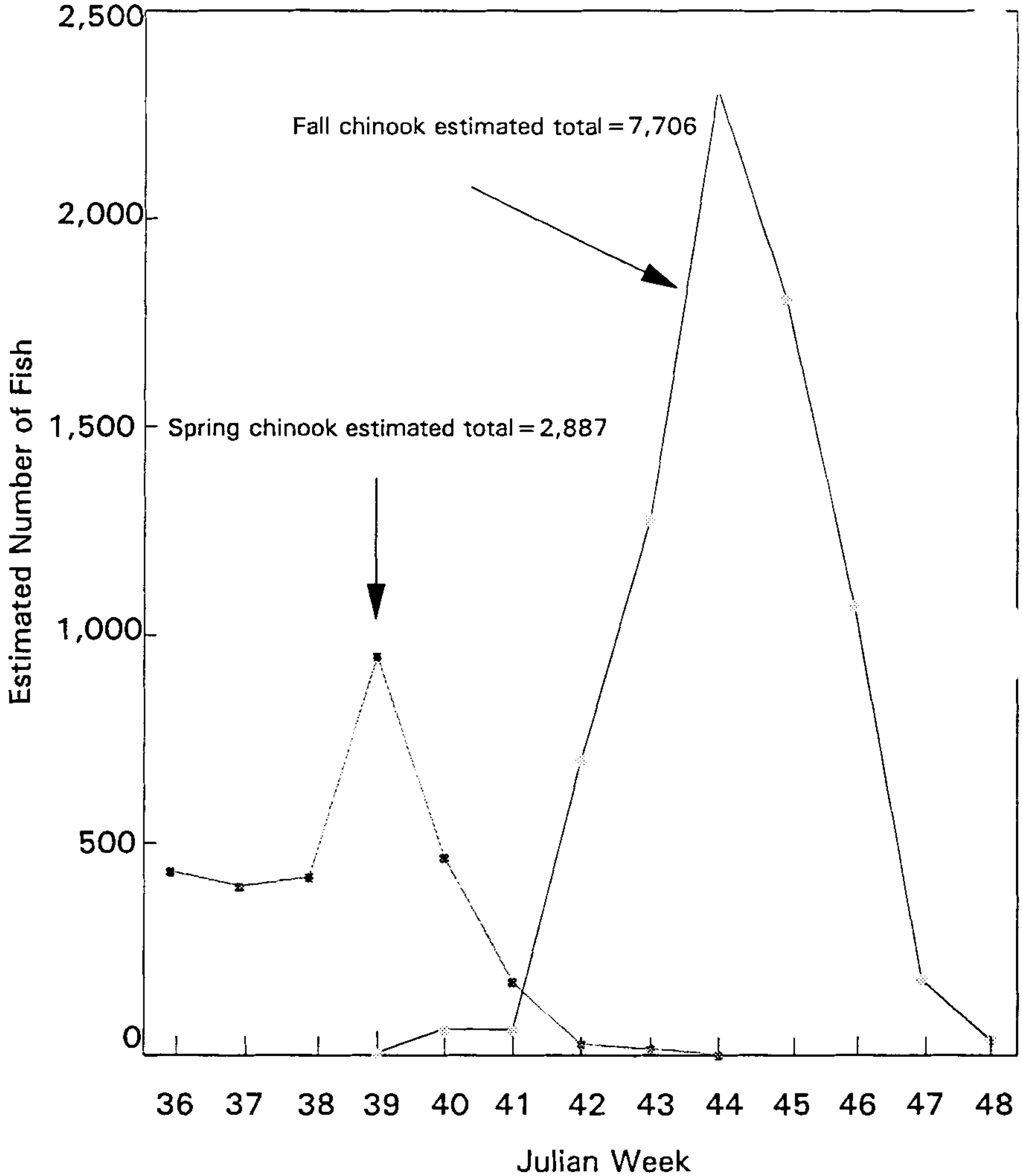


FIGURE 11. Estimated numbers of spring- and fall-run chinook salmon that entered Trinity River Hatchery each week during the 1994-1995 season, based on expansion of numbers of coded-wire tagged fish recovered.

TABLE 8. Recoveries of coded-wire-tagged, Trinity River Hatchery-produced, spring-run chinook salmon at Trinity River Hatchery during the 1994-95 season. a/

		Brood year									
		1990			1991		1992				
Julian week		Coded-wire tag number									
of entry b/	Inclusive dates	601040103	065636	065640	0601040105	065658	0601040106	065734	065735	Shed tags c/	Total
36	09/03 - 09/09	18	2	7	22	15	37	3	1	12	117
37	09/10 - 09/16	18	1	3	27	4	34	3	0	9	99
38	09/17 - 09/23	17	0	0	18	4	35	1	2	11	88
39	09/24 - 09/30	12	14	3	30	5	85	2	1	26	178
40	10/01 - 10/07	3	0	1	24	3	57	7	4	15	114
41	10/08 - 10/14	0	0	2	4	0	22	2	0	5	35
42	10/15 - 10/21	0	0	0	3	0	3	2	0	0	8
43	10/22 - 10/28	0	0	0	2	0	1	1	1	0	5
Totals:		68	17	16	130	31	274	21	9	78	644

a/ The fish ladder was open from 6 September 1994 (JW 36) through 13 April 1995 (JW 15).

b/ Entry week was the week that fish were initially sorted, although they may have actually entered the hatchery during the previous sorting week.

c/ No CWTs were recovered from the Ad-clipped fish. Chinook with shed tags recovered after 14 October 1994 (JW 41) were considered fall-chinook and are shown in Table 10.

spring chinook (944 grilse and 1,943 adults) entered TRH during the 1994-95 season.

We recovered 50 (17.5%) of 286 WCW-tagged spring chinook at TRH (Table 9). The mean FL of the Project-tagged spring chinook from WCW that entered TRH was 4.2 cm less than the mean of those effectively tagged at the weirs (Appendix 4).

We recaptured 350 spring chinook (90 grilse and 260 adults) at TRH that we had tagged at JCW, including five fish which had been tagged at WCW, and recovered at both JCW and TRH (Table 9). Thus, we recovered 42.5% of the spring chinook which were effectively tagged at JCW (Appendix 4). The mean FLs of effectively tagged JCW fish (62.9 cm) and JCW-tagged fish recovered at TRH (62.5 cm) were essentially the same.

We recovered 644 Ad-clipped spring chinook at TRH, from which 566 CWTs were recovered (Table 8). The greatest returns of CWTed fish were from the 1991 and 1992 BYs that had been released as fingerlings.

Fall Chinook. Based on the recovery of CWTs, the first fall chinook entered TRH during JW 39 (24-30 Sept 1994), the run peaked JW 44 (29 Oct-4 Nov), and decreased steadily through JW 48 (26 Nov-2 Dec), when the last CWTed chinook entered the hatche (Table 10, Figure 11). We estimated that 7,706 fall chinook (4,442 grilse and 3,264 adults) entered TRH during the 1994-95 season.

We recaptured 707 fall chinook (300 grilse and 407 adults) at TRH that we had tagged at WCW (Table 9), which was 35.1% of those effectively tagged at the weir. These Project-tagged fish recovered at TRH averaged 60.4 cm in FL, 2.6 cm smaller than the mean size of those effectively tagged at the weirs (Appendix 5).

We recaptured 171 (109 grilse and 62 adults) JCW-tagged fall chinook (45.4% of those effectively tagged) at TRH (Table 9). These counts included 16 fall chinook that had been previously tagged and released at WCW. The Project-tagged fish recovered at TRH averaged 56.0 cm in FL, 1.8 cm smaller than the mean size of those effectively tagged (Appendix 5).

We recovered 989 Ad-clipped fall chinook at TRH, from which 891 CWTs were recovered (Table 10). TRH fingerling-released CWT-group 0601040104 (1991 BY) and yearling-released group 065733 (1992 BY) comprised 37.0% and 26.4%, respectively, of the CWTed fall chinook recovered.

Coho Salmon. The first coho entered TRH during JW 42 (15-21 Oct 1994), peaked during JW 44 (29 Oct-4 Nov), remained relatively high the next four weeks, and then decreased thereafter until JW 1 (1-6 Jan 1995) when the last coho was noted

TABLE 9 . Total numbers and numbers of Project-tagged chinook and coho salmon that entered Trinity River Hatchery (TRH) during the 1994-95 season. a/

		Numbers of chinook salmon					Numbers of coho salmon		
		Total entering	Spring-run from tagging site b/		Fall-run from tagging site		Total entering	From tagging site	
Julian week of entry c/	Inclusive dates	TRH d/	JCW	WCW	JCW	WCW	TRH d/	JCW	WCW
36	09/03/94 - 09/09/94	436	45						
37	09/10/94 - 09/16/94	399	44	1					
38	09/17/94 - 09/23/94	421	55	0					
39	09/24/94 - 09/30/94	957	109 (3)e/	15		1			
40	10/01/94 - 10/07/94	631	65 (2)	19	2 (1)	9			
41	10/08/94 - 10/14/94	331	17	5	5 (2)	11			
42	10/15/94 - 10/21/94	725	12	6	32 (5)	69	5		
43	10/22/94 - 10/28/94	1,291	1	2	45 (1)	120	3		
44	10/29/94 - 11/04/94	2,311	1	2	56 (5)	192	59	2	8
45	11/05/94 - 11/11/94	1,805	1		15 (2)	184	44	1	3
46	11/12/94 - 11/18/94	1,073			16	103	33	1	2
47	11/19/94 - 11/25/94	179				15	31	1	1
48	11/26/94 - 12/02/94	34				3	48	0	2
49	12/03/94 - 12/09/94	0					37	0	1
50	12/10/94 - 12/16/94	0					15	0	
51	12/17/94 - 12/23/94	0					15	1	
52	12/24/94 - 12/31/94	0					0		
1	01/01/95 - 01/07/95	0					4		
Totals:		10,593	350 (5)	50	171 (16)	707	294	6	17

a/ The fish ladder was open 6 September 1994 (JW 36) through 13 April 1995 (JW 15).
b/ Tagging site: JCW=Junction City Weir, WCW=Willow Creek Weir
c/ Entry week was the week that fish were initially sorted, although they may have actually entered the hatchery during the previous sorting week.
d/ Numbers shown include tagged fish recovered in the same week.
e/ Numbers in parenthesis are fish tagged and released at WCW that were recaptured and re-released at JCW, and that subsequently entered TRH. They are included in the total entering TRH.

TABLE 10. Recoveries of coded-wire-tagged, Trinity River Hatchery-produced, fall-run chinook salmon at Trinity River Hatchery during the 1994-95 seasons. a/

		Brood year								
		1990	1991			1992				
		Coded-wire tag number								
Julian week of entry b/	Inclusive dates	065638	0601040104	065731	065732	065733	065748	065749	Shed tags c/	Total
39	09/24 - 09/30	0	1	0	0	0	0	0	0	1
40	10/01 - 10/07	10	4	0	0	1	0	0	0	15
41	10/08 - 10/14	4	5	1	1	0	0	0	0	11
42	10/15 - 10/21	14	28	8	9	8	0	0	10	77
43	10/22 - 10/28	7	82	18	22	27	1	3	17	177
44	10/29 - 11/04	5	95	40	43	88	15	4	31	321
45	11/05 - 11/11	1	65	13	23	77	9	9	25	222
46	11/12 - 11/18	0	41	18	22	30	10	5	14	140
47	11/19 - 11/25	0	8	3	2	4	0	2	1	20
48	11/26 - 12/02	0	1	1	2	0	1	0	0	5
Totals:		41	330	102	124	235	36	23	98	989

a/ The fish ladder was open from 6 September 1994 (JW 36) through 13 April 1995 (JW15).

b/ Entry week was the week that fish were initially sorted, although they may have actually entered the hatchery during the previous sorting week.

c/ No CWT were recovered from the Ad-clipped fish. Chinook with shed tags recovered before 15 October 1994 (JW 42) were considered spring-run and are shown in Table 8.

(Table 9). We recovered 294 coho (160 grilse and 134 adults) at TRH during the 1994-95 season.

We recovered 17 WCW-tagged coho (14 grilse and three adults) at TRH (33.3% those effectively tagged). Their mean FL (48.9 cm) was 2.0 cm less than the mean FL of WCW effectively tagged coho (Appendix 6).

We recovered 6 coho (four grilse and two adults) at TRH that had been tagged at JCW, 20.7% of those effectively tagged (Table 9). These fish ranged in size from 43 to 69 cm FL and averaged 51.2 cm FL, essentially the same as the mean size of effectively tagged coho at JCW (Appendix 6).

We recovered 15 CWTs from the 18 Ad-clipped coho that entered TRH (Table 11). The CWTs represented two tag-groups: code numbers 065662 (1991 BY) and 065760 (1992 BY).

Fall-run Steelhead. The steelhead run into TRH began JW 39 (24-30 Sept 1994) and ended JW 14 (2-8 April 1995) after which the fish ladder was closed. A total of 436 steelhead (25 sub-adults and 411 adults) entered TRH during the 1994-95 season (Table 12).

Fifty-two WCW-tagged steelhead (9.5% of those effectively tagged) entered TRH (Table 12). They ranged in size from 53 to 71 cm FL, with a mean of 58.9 cm FL, 1.1 cm larger than those effectively tagged at WCW (Appendix 8). We recovered 23 Project-tagged steelhead from JCW (29.1% of those effectively tagged) at TRH (Table 12). These fish ranged from 53 to 67 cm FL with a mean of 58.2 cm FL, 0.5 cm larger than the effectively tagged fish (Appendix 8).

We recovered 403 adult (>41 cm FL) steelhead at TRH that had been fin-clipped as juveniles by Trinity Fisheries Investigation Project (TFIP) personnel (another element of CDFG working within the Trinity River basin). Fin-clipped steelhead accounted for 98.1% of the adult steelhead entering TRH (97.7% of adults and sub-adults combined). The bulk of the fin-clipped recoveries (360/403) were from the 1992 BY marked with an adipose plus left ventral fin-clip[9/] released as yearlings in 1993 (Appendix 9). Sizes of all Ad+LV fin-clipped steelhead recovered at TRH ranged from 36-75 cm FL, averaging 57.7 cm FL (Appendix 11).

9/ It is possible that some steelhead with this fin-clip were from the 1990 BY released from TRH in March of 1991.

TABLE 11. Recoveries of coded-wire-tagged, Trinity River Hatchery-produced, coho salmon at Trinity River Hatchery during the 1994-95 season. a/

		Brood year			
		1991	1992		
Julian week		Coded-wire tag number			
of entry b/	Inclusive dates	065662	065760	Shed tags c/	Total
44	10/29/94 - 11/04/94	0	4	1	5
45	11/05/94 - 11/11/94	1	3	1	5
46	11/12/94 - 11/18/94	0	0	1	1
47	11/19/94 - 11/25/94	1	2	0	3
48	11/26/94 - 12/02/94	2	0	0	2
49	12/03/94 - 12/09/94	1	0	0	1
50	12/10/94 - 12/16/94	0	0	0	0
51	12/17/94 - 12/23/94	0	0	0	0
52	12/24/94 - 12/31/94	0	0	0	0
1	01/01/95 - 01/07/95	1	0	0	1
Totals:		6	9	3	18

a/ The fish ladder was open from 6 September 1994 (JW 36) through 13 April 1995 (JW 15).

b/ Entry week was the week that fish were initially sorted, although they may have actually entered the hatchery during the previous sorting week.

c/ No tag was recovered from the Ad-clipped fish.

TABLE 12. Total numbers and numbers of Project-tagged fall-run steelhead that entered Trinity River Hatchery (TRH) each week during the 1994-95 season. a/

Julian week of entry c/	Inclusive dates			Number entering TRH: Adults d/	Number entering TRH: Sub-adults d/	Number entering TRH: Total	Recoveries from tagging site b/: JCW	Recoveries from tagging site b/: WCW
39	09/24/94	-	09/30/94	1	0	1		
40	10/01/94	-	10/07/94	3	0	3		
41	10/08/94	-	10/14/94	0	0	0		
42	10/15/94	-	10/21/94	1	0	1		
43	10/22/94	-	10/28/94	0	0	0		
44	10/29/94	-	11/04/94	14	0	14	1	1
45	11/05/94	-	11/11/94	10	0	10	1	3
46	11/12/94	-	11/18/94	1	0	1	0	0
47	11/19/94	-	11/25/94	1	0	1	0	0
48	11/26/94	-	12/02/94	0	0	0	0	0
49	12/03/94	-	12/09/94	0	0	0	0	0
50	12/10/94	-	12/16/94	0	0	0	0	0
51	12/17/94	-	12/23/94	0	0	0	0	0
52	12/24/94	-	12/31/94	0	0	0	0	0
1	01/01/95	-	01/07/95	1	0	1	0	0
2	01/08/95	-	01/14/95	33	1	34	3	6
3	01/15/95	-	01/21/95	12	0	12	1	3
4	01/22/95	-	01/28/95	89	3	92	3	6
5	01/29/95	-	02/04/95	50	10	60	8	11
6	02/05/95	-	02/11/95	17	2	19	0	6
7	02/12/95	-	02/18/95	14	0	14	2	2
8	02/19/95	-	02/25/95	12	1	13	0	0
9	02/26/95	-	03/04/95	47	1	48	1	3
10	03/05/95	-	03/11/95	32	1	33	2	4
11	03/12/95	-	03/18/95	58	5	63	1	7
12	03/19/95	-	03/25/95	9	1	10		
13	03/26/95	-	04/01/95	4	0	4		
14	04/02/95	-	04/08/95	2	0	2		
Totals:				411	25	436	23	52

a/ The fish ladder was open 6 September 1994 (JW 36) through 13 April 1995 (JW 15).

b/ Tagging site: JCW=Junction City Weir, WCW=Willow Creek Weir

c/ Entry week was the week that fish were initially sorted, although they may have actually entered the hatchery during the previous sorting week.

d/ Steelhead less than or equal to 41 cm FL are considered sub-adults; larger fish were adults.

Run-size, Angler Harvest, and Spawner Escapement Estimates

We tagged and recovered too few grilse salmon to stratify our estimates by adults and grilse this year. Instead, we combined the numbers of adults and grilse tagged and recovered for calculating the population estimate, and then proportioned the estimate based on the ratio of adults and grilse observed at each of the weirs.

Spring-run Chinook Salmon

We estimated that 6,788 (4,995 adults and 1,793 grilse) spring chinook (including those harvested) migrated into the Trinity River basin upstream of JCW during the 1994-95 season (Table 13). Anglers caught and kept an estimated 299 (16.7%) of the grilse and 155 (3.1%) of the adults from the spring run. The spawning escapement above JCW during the 1994-95 season was estimated to be 4,840 adult fish, including 1,943 adult spring chinook that entered TRH (Table 14).

Based on the Normal Approximation, the 95% confidence interval for the run-size estimate was 6,140 to 7,472 fish (Table 13).

Estimated run size has ranged from 62,692 fish in 1988 to 2,381 fish in 1991 (Appendix 12).

Fall-run Chinook Salmon

We estimated that 21,924 (14,430 adults and 7,494 grilse) fall chinook (including those harvested) migrated into the Trinity River basin upstream of WCW during the 1994-95 season, and 16,937 (7,276 adults and 9,661 grilse) of these fish continued their migration upstream of JCW (Table 13). We estimated that anglers harvested 260 adults (1.8%) and 547 (7.3%) grilse from the 1994 fall chinook run, including 48 grilse caught upstream of JCW. Therefore, we estimated the Trinity River fall chinook spawner escapement at 14,170 adult fish upstream of WCW and 7,276 adults upstream of JCW, including the 3,264 adult fall chinook that entered TRH (Table 14).

Based on the Normal Approximation, the 95% confidence interval for the fall chinook run-size estimate upstream of Willow Creek Weir was 20,413 to 23,491 fish (Table 13).

The fall chinook total (grilse plus adults) run size upstream of WCW this year was the highest since 1989 and was approximately 53% of the mean run size for the 18 years since the current program began in 1977. The estimated total run size upstream of WCW has ranged from 147,888 fish in 1986 to 9,207 fish in 1991 (Appendix 13). For adults alone, the estimated run size has ranged from 120,382 in 1986 to last year's low of 7,104 fish (Appendix 13).

TABLE 13. Run-size estimates and confidence limits for Trinity River basin chinook and coho salmon, and fall-run steelhead during the 1994-95 season.

Species/ race	Area of Trinity River basin for run-size estimate	Stratum a/	Number effectively-tagged b/	Trinity River Hatchery recoveries: Number examined for tags c/	Trinity River Hatchery recoveries: Number of tags in sample	Run-size estimate d/	Confidence limits 1-P=0.95	Confidence limit estimator
Spring-run chinook	Upstream of Junction City Weir	Grilse	217	944	90	1,793		
		Adults	607	1,943	260	4,995		
		Total	824	2,887	350	6,788	6,140 - 7,472	Normal
Fall-run chinook	Upstream of Willow Creek Weir	Grilse	685	4,442	300	7,494		
		Adults	1,328	3,264	407	14,430		
		Total	2,013	7,706	707	21,924	20,413 - 23,491	Normal
Fall-run chinook	Upstream of Junction City Weir	Grilse	211	4,442	109	9,661		
		Adults	166	3,264	62	7,276		
		Total	377	7,706	171	16,937	14,632 - 19,744	Poisson
Coho	Upstream of Willow Creek Weir	Grilse	35	160	14	613		
		Adults	16	134	3	239		
		Total	51	294	17	852	552 - 1,423	Poisson
Fall-run steelhead	Upstream of Willow Creek Weir	Adults	545	411	52	4,244	3,369 - 5,396	Binomial
Fall-run steelhead	Upstream of Junction City Weir	Adults	79	411	23	1,373	943 - 2,129	Poisson

a/ Stratum: Grilse = two-year-old salmon, Adults = three years and older salmon. Steelhead adults were fish greater than 41 cm FL.

b/ The number of effectively tagged fish was corrected for tagging mortalities, fish not tagged and fish which had their tags removed (caught and released by anglers).

c/ Numbers of spring- and fall-run chinook were estimated from expansion of coded-wire tag recoveries at Trinity River Hatchery. Coho and steelhead numbers were actual recoveries.

d/ Estimates for grilse and adult salmon were based on proportioning the total run-size by the ratio of grilse to adults observed at the respective weir.

TABLE 14. Estimates of Trinity River basin chinook and coho salmon, and adult fall-run steelhead run-size, angler harvest and spawner escapements during the 1994-95 season.

				Angler harvest		Spawner escapement		
Species/ race	Area of Trinity River basin for run-size estimate	Stratum a/	Run size	Harvest rate b/	Number of fish c/	Natural d/	Trinity River Hatchery	Total
Spring-run chinook	Upstream of Junction City Weir	Grilse	1,793	16.7%	299	550	944	1,494
		Adults	4,995	3.1%	155	2,897	1,943	4,840
		Total	6,788	6.7%	454	3,447	2,887	6,334
Fall-run chinook	Upstream of Willow Creek Weir	Grilse	7,494	7.3%	547	2,505	4,442	6,947
		Adults	14,430	1.8%	260	10,906	3,264	14,170
		Total	21,924	3.7%	807	13,411	7,706	21,117
Fall-run chinook	Upstream of Junction City Weir	Grilse	9,661	0.5%	48	5,171	4,442	9,613
		Adults	7,276	0.0%	0	4,012	3,264	7,276
		Total	16,937	0.3%	48	9,183	7,706	16,889
Coho	Upstream of Willow Creek Weir	Grilse	613	0.0%	0	453	160	613
		Adults	239	0.0%	0	105	134	239
		Total	852	0.0%	0	558	294	852
Fall-run steelhead	Upstream of Willow Creek Weir	Natural	2,767	12.6%	349	2,410	8	2,418
		Hatchery	1,477	13.3%	196	878	403	1,281
		Total	4,244	12.8%	545	3,288	411	3,699
Fall-run steelhead	Upstream of Junction City Weir	Natural	218	8.3%	18	192	8	200
		Hatchery	1,155	9.0%	104	648	403	1,051
		Total	1,373	8.9%	122	840	411	1,251

a/ Stratum: Grilse = two-year-old salmon, Adults = three years and older salmon, Natural = naturally produced steelhead, Hatchery = hatchery-produced steelhead. Natural and hatchery components calculated by proportioning the total run size by the ratio of fin-clipped (hatchery) to non-fin-clipped (natural) steelhead observed at the respective weirs.

b/ Except for fall chinook at Junction City weir, all harvest rates were based on the return of reward-tags. The harvest rate of fall chinook at Junction City weir was based on the return of reward plus non-reward tags.

c/ Calculated as the run size times the harvest rate.

d/ Calculated as run size minus angler-harvest minus hatchery escapement.

The estimated total run size upstream of JCW is also the highest since 1989. The total run size upstream of JCW has ranged between 121,033 and 4,787 fish. For adults alone, run size has ranged between 104,469 and last year's low of 3,597 fish (Appendix 14).

Coho Salmon

We estimated that 852 (239 adults and 613 grilse) coho migrated into the Trinity River basin upstream of WCW during the 1994-95 season (Table 13). None of the tags applied to coho were returned from anglers. We therefore concluded that there was no harvest of coho salmon upstream of the WCW this year. The spawning escapement estimate for coho upstream of WCW was 239 adult fish, 134 of which entered TRH (Table 14).

Based on the Poisson Approximation, the 95% confidence interval for the coho run-size estimate upstream of WCW was 552 to 1,423 fish (Table 13).

Estimated coho salmon run size upstream of WCW has ranged from 59,079 fish in 1987 to this year's low of 852 (Appendix 15). This year's number of returning adult coho (239 fish) was also the lowest recorded since our monitoring began in 1977. A historical low for coho returns was also noted at TRH this year and was attributed primarily to the poor contribution of the CWT group 065662, returning as three-year-olds (BY 1991).

We tagged and recaptured too few coho to generate a reliable run-size estimate upstream of JCW this year.

Estimated coho run size upstream of JCW has ranged from a low of 2,177 fish in 1990 to a high of 26,370 fish in 1988 (Appendix 16). However, had there been sufficient tag recovery numbers to generate a reliable run-size estimate upstream of JCW this year, the coho run size would have probably been an all-time low (considering the fact that the run size above WCW was only 852 fish).

Adult Fall-run Steelhead

We estimated that 4,244 adult steelhead, comprised of 2,767 naturally produced and 1,477 hatchery-produced fish, migrated upstream of WCW (Tables 13 and 14). From these, anglers harvested an estimated 349 (12.6%) naturally produced and 196 (13.3%) hatchery-produced adult steelhead. Eight naturally produced and 403 hatchery-produced adult steelhead entered the hatchery leaving 2,410 naturally produced and 878 hatchery-produced steelhead to spawn in the wild upstream of WCW (Table 14).

The 95% confidence interval, based on the Binomial Approximation, was between 3,369 and 5,396 adult steelhead upstream of WCW (Table 13).

We estimated 1,373 adult steelhead (218 naturally produced and 1,155 hatchery-produced fish) migrated upstream of JCW (Tables 13 and 14). Anglers harvested an estimated 122 adults consisting of 18 naturally produced and 104 hatchery-produced fish, leaving 840 adults (192 naturally produced and 648 hatchery-produced) to spawn in the wild (Table 14).

The 95% confidence interval, based on the Poisson Approximation, was 943 to 2,129 adult steelhead upstream of JCW (Table 13).

The adult steelhead run size upstream of WCW this year showed a slight improvement over last year's run (4,244 vs. 3,243 fish). Intermittent estimates made since 1980 have ranged from 37,276 fish in 1989 to 3,046 in 1992 (Appendix 17). The run size for the past three years (1992-94) has averaged 3,511 fish, approximately 30% of the mean estimated run size (11,726 fish) that was observed from 1980 through this year (not including years in which no estimate was made).

Steelhead run size upstream of JCW this year was the lowest on record. Previous run-size estimates upstream of JCW have range from this year's low of 1,373 fish to 13,574 in 1989 (Appendix 18).

RECOMMENDATIONS

1. Tagging and recapture operations for adult spring-run and fall-run chinook and coho salmon, and adult fall-run steelhead in the Trinity River basin should be continued during the 1995-96 migration season, using the capture sites near Willow Creek and Junction City.

2. All coho salmon should be tagged with reward tags to ensure reliable estimates of harvest and catch-and-release rates. A declining Trinity River coho salmon population and the possible listing of these coho as threatened or endangered are the rationale for this recommendation.

3. Continue to trap at WCW for five (instead of four) nights-per-week with mid-day weir openings. Preliminary data indicated that our trapping efficiency was increased using the five-day schedule, while reducing numbers of fish "stacking up" downstream of the weir.

LITERATURE CITED

Chapman, D. G. 1948. A mathematical study of confidence of salmon populations calculated from sample tag ratios. Int. Pac. Sal. Fish. Comm. Bull. 2, pp. 69-85.

Dixon, W. and F. Massey. 1969. Introduction to Statistical Analysis. McGraw-Hill Book Co., New York, N.Y. 638 p.

Gibbs, E. D. 1956. A report on the king salmon, Oncorhynchus tshawytscha, in the upper Trinity River, 1955. Calif. Dept. of Fish and Game, Inland Fish. Admin. Rep. No. 56-10. 14 p.

Heubach, B. 1984a. Progress report 1980-81 season. Task VI. Trinity River salmon and steelhead tagging program. pp. 92-151. In: P. M. Hubbell (ed.), Progress Report. Fishery Investigations - Trinity River. Trinity River Basin Fish and Wildlife Task Force Priority Work Item No. 5. Tasks I and VI. November 1984. 151 p. Available from Calif. Dept. Fish and Game, Inland Fish. Div., 1416 9th St., Sacramento, CA 95814.

__________ 1984b. Progress report 1981-82 season. Task VI. Trinity River salmon and steelhead tagging program. pp. 49-106. In: P. M. Hubbell (ed.), Progress Report. Fishery Investigations - Trinity River. Trinity River Basin Fish and Wildlife Task Force Priority Work Item No. 5. Tasks I and VI. December 1984. 106 p. Available from Calif. Dept. Fish and Game, Inland Fish. Div., 1416 9th St., Sacramento, CA 95814.

Heubach, B., and P. M. Hubbell. 1980. FY 1979 progress report. Task VI. Lower Trinity River salmon and steelhead tagging program. pp. 80-132. In: P. M. Hubbell (ed.), Progress Report. Fishery Investigations - Trinity River. Trinity River Basin Fish and Wildlife Task Force Priority Work Item No. 5. September 1980. 141 p. Available from California Dept. Fish and Game, Inland Fish. Div., 1416 9th St., Sacramento, CA 95814.

Heubach, B., M. Lau, and M. Boucke. 1992a. Annual run-size, angler harvest, and spawner escapement of chinook and coho salmon in the Trinity River basin. Chapter IV. Job IV. pp. 82-127. In: K. Urquhart (ed.), Annual Report of the Trinity River Basin Salmon and Steelhead Monitoring Project, 1989-90 Season. June 1992. 140 p. Available from Calif. Dept. Fish and Game, Inland Fish. Div., 1416 9th St., Sacramento, CA 95814.

Heubach, B., M. Lau, and E. Miller. 1992b. Annual run-size, angler harvest, and spawner escapement of chinook and coho salmon in the Trinity River basin. Chapter IV. Job IV. pp. 93-145. In: K. Urquhart, and R. Carpenter (eds.), Annual Report of the Trinity River Basin Salmon and Steelhead Monitoring Project, 1990-91 Season. December 1992. 186 p. Available from Calif. Dept. Fish and Game, Inland Fish. Div., 1416 9th St., Sacramento, CA 95814.

La Faunce, D. A. 1965a. King (chinook) salmon spawning escapement in the upper Trinity River, 1963. Calif. Dept. Fish and Game, Mar. Res. Admin. Rep. No. 65-3. 10 p.

_______________. 1965b. A steelhead spawning survey of the upper Trinity River system, 1964. Calif. Dept. Fish and Game, Mar. Res. Admin. Rep. No. 65-4. 5 p.

_______________. 1967. A king salmon spawning survey of the South Fork Trinity River, 1964. Calif. Dept. Fish and Game, Mar. Res. Admin. Rep. No. 67-10. 13 p.

Lau M., B. Heubach, and E. Miller. 1994. Annual run-size, harvest, and spawner escapement estimates for Trinity River Basin chinook and coho salmon and steelhead. Chapter IV. Job IV. pp. 103-167. In: K. Urquhart and R. M. Kano (eds.), Annual Report of the Trinity River Basin Salmon and Steelhead Monitoring Project, 1991-1992 Season. February 1994. 235 p. Available from Calif. Dept. Fish and Game, Inland Fish. Div., 1416 9th St., Sacramento, CA 95814.

Miller, E. E. 1975. A steelhead spawning survey of the tributaries of the upper Trinity River and upper Hayfork Creek drainages, 1973. Calif. Dept. Fish and Game, Anad. Fish. Admin. Rep. No. 75-5. 8 p.

Moffett, J. W. and S. H. Smith. 1950. Biological investigations of the fishery resources of Trinity River, California. USFWS Spec. Sci. Rep.-Fisheries, No. 12. 71 p.

Ricker, W. E. 1975. Computation and Interpretation of Biological Statistics of Fish Populations. Bull. Fish. Res. Bd. Can. No. 191. 382 p.

Rogers, D. W. 1970. A king salmon spawning escapement and spawning habitat survey in the upper Trinity River and its tributaries, 1968. Calif. Dept. Fish and Game, Anad. Fish. Admin. Rep. No. 70-16. 13 p.

Rogers, D. W. 1972. A steelhead spawning survey of the tributaries of the upper Trinity River and upper Hayfork Creek drainage, 1971. Calif. Dept. Fish and Game, Anad. Fish. Admin. Rep. 72-12. 6 p.

____________. 1973a. A steelhead spawning survey of the tributaries of the upper Trinity River and upper Hayfork Creek drainage, 1972. Calif. Dept. Fish and Game, Anad. Fish. Admin. Rep. No. 73-5a. 8 p.

____________. 1973b. King salmon (Oncorhynchus tshawytscha) and silver salmon (Oncorhynchus kisutch) spawning escapement and spawning habitat in upper Trinity River, 1970. Calif. Dept. Fish and Game, Anad. Fish. Admin. Rep. No. 73-10. 14 p.

____________. 1982. A spawning escapement survey of anadromous salmonids in the upper Trinity River, 1971. Calif. Dept. Fish and Game, Anad. Fish. Admin. Rep. No. 82-2. 11 p.

Smith, G. E. 1975. Anadromous salmonid spawning escapements in the upper Trinity River, California, 1969. Calif. Dept. Fish and Game, Anad. Fish. Admin. Rep. No. 75-7. 17 p.

Weber, G. 1965. North coast king salmon spawning stock survey, 1956-57 season. Calif. Dept. Fish and Game, Mar. Res. Admin. Rep. No. 65-1. 34 p.

Zuspan, M. G., D. Maria and B. Heubach. 1985. Progress report 1982-83 season. Task IV. Trinity River salmon and steelhead tagging program. pp. 62-146. In: P. M. Hubbell (ed.), Progress Report. Fishery Investigations - Trinity River. Trinity River Basin Fish and Wildlife Task Force Priority Item No. 5. January 1985. 145 p. Available from Calif. to Dept. Fish and Game, Inland Fish. Div., 1416 9th St., Sacramento, CA 95814.

Zuspan, M., W. Sinnen and E. Miller. 1995. Annual run-size, harvest, and spawner escapement estimates for Trinity River Basin chinook and coho salmon and steelhead. Chapter IV. Job IV. pp. 93 - 156. In: R. M. Kano (ed.), Annual Report of the Trinity River Basin Salmon and Steelhead Monitoring Project, 1992-1993 Season. March 1995. 235 p. Available from Calif. Dept. Fish and Game, Inland Fish. Div., 1416 9th St., Sacramento, CA 95814.

Zuspan, M. and W. Sinnen. 1996. Annual run-size, harvest, and spawner escapement estimates for Trinity River Basin chinook and coho salmon and steelhead. Chapter IV. Job IV. pp.97 - 162. In: R. M. Kano (ed.), Annual Report of the Trinity River Basin Salmon and Steelhead Monitoring Project, 1993-1994 Season. February 1995. 266 p. Available from Calif. Dept. Fish and Game, Inland Fish. Div., 1416 9th St., Sacramento, CA 95814.

APPENDIX 1. List of Julian weeks and their calendar date equivalents.

Julian week	Inclusive dates			Julian week	Inclusive dates		
1	01-Jan	–	07-Jan	27	02-Jul	–	08-Jul
2	08-Jan	–	14-Jan	28	09-Jul	–	15-Jul
3	15-Jan	–	21-Jan	29	16-Jul	–	22-Jul
4	22-Jan	–	28-Jan	30	23-Jul	–	29-Jul
5	29-Jan	–	04-Feb	31	30-Jul	–	05-Aug
6	05-Feb	–	11-Feb	32	06-Aug	–	12-Aug
7	12-Feb	–	18-Feb	33	13-Aug	–	19-Aug
8	19-Feb	–	25-Feb	34	20-Aug	–	26-Aug
9 a/	26-Feb	–	04-Mar	35	27-Aug	–	02-Sep
10	05-Mar	–	11-Mar	36	03-Sep	–	09-Sep
11	12-Mar	–	18-Mar	37	10-Sep	–	16-Sep
12	19-Mar	–	25-Mar	38	17-Sep	–	23-Sep
13	26-Mar	–	01-Apr	39	24-Sep	–	30-Sep
14	02-Apr	–	08-Apr	40	01-Oct	–	07-Oct
15	09-Apr	–	15-Apr	41	08-Oct	–	14-Oct
16	16-Apr	–	22-Apr	42	15-Oct	–	21-Oct
17	23-Apr	–	29-Apr	43	22-Oct	–	28-Oct
18	30-Apr	–	06-May	44	29-Oct	–	04-Nov
19	07-May	–	13-May	45	05-Nov	–	11-Nov
20	14-May	–	20-May	46	12-Nov	–	18-Nov
21	21-May	–	27-May	47	19-Nov	–	25-Nov
22	28-May	–	03-Jun	48	26-Nov	–	02-Dec
23	04-Jun	–	10-Jun	49	03-Dec	–	09-Dec
24	11-Jun	–	17-Jun	50	10-Dec	–	16-Dec
25	18-Jun	–	24-Jun	51	17-Dec	–	23-Dec
26	25-Jun	–	01-Jul	52 b/	24-Dec	–	31-Dec

a/ Eight-day week in each leap year (years divisible by 4).

b/ Eight-day week every year.

APPENDIX 2. Fork length (FL) distribution of coded-wire-tagged, Trinity River Hatchery-produced, spring-run chinook salmon recovered at Trinity River Hatchery during the 1994-95 season. a/

	Brood year								
	1990			1991		1992			
	Coded-wire tag number-age at release b/								
FL (cm)	0601040103-f	065636-y	065640-y	0601040105-f	065658-y	0601040106-f	065734-y	065735-y	Total
39							1		1
40							0		0
41						3	3	1	7
42						3	1	1	5
43						6	1	1	8
44						15	0	2	17
45						14	2	1	17
46						19	2	1	22
47				2	1	27	1	1	32
48				1	0	32	4	1	38
49				0	0	33	1		34
50				1	1	28	2		32
51				0	0	27	0		27
52				2	1	24	2		29
53				1	0	12	0		13
54				1	3	9	0		13
55			1	1	0	11	0		13
56			0	4	1	4	0		9
57			0	3	3	2	0		8
58			1	8	1	2	0		12
59			1	8	5	0	0		14
60		1	0	11	2	2	0		16
61		1	1	6	1	0	0		9
62		1	0	9	2	0	0		12
63	1	0	1	7	0	1	0		10
64	5	1	1	9	2		0		18
65	1	3	2	7	3		1		17
66	2	0	0	5	1				8
67	10	1	1	10	0				22
68	0	0	1	8	1				10
69	1	0	0	7	1				9
70	9	1	1	2	0				13
71	4	1	1	4	2				12
72	5	0	0	0					5
73	1	1	0	2					4
74	5	0	2	1					8
75	4	1	0	5					10
76	3	0	0	1					4
77	0	2	1	1					4
78	3	1	0	0					4
79	2	0	0	0					2
80	3	1	0	2					6
81	1	0	0	0					1
82	2	0	1	0					3
83	2	0		0					2
84	3	1		0					4
85	1			0					1
86				1					1
Totals:	68	17	16	130	31	274	21	9	566
Mean FL:	72.7	70.2	67.1	63.8	60.1	49.2	47.0	44.4	56.9

a/ The fish ladder was open from 6 September 1994 through 13 April 1995 (Julian weeks 37 through 15)
b/ Age at release: f = fingerlings, y = yearlings.

APPENDIX 3. Fork length (FL) distribution of coded-wire-tagged, Trinity River Hatchery-produced, fall-run chinook salmon recovered at Trinity River Hatchery during the 1994-95 season. a/

	Brood year							
	1990	1991			1992			
	Coded-wire tag number-age at release b/							
FL (cm)	065638-y	0601040104-f	065731-y	065732-y	065733-f	065748-y	065749-y	Total
40						1		1
41						0		0
42						1	1	2
43						2	2	4
44						1	2	3
45		1			1	4	0	6
46		0			2	5	3	10
47		0			10	2	3	15
48		0			2	5	4	11
49		0			6	5	1	12
50		0			11	3	1	15
51		1			12	1	3	17
52		0			21	2	2	25
53		1			26	2	1	30
54		0			32	1		33
55	1	1			31	0		33
56	1	0	1		19	0		21
57	0	1	4	1	23	1		30
58	0	3	5	0	11			19
59	1	6	3	4	14			28
60	0	8	9	2	11			30
61	0	14	5	4	2			25
62	2	13	6	10	0			31
63	0	18	9	18	0			45
64	1	21	8	14	0			44
65	4	25	17	16	1			63
66	3	26	5	11				45
67	3	39	11	13				66
68	4	29	6	11				50
69	5	25	6	5				41
70	4	23	1	7				35
71	2	17	1	1				21
72	2	20	2	3				27
73	1	9	1	2				13
74	0	7	1	2				10
75	3	5	0					8
76	1	5	1					7
77	0	6						6
78	2	3						5
79	1	0						1
80		1						1
81		1						1
82		0						0
83		0						0
84		0						0
85		1						1
Totals:	41	330	102	124	235	36	23	891
Mean FL:	68.5	67.2	64.2	65.4	54.2	47.9	47.7	62.0

a/ The fish ladder was open from 6 September 1994 through 13 April 1995 (Julian weeeks 37 through 15).

b/ Age at release: f = fingerlings, y = yearlings

APPENDIX 4. Fork length (FL) distribution of spring-run chinook salmon trapped and tagged in the Trinity River at Willow Creek and Junction City weirs, and recovered at Trinity River Hatchery (TRH) during the 1994-95 season.

	Willow Creek Weir a/				Junction City Weir b/			
FL (cm)	Total trapped	Ad-clips c/	Effective tags d/	TRH recoveries	Total trapped	Ad-clips c/	Effective tags d/	TRH recoveries
37	2				1		1	
38	3		1		0		0	
39	0		0		2		2	
40	4	1	2		3		3	
41	4	1	3	1	11	4	11	4
42	1	0	0	0	9	1	9	4
43	1	0	1	0	12	2	12	5
44	4	1	3	0	13	5	13	7
45	8	1	8	3	23	3	21	7
46	9	1	9	2	25	6	25	6
47	4	0	4	2	18	4	18	8
48	8	0	8	0	25	7	24	12
49	12	1	11	1	20	3	20	9
50	10	0	9	1	14	5	14	6
51	19	5	18	6	12	4	12	4
52	13	3	12	4	10	3	10	5
53	4	0	4	1	9	2	9	6
54	7	0	7	4	5	0	5	3
55	3	0	2	0	7	3	7	4
56	3	0	3	2	1	0	1	0
57	4	0	4	1	10	4	10	8
58	4	0	4	1	10	6	10	7
59	4	2	3	1	12	6	12	7
60	1	0	1	0	18	6	18	9
61	2	0	2	1	17	5	17	10
62	9	1	7	3	21	2	21	8
63	8	2	7	0	31	3	31	13
64	7	0	7	0	45	7	44	21
65	8	1	6	1	35	4	35	15
66	8	0	6	1	37	2	37	19
67	16	1	14	3	40	6	40	20
68	15	0	15	2	37	1	37	14
69	7	0	7	0	45	5	44	17
70	10	0	10	0	37	5	37	11
71	6	0	5	1	43	7	42	13
72	14	0	13	1	28	2	28	15
73	12	1	11	1	30	1	28	12
74	12	0	11	1	25	3	25	8
75	15	0	14	1	18	3	18	7
76	6	1	6	0	19	2	19	8
77	9		6	2	18	3	18	7
78	3		3	1	7	0	6	4
79	3		3	0	8	1	8	0
80	2		2	0	9	2	9	4
81	4		4	0	2	0	2	0
82	1		1	0	4	2	4	1
83	0		0	0	3	0	3	1
84	1		1	0	1	1	1	1
85	2		2	1	1		1	
86	2		2		0		0	
87	1		1		1		1	
88	0		0		1		1	
89	2		1					
90	2		2					
Totals:	319	23	286	50	833	141	824	350
Mean FL:	62.3	54.9	62.7	58.5	62.9	59.7	62.9	62.5
Total grilse e/:	119	14	105	27	220	52	217	90
Total adults:	200	9	181	23	613	89	607	260

a/ Trapping at Willow Creek Weir took place from Julian week 31 (3 August) through Julian week 50 (11 December) of 1994. Only chinook trapped through Julian week 35 were considered spring-run chinook.

b/ Trapping at Junction City Weir took place from Julian week 21 (24 May) through Julian week 50 (13 December) of 1994. Only chinook trapped through Julian week 38 were considered spring-run chinook

c/ Ad-clip=Adipose fin-clipped fish.

d/ The number of effectively tagged fish excludes fish that were not tagged, tagging mortalities, and fish which had their tags removed (caught and released by anglers).

e/ Spring-run chinook salmon less than or equal to 56 cm FL were considered grilse; larger fish were adults.

APPENDIX 5. Fork length (FL) distribution of fall-run chinook salmon trapped and tagged in the Trinity River at Willow Creek and Junction City weirs, and recovered at Trinity River Hatchery (TRH) during the 1994-95 season.

	Willow Creek Weir a/				Junction City Weir b/			
FL (cm)	Total trapped	Ad-clips c/	Effective tags d/	TRH recoveries	Total trapped	Ad-clips c/	Effective tags d/	TRH recoveries
35					1		1	
36	1				0		0	
37	0				0		0	
38	1				4		2	
39	1				2		1	
40	0				3	1	3	1
41	9		2	1	2	0	2	0
42	6		6	1	2	0	2	1
43	9		7	1	10	0	10	3
44	18	1	18	3	6	2	4	3
45	21	1	18	5	10	0	6	4
46	23	0	21	4	11	1	8	6
47	42	1	39	14	13	0	11	5
48	45	3	42	13	14	2	14	5
49	44	2	43	18	13	0	11	4
50	52	4	50	21	28	1	25	12
51	45	1	44	18	18	0	16	9
52	63	1	58	25	18	3	17	14
53	72	5	67	32	17	1	17	10
54	55	4	51	33	16	1	14	9
55	52	5	49	30	15	4	15	12
56	58	7	52	29	12	0	10	4
57	38	4	35	13	7	1	7	3
58	48	0	47	20	8	1	7	2
59	37	4	36	19	9	1	8	2
60	48	2	46	22	15	2	13	6
61	54	7	48	19	9	1	8	5
62	71	9	69	34	13	1	12	7
63	88	9	83	35	14	1	14	9
64	99	8	97	48	11	1	11	6
65	120	20	112	54	16	0	16	8
66	101	13	92	32	15	1	15	5
67	125	17	119	47	16	3	15	3
68	102	8	97	26	8	1	8	2
69	103	10	101	29	12	0	10	3
70	87	6	81	14	7	0	7	3
71	53	6	50	9	4	0	4	0
72	55	11	52	12	8	1	7	2
73	59	4	52	9	6		5	2
74	42	2	37	4	6		6	0
75	45	3	42	2	5		5	0
76	42	0	39	2	5		2	0
77	20	0	17	2	3		3	1
78	33	0	27	4	2		1	
79	17	1	15	0	1		1	
80	13	1	13	1	1		1	
81	12	1	11	1	2		1	
82	8		8	0	0		0	
83	7		4	1	1		1	
84	7		6		0			
85	3		1		0			
86	4		4		0			
87	1		1		0			
88	2		2		0			
89	1		1		0			
90	0		0		0			
91	0		0		0			
92	0		0		0			
93	2		1		0			
94	0				0			
95	0				0			
96	1				0			
Totals:	2,165	181	2,013	707	419	31	377	171
Mean FL:	63.0	64.0	63.0	60.4	57.6	56.6	57.8	56.0
Total grilse e/:	740	43	685	300	239	19	211	109
Total adults:	1,425	138	1,328	407	180	12	166	62

a/ Trapping at Willow Creek Weir took place from Julian week 31 (3 August) through Julian week 50 (11 December) of 1994. Only chinook trapped after Julian week 35 were considered fall-run chinook.

b/ Trapping at Junction City Weir took place from Julian week 21 (24 May) through Julian week 50 (13 December) of 1994. Only chinook trapped after Julian week 38 were considered fall-run chinook.

c/ Ad-clip=Adipose fin-clipped fish.

d/ The number of effectively tagged fish excludes fish that were not tagged, tagging mortalities, and fish which had their tags removed (caught and released by anglers).

e/ Fall-run chinook salmon less than or equal to 59 cm FL were considered grilse; larger fish were adults.

APPENDIX 6. Fork Length (FL) distribution of coho salmon trapped and tagged in the Trinity River at W[illegible]w Creek and Junction City weirs, and recovered at Trinity River Hatchery (TRH) during the 1994-95 seas[illegible]

	Willow Creek Weir a/				Junction City Weir b/			
FL (cm)	Total trapped	Ad-clips c/	Effective tags d/	TRH recoveries	Total trapped	Ad-clips c/	Effective tags d/	TRH recoveries
37	1				1			
38	0				0			
39	0				0			
40	5	1	3		3		3	
41	4	0	1		1		1	
42	4	0	4		2		2	
43	5	2	5	1	4	1	4	2
44	5	0	5	2	4	1	4	0
45	5	0	5	3	2	0	2	1
46	3	0	3	3	0	0	0	0
47	3	0	3	1	2	0	1	1
48	1	0	1	1	0	0	0	0
49	1	0	1	1	0	0	0	0
50	2	0	2	1	0	0	0	0
51	2	0	2	1	0	0	0	0
52	0	0	0	0	0	0	0	0
53	0	0	0	0	0	0	0	0
54	0	0	0	0	0	0	0	0
55	0	0	0	0	0	0	0	0
56	3	0	3	1	0	0	0	0
57	0	0	0	0	2	0	2	0
58	0	0	0	0	1	0	1	0
59	0	0	0	0	0	0	0	0
60	1	0	1	0	2	0	2	1
61	1	0	1	1	0	0	0	0
62	0	0	0	0	1	0	0	0
63	1	0	1	0	1	0	1	0
64	0	0	0	0	0	0	0	0
65	1	0	1	1	1	1	1	0
66	3	1	3		2		2	0
67	0		0		0		0	0
68	1		1		0		0	0
69	3		3		1		1	1
70	1		1		0		0	
71	1		1		1		1	
72					1		1	
Totals:	57	4	51	17	32	3	29	6
Mean FL:	49.8	48.0	50.9	48.9	51.3	50.7	51.5	51.2
Total grilse e/:	41	3	35	14	19	2	17	4
Total adults:	16	1	16	3	13	1	12	2

a/ Trapping at Willow Creek Weir took place from Julian week 31 (3 August) through Julian week 50 (11 December) of 1994.

b/ Trapping at Junction City Weir took place from Julian week 21 (24 May) through Julian week 50 (13 December) of 1994.

c/ Ad-clip=Adipose fin-clipped fish.

d/ The number of effectively tagged fish excludes fish that were not tagged, tagging mortalities and fish which had their tags removed (caught and released by anglers).

e/ Coho salmon less than or equal to 54 cm FL were considered grilse; larger fish were adults.

APPENDIX 7. Fork length (FL) distribution of coded-wire-tagged, Trinity River Hatchery-produced coho salmon recovered at Trinity River Hatchery during the 1994-95 season. a/

	Brood Year 1991	Brood Year 1992		
	Coded-wire tag number		Shed	
FL (cm)	065662	065760	tags b/	Total
39		1		1
40		0		0
41		2		2
42		0		0
43		5	1	6
44		0	0	0
45		0	0	0
46		0	0	0
47		0	0	0
48		0	1	1
49		0	0	0
50		1	0	1
51			0	0
52			0	0
53			0	0
54			0	0
55			0	0
56			0	0
57			0	0
58	1		0	1
59	0		0	0
60	0		0	0
61	0		0	0
62	0		0	0
63	1		0	1
64	0		1	1
65	2			2
66	1			1
67	0			0
68	0			0
69	1			1
Totals:	6	9	3	18
Mean FL:	64.3	42.9	51.7	51.5

a/ The fish ladder was open from 6 September 1994 through 13 April 1995 (Julian weeks 36 through 15)

b/ Adipose fin-clipped coho salmon without coded-wire tags.

APPENDIX 8. Fork Length (FL) distribution of fall-run steelhead trapped and tagged in the Trinity River at Willow Creek and Junction City weirs, and recovered at Trinity River Hatchery (TRH) during the 1994-95 season.

	Willow Creek Weir a/				Junction City Weir b/			
FL (cm)	Total trapped	Fin-clips c/	Effective tags d/	TRH recoveries	Total trapped	Fin-clips c/	Effective tags d/	TRH recoveries
31	1				1			
32	2				0			
33	3				0			
34	1				0			
35	0				0			
36	4				2			
37	0				1			
38	4	1			0			
39	5	0			1	1		
40	4	1			0	0		
41	4	1			2	2		
42	2	1	1		0	0		
43	3	2	3		0	0		
44	4	1	4		2	1	2	
45	4	1	3		0	0	0	
46	1	0	1		1	1	1	
47	3	1	2		1	1	1	
48	2	0	1		0	0	0	
49	3	1	3		0	0	0	
50	7	0	7		2	1	2	
51	9	4	8		3	3	3	
52	30	6	27		2	2	2	
53	24	10	22	1	10	9	10	1
54	51	20	46	5	6	6	6	2
55	46	17	41	7	10	7	9	3
56	59	23	52	6	11	9	11	2
57	55	22	51	5	14	12	14	4
58	59	23	52	4	6	4	5	4
59	54	14	52	4	2	1	2	0
60	47	15	43	5	1	1	1	0
61	29	9	25	2	3	3	3	2
62	21	7	17	1	3	3	3	2
63	18	9	17	4	1	1	0	0
64	20	10	19	3	2	2	2	2
65	13	6	12	1	0	0	0	0
66	15	2	13	1	0	0	0	0
67	6	2	5	1	2	2	2	1
68	5	2	5	1				
69	4	1	4	0				
70	0	0	0	0				
71	3	1	3	1				
72	3		3					
73	2		2					
74	0		0					
75	0		0					
76	0		0					
77	0		0					
78	0		0					
79	0		0					
80	0		0					
81	0		0					
82	1		1					
Totals:	631	213	545	52	89	72	79	23
Mean FL:	56.8	57.4	57.8	58.9	54.4	55.3	55.7	58.2
Total half-pounders e/:	28	3	0	0	7	3	0	0
Total adults:	603	210	545	52	82	69	79	23

a/ Trapping at Willow Creek Weir took place from Julian week 31 (3 August) through Julian week 50 (11 December) of 1994.

b/ Trapping at Junction City Weir took place from Julian week 21 (24 June) through Julian week 50 (13 December) of 1994.

c/ Since brood year 1989 all steelhead released from Trinity River Hatchery have been fin-clipped.

d/ The number of effectively tagged fish excludes fish that were not tagged, tagging mortalities and fish which had their tags removed (caught and released by anglers).

e/ Fall-run steelhead less than or equal to 41 cm FL were considered half-pounders; larger fish were adults.

APPENDIX 9. Release and recovery data for Trinity River Hatchery-produced, fin-clipped and non-fin-clipped fall-run adult steelhead in the Trinity River during the 1994-95 season.

	Release data				Recovery data			
					Numbers recovered at: a/			
Fin clip	Brood year b/	Number of marked fish	Date	Mean fork length (cm)	WCW	JCW	ANGLER	TRH
Left ventral	1991	959,313	03/16/92	18.4	19	6	4	30
Adipose+right ventral	1991	13,582	04/12/93	32.2	4	0	1	11
Adipose+left ventral	1992	323,583	04/12/93	12.5,19.8 c/	185	62	44	360
Adipose d/					2	1	1	2
Non-fin-clipped e/					393	13	77	8
Totals:					603	82	127	411

a/ WCW=Willow Creek Weir, JCW=Junction City Weir, ANGLER=Angler-harvested fish, TRH=Trinity River Hatchery. These counts are not mutually exclusive. For example, a WCW-caught steelhead could have been trapped and counted again at both JCW and TRH.

b/ Assumed brood year of the returning adults. Because fin clips were repeated every second year at the hatchery, fish with the same fin-clips may be from different brood years.

c/ Mean sizes of each of two release groups.

d/ Fin clip of unknown origin.

e/ Non-fin-clipped fall-run steelhead were assumed to be naturally produced.

APPENDIX 10. California Fish and Game Commission regulations that affected salmonid harvest in the Trinity River upstream of Willow Creek Weir during the 1994-95 season. [a/]

Body of Water		Open Season and Special Regulations.	Daily Bag and Possession Limit
(91.1) Klamath River Below Iron Gate Dam			
(I) Trinity River			
2.	Lewiston Dam to 250 feet downstream from Lewiston Dam.	Closed to all fishing all year.	
3.	From 250 feet below Lewiston Dam to Old Lewiston bridge.	Last Saturday in April through September 15. Only artificial flies with barbless hooks may be used.	2 trout, 0 salmon
4.	From Old Lewiston bridge to Highway 299 West bridge at Cedar Flat.	Last Saturday in April through March 14. Only barbless hooks may be used from August 1 through December 31.	No more than 2 trout. No more than 1 salmon over 22 inches total length. No more than 3 salmon over 22 inches in any 7 consecutive days. No more than 8 salmon may be possessed, of which no more than 3 may be over 22 inches total length.
5.	From the Highway 299 West bridge at Cedar Flat downstream to the Hawkins Bar Bridge (Road to Denny).	Last Saturday in April through August 31. November 16 through March 14. Only barbless hooks may be used from August 1 through December 31.	
6.	From Hawkins Bar Bridge (Road to Denny)to the mouth of the South Fork Trinity.	Last Saturday in April through March 14. Only barbless hooks may be used from August 1 through December 31.	
7.	The main stem Trinity River downstream from mouth of the South Fork of the Trinity.	All year. Only barbless hooks may be used from August 1 through December 31.	
8.	South Fork of the Trinity River downstream from the South Fork Trinity River bridge at Hyampom.	Saturday preceding Memorial Day through Mar. 14. Only barbless hooks may be used from August 1 through December 31.	
9.	South Fork Trinity River main stem above the South Fork Trinity River bridge near Hyampom.	Closed to all fishing all year.	
10.	North Fork Trinity River above the lower boundary of the Hobo Gulch Campground.	Closed to all fishing all year.	
11.	New River main stem above the confluence with the East Fork.	Closed to all fishing all year.	
12.	All tributaries of the Trinity River not listed above.	Last Saturday in Apr. through Nov. 15; Maximum size limit: 14 inches total length.	2 trout, 0 salmon
13...	NO PERSON SHALL RETAIN ANY KING SALMON OVER 22.0 INCHES TOTAL LENGTH IN THE TRINITY RIVER AND SOUTH FORK TRINITY RIVER COMMENCING 28 DAYS AFTER THE DEPARTMENT DETERMINES THAT 50% OF THE ALLOWABLE KLAMATH RIVER BASIN SPORT CATCH HAS BEEN TAKEN BELOW THE FALLS AT COON CREEK ON THE KLAMATH RIVER IN ANY YEAR. DEPARTMENT SHALL INFORM THE COMMISSION, AND THE PUBLIC VIA THE NEWS MEDIA PRIOR TO ANY IMPLEMENTATION OF THE PROVISIONS OF THIS SUBSECTION. [b/]		

a/ From State of California, Fish and Game Commission, California Code of Regulations for 1994, Title 14. Natural Resources, Division 1. Fish and Game Commission-Department of Fish and Game, Chapter 3, Article 3, Section 7.50 (Alphabetical List of Waters with Special Fishing Regulations).

b/ Subsection 13 became effective 3 October 1994.

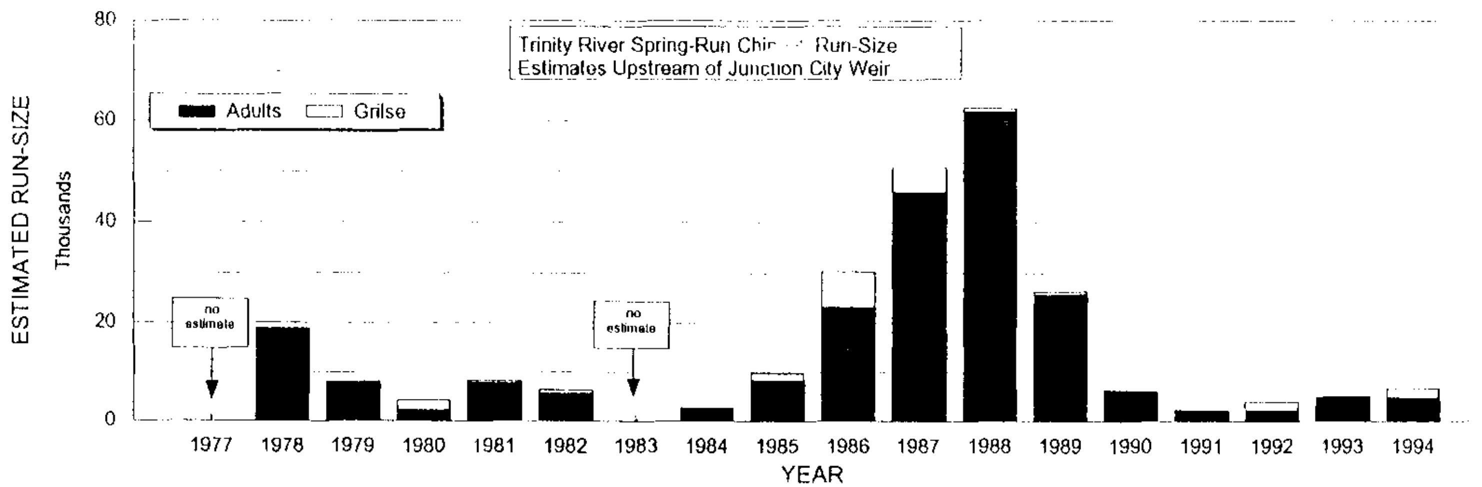
APPENDIX 11. Fork length (FL) distribution of fin-clipped and non-fin-clipped fall-run steelhead trapped in the Trinity River at Willow Creek and Junction City weirs and that entered Trinity River Hatchery during the 1994-95 season.

	Recovery location														
	Willow Creek Weir a/					Junction City Weir b/				Trinity River Hatchery c/					
	Fin-clip d/														
FL (cm)	Unmk	LV	Ad+RV	Ad+LV	Ad	Unmk	LV	Ad+LV	Ad	Unmk	RV	LV	Ad+RV	Ad+LV	Ad
26												1			
27												0			
28												0			
29												1			
30												1			
31	1					1					1	0			
32	2					0						4			
33	3					0						0			
34	1					0						2			
35	0					0						0			
36	4					2				1		0		1	
37	0					1				0		0		0	
38	3	1				0				0		0		4	
39	5	0				0	1			0		2		1	
40	3	1				0	0			1		0	1	1	
41	3	1				0	2			0		1	0	2	
42	1	1				0	0			0		0	1	2	
43	1	2				0	0			0		4	0	2	
44	3	1				1	1			0		1	2	4	
45	3	1				0	0			1		0	0	7	
46	1	0				0	0	1		0		1	4	5	1
47	2	1				0	0	1		2		1	0	5	0
48	2	0				0	0	0		0		3	2	1	0
49	2	0		1		0	0	0		0		0	0	1	0
50	7	0		0		1	0	1		0		0	0	2	0
51	5	0		4		0	0	3		1		0	0	2	0
52	24	0		6		0	0	2		1		1	1	5	0
53	14	0		10		1	0	9		0		0	0	6	0
54	31	1		19		0	0	6		0		0	0	14	0
55	29	0		17		3	0	7		0		0	0	22	0
56	36	0		23		2	1	8		0		0	0	28	0
57	33	0	1	21		2	0	12		0		0	0	34	0
58	36	0	1	21	1	2	0	4		2		0	0	43	0
59	40	1	0	13	0	1	0	1		0		1	0	31	0
60	32	0	0	15	0		0	0	1	0		2	0	31	1
61	20	0	0	8	1		0	3		0		0	0	32	
62	14	1	0	6			0	3		0		0	1	20	
63	9	3	1	5			0	1		0		1		24	
64	10	1	1	8			2			0		3		12	
65	7	2		4			0			0		2		10	
66	13	0		2			0			0		2		6	
67	4	0		2			2			0		2		3	
68	3	2								0		1		4	
69	3	1								1		0		1	
70	0	0										0		1	
71	2	1										1		0	
72	3											1		1	
73	2											0		0	
74	0											0		0	
75	0											1		1	
76	0											1			
77	0											0			
78	0											0			
79	0											0			
80	0											1			
81	0														
82	1														
Totals:	418	22	4	185	2	17	9	62	1	10	1	42	12	369	2
Mean FL:	56.5	55.3	60.5	57.5	59.5	50.2	53.7	55.5	—	50.3	—	51.8	47.0	57.7	53.0
Total subadults:e/	25	3	0	0	0	4	3	0	0	2	1	12	1	9	0
Total adults:	393	19	4	185	2	13	6	62	1	8	0	30	11	360	2

a/ Trapping at Willow Creek Weir took place from Julian week 31 (3 August) through Julian week 50 (11 December) of 1994.
b/ Trapping at Junction City Weir took place from Julian week 21 (24 May) through Julian week 50 (13 December) of 1994.
c/ The fish ladder was open 6 September 1994 through 13 April 1995 (Julian weeks 36-15).
d/ Unmk = Unmarked steelhead; assumed to be naturally produced.
RV = Right ventral clip; 1994 brood year, released from Trinity River Hatchery in 1995.
LV = Left ventral fin clip; 1991 or 1993 brood year, released from Trinity River Hatchery in 1993 and 1994.
Ad+RV = Adipose and right ventral fin clip; 1991 brood year, released from Trinity River Hatchery in 1993.
Ad+LV = Adipose and left ventral fin clip; 1990 or 1992 brood year, released from Trinity River Hatchery in 1991 and 1993.
Ad = Adipose fin clip; unknown origin.
e/ Subadults were steelhead less than or equal to 41 cm FL; larger fish were adults.

...ction City Weir from 1977 through 1994

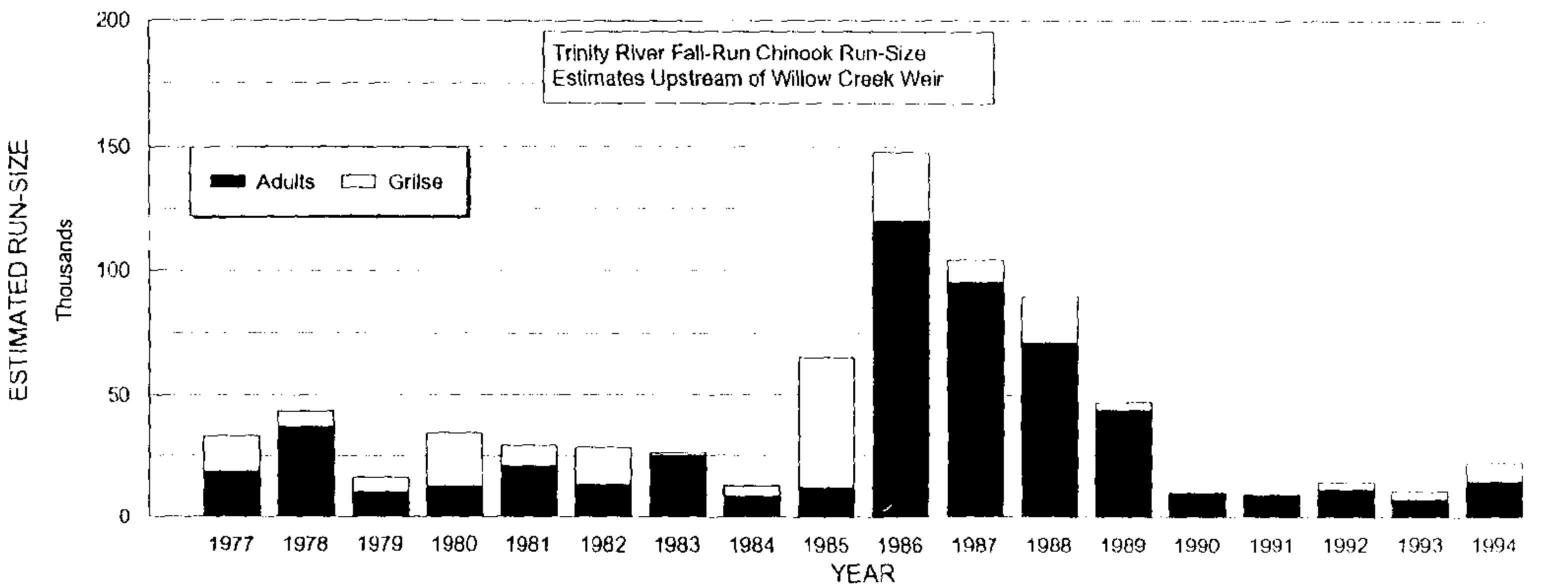
	Run-size estimate					ner escapements						Angler harvest		
						Natural			Trinity River Hatchery					
	Grilse		Adults		Total	Grilse	Adults	Total	Grilse	Adults	Total	Grilse	Adults	Total
Year	Number	Percent	Number	Percent										
1977			No estimates				No estimates		385	1,124	1,509		No estimates	
1978	190	1.0%	18,816	99.0%	19,006	29	14,384	14,413	153	3,680	3,833	8	752	760 a/
1979	113	1.4%	7,964	98.6%	8,077	0	5,008	5,008	113	1,658	1,771	0	1,298	1,298
1980	1,949	45.9%	2,301	54.1%	4,250	1,312	1,614	2,926	353	547	900	284	140	424
1981	347	4.2%	7,913	95.8%	8,260	242	3,362	3,604	95	2,405	2,500	10	2,146	2,156
1982	656	10.3%	5,731	89.7%	6,387	387	3,868	4,255	150	1,226	1,376	119	637	756
1983			No estimates				No estimates		228	930	1,158		No estimates	
1984	255	9.4%	2,465	90.6%	2,720	140	1,354	1,494	76	736	812	39	375	414
1985	1,434	14.8%	8,278	85.2%	9,712	799	4,897	5,696	508	2,645	3,153	127	736 b/	863
1986	7,018	23.1%	23,403	76.9%	30,421	4,335	13,371	17,706	1,461	7,083	8,544	1,222	2,949	4,171
1987	4,858	9.5%	46,016	90.5%	50,874	2,577	29,083	31,660	1,387	8,466	9,853	894	8,467	9,361
1988	720	1.1%	61,972	98.9%	62,692	241	39,329	39,570	377	13,905	14,282	102	8,738	8,840
1989	502	1.9%	25,804	98.1%	26,306	435	18,241	18,676	17	4,983	5,000	50	2,580	2,630
1990	265	4.1%	6,123	95.9%	6,388	126	2,880	3,006	104	2,433	2,537	35	810	845
1991	190	8.0%	2,191	92.0%	2,381	92	1,268	1,360	71	614	685	27	309	336
1992	1,671	41.5%	2,359	58.5%	4,030	944	942	1,886	533	1,313	1,846	194	104 b/	298
1993	68	1.3%	5,164	98.7%	5,232	37	2,111	2,148	31	2,630	2,661	0	423 b/	423
1994	1,793	26.4%	4,995	73.6%	6,788	550	2,897	3,447	944	1,943	2,887	299	155 b/	454



a/ The 1978 sport harvest of spring-run chinook was limited by a salmon fishing closure begining 25 August 1978.
b/ The sport harvest of adult spring-run chinook was limited by fishing closures to the taking chinook salmon greater than or equal to 56 cm total length during these years. The closures took effect 22 September in 1985, 5 November 1992, 9 October 1993, and 3 October 1994

APPENDIX 13. Fall-run chinook salmon run-size, spawner escapement and angler harvest estimates for the Trinity River upstream of Willow Creek Weir from 1977 through 1994

	Run-size estimate					Spawner escapements						Angler harvest		
	Grilse		Adults			Natural			Trinity River Hatchery					
Year	Number	Percent	Number	Percent	Total	Grilse	Adults	Total	Grilse	Adults	Total	Grilse	Adults	Total
1977	14,318	43.5%	18,596	56.5%	32,914	9,737	13,501	23,238	2,177	2,035	4,212	2,404	3,060	5,464
1978	6,037	14.0%	37,086	86.0%	43,123	4,712	31,052	35,764	1,325	6,034	7,359	Fishing closure a/		0
1979	5,665	35.0%	10,520	65.0%	16,185	3,936	8,028	11,964	964	1,335	2,299	765	1,157	1,922
1980	21,549	62.7%	12,797	37.3%	34,346	16,837	7,700	24,537	2,256	4,099	6,355	2,456	998	3,454
1981	8,366	28.6%	20,884	71.4%	29,250	5,906	15,340	21,246	1,004	2,370	3,374	1,456	3,174	4,630
1982	14,938	52.2%	13,653	47.8%	28,591	8,149	9,274	17,423	4,235	2,058	6,293	2,554	2,321	4,875
1983	1,240	4.7%	25,138	95.3%	26,378	853	17,284	18,137	271	5,494	5,765	116	2,360	2,476
1984	4,575	34.8%	8,556	65.2%	13,131	3,416	5,654	9,070	766	2,166	2,932	393	736	1,129
1985	53,062	81.6%	11,954	18.4%	65,016	29,454	9,217	38,671	18,166	2,583	20,749	5,442	154 b/	5,596
1986	27,506	18.6%	120,382	81.4%	147,888	20,459	92,548	113,007	3,609	15,795	19,404	3,438	12,039	15,477
1987	9 325	8.9%	95,287	91.1%	104,612	5,949	71,920	77,869	2,453	13,934	16,387	923	9,433	10,356
1988	18,113	20.3%	71,309	79.7%	89,422	10,626	44,616	55,242	4,752	17,352	22,104	2,735	9,341	12,076
1989	2,991	6.4%	43,631	93.6%	46,622	2,543	29,445	31,988	239	11,132	11,371	209	3,054	3,263
1990	634	6.3%	9,358	93.7%	9,992	241	7,682	7,923	371	1,348	1,719	22	328	350
1991	681	7.4%	8,526	92.6%	9,207	382	4,867	5,249	205	2,482	2,687	94	1,177	1,271
1992	2,932	20.7%	11,232	79.3%	14,164	2,563	7,139	9,702	211	3,779	3,990	158	314 b/	472
1993	3,381	32.2%	7,104	67.8%	10,485	2,473	5,898	8,371	736	815	1,551	172	391 b/	563
1994	7,494	34.2%	14,430	65.8%	21,924	2,505	10,906	13,411	4,442	3,264	7,706	547	260 b/	807

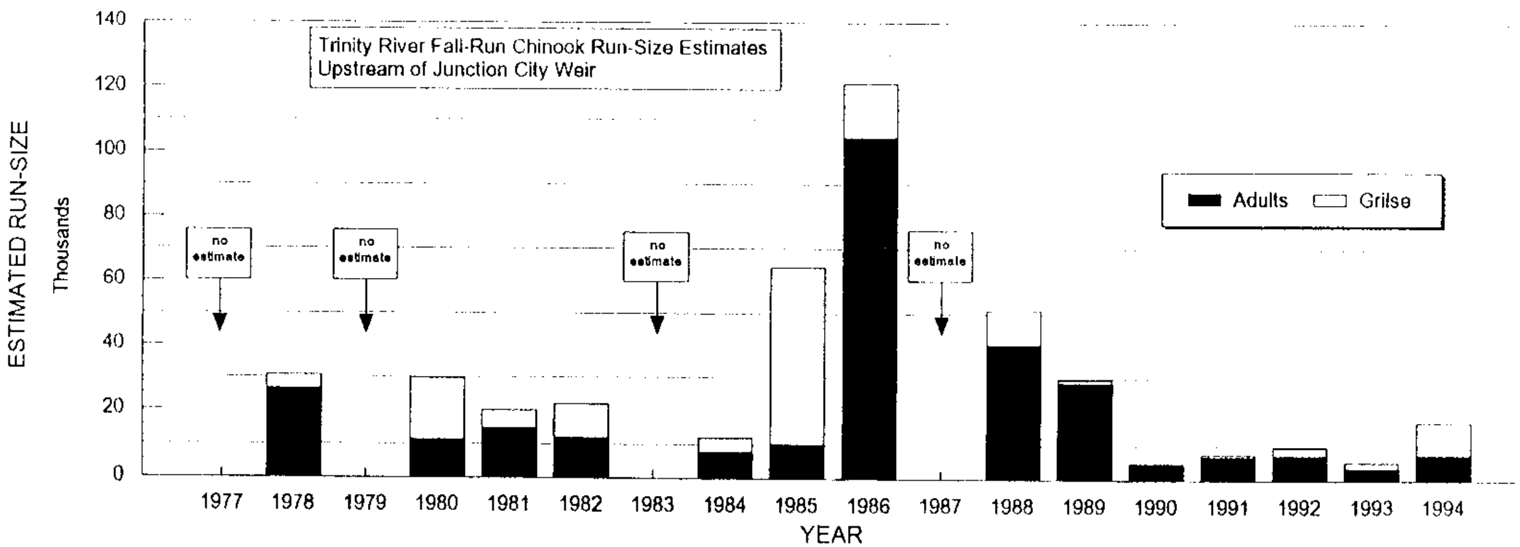


a/ The 1978 sport harvest of fall-run chinook was essentially eliminated by a salmon fishing closure beginning 25 August 1978.

b/ The sport harvest of adult fall-run chinook was limited by fishing closures to the taking chinook salmon greater than or equal to 56 cm total length during these years The closures took effect 22 September 1985, 5 November 1992, 9 October 1993, and 3 October 1994.

... ngler harvest estimates for the T... ...iver upstream of Junction City Weir from 1977 through 1994

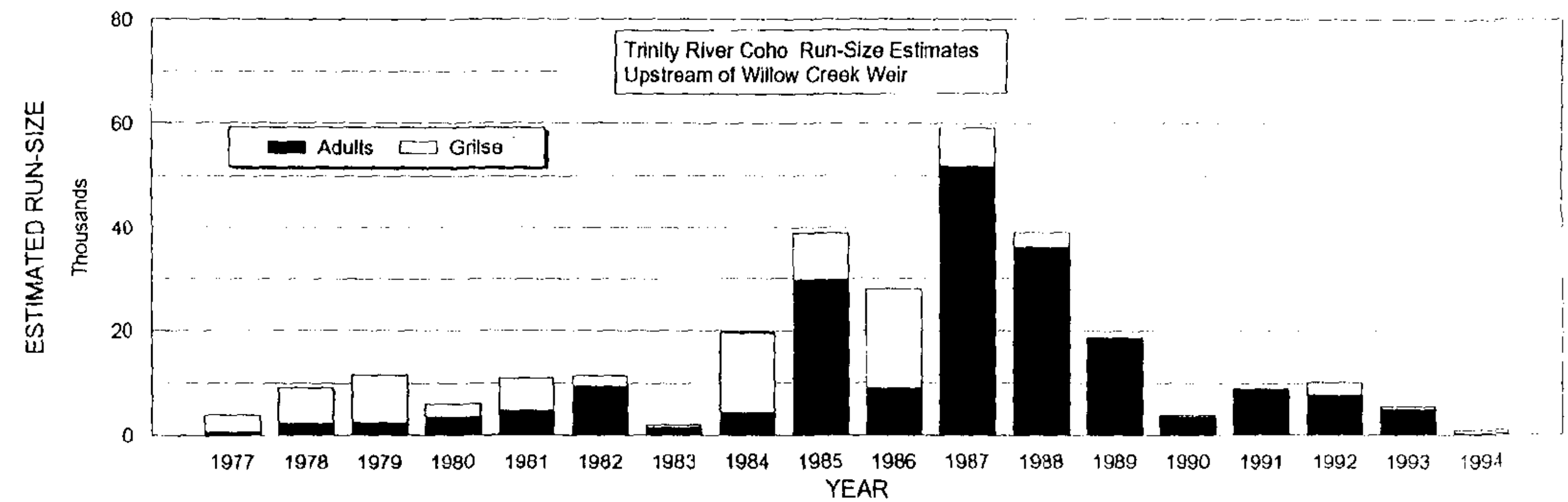
Year	Run-size estimate: Grilse Number	Run-size estimate: Grilse Percent	Run-size estimate: Adults Number	Run-size estimate: Adults Percent	Run-size estimate: Total	Spawner escapements: Natural Grilse	Spawner escapements: Natural Adults	Spawner escapements: Natural Total	Spawner escapements: Trinity River Hatchery Grilse	Spawner escapements: Trinity River Hatchery Adults	Spawner escapements: Trinity River Hatchery Total	Angler harvest: Grilse	Angler harvest: Adults	Angler harvest: Total
1977			No estimates				No estimates		2,177	2,035	4,212		No estimates	
1978	4,299	14.0%	26,408	86.0%	30,707	2,974	20,374	23,348	1,325	6,034	7,359		Fishing closure a/	0
1979			No estimates				No estimates		964	1,335	2,299		No estimates	
1980	18,390	62.0%	11,271	38.0%	29,661	16,134	7,172	23,306 b/	2,256	4,099	6,355		"	
1981	5,155	26.0%	14,673	74.0%	19,828	4,151	12,303	16,454 b/	1,004	2,370	3,374		"	
1982	9,925	45.6%	11,862	54.4%	21,787	5,690	9,804	15,494 b/	4,235	2,058	6,293		"	
1983			No estimates				No estimates		271	5,494	5,765		"	
1984	4,121	34.8%	7,722	65.2%	11,843	3,355	5,556	8,911 b/	766	2,166	2,932		"	
1985	54,154	84.3%	10,072	15.7%	64,226	33,267	7,412	40,679	18,166	2,583	20,749	2,721	77 c/	2,798
1986	16,564	13.7%	104,469	86.3%	121,033	11,615	83,982	95,597	3,609	15,795	19,404	1,340	4,692	6,032
1987			No estimates				No estimates		2,453	13,934	16,387		No estimates	
1988	10,750	21.0%	40,427	79.0%	51,177	5,145	20,160	25,305	4,752	17,352	22,104	853	2,915	3,768
1989	973	3.3%	28,743	96.7%	29,716	691	16,346	17,037	239	11,132	11,371	43	1,265	1,308
1990	457	9.5%	4,330	90.5%	4,787	83	2,931	3,014	371	1,348	1,719	3	51	54
1991	552	7.6%	6,679	92.4%	7,231	338	4,088	4,426	205	2,482	2,687	9	109	118
1992	2,530	26.4%	7,054	73.6%	9,584	2,304	3,148	5,452	211	3,779	3,990	15	127 c/	142
1993	1,542	30.0%	3,597	70.0%	5,139	806	2,742	3,548	736	815	1,551	0	40 c/	40
1994	9,661	57.0%	7,276	43.0%	16,937	5,171	4,012	9,183	4,442	3,264	7,706	48	0 c/	48



a/ The 1978 sport harvest of fall-run chinook was essentially eliminated by a salmon harvest closure beginning 25 August 1978.
b/ The natural spawner escapement reflects an overestimate due to the unknown number of fish harvested by anglers upstream of Junction City Weir.
c/ The sport harvest of adult fall-run chinook was limited by fishing closures to the taking chinook salmon greater than or equal to 56 cm total length during these years. The closures took effect 22 September 1985, 5 November 1992, 9 October 1993, and 3 October 1994.

APPENDIX 15. Coho salmon run-size, spawner escapement and angler harvest estimates for the Trinity River upstream of Willow Creek Weir from 1977 through 1994

	Run-size estimate					Spawner escapements						Angler harvest		
						Natural			Trinity River Hatchery					
	Grilse		Adults		Total	Grilse	Adults	Total	Grilse	Adults	Total	Grilse	Adults	Total
Year	Number	Percent	Number	Percent										
1977	3,106	80.5%	752	19.5%	3,858	1,756	25	1,781	1,230	698	1,928	120	29	149
1978	6,685	73.2%	2,447	26.8%	9,132	4,309	1,168	5,477	2,376	1,279	3,655	Fishing closure a/		0
1979	9,067	78.0%	2,557	22.0%	11,624	5,567	1,695	7,262	2,793	742	3,535	707	120	827
1980	2,499	41.0%	3,595	59.0%	6,094	954	1,817	2,771	1,545	1,778	3,323			0
1981	6,144	56.0%	4,826	44.0%	10,970	3,486	1,995	5,481	1,994	2,529	4,523	664	302	966
1982	2,021	17.5%	9,508	82.5%	11,529	1,158	5,097	6,255	823	3,975	4,798	40	436	476
1983	536	27.2%	1,435	72.8%	1,971	295	788	1,083	192	514	706	49	133	182
1984	15,208	77.2%	4,486	22.8%	19,694	6,188	2,971	9,159	7,727	1,134	8,861	1,293	381	1,674
1985	9,216	23.7%	29,717	76.3%	38,933	4,798	21,586	26,384	4,237	7,549	11,786	181	582 b/	763
1986	18,909	67.6%	9,063	32.4%	27,972	13,034	6,247	19,281	5,402	2,589	7,991	473	227	700
1987	7,253	12.3%	51,826	87.7%	59,079	3,975	28,398	32,373	2,865	20,473	23,338	413	2,955	3,368
1988	2,731	7.0%	36,173	93.0%	38,904	1,850	22,277	24,127	743	12,073	12,816	138	1,823	1,961
1989	290	1.5%	18,462	98.5%	18,752	208	13,274	13,482	77	4,893	4,970	5	295	300
1990	412	10.6%	3,485	89.4%	3,897	234	1,981	2,215	173	1,462	1,635	5	42	47
1991	265	2.9%	8,859	97.1%	9,124	164	6,163	6,327	98	2,590	2,688	3	106	109
1992	2,378	23.0%	7,961	77.0%	10,339	1,168	5,565	6,733	1,210	2,372	3,582	0	24	24
1993	573	10.2%	5,048	89.8%	5,621	416	3,024	3,440	93	2,024	2,117	64	0	64
1994	613	71.9%	239	28.1%	852	453	105	558	160	134	294	0	0	0

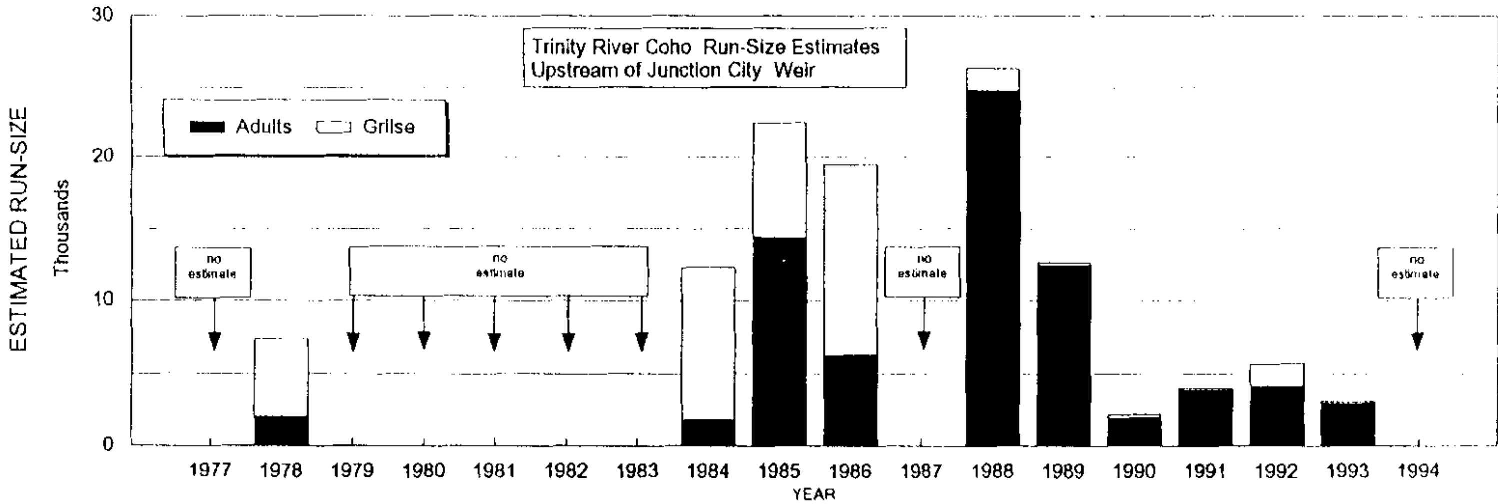


a/ The 1978 sport harvest of coho was essentially eliminated by a salmon fishing closure beginning 25 August 1978.

b/ The 1985 sport harvest of adult coho was limited by a closure for the taking salmon greater than or equal to 56 cm total length beginning 22 September 1985.

...the Trinity River upstream of Junction City Weir from 1977 through 1994.

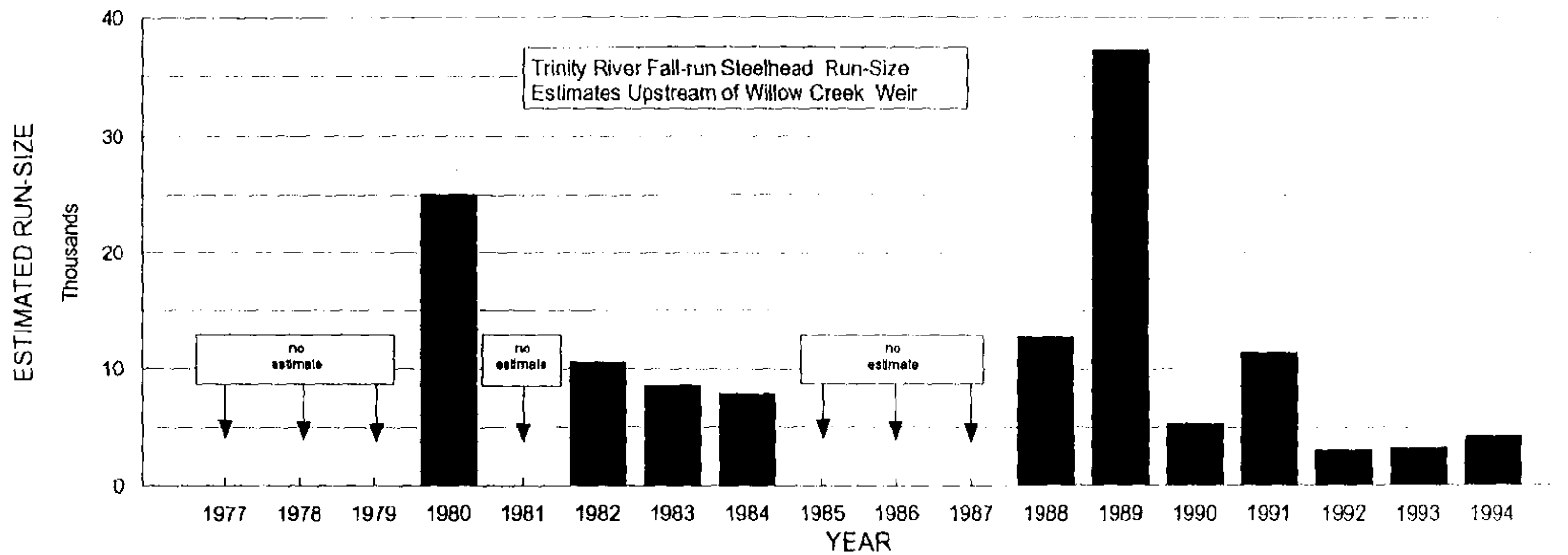
	Run-size estimate					Spawner escapements						Angler harvest		
	Grilse		Adults		Total	Natural			Trinity River Hatchery					
Year	Number	Percent	Number	Percent		Grilse	Adults	Total	Grilse	Adults	Total	Grilse	Adults	Total
1977	No estimates						No estimates		1,230	698	1,928		No estimates	
1978	5,324	72.3%	2,036	27.7%	7,360	2,948	757	3,705	2,376	1,279	3,655		Fishing closure a/	0
1979	No estimates						No estimates		2,793	742	3,535		No estimates	
1980	"						"		1,545	1,778	3,323		"	
1981	"						"		1,994	2,529	4,523		"	
1982	"						"		823	3,975	4,798		"	
1983	"						"		192	514	706		"	
1984	10,488	85.4%	1,797	14.6%	12,285	2,761	663	3,424	7,727	1,134	8,861			0
1985	8,064	35.9%	14,398	64.1%	22,462	3,827	6,849	10,676	4,237	7,549	11,786			0
1986	13,168	67.6%	6,312	32.4%	19,480	7,766	3,723	11,489	5,402	2,589	7,991			0
1987	No estimates						No estimates		2,865	20,473	23,338		No estimates	
1988	1,529	5.8%	24,841	94.2%	26,370	723	11,929	12,652	743	12,073	12,816	63	839	902
1989	196	1.6%	12,429	98.4%	12,625	118	7,461	7,579	77	4,893	4,970	1	75	76
1990	230	10.6%	1,947	89.4%	2,177	57	485	542	173	1,462	1,635	0	0	0
1991	131	3.3%	3,865	96.7%	3,996	32	1,252	1,284	98	2,590	2,688	1	23	24
1992	1,539	27.1%	4,144	72.9%	5,683	329	1,772	2,101	1,210	2,372	3,582	0	0	0
1993	124	4.0%	2,974	96.0%	3,098	31	950	981	93	2,024	2,117	0	0	0
1994	No estimates						No estimates		160	134	294		No estimates	



a/ The 1978 sport harvest of coho was essentially eliminated by a salmon fishing closure beginning 25 August 1978.

APPENDIX 17. Fall-run steelhead run-size, spawner escapement and angler harvest estimates for the Trinity River upstream of Willow Creek Weir from 1977 through 1994.

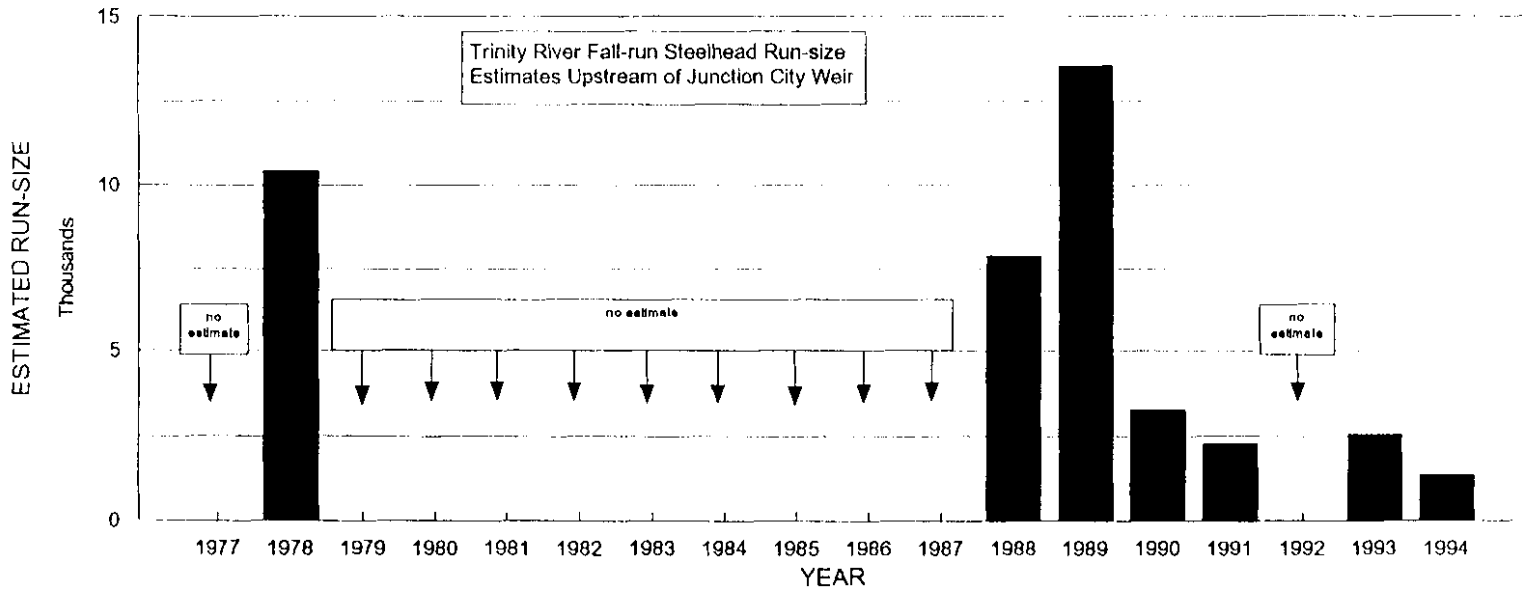
	Run-size estimate					Spawner escapement						Angler harvest		
	Hatchery a/		Wild b/			Natural			Trinity River Hatchery					
Year	Number	Percent	Number	Percent	Total	Hatchery	Wild	Total	Hatchery	Wild	Total	Hatchery	Wild	Total
1977			No estimates				No estimates		269	16	285		No estimates	
1978			"				"		628	55	683		"	
1979			"				"		329	53	382		.	
1980	8,449	33.7%	16,645	66.3%	25,094	5,101	14,462	19,563	1,903	102	2,005	1,445	2,081	3,526
1981			No estimates				No estimates		892	112	1,004		No estimates	
1982	2,106	20.0%	8,426	80.0%	10,532	971	6,889	7,860	634	79	713	501	1,458	1,959
1983	No estimates for hatchery/wild components				8,605			6,661			599			1 345
1984			"		7,833			6,430			142			1 261
1985			No estimates				No estimates				461		No estimates	
1986			"				"				3,780		"	
1987			"				"				3,007		"	
1988	No estimates for hatchery/wild components				12,743			11,926 c/			817		"	
1989			"		37,276			28,933			4,765			3,578
1990			"		5,348			3,188			930			1,230
1991			"		11,417			8,631			446			2,340
1992	1,315	43.2%	1,731	56.8%	3,046	759	1,540	2,299	430	25	455	126	166	292
1993	1,894	58.4%	1,349	41.6%	3,243	801	1,176	1,977	875	10	885	218	163	381
1994	1,477	34.8%	2,767	65.2%	4,244	878	2,410	3,288	403	8	411	196	349	545



a/ Trinity River Hatchery-produced steelhead.
b/ Naturally produced steelhead.
c/ The natural spawner escapement reflects an overestimate due to the unknown number of fish harvested by anglers upstream of Willow Creek Weir.

... upstream of Junction City Weir from 1977 through 1994.

	Run-size estimate					Spawner escapements						Angler Harvest		
	Hatchery a/		Wild b/			Natural			Trinity River Hatchery					
Year	Number	Percent	Number	Percent	Total	Hatchery	Wild	Total	Hatchery	Wild	Total	Hatchery	Wild	Total
1977	No estimates					No estimates			269	16	285	No estimates		
1978	3,965	38.0%	6,469	62.0%	10,434	3,059	4,603	7,662	628	55	683	278	1,811	2,089
1979	No estimates					No estimates			329	53	382	No estimates		
1980	"					"			1,903	102	2,005	"		
1981	"					"			892	112	1,004	"		
1982	"					"			634	79	713	"		
1983	"					"					599	"		
1984	"					"					142	"		
1985	"					"					461	"		
1986	"					"					3,780	"		
1987	"					"					3,007	"		
1988	No estimates for hatchery/wild component				7,907			7,090 c/			817	"		
1989	"				13,574			6,596			4,765			2,213
1990	"				3,296			1,955			930			411
1991	"				2,285			1,355			446			484
1992	No estimates					No estimates			430	25	455	No estimates		
1993	1,787	69.8%	773	30.2%	2,560	724	763	1,487	875	10	885	188	0	188
1994	1,155	84.1%	218	15.9%	1,373	648	192	840	403	8	411	104	18	122



a/ Trinity River Hatchery-produced steelhead.
b/ Naturally produced steelhead.
c/ The natural spawner escapement reflects an overestimate due to the unknown number of fish harvested by anglers upstream of Willow Creek Weir.

ANNUAL REPORT
TRINITY RIVER BASIN SALMON AND STEELHEAD MONITORING PROJECT
1994-95 SEASON

CHAPTER V

JOB V
SURVIVAL AND CONTRIBUTIONS TO THE FISHERIES AND SPAWNER ESCAPEMENTS MADE BY CHINOOK AND COHO SALMON PRODUCED AT TRINITY RIVER HATCHERY

by

Mark Zuspan

ABSTRACT

Between 1 July 1994 and 30 June 1995, the California Department of Fish and Game's Trinity River Project marked (adipose fin-clipped and binary coded-wire tagged)seven groups of chinook salmon (Oncorhynchus tshawytscha) at Trinity River Hatchery. The fish were released into the Trinity River through the hatchery release facility. We effectively marked 111,525 spring-run and 326,951 fall-run chinook salmon. Additionally, the Hoopa Valley Tribal Fisheries Department effectively marked one group of 113,236 spring-run chinook at the hatchery.

Recovery operations at Trinity River Hatchery captured 1,651 adipose fin-clipped chinook and coho salmon. Coded-wire tags were recovered from 566 spring-run and 891 fall-run chinook salmon, and 15 coho salmon.

Run-size, in-river angler harvest, and spawner escapements of marked spring- and fall-run chinook, and coho salmon of the 1989 through 1992 brood years are presented. Complete returns are only available for both runs of chinook from the 1989 brood year, returning as two- through five-year-olds, and for coho from the 1991 brood year returning as two- and three-year-olds.

We estimated that 176 spring-run and 194 fall-run chinook salmon from the 1989 brood year marked at Trinity River Hatchery returned to the Trinity River basin upstream of the Junction City Weir and the Willow Creek Weir, respectively, as two- through five-year-olds during the period of 1991 through 1994. We also estimated that 33 marked coho salmon from the 1991 brood year entered the Trinity River basin upstream of the Willow Creek Weir during the 1993 and 1994 seasons.

JOB OBJECTIVES

To determine relative return rates and the contribution to spawning escapement and the fisheries made by chinook and coho salmon produced at Trinity River Hatchery, and to evaluate experimental hatchery management practices aimed at increasing adult returns.

INTRODUCTION

During the period of 1 July 1994 through 30 June 1995, the California Department of Fish and Game's (CDFG) Trinity River Project marked and released chinook salmon smolts and yearlings produced at Trinity River Hatchery (TRH), and recaptured fish from previously marked brood years (BY) returning to TRH. Similar marking studies began at TRH in 1977 with the marking and release of fall-run chinook salmon (fall chinook) from the 1976 BY. Beginning with the 1977 BY, representative, marked subsets of TRH-produced fish have been included in all releases of smolt, yearling, and yearling+ spring-run (spring chinook) and fall chinook released from TRH and its associated off-site rearing locations. Beginning in 1978, representative samples of coho salmon (coho) were marked and released from TRH in most years, except BYs 1987, 1988 and 1993.

These earlier studies were funded by the U.S. Bureau of Reclamation (USBR), and with Anadromous Fish Act funds administered by the U.S. Fish and Wildlife Service. The current program has been funded by the USBR since 1 October 1989 and is scheduled to end 30 September 1995.

These marking studies are designed to provide survival rates and catch-to-escapement ratios for spring and fall chinook and coho salmon reared at TRH. State and Federal management agencies need to evaluate the contributions of salmon produced at TRH to the various fisheries and spawner escapements in the Trinity River basin, in order to properly manage hatchery production and fishery harvest.

METHODS

Fish Marking and Release

Marking and release methods were similar to those used in the 1993-94 season (Zuspan 1996). Salmon selected for marking at TRH were crowded into a small area beneath a marking shed situated over their rearing pond. After crowding, fish were dip-netted into a 152.4 x 61.0 x 76.2-cm wooden holding tank in the tagging shed through which water from the pond was circulated. We dip-netted approximately 25 fish at a time from the holding tank into pans containing an anesthetic solution of tricaine methanesulfonate. Once anesthetized, we marked the fish by removing their adipose (Ad) fin and injected a coded-wire tag (CWT) into their rostrum with a Northwest Marine Technologies Mark IV[1/] tagging unit. Approximately one-half of the fall chinook smolts received half-length tags, while all other groups received full-length tags.

After marking, fish were dropped into a funnel supplied with running water that led to a quality control device. If the fish had a CWT, the quality control device tallied it and diverted the fish into a separate rearing pond. If a fish had not received a CWT, the quality control device gave a warning signal and diverted the fish into a rejection bucket. Fish in the rejection bucket were re-tagged later that day. Periodically during the marking period, we inspected samples of fish for the placement and retention of the CWT and quality of the Ad-clip.

Salmon from a particular tag group were held together in separate rearing ponds until release. Immediately before release, a systematic sample of 300-to-500 fish from each tag group was examined for CWT retention and the quality of the Ad-clip, and measured to the nearest mm fork length (FL).

We determined the number of properly tagged and fin-clipped (effectively marked) fish released by subtracting mortalities, which occurred during and after tagging operations, and the estimated number of fish that had shed CWTs or were improperly fin-clipped, from the total fish marked.

All tagged fish of a particular CWT group were released concurrently with unmarked fish of the same strain, BY, and size into the Trinity River through the hatchery release facility.

Due to uncertain funding beyond September 1995, we radically reduced our Project's marking efforts this year at TRH; we did not mark any spring chinook salmon smolts, nor coho salmon. However, a small group of spring chinook smolts (about half the number effectively marked in past seasons) was marked and released by the Hoopa Valley Tribal Fisheries Department from TRH.

Coded-wire Tag Recovery

The TRH fish ladder was open from 6 September 1994 through 13 April 1995. Normally, hatchery personnel conducted fish sorting and spawning operations two days per week.

[1/] The use of brand or trade names is for identification purposes only, and does not imply the endorsement of any product by the CDFG.

Fish were sorted by species and spawning condition. Each fish was examined for external tags[2] and fin clips, and its sex and FL (cm) were recorded. Chinook which were not ready to spawn were given an additional distinguishing fin-clip and placed in ponds to ripen. Later, when these fish were killed and spawned, we determined the initial day the fish was sorted from its unique fin-clip. These dates were used in Chapter IV to document the timing of the returns of hatchery fish to TRH. We removed the heads of all Ad-clipped salmon and placed each in a sealable plastic bag with a serially numbered tab noting the date, location recovered, species, sex, and FL. Salmon heads were frozen for subsequent tag extraction and decoding.

Run-size, Contribution to Fisheries and Spawner Escapement of Coded-wire Tagged Salmon

The information needed to estimate the numbers of the salmon of a specific CWT group that returned to the Trinity River basin, and contributed to the fisheries and spawner escapement are: 1) run size; 2) the proportion of the run comprised by the various CWT groups; and 3) the harvest rate. Methods to determine the run-size and harvest estimates are presented in Chapter IV (p. 80). The same sets of equations employed during the 1993-94 season were used to determine run-size, harvest, and spawner escapement (Zuspan and Sinnen 1996).

To estimate the numbers of the salmon above a specific weir site with a CWT, we used the equation:

$$N_{CWT} = \frac{NW_{ADclip}}{NW} \times \frac{NH_{ADCWT}}{NH_{ADclip}} \times N_{run\text{-}size\ estimate}$$

where, N_{CWT} = estimated number of the specific species of salmon above the weir with a CWT; NW_{ADclip} = number of salmon observed at the weir with an Ad clip; NW = total number of salmon observed at the respective weir; NH_{ADCWT} = number of salmon observed at TRH with an Ad clip <u>and</u> a CWT; NH_{ADclip} = total number of Ad-clipped salmon observed at TRH; and $N_{run\text{-}size\ estimate}$ = run-size estimate.

---

[2] Trinity River Project personnel tagged returning salmon and steelhead as part of Job IV activities.

Using the various CWT groups recovered at TRH, we estimated the fraction of the population upstream of the weir with a specific CWT with the equation:

$$F_{CWT\ group} = \frac{NH_{CWT\ group}}{NH_{ADCWT}}$$

where, $F_{CWT\ group}$ = fraction of the salmon population with a specific CWT code; and $NH_{CWT\ group}$ = number of salmon observed at TRH with a specific CWT code.

We estimated the total number of chinook salmon upstream of the weir with a specific CWT code with the equation:

$$N_{CWT\ group} = N_{CWT} \quad X \quad F_{CWT\ group}$$

where, $N_{CWT\ group}$ = estimated total number of salmon of a specific CWT group.

The estimated number of fish from each CWT group caught in the Trinity River sport fishery upstream of the weir was then estimated by the equation:

$$SF_{CWT\ group} = N_{CWT\ group} \quad X \quad N_{harvest\ rate\ estimate}$$

where, $SF_{CWT\ group}$ = number of salmon of a specific CWT group caught in the Trinity River sport fishery; and $N_{harvest\ rate\ estimate}$ = harvest rate estimate.

We estimated the total number of fish of a specific CWT code group available to the spawner escapement by the equation:

$$N_{CWT\ escapement} = N_{CWT\ group} - SF_{CWT\ group}$$

where, $N_{CWT\ escapement}$ = the total number of salmon of a specific CWT group available to the spawner escapement.

The estimated number of salmon of specific CWT code group available to natural spawner escapement was:

$$N_{CWT\ natural\ escapement} = N_{CWT\ escapement} - NH_{CWT\ group}$$

where, $N_{CWT\ natural\ escapement}$ = the estimated number of a specific CWT group contributing to natural spawning escapement.

All estimates for spring and fall chinook are for the Trinity River upstream of the Junction City Weir (river km [RKM] 137.1) and the Willow Creek Weir (RKM 48.4), respectively.

RESULTS AND DISCUSSION

Fish Marking and Release

Eight groups of chinook salmon reared at TRH, totaling 551,712 fish, were effectively marked and released into the Trinity River from the hatchery this season (Table 1). These included two groups each of the 1993 BY spring and fall chinook yearlings released in October 1994. Four groups (one spring and three fall chinook) of 1994 BY smolts were released in June 1995 (Table 1). We did not mark any coho from the 1993 BY.

All chinook tag groups were released concurrently with unmarked fish of the same BY, strain, and size.

Coded-wire Tag Recovery

We recaptured 1,651 TRH-produced, Ad-clipped chinook and coho at TRH during the 1994-95 season. These consisted of 471 male and 173 female spring chinook, 628 male and 361 female fall chinook and 16 male and 2 female coho (Table 2).

CWTs were extracted from 1,472 of the 1,651 Ad-clipped salmon recaptured. These CWTs were from 566 spring chinook, 891 fall chinook, and 15 coho (Table 2).

In addition to the CWTs from TRH-produced fish, we also recovered at TRH ten CWTs from fish tagged by the Trinity River Fisheries Investigations Project (another element of CDFG's Klamath-Trinity Program). These were naturally produced chinook captured and tagged as juveniles in the mainstem Trinity River from the BYs 1990 (two fish), 1991 (seven fish) and 1992 (one fish) (see Chapter II).

Run-size and Contribution to Fisheries and Spawner Escapement of Coded-wire-tagged Salmon

Spring-run Chinook Salmon

We estimated the run size, angler harvest, and spawning escapement of the ten spring chinook CWT groups returning to the Trinity River upstream of Junction City Weir this season (Table 3).

1989 Brood Year. Two CWT groups from the 1989 BY completed their life cycle this season, since adults from both groups should have reached five years of age; however, there were no

TABLE 1. Coded-wire tagging and release of spring- and fall-run chinook salmon from Trinity River Hatchery, 1994-95 season. a/

CWT b/ code	Brood year	Total number tagged	Mortality Number	Mortality %	Extrapolated shed tags & poor fin-clips Number c/	Extrapolated shed tags & poor fin-clips %	Number of tagged fish d/	Release data Date e/	Release data No./kg	Release data FL (mm) f/	No. unmarked fish
Spring-run chinook salmon											
065220 g/	1994	113,759	68	0.06%	455	0.40%	113,236	06/06-09/95	138.9	h/	1,345,225
065708	1993	54,532	284	0.52%	510	0.94%	53,738	10/03-14/94	23.6	147.4	332,045
065709	1993	57,973	74	0.13%	112	0.19%	57,787	10/03-14/94	23.6	148.4	356,635
Subtotal yearlings:		112,505	358	0.32%	622	0.55%	111,525				688,680
Total spring-run:		226,264	426	0.19%	1,077	0.48%	224,761				2,033,905
Fall-run chinook salmon											
0601040108	1994	110,523	273	0.25%	2,315	2.10%	107,935	06/01-09/95	353.0	67.4	1,003,868
065021	1994	54,777	43	0.08%	11	0.02%	54,723	06/01-09/95	271.0	71.4	466,367
065022	1994	53,980	32	0.06%	43	0.08%	53,905	06/01-09/95	271.0	71.9	467,184
Subtotal smolts:		219,280	348		2,369		216,563				1,937,419
065705	1993	55,223	73	0.13%	111	0.20%	55,039	10/03-14/94	27.6	138.9	50,468
065706	1993	57,152	146	0.26%	1,657	2.91%	55,349	10/03-14/94	27.6	132.2	52,297
Subtotal yearlings:		112,375	219	0.19%	1,768	1.58%	110,388				102,765
Total fall-run:		331,655	567	0.17%	4,137	1.25%	326,951				2,040,184
Total chinook:		557,919	993	0.18%	5,214	0.94%	551,712				4,074,089

a/ All releases were made into the Trinity River from the hatchery release facility.
b/ CWT = coded-wire tag.
c/ Numbers of poorly marked fish were calculated from percentages observed in samples of pre-release fish and total number of marked fish less mortalities.
d/ The number of tagged fish released equals total number of fish marked minus mortality and extrapolated number of fish with shed tags or poor fin-clips.
e/ Chinook salmon released in June were smolts, those released in October were yearlings.
f/ FL = Average fork length.
g/ Tagged by the Hoopa Valley Tribal Fisheries Department.
h/ Not reported.

T E 2. Release and recovery data for adipose fin-clipped chinook a oho salmon recovered at Trinity River Hatchery (TRH) d. g the 1994-95 season.

Release data							Recovery data				
							Males		Females		
CWT a/ code	Egg source	Brood year	Date	Number	Size (No./kg)	Site	No.	FL b/	No.	FL b/	Total No.
Spring-run chinook salmon											
0601040103	TRH	1990	05/28/91	196,908	158.4	TRH	29	79	39	71	68
065636	TRH	1990	10/08/91	48,553	21.8	TRH	8	75	9	66	17
065640	TRH	1990	10/08/91	46,086	21.8	TRH	8	69	8	66	16
0601040105	TRH	1991	06/05/92	198,277	74.8	TRH	59	65	71	63	130
065658	TRH	1991	10/02/92	110,797	18.0	TRH	18	61	13	59	31
0601040106	TRH	1992	06/15/93	215,038	97.9	TRH	273	49	1		274
065734	TRH	1992	10/1-7/93	53,675	25.1	TRH	20	46	1	--	21
065735	TRH	1992	10/1-7/93	56,281	25.1	TRH	9	44	0	--	9
100000 c/ d/							47	55	31	66	78
				Spring-run chinook salmon totals:			471		173		644
Fall-run chinook salmon											
065638	TRH	1990	10/09/91	103,040	25.7	TRH	21	68	20	69	41
0601040104	TRH	1991	06/22/92	206,416	85.0	TRH	124	68	206	67	330
065731	TRH	1991	10/02/92	58,580	21.3	TRH	54	64	48	64	102
065732	TRH	1991	10/02/92	56,720	21.3	TRH	73	66	51	65	124
065733	TRH	1992	06/16/93	192,032	145.9	TRH	226	54	9	54	235
065748	TRH	1992	10/1-7/93	54,586	33.7	TRH	35	48	1	--	36
065749	TRH	1992	10/1-7/93	54,308	33.7	TRH	23	48	0	--	23
100000 c/ e/							72	57	26	67	98
				Fall-run chinook salmon totals:			628		361		989
Coho salmon											
065662	TRH	1991	03/29/93	53,058	17.6	TRH	5	63	1	--	6
065760	TRH	1992	03/15-28/94	54,723	22.7	TRH	9	43	0	--	9
100000 c/	TRH						2	46	1	--	3
				Coho salmon totals:			16		2		18

a/ CWT = Coded-wire tag.
b/ FL = Average fork length in cm.
c/ 100000 = No CWT found or it was lost during recovery.
d/ Assumed to be spring-run chinook from their entry dates into Trinity River Hatchery.
e/ Assumed to be fall-run chinook from their entry dates into Trinity River Hatchery.

TABLE 3. Run-size, percent return, in-river sport catch and spawner escapement estimates for Trinity River Hatchery-produced, coded-wire-tagged spring-run chinook salmon returning to the Trinity River upstream of Junction City Weir during the period 1991 through 1994.

Release data					Estimated returns						
CWT a/ code	Brood year	Date b/	Number	Site	Age	Run-size	% of release	River harvest	Spawning escapement TRH c/	Spawning escapement Natural	Spawning escapement Total
0601040102	1989	05/18-21/90	186,413	TRH	2	0	0.	0	0	0	0
					3	5	0.003	0	3	2	5
					4	2	0.001	0	1	1	2
					5	0	0.	0	0	0	0
				Totals: d/		7	0.004	0	4	3	7
				Total adults: e/		7	0.004	0	4	3	7
065639	1989	10/01/90	102,555	TRH	2	9	0.009	1	6	2	8
					3	89	0.087	4	52	33	85
					4	71	0.069	6	35	30	65
					5	0	0.	0	0	0	0
				Totals: d/		169	0.165	11	93	65	158
				Total adults: e/		160	0.156	10	87	63	150
0601040103	1990	05/28/91	196,908	TRH	2	62	0.031	7	36	19	55
					3	297	0.151	24	147	125	272
					4	121	0.061	4	68	49	117
065636	1990	10/08/91	48,553	TRH	2	2	0.004	0	1	1	2
					3	8	0.016	1	4	3	7
					4	30	0.062	1	17	12	29
065640	1990	10/18/91	46,086	TRH	2	5	0.011	1	3	1	4
					3	6	0.013	0	3	3	6
					4	29	0.063	1	16	12	28
0601040105	1991	06/05/92	198,277	TRH	2	44	0.022	0	22	22	44
					3	232	0.117	7	130	95	225
065658	1991	10/02/92	110,797	TRH	2	10	0.009	0	5	5	10
					3	55	0.050	2	31	22	53
0601040106	1992	06/15/93	215,038	TRH	2	489	0.227	83	274	132	406
065734	1992	10/01-07/93	53,675	TRH	2	37	0.069	6	21	10	31
065735	1992	10/01-07/93	56,281	TRH	2	16	0.028	3	9	4	13

a/ CWT = coded-wire tag.

b/ Chinook salmon released during May or June were smolts, those released in October were yearlings.

c/ TRH = Trinity River Hatchery.

d/ Totals are presented only for brood year 1989. These fish have reached five years of age and are considered to have completed their life cycle.

e/ The term "adults" means chinook aged three- through five-years-olds.

recoveries made for either group. CWT group 0601040102 (smolt-released) had an overall return rate of only 0.004%, and returning fish consisted entirely of adults (ages three- and four-year-olds). The yearling-released group (CWT 065639) had an overall return rate of 0.165%, over 41 times that of the smolt-released group. Adults from these yearlings returned at a rate of 0.156% (Table 3, Figure 1).

1990 Brood Year. Smolts from the 1990 BY (CWT 0601040103) have, so far, returned at about three times the average rate (0.243% vs. 0.085%) of their yearling-released counterparts (CWTs 065636 and 065640). Some fish from both these CWT groups can be expected to return next year as five-year-olds.

1991 Brood Year. Smolts from the 1991 BY (CWT 0601040105) are returning at over twice (0.139% vs. 0.059%) the rate of the yearling-released counterparts (CWT 065658) (Table 3, Figure 1). Tagged fish from this BY can be expected to return as four-and five-year-olds in 1995 and 1996, respectively.

1992 Brood Year. Smolts from this BY returned as two-year-olds at nearly five times the average rate of their yearling-released counterparts (0.227% vs. 0.048%, respectively) (Table 3, Figure 1). Tagged fish from this BY can be expected to return as three-, four- and five-year-olds in 1995, 1996, and 1997, respectively.

Fall-run Chinook Salmon

All fall chinook estimates were for the Trinity River basin upstream of the Willow Creek weir.

1989 Brood Year. Four CWT groups from this BY completed their life cycle this season. Three of the groups were yearling releases (CWTs 065634, 065637 and 065641) while one was a smolt release (CWT 0601040101). The highest returns were from the yearling-released CWT group 065641 (0.209%) while the lowest return rate was from the smolt-released CWT group 0601040101 (0.010%) (Table 4, Figure 1).

The two yearling-released CWT groups 065637 and 065641 were part of a food experiment conducted by Trinity River Hatchery personnel. The experiment was designed to determine if there was a difference in the adult returns of chinook raised on diets supplied by two different manufacturers. The CWT group 065641 returned at about 1.5 times the rate of CWT group 065637 (0.209% vs. 0.144%) (Table 4, Figure 1).

1990 Brood Year. TRH 1990 BY fall chinook suffered high mortality due to a particularly severe outbreak of Infectious Hematopoietic Necrosis. Because of this, all fall chinook from this BY were released as yearlings. Only one CWT group (065638)

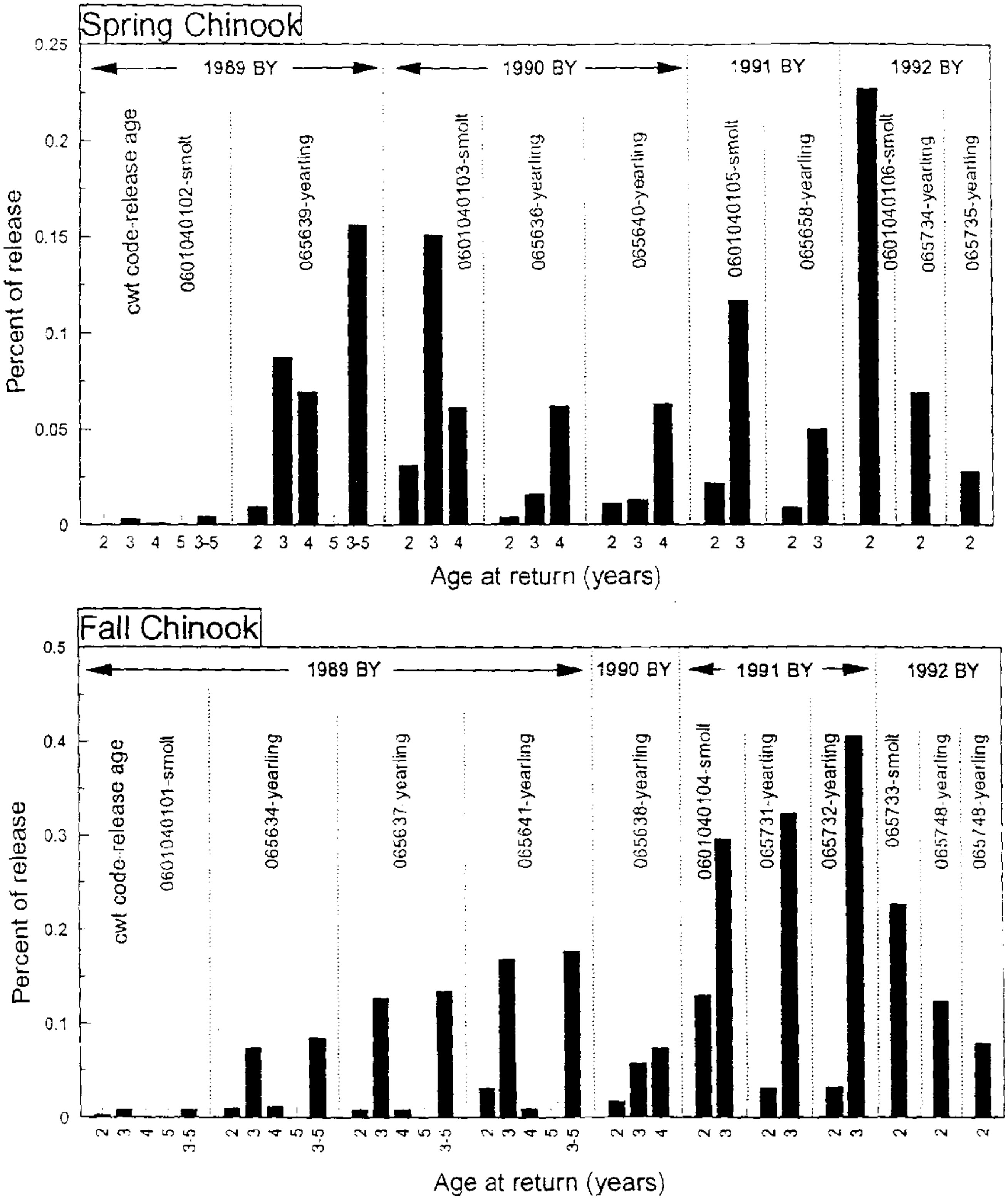


FIGURE 1. In-river return rates for Trinity River Hatchery-produced coded-wire tagged (CWT), spring- and fall-run chinook salmon of brood years (BY) 1989-1992 returning to the river during 1991 through 1994.

TABLE 4. Run-size, percent return, in-river sport catch, and spawner escapement estimates for Trinity River Hatchery-produced, coded-wire-tagged fall-run chinook salmon returning to the Trinity River upstream of Willow Creek Weir during the period 1991 through 1994.

Release data					Estimated returns						
CWT a/ code	Brood year	Date b/	Number	Site	Age	Run-size	% of release	River harvest	Spawning escapement TRH c/	Natural	Total
0601040101	1989	05/18/90	201,622	TRH	2	5	0.002	1	2	2	4
					3	16	0.008	0	9	7	16
					4	0	0.	0	0	0	0
					5	0	0.	0	0	0	0
				Totals: d/		21	0.010	1	11	9	20
				Total adults: e/		16	0.008	0	9	7	16
065634	1989	10/15/90	97,810	TRH	2	9	0.009	1	4	4	8
					3	72	0.074	2	40	30	70
					4	11	0.011	0	7	4	11
					5	0	0.	0	0	0	0
				Totals: d/		92	0.094	3	51	38	89
				Total adults: e/		83	0.085	2	47	34	81
065637 f/	1989	10/16/90	23,625	TRH	2	2	0.008	0	1	1	2
					3	30	0.127	1	17	12	29
					4	2	0.008	0	1	1	2
					5	0	0.	0	0	0	0
				Totals: d/		34	0.144	1	19	14	33
				Total adults: e/		32	0.135	1	18	13	31
065641 f/	1989	10/16/90	22,540	TRH	2	7	0.031	1	3	3	6
					3	38	0.169	1	21	16	37
					4	2	0.009	0	1	1	2
					5	0	0.	0	0	0	0
				Totals: d/		47	0.209	2	25	20	45
				Total adults: e/		40	0.177	1	22	17	[illegible]
065638	1990	10/09/91	103,040	TRH	2	18	0.017	1	10	7	17
					3	60	0.058	3	39	19	58
					4	76	0.074	1	41	34	75
0601040104	1991	06/22/92	206,416	TRH	2	268	0.130	14	174	81	255
					3	612	0.296	11	330	271	601
065731	1991	10/02/92	58,580	TRH	2	18	0.031	1	12	5	17
					3	189	0.323	3	102	84	186
065732	1991	10/02/92	56,720	TRH	2	18	0.032	1	12	5	17
					3	230	0.406	4	124	102	226
065733	1992	06/16/93	192,032	TRH	2	436	0.227	32	235	169	404
065748	1992	10/01-07/93	54,586	TRH	2	67	0.123	5	36	26	62
065749	1992	10/01-07/93	54,308	TRH	2	43	0.079	3	23	17	40

a/ CWT = coded-wire tag.
b/ Chinook salmon released during May or June were smolts, those released in October were yearlings.
c/ TRH = Trinity River Hatchery.
d/ Totals are presented only for brood year 1989. These fish have reached five years of age and are considered to have completed their life cycle.
e/ The term "adults" means chinook aged three- through five-years-olds.
f/ Tagged and released by Trinity River Hatchery personnel.

represented this BY. To date, this group has had an overall return rate of 0.149% (Table 4, Figure 1). Some tagged fish from this BY can be expected to return as five-year-olds next year.

1991 Brood Year. Three CWT groups (one smolt and two yearling releases) from this BY returned this season. So far, the smolt-released group (CWT 0601040104) is returning at about the same rate as the average of the yearling-released groups 065731 and 065732 (0.426% vs. 0.396%) (Table 4, Figure 1). Marked fish from this BY can be expected to return as four- and five-year-olds in 1995 and 1996, respectively.

1992 Brood Year. Three CWT groups (one smolt and two yearling releases) from this BY returned this season. So far, the smolt-released group 065733 is returning at about twice the average rate (0.227% vs. 0.101%) of the yearling-released groups 065748 and 065749 (Table 4, Figure 1). Tagged fish from this BY can be expected to return as three-, four-, and five-year-olds in 1995, 1996, and 1997, respectively.

Coho Salmon

Two coho CWT groups returned to the Trinity River upstream of Willow Creek Weir this season. The overall return of the 1991 BY CWT group 065662 was 0.063%. This was composed of 0.038% three-year-olds and 0.025% two-year-olds (Table 5).

TABLE 5. Run-size, percent return, in-river sport catch, and spawner escapement estimates for Trinity River Hatchery-produced, coded-wire-tagged coho salmon returning to the Trinity River upstream of Willow Creek Weir, 1994-95 season.

Release data						Estimated returns					
									Spawning escapement		
CWT code a/	Brood year	Date	Number	Site	Age	Run-size	% of release	River harvest	Hatchery	Natural	Total
065662	1991	03/29/93	53,058	TRH	2	13	0.025	1	5	7	12
					3	20	0.038	0	6	14	20
					Totals: b/	33	0.063	1	11	21	32
065760	1992	03/28/94	54,723	TRH	2	30	0.055	0	9	21	30

a/ CWT = coded-wire tag

b/ Totals are presented only for brood year 1991. These fish have reached three years of age and are considered to have completed their life cycle.

Two-year-olds from the 1992 BY (CWT 065760) returned at a rate of 0.055% (Table 5). Tagged fish from this BY can be expected to return as three-year-olds next year.

RECOMMENDATIONS

If funding can be secured, coded-wire tagging and release of smolt and yearling chinook and coho, and the monitoring of adult salmon returns at Trinity River Hatchery should be continued in 1995-96.

LITERATURE CITED

Heubach, B., M. Lau, and E. Miller. 1992. Survival and contribution to the fisheries and spawner escapement made by chinook and coho salmon produced at Trinity River Hatchery. Chapter V. Job V. pp. 146-157. In: K. Urquhart and R. Carpenter (eds.). Annual Report of the Trinity River Basin Salmon and Steelhead Monitoring Project, 1990-1991 Season. December, 1992. 186 p. Available from Calif. Dept. Fish and Game, Inland Fish. Div., 1416 Ninth St., Sacramento, CA 95814.

Zuspan, M. 1996. Survival and contribution to the fisheries an spawner escapement made by chinook and coho salmon produced at Trinity River Hatchery. Chapter V. Job V. pp. 146-157. In: R. M. Kano (ed.). Annual Report of the Trinity River Basin Salmon and Steelhead Monitoring Project, 1993-1994 Season. February, 1996. 266 p. Available from Calif. Dept. Fish and Game, Inland Fish. Div., 1416 Ninth St., Sacramento, CA 95814.

ANNUAL REPORT
TRINITY RIVER BASIN SALMON AND STEELHEAD MONITORING PROJECT
1994-1995 SEASON

CHAPTER VI

JOB VI
SURVIVAL, AND CONTRIBUTIONS TO THE FISHERIES AND SPAWNER ESCAPEMENTS MADE BY STEELHEAD PRODUCED AT TRINITY RIVER HATCHERY

by

Lanette D. Davis

ABSTRACT

Staff of the California Department of Fish and Game's Trinity Fisheries Investigations Project conducted a steelhead, Oncorhynchus mykiss, marking program at Trinity River Hatchery from 11 October 1994 through 23 February 1995. This season we marked 956,163 steelhead from the 1994 brood year with a right ventral fin-clip, which were released as yearlings. We checked 20,109 of these steelhead for fin-clip accuracy prior to release and found 0.08% overall with poor fin-clips.

Adult steelhead were monitored returning to Trinity River Hatchery from 29 September 1994 through 11 April 1994, when migration was complete. During that period 436 steelhead returned to Trinity River Hatchery, of which 97.7% were fin-clipped.

Trinity River Project personnel also checked steelhead for fin clips as they returned through the Willow Creek and Junction City Weirs. Six hundred thirty-one steelhead were recovered at the Willow Creek Weir, of which 33.8% were fin-clipped. Eighty-nine steelhead were recovered at the Junction City Weir, of which 80.9% were fin-clipped.

Fork length analysis of marked steelhead observed at all sites this year indicated that the majority of fish were three-year-olds from the 1992 brood year released as yearlings in 1993.

JOB OBJECTIVES

To determine relative return rates and contributions to spawning escapements and the fisheries made by steelhead produced at Trinity River Hatchery, and to evaluate experimental hatchery management practices aimed at increasing adult returns.

INTRODUCTION

Project Background

The completion of the Trinity River Division of the Central Valley Project (15 May 1963) blocked access to an estimated 50% of historic steelhead spawning and rearing habitat in the Trinity River basin, and also resulted in an approximately 70% decrease in flow in the river downstream of Trinity River Hatchery (Moffett and Smith 1950). These project-induced reductions in fishery habitat contributed to the decline of annual runs of steelhead in the Trinity River.

In October 1984, Public Law 98-541 was passed to mitigate for fish and wildlife losses. This act, commonly referred to as the Trinity River Basin Fish and Wildlife Restoration Act, authorized the expenditure of $57 million over a 10-year period to impleme restoration of fish and wildlife populations to pre-dam abundances.

Knowledge of hatchery- and naturally produced steelhead escapements into the Trinity River is a necessary component both for management recommendations and determining the effectiveness of those recommendations. To differentiate between naturally produced and hatchery-produced steelhead, all steelhead reared at Trinity River Hatchery (TRH) from 1978 through 1981 were systematically fin-clipped before being released. Run-size and escapement estimates of hatchery-produced and naturally produced steelhead were made during the 1978-79, 1980-81, and 1982-83 seasons. (Heubach and Hubbell 1980, Heubach 1984, Zuspan et al. 1985).

For the past five years, beginning with the 1988 and 1989 steelhead brood years released in 1990, staff of the California Department of Fish and Game's (CDFG) Trinity Fisheries Investigations Project (TFIP) have marked steelhead produced at TRH as part of the first phase in meeting the Job Objectives. The second phase includes the monitoring of adults returning to TRH.

Steelhead Life History

Juvenile steelhead migrate to sea after spending one to three years in fresh water, and they remain in the ocean from one to three years before making their first upstream migration to spawn. Steelhead are different from other anadromous Pacific salmonids in that they may return to the ocean after spawning, and repeat this migratory procedure each year after maturity up to four times before their life history is completed (Moffett and Smith 1950; Moyle 1976).

A fraction of the Trinity River steelhead run have a unique life-history pattern in that they will stay less than one year in salt water, and return to fresh water after several months (Hopelain 1987). These fish are referred to as half-pounders. In this report, steelhead observed during the 1994-95 season which were <41 cm FL were designated as half-pounders.

METHODS

Hatchery Marking Operations

Steelhead Growth

Steelhead from the TRH 1994 brood year (BY) were available for marking this season. This year, hatchery personnel used higher incubator water temperatures to raise the five lots of juvenile steelhead which were spawned last. This increased their growth rate so they were large enough to go out to the raceways along with the earlier spawned fish.

Hatchery personnel monitored and recorded fish growth through weekly standard weight counts (number of fish per pound), an operating procedure used to determine amount of food given to fish following feed manufacturers' recommendations (Gary Ramsden, Manager, Trinity River Hatchery, CDFG, pers. comm.). The average weight of individual fish reported in this Chapter is based on weight count data from TRH feeding schedules. Steelhead from the 1994 BY were fed using "demand" feeders.

To ensure that groups being marked would meet the hatchery minimum release size requirement of six inches, Project personnel also culled fish while marking, placing smaller fish into holding tanks until they could be moved into hatchery ponds for further growth. These smaller steelhead were fed by hand.

Fish Marking and Release

A crew of four marked the steelhead at TRH inside a wooden shed measuring 3 m X 3 m, positioned directly over the hatchery ponds. The shed contained a four-station marking table and a circulating fresh-water holding tank (approximately 284 liters). Fish were netted directly from the hatchery ponds, and placed into the holding tank. Another smaller holding tank with circulating fresh water, located in the center of the marking table, was used to hold fish immediately before marking. Each station was equipped with a manual counter to count each fish marked.

The marking shed was equipped with a recirculating tricaine methanesulfonate (MS-222[1/]) system (approximately 76 liters), which was changed at least once each day with a fresh MS-222 solution; this system used 1½ cups of MS-222 per week. The recirculating MS-222 system was installed to minimize fish mortality caused by overdosage of anaesthetic. Fresh-water and MS-222 solution temperatures were monitored regularly throughout the day.

Marking the steelhead involved anaesthetizing them, removing a fin by clipping, and releasing them into a pond reserved for marked fish. We marked the 1994 BY fish with a right ventral (RV) fin-clip, to be released as yearlings. To monitor how well the fins were being removed, we randomly checked steelhead one to four times each day throughout marking by examining a sample of fish as they exited the marking shed.

We also examined a sub-sample of marked steelhead immediately prior to release to determine fin-clip quality and fish size. Fish were anaesthetized with CO^2, measured to the nearest mm fork length (FL), and fin-clips were inspected. CO^2 was used instead of MS-222 so that these fish could be released without the 21-day holding period required by MS-222 use.

Fin clipping is considered a permanent mark if the fin rays are removed to the point of attachment to the bone. Fins which are less than one-half-removed are likely to regenerate (Stuart 1958; Eipper and Forney 1965; Jones 1979). Poor marks are usually unrecognizable unless persons checking for fin-clips specifically look for distorted rays. We determined the number of effectively marked fish by multiplying the percentage of fish with poor fin-clips by the total number of fish released, and subtracting this product from the total released.

Recovery Operations

Recoveries of returning marked steelhead were conducted at TRH, river km (RKM) 180.1, and downstream at two trapping locations; Junction City Weir (47.1 km downstream from TRH), and Willow

---

1/ The use of brand names is for identification purposes only, and does not imply the endorsement of any product by CDFG.

Creek Weir (131.4 km downstream from TRH). Trinity River Project (TRP) personnel examined fish for fin-clips, measured each to the nearest cm FL, and recorded the fish's sex at each recovery site. In addition, at the weir sites, scale samples were taken and steelhead were spaghetti-tagged prior to release back into the mainstem Trinity River.

RESULTS AND DISCUSSION

Hatchery Marking Operations

Steelhead Growth

According to TRH feeding schedule records, 1994 BY fish grew progressively throughout the rearing period. There were 2,511 smaller steelhead that were culled during the marking process because they did not meet the minimum release-size of six inches. The average weight of individual fish on 15 March 1995 was 23.4 g for these smaller fish and 96.5 g for all the other steelhead (Figure 1).

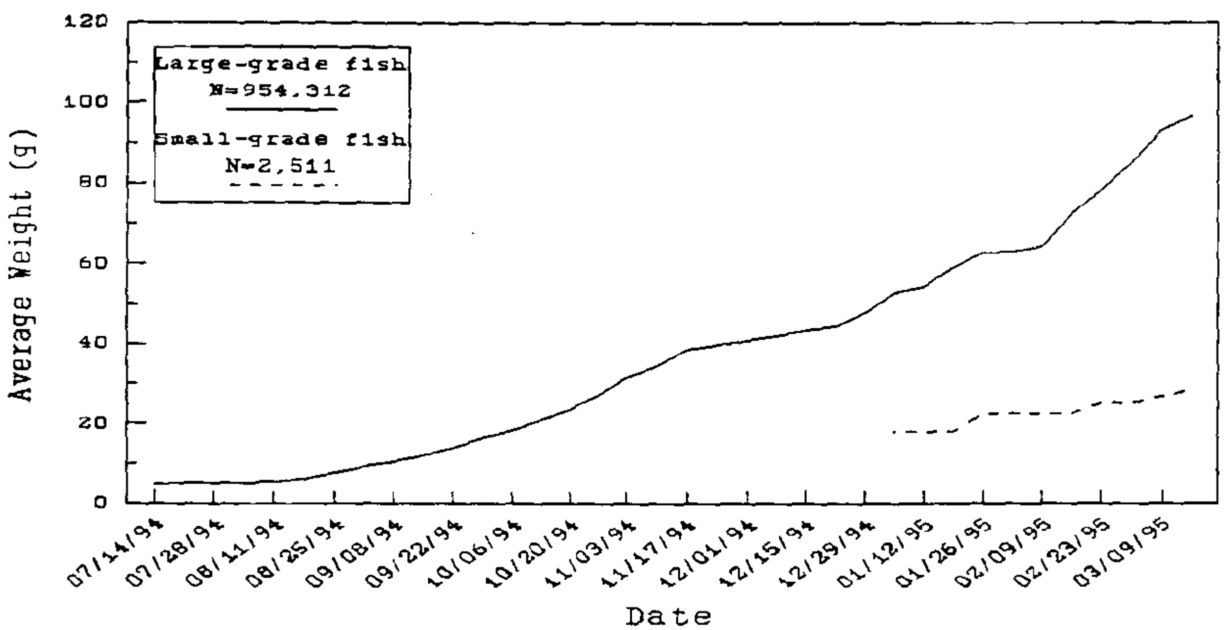


FIGURE 1. Average weight of steelhead from the 1994 brood year reared at Trinity River Hatchery from 14 July 1994 through 15 March 1995. Small-grade fish were culled during marking, and were not weighed until 4 January 1995.

Fish Marking and Release

This is the sixth season Project personnel completed marking and release operations at TRH. To date, we have marked seven BYs with a combination of various fin-clips (Appendix 1). We marked a total of 956,923 steelhead from the 1994 BY with a RV fin-clip this season between 11 October 1994 and 23 February 1995. All 1994 BY steelhead were volitionally released as yearlings on 15 through 23 March 1995 (Table 1).

We examined a total of 20,109 steelhead from the 1994 BY to see how well they were marked, and found 14 (0.08%) of the large-grade fish with poor fin-clips. We estimated that 760 steelhead of this size group were poorly marked. None of the small-grade fish showed poor fin-clips, so we estimated a total of 956,163 1994 BY steelhead were effectively marked at release (Table 2).

Of the 20,109 fish examined, we measured 7,180 of the large-grade fish and all of the 2,511 small-grade fish. Fork length statistics of the two groups were determined separately. Large-grade fish ranged from 105 to 270 mm FL (4.3 to 10.6 in), and averaged 195.4 mm FL (7.7 in) with a sample SD of 18.6. Smaller-grade fish ranged from 58 to 192 mm FL (2.3 to 7.6 in) , and averaged 122.0 mm (4.8 in) with a sample SD of 14.4 (Figure 2).

Recovery Operations

In relation to life-history patterns, we expected to see returns of marked fish from the 1988 through 1992 BYs released in 1990 through 1993. This was the third season that fish with the same mark from different BYs were expected to be recovered. During this season, recovered marked steelhead with adipose plus right ventral fin-clips (Ad+RV) and with left ventral (LV) fin-clips

TABLE 1. Summary of Trinity River Hatchery steelhead marking and release for the 1994-95 season.

Release group					
Brood year	Age	Number released	Fin-clip type[a]	Release date	Size at Release (# fish/kg)
1994	Yearling	954,412	RV	3/15-23/95	10.5
1994	Yearling	2,511	RV	3/15-23/95	35.2

a/ Fin-clip type was right ventral.

TABLE 2. Summary of hatchery mark evaluations for steelhead fin-clipped from 3 January through 22 April 1994.

Release group						
Brood year	Age	Number released	Fin-clip type[a]	Number evaluated	% poor clips	Number effectively marked[b]
1994	Yearling	954,412	RV	17,598	0.08%	953,652
1994	Yearling	2,511	RV	2,511	0.0%	2,511

a/ Fin-clip type was right ventral.
b/ Number of effectively marked fish = number released X ((100 - % poor clips)/100).

both could have been from either the 1989 or 1991 BYs. Recovered fish with adipose plus left ventral fin-clips (Ad+LV) could have been from the 1990 and 1992 BYs. Based on a comparison of mean the FL of 1995 combined recoveries from TRH and Junction City and Willow Creek weirs to those of past years, Ad+RV recoveries were probably mostly four-year-olds, while LV recoveries were probably a combination of four- and two-year-olds. The mean FL of 1995 recovered Ad+LV fin-clips (57.5 cm) was similar to the mean FL (55.8 cm) of Ad+LV recoveries in 1993 when only one BY was at-large, so these fish were assumed to be mostly three-year-olds (Appendix 3).

Trinity River Hatchery

Project personnel and Trinity River Project personnel monitored steelhead returning to TRH from 29 September 1994 through 8 April 1995, when migration was completed. During that period 436 steelhead returned, 426 (97.7%) of which were marked. Of the marked fish, one (0.2%) was marked with a RV fin-clip, 12 (2.8%) had Ad+RV fin-clips, 42 (9.9%) had LV fin-clips, 369 (86.6%) had Ad+LV fin-clips, and two (0.5%) were marked with Ad fin-clips only. The Ad fin-clipped-only fish may have at one time been marked in conjunction with a ventral clip, and were probably the result of poor fin-clipping and regeneration.

For comparison with past results, a total of 927, 571, 586, and 891 steelhead, respectively, were recovered at TRH during the 1990-91, 1991-91, 1992-93, and 1993-94 seasons. Marked fish constituted 2.8% of the 1990-91 recoveries, 74.6% of the 1991-92 recoveries, 96.9% of the 1992-93 recoveries, and 98.9% of the 1993-94 recoveries (Appendix 2).

Ad+LV fin-clipped steelhead made up the largest proportion of marked recoveries at TRH this year (Appendix 2). Fork length analysis indicated that the majority of Ad+LV-clipped fish were

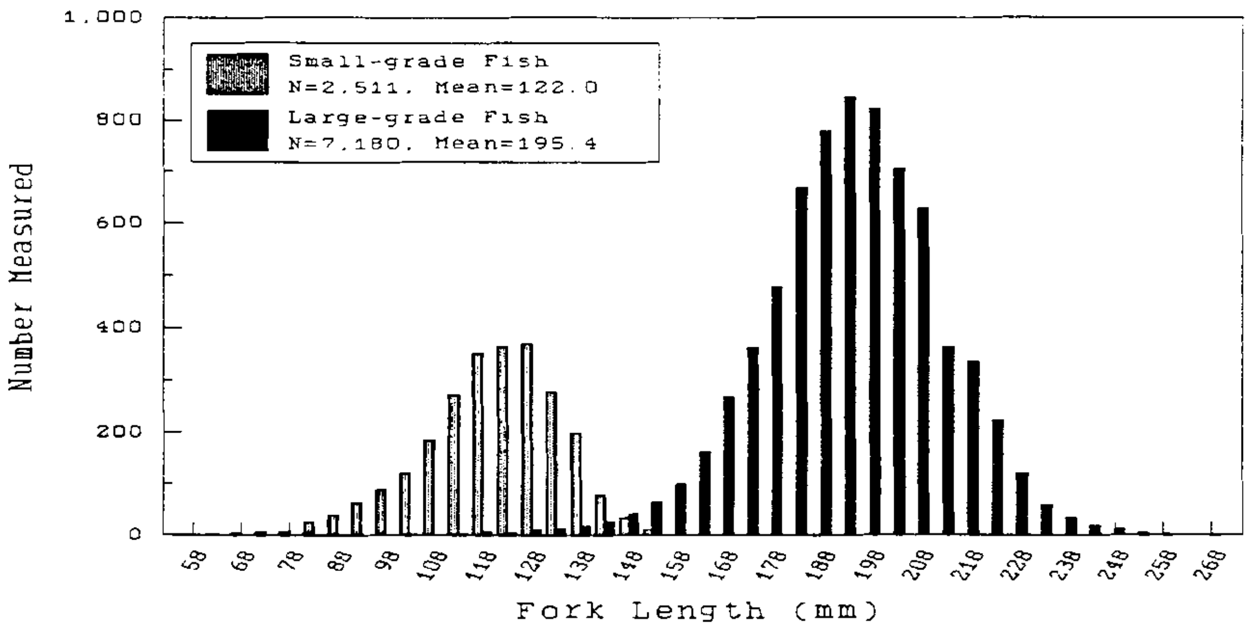


FIGURE 2. Length frequency of marked yearling steelhead from the 1994 brood year released from Trinity River Hatchery during the 1994-95 season. Lengths are grouped in 5-mm increments.

three-year-olds (1992 BY) (Appendix 3). Adults of the 1988 BY released as two-year-olds comprised the largest proportions of the marked fish recovered at TRH as three- and four-year-olds during the 1990-91 and 1991-92 seasons, respectively. Three-year-old adults of the 1991 and the 1990 BYs released as yearlings comprised the largest proportion of marked fish recovered at TRH for the 1992-93 and 1993-94 seasons (Appendices 2 and 3).

Junction City Recovery Weir

TRP personnel monitored steelhead at Junction City Weir from 24 May through 13 December 1994 when operations were terminated because of high flows. During that time 89 steelhead were recorded, of which 72 (80.9%) were fin-clipped and seven (7.9%) were considered half-pounders (<41 cm FL). Of the marked steelhead, 62 (86.1%) were marked with a Ad+LV fin-clip indicating they were three- or five-year-olds from the 1992 or 1990 BYs, respectively. Nine fish (12.5%) were marked with a LV fin-clip indicating they were two- or four-year-olds from the 1993 or 1991 BYs, respectively. One fish was marked with an Ad fin-clip only of unknown origin, and 17 were unmarked (Appendices 2 and 3).

During the past five seasons, the total number of steelhead caught at Junction City Weir was lower than at either of the other two recovery sites. The percentage of marked fish seen at Junction City Weir, however, was intermediate to the percentages seen at TRH and Willow Creek Weir. Only one marked fish was recovered at the Junction City Weir during the 1990-91 season and could not be identified with a BY because of a questionable fin-clip. Fin-clipped four-year-olds from the 1988 BY comprised the largest proportion of marked fish recovered at Junction City Weir during the 1991-92 season. Three-year-olds from the 1990 BY comprised the largest proportion of marked fish recovered at Junction City Weir during the 1992-93 season. Three-year-olds from the 1991 BY comprised the only marked fish recovered at Junction City Weir during the 1993-94 season (Appendices 2 and 3).

Willow Creek Recovery Weir

TRP personnel monitored steelhead at Willow Creek Weir from 3 August through 11 December 1994, when operations were terminated because of high flows. During that time 631 steelhead were recorded, of which 213 (33.8%) were fin-clipped and 28 (4.4%) were considered half-pounders (<41 cm FL). Of the marked fish, 185 (86.9%) were marked with an Ad+LV fin-clip indicating they were three- or five-year-olds from the 1992 or 1990 BYs, respectively. Twenty-two fish (10.3%) were marked with a LV fin-clip indicating they were two- or four-year-olds from the 1993 or 1991 BYs, respectively. Four fish (1.9%) were marked with an Ad+RV fin-clip indicating they were four-year-olds from the 1991 BY. Two fish were marked with an Ad fin-clip only.

No marked steelhead were seen at Willow Creek Weir during the 1990-91 season. During the 1991-92 season four-year-olds from the 1988 BY constituted the largest proportion of marked fish recoveries. During the 1992-93 and 1993-94 seasons, three-year-olds constituted the largest proportion of marked fish recovered (Appendices 2 and 3).

RECOMMENDATIONS

1. Marking of all hatchery steelhead should continue during the 1995-96 season.

2. Only the marking shed with the recirculating MS-222 tank should be used during the next marking season to reduce chances of anesthetic overdose.

3. Marking should take place regardless of fish size, and smaller marked fish should be culled and held for release at a later date. This should eliminate unnecessary delays during marking.

4. Scales should be taken from steelhead returning to TRH next season and scale analysis should be done on a sample of returning fish to more accurately determine ages and the extent that steelhead from a particular brood year return over several seasons.

LITERATURE CITED

Eipper, A. and J. Forney. 1965. Evaluation of partial fin-clips for marking largemouth bass, walleyes, and rainbow trout. New York Fish and Game Journal. 12:233-240.

Jones, R. 1979. Materials and methods used in marking experiments in fishery research. Food and Agriculture Organization of the United Nations, Fisheries Technical Paper Number 190 (FIRM/T190). Rome, Italy.

Heubach, B. 1984. FY 1982 progress report. Task VI. Lower Trinity River salmon and steelhead tagging program. pp. 49-106. In: P.M. Hubbell (ed.), Progress Report. Fishery Investigations--Trinity River. Trinity River Basin Fish and Wildlife Task Force Priority Work Item No. 5. Tasks I and VI. December 1984. 106 p. Available from Calif. Dept. of Fish and Game, Inland Fish. Div., 1416 9th St., Sacramento, CA, 95814.

Heubach, B. and P. M. Hubbell. 1980. FY 1979 progress report. Task VI. Lower Trinity River salmon and steelhead tagging program. pp. 80-132. In: P.M. Hubbell (ed.), Progress Report. Fishery Investigations--Trinity River. Trinity River Basin Fish and Wildlife Task Force Priority Work Ite No. 5. September 1980. 141 p. Available from Calif. Dep. of Fish and Game, Inland Fish. Div., 1416 9th St., Sacramento CA 95814.

Hopelain, J. S. 1987. Age, growth, and life history of Klamath River basin steelhead (Salmo gairdnerii), as determined from scale analysis. 33 p. (Mimeo). Available from Calif. Dept. of Fish and Game, Inland Fisheries Div., 1416 9th St., Sacramento, CA, 95814.

Moffett, J. W. and S. H. Smith. 1950. Biological investigations of the fishery resources of Trinity River, California. United States Department of the Interior, Special Scientific Report, Fisheries No. 12.

Moyle, P. B. 1976. Inland Fishes of California. pp. 131-132. Univ. of Calif. Press, Berkeley, CA. 405 p.

Stuart, T. A. 1958. Marking and regeneration of fins. Freshwater Salmon Fisheries Research, Edinburgh, Scotland 22.

Zuspan, M., D. Maria, and B. Heubach. 1985. FY 1982 progress report. Task IV. Trinity River salmon and steelhead tagging program. pp. 62-146. In: P.M. Hubbell (ed.), Progress Report. Fishery Investigations--Trinity River. Trinity River Basin Fish and Wildlife Task Force Priority Work Item No. 5. January 1985. 146 p. Available from Calif. Dept. of Fish and Game, Inland Fish. Div., 1416 9th St., Sacramento, CA, 95814.

APPENDIX 1. Summary of Trinity River Hatchery (TRH) marked steelhead releases for the 1989-90 through 1994-95 seasons.

Marking season	Fin-clip type	Brood year	Age at release	Size at release: # Fish per kg	Size at release: Mean FL (cm)	Size at release: Range FL (cm)	Release date	Release site	Number of effectively-marked fish released
1989-1990	Right ventral	1988	2-year-old	3.5	26.6	16.0-40.0	03/15/90	TRH	50,490
	Left ventral	1989	Yearling	19.8	15.9	10.7-23.0	04/06/90	TRH	257,997
	Left ventral	1989	Yearling	22.0	-- a/	--	04/23/90	TRH	148,000
1990-1991	Adipose+Right ventral	1989	2-year-old	2.0	-- a/	--	03/18/91	Sawmill ponds	81,796
	Adipose+Right ventral	1989	2-year-old	1.6	21.7	11.0-32.0	03/18/91	TRH	99,171
	Adipose+Left ventral	1990	Yearling	3.2	18.0	10.0-24.0	03/18/91	TRH	962,812
1991-1992	Right ventral	1990	2-year-old	2.4	35.2	20.5-45.5	03/16/92	TRH	1,909
	Left ventral	1991	Yearling	17.5	18.1	7.5-28.3	03/16/92	TRH	959,313
1992-1993	Adipose+Right ventral	1991	2-year-old	2.6	32.2	18.4-42.1	04/12/93	TRH	-- b/
				2.6	32.2	18.4-42.1	04/12/93	Old weir site	-- b/
				2.6	32.2	18.4-42.1	04/12/93	Lewiston bridge	-- b/
								Total	13,582
	Adipose+Left ventral	1992	Yearling	9.7	19.8	15.2-29.1	04/12/93	TRH	-- b/
				15.7	12.5	7.6-15.1	04/12/93	TRH	-- b/
								Total	323,583
1993-1994	Left ventral	1993	Yearling	8.4	20.5	11.8-26.2	03/15/94	TRH	140,999
				11.9	18.9	14.3-25.1	03/15/94	TRH	144,801
				17.4	16.5	12.0-21.1	03/15/94	TRH	37,991
				-- a/	14.9	6.3-19.6	05/15/94	TRH	6,662
								Total	330,453
1994-1995	Right ventral	1994	Yearling	10.5	19.5	10.5-27.0	03/15/95	TRH	953,652
				-- a/	12.2	5.8-19.2	03/15/95	TRH	2,511
								Total	956,823

a/ Data not available for this size group.
b/ Numbers released not available by site.

APPENDIX 2. Summary of adult steelhead recoveries made at Trinity River Hatchery (TRH), Junction City Weir (JCW), and Willow Creek Weir (WCW) during the 1990–91 through 1994–95 seasons.

	All recoveries			Right ventral fin–clip 1/		Left ventral fin–clip 2/		Adipose + right ventral fin–clip 3/		Adipose + left ventral fin–clip 4/		Adipose fin–clip only	
Recovery season and location	Number of steelhead observed	Number of marked fish recovered	Percent of total observed	No. with mark	Percent of marks recovered	No. with mark	Percent of marks recovered	No. with mark	Percent of marks recovered	No. with mark	Percent of marks recovered	No. with mark	Percent of marks recovered
1990–1991													
TRH	927	26	2.8	19	73.2	1	3.8	1	3.8	0	--	5	19.2
JCW	138	1	0.7	0	--	0	--	0	--	0	--	1	100.0
WCW	325	0	--	0	--	0	--	0	--	0	--	0	--
Totals	1390	27		19		1		1		0		6	
(Overall percent)			(1.9)		(70.4)		(3.7)		(3.7)		(--)		(22.2)
1991–1992													
TRH	571	426	74.6	179	42.0	53	12.4	155	36.4	37	8.7	2	0.5
JCW	103	35	34.0	13	37.1	9	25.7	8	22.9	5	14.3	0	--
WCW	638	71	11.1	49	69.0	9	12.7	7	9.9	4	5.6	2	2.8
Totals	1312	532		241		71		170		46		4	
(Overall percent)			(40.5)		(45.3)		(13.3)		(32.0)		(8.6)		(0.8)
1992–1993													
TRH	586	568	96.9	130	22.2	119	20.3	76	13.0	234	39.9	9	1.5
JCW	29	17	58.6	0	--	1	6.9	3	17.6	12	70.6	1	5.9
WCW	190	85	44.7	1	1.2	12	14.1	17	20.0	47	22.3	8	9.4
Totals	805	670		131		132		96		293		18	
(Overall percent)			(83.2)		(19.6)		(19.7)		(14.3)		(43.7)		(2.7)
1993–1994													
TRH	891	881	98.9	9	1.0	803	91.2	51	5.8	15	1.7	3	0.3
JCW	68	45	66.2	0	0.0	45	100.0	0	0.0	0	0.0	0	0.0
WCW	494	288	58.3	0	0.0	267	92.7	4	1.4	16	5.6	1	0.3
Totals	1453	1214		9		1115		55		31		4	
(Overall percent)			(83.2)		(0.8)		(91.8)		(4.5)		(2.6)		(0.3)
1994–1995													
TRH	436	426	90.7	1	0.2	42	9.9	12	2.8	369	86.6	2	0.5
JCW	89	72	80.9	0	0.0	9	12.5	0	0.0	62	86.1	1	1.4
WCW	631	213	33.8	0	0.0	22	10.3	4	1.9	185	87.8	2	0.9
Totals	1156	711		1		73		16		616		5	
(Overall percent)			(61.5)		(0.1)		(10.3)		(2.3)		(86.6)		(0.7)

1/ 1988 brood year, yearling releases; and 1990 brood year, two–year–old releases.
2/ 1989 brood year, yearling releases; and 1991 brood year, yearling releases; and 1993 brood year, yearling releases.
3/ 1989 brood year, two–year–old releases; and 1991 brood year, two–year–old releases.
4/ 1990 brood year, yearling releases; and 1992 brood year, yearling releases.

APPENDIX 3. Mean fork lengths and age compositions of fin–clipped steelhead from brood years 1988 through 1993 recovered at Trinity River Hatchery, Junction City Weir, and Willow Creek Weir during 1991 through 1995.

			Year of recovery									
			1991		1992		1993		1994		1995	
Fin–clip a/	Brood years marked	Age–at–release	Mean FL b/	Age class c/	Mean FL b/	Age class c/	Mean FL b/	Age class c/	Mean FL b/	Age class c/	Mean FL b/	Age class c/
RV	1988, 1990	2–yr–old	46.5	3	60.2	4	46.4	3	52.2	4	31.0 d/	5
Ad + RV	1989, 1991	2–yr–old	61.0 d/	2	40.2	3	54.4	4	47.9	5 & 3	50.4	4
LV	1989, 1991, 1993	Yearling	52.0 d/	2	56.7	3	38.7	2	57.0	3	52.6	4 & 2
Ad + LV	1990, 1992	Yearling	–– e/	––	36.2	2	55.8	3	48.7	4 & 2	57.5	3

a/ Fin–clips were: RV = right ventral.
Ad + RV = Adipose and right ventral.
LV = Left ventral.
Ad + LV = Adipose and left ventral.
b/ Mean fork length (cm) of combined recoveries at Trinity River Hatchery, Junction City Weir, and Willow Creek Weir.
c/ Assumed age composition (–year–olds) of fin–clipped fish based on brood years possible to be recovered.
d/ Number represents the fork length of only one fish recovered.
e/ No recoveries were made.

ANNUAL REPORT

TRINITY RIVER BASIN SALMON AND STEELHEAD MONITORING PROJECT
1994-1995 SEASON

CHAPTER VII

JOB VII
LIFE HISTORY, DISTRIBUTION, RUN SIZE, AND HARVEST OF SPRING CHINOOK SALMON IN THE SOUTH FORK TRINITY RIVER BASIN

by

Michael Dean

ABSTRACT

The California Department of Fish and Game, South Fork Trinity River Project conducted a study of spring-run chinook salmon (Oncorhynchus tshawytscha) in the South Fork Trinity River (SFTR) basin. During the 1994-1995 season, we conducted snorkel, redd, and carcass recovery surveys, analyzed adult scales, and trapped emigrant juvenile salmon.

During the adult trapping operation in the spring of 1994 (previously reported), we captured 79 spring-run chinook salmon (spring chinook). Recovery weirs were not operated due to low stream flows. During snorkel surveys of the SFTR in late July and early August, we observed 243 spring chinook, 35 of which had been marked at the tagging weir. Based on the above recovery numbers we estimated the run-size to be 472 fish (448 adults and 24 grilse). Weir operation and snorkel surveys showed that the spring chinook run began this season in early-May, peaked in late-May to early-June, and ended by late July.

From scale analysis, we determined that the age-class distribution of returning fish was 1% two-year-olds, 16% three-year-olds, 49% four-year-olds, and 34% five-year-olds. We also determined that 67% of these fish exhibited an ocean-type juvenile life history, while 33% exhibited a stream-type life history.

Pools were the primary adult summer holding habitat in the basin. Sixteen pools were located which consistently held three or more spring chinook.

Based on tag returns and creel surveys, the angler harvest of spring chinook in the SFTR was zero in 1994. No angler harvest estimate was made for 1995.

Spring chinook spawning began on 25 September and was complete by 27 October, 1994. During redd surveys, we located 105 spring chinook redds in the mainstem SFTR, but none in lower Hayfork Creek. Redds were distributed primarily between Forest Glen and Hyampom, with only four downstream of Hyampom. We recovered only 12 spring chinook carcasses, three of which had been marked at the tagging weir.

We trapped emigrant juvenile chinook in the SFTR during late summer and fall near Hyampom and Sandy Bar. We captured and released 37 juvenile chinook at these sites ranging in size from 68 to 104 mm FL.

JOB OBJECTIVES

1. To determine the size, composition, distribution, and timing of the adult spring chinook salmon run in the South Fork Trinity River basin.

2. To determine the angler harvest of spring-run chinook salmon in the South Fork Trinity River basin.

3. To determine life-history patterns of spring-run chinook salmon produced in the South Fork Trinity River basin.

INTRODUCTION

This study was designed to be a thorough evaluation of the life history of spring-run chinook salmon (spring chinook), Oncorhynchus tshawytscha, within the South Fork Trinity River (SFTR) basin. This was the first major study of spring chinook in this basin. The only other study was conducted in the late summer and fall of 1964 prior to the devastating flood which occurred that year (LaFaunce 1967). The California Department of Fish and Game (CDFG) and the U.S. Forest Service (USFS) have made numerous attempts to count adult spring chinook (and spring-run steelhead) in the SFTR in order to track population trends and evaluate post-flood habitat recovery. These efforts have been sporadic, short-term, and made no attempt to determine complete life history (Appendix 1). In addition, reliable, statistically-valid population estimates were not determined during any of these efforts.

The current population of spring chinook in the SFTR is, at most, a few hundred fish. Estimates of annual run size from various sources (Appendix 1) ranged from multiples of ten to about 350 fish. The population has experienced serious decline since 1964, when the run was estimated to be 11,604 (LaFaunce 1967). Up-to-date, valid population estimates and understanding of life-history patterns are crucial to any management or restoration effort for spring chinook.

This was the final year of a five-year study of SFTR spring chinook by the South Fork Trinity River Project (SFTRP). Since our annual reports cover the period from 1 July through 30 June, the snorkel survey, redd and carcass recovery surveys and other observations made during summer and fall 1994 relate to those fish trapped and marked during the 1993-1994 reporting period. Also, most scales used for life-history determinations were obtained from those adult fish trapped and released during the 1993-1994 reporting period.

METHODS

The study area included the lower 124 km of the SFTR, the lower 7 km of the East Fork of the SFTR, and the lower 16 km of Hayfork Creek, totaling 147 km of river. Lafaunce (1967) and USFS surveys (Appendix 1) broke this area into 16 roughly equal sections. We attempted to use these same sections for comparison, but for logistical reasons deviated slightly from their delineations (Figures 1 & 2).

This study is comprised of several distinct elements, each intended to generate an escapement estimate or provide information on in-stream life history or distribution.

To meet Job Objective 1, we used the Petersen mark and recapture method, with some variation. We operated a weir at which fish were trapped, tagged, and released. We recovered fish or observed tags in two ways: 1) snorkel surveys of the entire study area; and 2) carcass recoveries during the spawning season. Data from both recovery techniques were intended to be used in making separate Petersen estimates. Petersen estimates represent point-in-time run-size estimates upstream of the tagging weir. Snorkel surveys were also used to determine in-river distribution, and to continue documenting run-timing once the tagging weir was removed. The number and distribution of redds were determined by foot and helicopter surveys (redd surveys).

To meet Job Objective 2, we utilized non-reward tag returns and creel surveys. Historically, poaching has been a problem in the SFTR. Non-reward tags were chosen so the potential of poaching, primarily for the reward, was not increased.

To meet Job Objective 3, we analyzed scales collected during the adult trapping operation and carcass recovery surveys, and performed emigrant juvenile trapping.

Immigrant Chinook Trapping and Tagging

Early-entering Portion of the Run

The primary trapping and tagging weir (Gates Weir) was located at river kilometer (RKM) 31.7, 16 km downstream from the township of Hyampom (Figure 1). The weir functioned as a fence across the river, guiding fish into a trap. The weir was constructed of 1.5-m-wide by 1.2-m-high panels, which reached completely across the river. Each panel was constructed of 1.9-cm-diameter galvanized conduit welded horizontally on 5.7-cm centers to 2.5-cm by 2.5-cm steel angle-iron uprights. Panels were wired together with steel tie-wire, and supported with conventional steel fence posts driven into the river bottom. Netting was placed atop the panels to prevent fish from jumping over the weir.

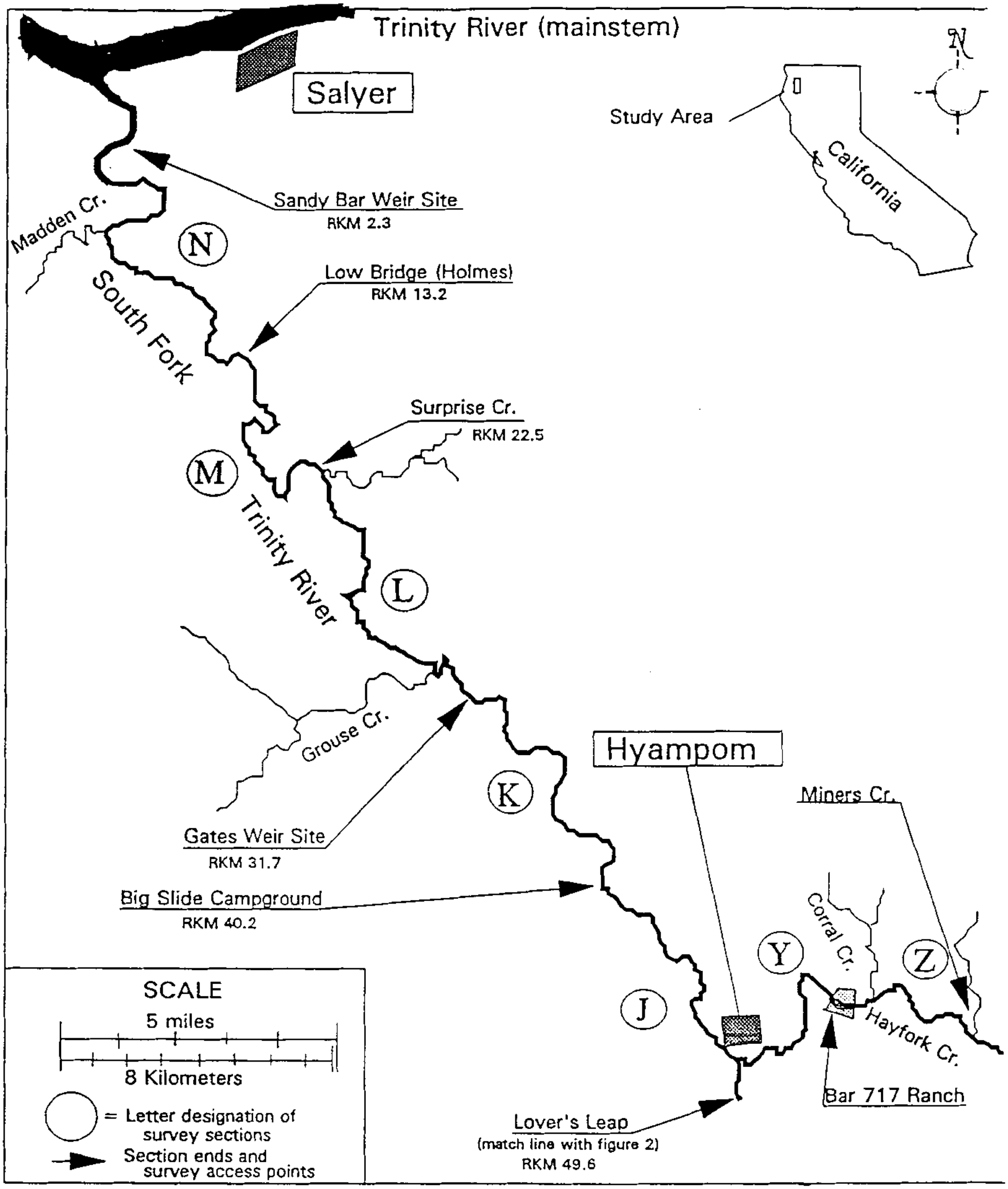


FIGURE 1. Map of the South Fork Trinity River, Hyampom and below, depicting survey sections and major tributaries (RKM = river kilometer, from the mouth of the South Fork Trinity River).

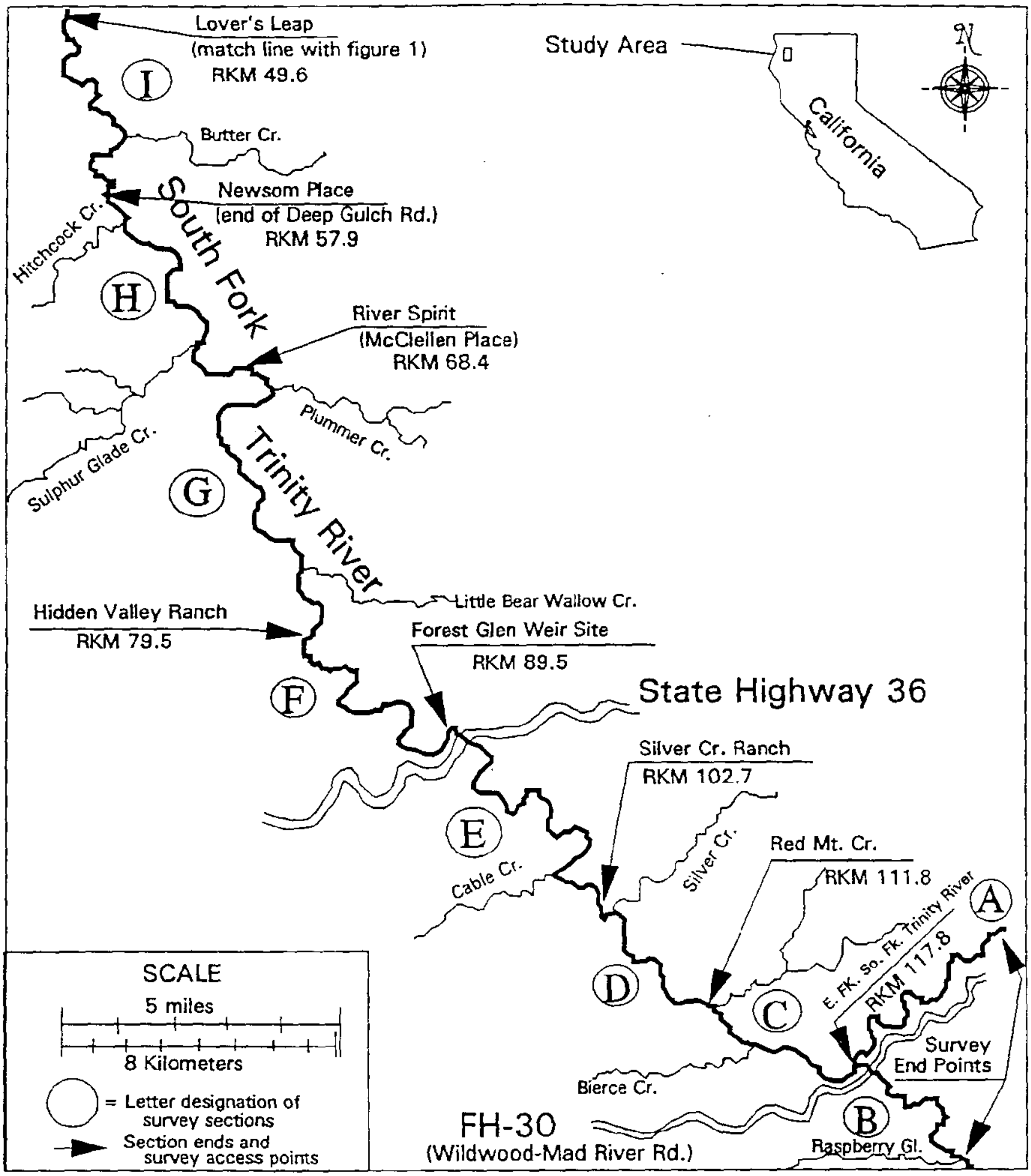


FIGURE 2. Map of the South Fork Trinity River above Hyampom depicting survey sections and major tributaries (RKM = river kilometer, from the mouth of the South Fork Trinity River).

The trap was 2.4 m long by 2.4 m wide by 1.2 m high (vertical dimension) and was constructed with the weir panels described above. Two 1.2-m^2 panels were placed inside the open end of the trap forming a fyke, guiding fish inside and deterring their escape. The conduit of the upstream and side panels was sleeved with clear vinyl tubing to minimize potential abrasion to trapped fish. To make fish more "at ease" in the trap and less likely to try to jump out, a piece of dark-blue nylon fabric was floated on the water surface inside the trap. It was attached only at the upstream end of the trap, so if a fish were to jump and land atop the fabric, it would sink, allowing the fish to settle back into the water. This device also provided cover and made fish difficult to see from outside the trap. Great care was taken to insure that there were no sharp projections, wire, etc. inside the trap which might injure fish. Foam pipe insulation was used in areas where unavoidable abrasion might occur. The trap was provided with a lockable plywood lid and solid plywood bottom.

Fish were netted from the trap with a knotless-nylon-mesh net and placed in a tagging cradle. The tagging cradle consisted of a frame, constructed from 1.9-cm-diameter copper pipe, measuring 100 by 50 cm, and was fitted with a nylon cradle and a metric ruler for measuring fork lengths (FL). The cradle assembly was designed to slide into a channel in the front of the trap. A sliding door made from perforated aluminum plate (0.32-cm holes) formed the upstream end of the cradle. Once marked and measured fish were released by raising the sliding door.

During tagging, fish were examined for marks, scars, and general condition, their FL measured to the nearest cm, and a scale sample was taken. A small knife was used to collect scales from the left side of the fish just below the dorsal fin. Spring chinook from the 1994 cohort, which appeared healthy, were marked with a one-half right ventral (½RV) fin-clip and a bi-colored Floy[1/] anchor tag. Anchor tags were placed on the left side of spring chinook, just below the dorsal fin, and just posterior to the midline. Spring-run steelhead were marked with an anchor tag on the right side and a one-half left ventral (½LV) fin clip.

Tagged fish were sprayed with a 25% aqueous solution of Propolyaqua[1/] (artificial slime) to help prevent infection caused by the removal of mucus during handling. Spraying was focused on areas such as the caudal peduncle, scale-sample site, and the tag location. Care was taken to insure that the head, operculum, and gills were not sprayed with the solution.

1/ The use of brand names is for identification purposes only and does not imply the official endorsement of any product by t' California Department of Fish and Game.

Fish which appeared fresh and strong were released directly from the tagging cradle to the river, upstream of the weir, without further handling. However, most fish were allowed to swim from the cradle into a recovery tube and held there for at least 60 minutes. Recovery tubes were made from plastic pipe measuring 3.5 m long by 25 cm in diameter. The upstream and downstream ends were fitted with sliding plexiglas doors, each with numerous 2-cm holes allowing ample water to flow through the tube. The tubes were oriented with their long axis parallel to the current and held on the river bottom with large rocks or steel fence posts. After the recovery period, the upstream door was opened and fish were allowed to leave of their own volition.

Late-entering Portion of the Run

Instead of a weir operation, we conducted snorkel surveys and pool follow-up observations to determine the size and distribution of the late-entering segment of the 1994 spring chinook run. We felt that the operation of a weir during August and early September, when minimum water temperatures regularly exceed 21 °C, would result in unacceptable fish mortality.

Another significant problem encountered in operating a weir at this time of year, was defining spring-run vs. fall-run chinook salmon (fall chinook), since both may be present at this time. Late-entering spring chinook were identified as those fish which were dark, brassy, and may have had other physical marks indicating they had over-summered lower in the Klamath-Trinity system. Fall chinook were identified as those which appeared fresh, bright, nickel-colored, and usually lacked old marks and scars. However, this technique of identification can be misleading, so it was used with caution.

Recapture Weirs

Recapture weirs were not used this season due to extremely low stream flows and excessively high water temperatures during the summer.

Snorkel Survey

During the summer of 1994, snorkel surveys were conducted in late July, and again in late August/early September, and systematically covered the study area upstream of Surprise Creek (Figures 1 and 2). Our primary goal was to observe and record the numbers of marked and unmarked spring chinook for making run-size estimates. We also documented the number and location of over-summer holding pools utilized by three or more spring chinook. We also recorded the numbers of marked and unmarked adult spring-run steelhead seen.

Use of Standard Julian Week

Some data collected are presented in Julian week (JW) format. Each JW is defined as one of a consecutive set of 52 weekly periods, beginning 1 January, regardless of the day of the week on which 1 January falls. The extra day during a leap year is added to the ninth week, and the last day of the year is included in the 52nd week (Appendix 2). This procedure allows inter-annual comparisons of identical weekly periods.

RESULTS AND DISCUSSION

1993-1994 Reporting Period

Trapping and Tagging (Early-entering Portion of the Run)

The following paragraphs repeat results from the 1993-1994 Annual Report (Dean 1996) to allow the reader to follow the 1994 spring chinook cohort through the summer and fall covered in this report, and to present a more coherent picture of the 1994 run.

During the 1994 season, we operated the Gates Weir for 43 days, from 28 April through 10 June; the weir was removed on this date due to low stream flows and excessively high water temperatures. We captured and released 75 adult and 4 grilse spring chinook salmon, and 9 adult spring-run steelhead from the immigrant trap (Table 1).

Spring chinook captured at the Gates Weir ranged in size from 52 to 75 cm FL (Figure 3). The average FL was 63.4 cm, significantly larger than the 52.4 cm average of last season ($X^2 = 0.006$). Over one-third (24/62) of fish seen in 1993 were <52 cm FL, while the 1994 run was composed entirely of fish ≥52 cm FL, with almost 25% (17/79) measuring ≥69 cm FL.

All 79 spring chinook were tagged with an anchor tag on the left side and marked with a ½RV fin-clip. All spring-run steelhead were tagged with an anchor tag on the right side and marked with ½LV fin-clip. Two spring chinook, which had shed their tags, were re-captured in the emigrant trap, and were released downstream.

Extremely low stream flows forced the early removal of the Forest Glen Weir in 1994. No spring chinook were captured at this location.

TABLE 1. Trapping summary for the Gates Weir by Julian week from 28 April through 10 June 1994. The Gates Weir was located in the South Fork Trinity River 32 kilometers upstream from the mouth.

		Immigrant trap				Emigrant trap
		Spring-run chinook salmon		Steelhead		
Julian week	Start date	Adults	Grilse a/	Winter-run b/	Spring-run c/	Spawned fall and winter-run steelhead
17	4/28/94	0	0	0	0	3
18	4/30/94	0	0	0	1	17
19	5/07/94	7	0	0	4	14
20	5/14/94	5	0	0	2	7
21	5/21/94	22	3	0	0	14
22	5/28/94	29	0	1	2	3
23	6/04/94	12	1	1	0	13
	Totals:	75	4	2	9	71

a/ Grilse were chinook measuring $\leq$ 53 cm FL, adults were >53 cm FL.
b/ Winter-run steelhead were upstream-migrating, sexually mature fish.
c/ Spring-run steelhead were upstream-migrating, sexually immature fish.

1994-1995 Reporting Period

1994 SFTR Summer Habitat Conditions and Related Observations

The winter of 1993-94 was extremely dry (less than 40% of "normal" rainfall occurred), and SFTR flows were lower during the following summer than we had seen in any of the previous four study years. During July and August 1994, SFTR flows at Forest Glen were consistently less than 10 cubic feet per second (CFS); normal flows at Forest Glen in July are usually 20 to 40 CFS. As a result, the movement of spring chinook between over-summer holding pools, and access to specific spawning areas, was restricted by these low water levels and correspondingly higher water temperatures (sometimes exceeding 26 °C). A large beaver dam two km upstream from Forest Glen further limited chinook access to the upper sections of the SFTR after mid-July. Many of our findings during the summer and fall of 1994 reflected the effects of these decreased stream flows on spring chinook health and summer survival, and in holding pool and redd distributions.

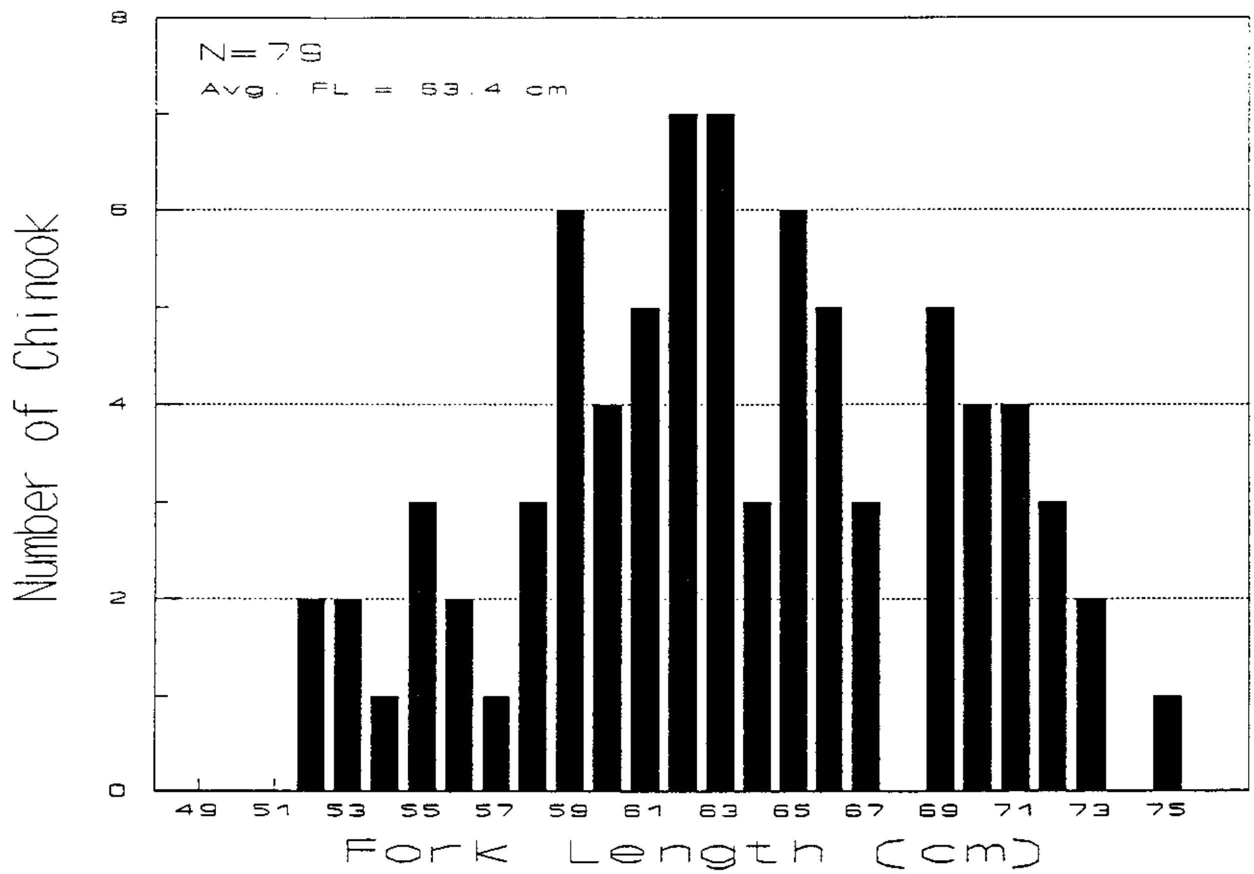


FIGURE 3. Fork length distribution for spring-run chinook salmon captured at the Gates Weir in the South Fork Trinity River in 1994.

SFTR snorkel observations and Gates Weir trapping initially indicated the possibility of a good 1994 spring chinook run. However, the run ended earlier than in past seasons and spring chinook already present did not survive the summer well. The virtual "stranding" of spring chinook in over-summer holding pools resulted in what we considered overcrowded conditions in some river sections, especially considering the poor water quality. We noted very small volumes of cool bottom water in almost every pool. This apparently led to unprecedented over-summer mortality among spring chinook in 1994 compared to other study years. We documented 13 summer mortalities in the July snorkel survey, compared to a total of only two in 1992, and none in 1993. Mortality was apparently disease-related, since during our snorkel surveys, we noted that up to 75% of the spring chinook in some reaches showed signs of active bacterial infection (Flexibacter columnaris), and most of these fish appeared to be blind in at least one eye. Based on snorkel survey data and other observations, we estimated that approximately 30 to 45% of spring chinook died before spawning.

Observation or Recovery of Tags and Marks

Effectively Marked Fish. As stated in the METHODS section, "M" in the Petersen formula represents the number of marked fish minus weir mortalities and those fish which had shed tags. During the last reporting period (see previous section), we captured and tagged 79 spring chinook. Subsequently two fish were known to have shed their tags within a week, and no weir mortalities were seen. Therefore, we effectively tagged 77 spring chinook in 1994.

Snorkel Surveys. During the July snorkel survey, we observed 243 spring chinook and 16 spring-run steelhead. Two-hundred seventeen of the spring chinook and all of the steelhead were seen well enough to positively identify marks. Thirty-five of the spring chinook were marked. Using these data in the Petersen formula yields a run-size estimate of 472 fish (95% confidence limits 350 to 642; Binomial). Only 13 (5.3%) of the spring chinook seen were grilse. Therefore, in July, the adult run size was estimated to be 448 fish. This is essentially the same as the adult run size estimate for July 1993. Only two of the steelhead seen were marked. No run-size estimate for spring-run steelhead was possible from these data.

During the August survey, we observed 235 spring chinook and 22 spring-run steelhead. We saw 233 of the spring chinook well enough to positively identify marks. We counted 27 marked spring chinook, and no marked steelhead. Using these data in the Petersen formula yields a spring chinook run-size estimate of 652 fish (95% confidence limits 359 to 896; Binomial). We counted 18 (7.7%) grilse in the August snorkel survey. Therefore, the adult run-size was estimated to be 602 fish. No run-size estimate for spring-run steelhead was possible.

There may have been some differential mortality among tagged fish this season because of the effect of low and very warm water conditions, but this difference was not apparent. Overall, we saw fewer fish in August than in July, just the opposite of other study years. Among fish seen well enough to identify tags and marks, the tagged to untagged ratio was 0.12 in August (27/233) and 0.16 in July (35/217). Fewer tagged fish relative to untagged fish in the sample would give a higher run-size estimate. Yet, comparison of the confidence limits of both estimates shows that estimates are essentially the same, with the July estimate being more precise. Further, based on snorkel and pool observations, and general habitat conditions ~~discussed above,~~ we were virtually certain very few, if any, spring chinook entered the SFTR after mid-July (see also the section discussing trapping and tagging of the late entering portion of the run).

This summer spring chinook were distributed upstream of the Gates Weir in river sections K through C, with the largest concentrations of both marked and unmarked fish found in sections H, G, and F (Table 2). Very few fish were seen upstream of Forest Glen (sections A-E). Sections M and N were not surveyed this year because we had not observed a significant number of spring chinook in those sections in past years, especially when water temperatures were high (Dean 1994, 1995). We feel very strongly that the lowest sections of the SFTR are not used by spring chinook for over-summer holding.

TABLE 2. Distribution of spring-run chinook salmon (including marked fish) and redds seen in the South Fork Trinity River during 1994 surveys.

River Section	Number of salmon[a]		Number of Redds
	July Survey	August Survey	
A(RKM 124)	0(0)	0(0)	0
B	0(0)	0(0)	0
C	4(3)	2(2)	2
D	2(1)	0(0)	1
E	4(2)	3(2)	4
F	64(11)	46(6)	42
G	80(10)	92(8)	36
H	78(6)	75(8)	12
I	0(0)	1(1)	4
J	6(1)	5(0)	2
K	5(1)	11(0)	2
L	3(0)	0(0)	0
M	NS[b]	NS	NS
N(RKM 0)	NS	NS	NS
Totals	**246(35)**	**235(27)**	**105**

a/ Number of marked or tagged fish observed are indicated in parenthesis.
b/ NS: No survey conducted in these sections.

Due to very low stream flows, snorkel surveys were not conducted in lower Hayfork Creek or Grouse Creek in 1994.

Holding Pools. We documented 16 spring chinook summer holding pools throughout the SFTR, with only one downstream of Hyampom and none upstream of Forest Glen (Figures 4 & 5). At least three spring chinook utilized each pool during August. The factors most limiting to spring chinook holding distribution this season were the low water levels and resulting high water temperatures.

We made a distinction between pools with three or more spring chinook and those with fewer than three, because those pools which met this criterion were utilized consistently. Those pools which did not meet this criterion were used intermittently, or only for a short period of time. In addition, we did not feel it important to document the location of pools which held only one or two fish. Most of the pools that we documented held five or more spring chinook. Eight of the 16 pools used this season were also used last season. Such recurrent use by significant numbers of spring chinook suggests either that these pools are providing optimal over-summer holding conditions that chinook are able to distinguish and locate, or that the number of such "good" pools is limited.

However, our combined snorkel survey observations for the previous study years indicated that there was little shortage of over-summer holding habitat for the current SFTR spring chinook population. We found large pools which appeared to be of adequate size and depth, with good in-stream cover, that were not being utilized. Hillemeier (1995) found that pool surface area was the pool characteristic most strongly correlated with spring chinook use. Many "good" pools were utilized by only one or two fish. These pools were often found in areas where human access was high. Conversely, some of the utilized pools appeared to be of poor quality, e.g. shallow and relatively small; these pools were almost always in isolated areas where human access was low. Human disturbance may be an important factor in chinook use of "poorer" quality pools and their absence from some "good" quality pools. However, in very dry years like 1994, the availability of good quality pools may be a significant factor limiting spring chinook run size; i.e., poor habitat resulted in decreased survival.

Follow-up Observations at Holding Pools. As discussed in the Snorkel Surveys section, from late July through early-September, spring chinook numbers decreased in many of the individual holding pools, as well as throughout the SFTR. We felt this was due primarily to temperature stress and disease-related mortality.

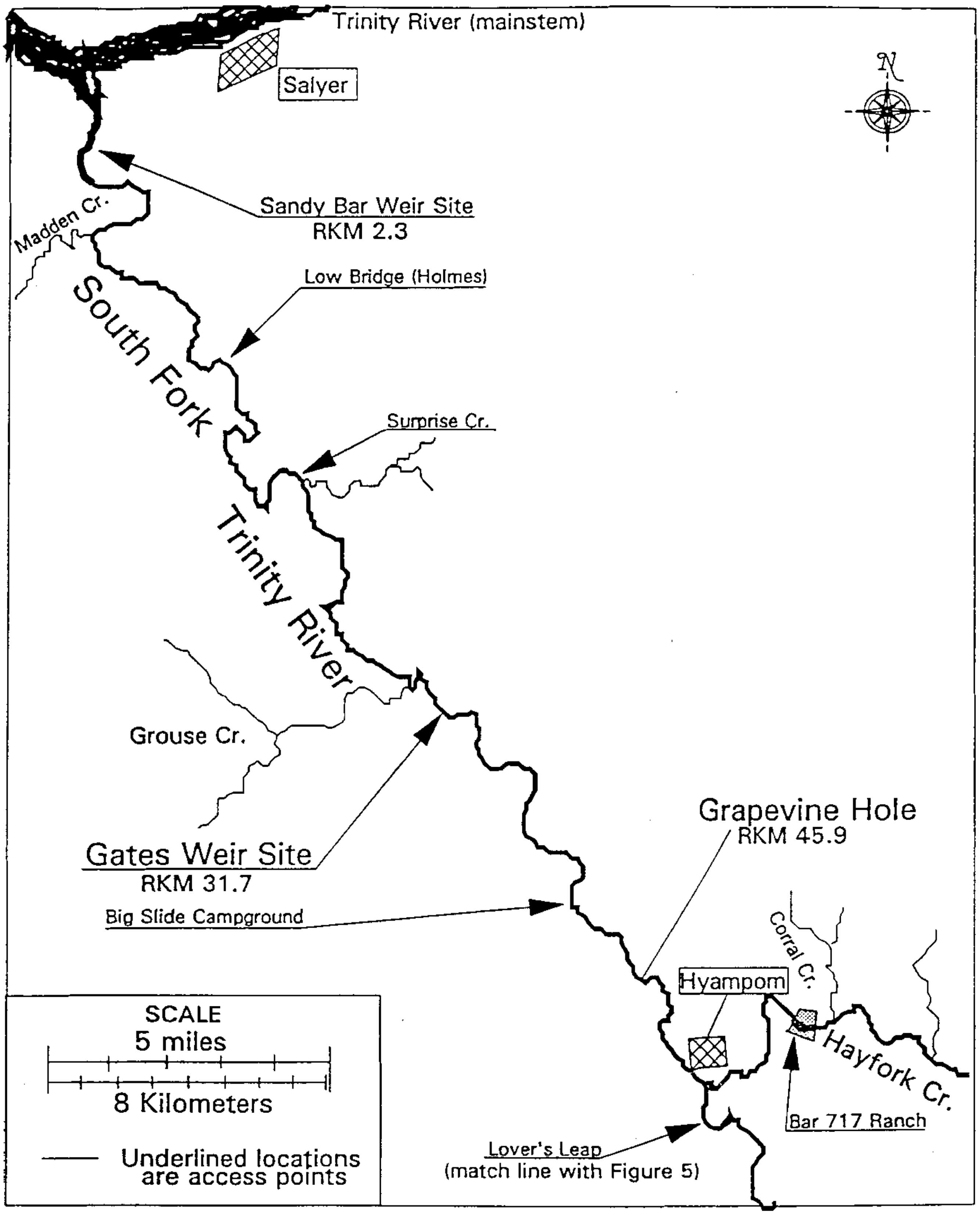


FIGURE 4. Location of summer holding pools utilized by spring-run chinook salmon in 1994, from Hyampom downstream to the mouth of the South Fork Trinity River. (RKM = river kilometers from mouth)

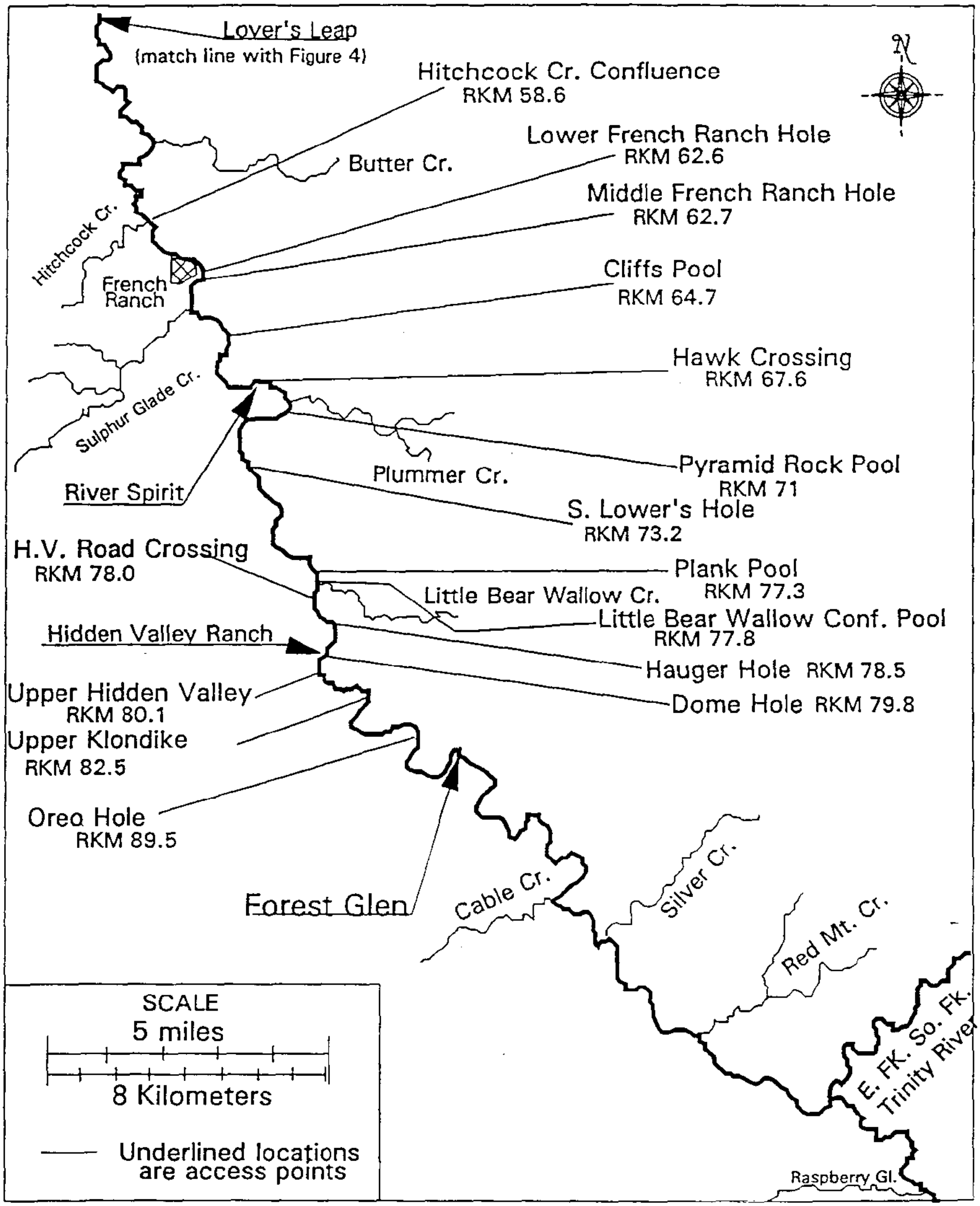


FIGURE 5. Location of summer holding pools utilized by spring-run chinook salmon in the South Fork Trinity River in 1994, from Hyampom upstream. (RKM = river kilometers from the mouth)

The onset of spawning can be determined from the pre-spawning activity of spring chinook in holding pools. When fish are in a "summer holding-mode", they simply circle lazily about the pool. Once fish near spawning condition, some (especially the males) begin chasing one another around the pool, some males and females form "loose pairs", and females often dig false redds near the pool. Many times most of the fish then leave the pool at the same time. After we observed these activities occurring, we saw fish begin actual spawning within a week to ten days.

<u>Redd Surveys.</u> We conducted 37 individual redd surveys between 27 September and 27 October 1994, locating 105 spring chinook redds in the mainstem SFTR (Figures 6 & 7, Table 2). We first observed spring chinook spawning in the upper river (upstream of Red Mt. Creek) on 25 September during a pool follow-up check. Spawning incidences progressed downstream over time, and spawning was completed by 27 October.

Lower Hayfork Creek was surveyed by helicopter on 21 October, but no redds were seen. Stream flows were so low and water quality so poor that we did not believe spring chinook would spawn in this tributary this year. In previous study years, we surveyed lower Hayfork Creek on foot and by helicopter. We saw spawning activity in this reach only in 1993 following the wet winter of that year.

Nearly all spring chinook redds found during the 1994 surveys were located upstream of Hyampom (Section J, RKM 48.3) (Table 2). The majority of the redds (86%) were found between Hitchcock Creek (RKM 58.8) and Red Mountain Creek (RKM 111.8). Prior to the 1964 flood, LaFaunce (1967) found that 82% of mainstem SFTR spawning activity occurred in this same reach (Hitchcock Creek to Red Mt. Creek). LaFaunce also found 2.5% of spawning occurred in the East Fork of the SFTR. This year we found one spring chinook redd in the East Fork, but it was just a few meters above the confluence with the mainstem. It is our belief that the East Fork is the upper limit of spring chinook spawning, and is only utilized to any significant degree when spring chinook are relatively abundant. Further, it is apparent that the reach between Forest Glen and Hitchcock Creek is critical to spring chinook for over-summering and spawning, especially in dry years. In normal to wet years, the river sections E, D, and C upstream of Forest Glen are also important.

In 1994, only seven (6.6%) spring chinook redds were found upstream of Forest Glen (sections C-E). This was unusual, but consistent with low stream flow conditions. Only four (3.8%) spring chinook redds were found near or downstream of Hyampom (sections J and K). This was almost certainly the result of high water temperatures that occurred well into the fall, and which may have been lethal to spring chinook attempting to spawn there.

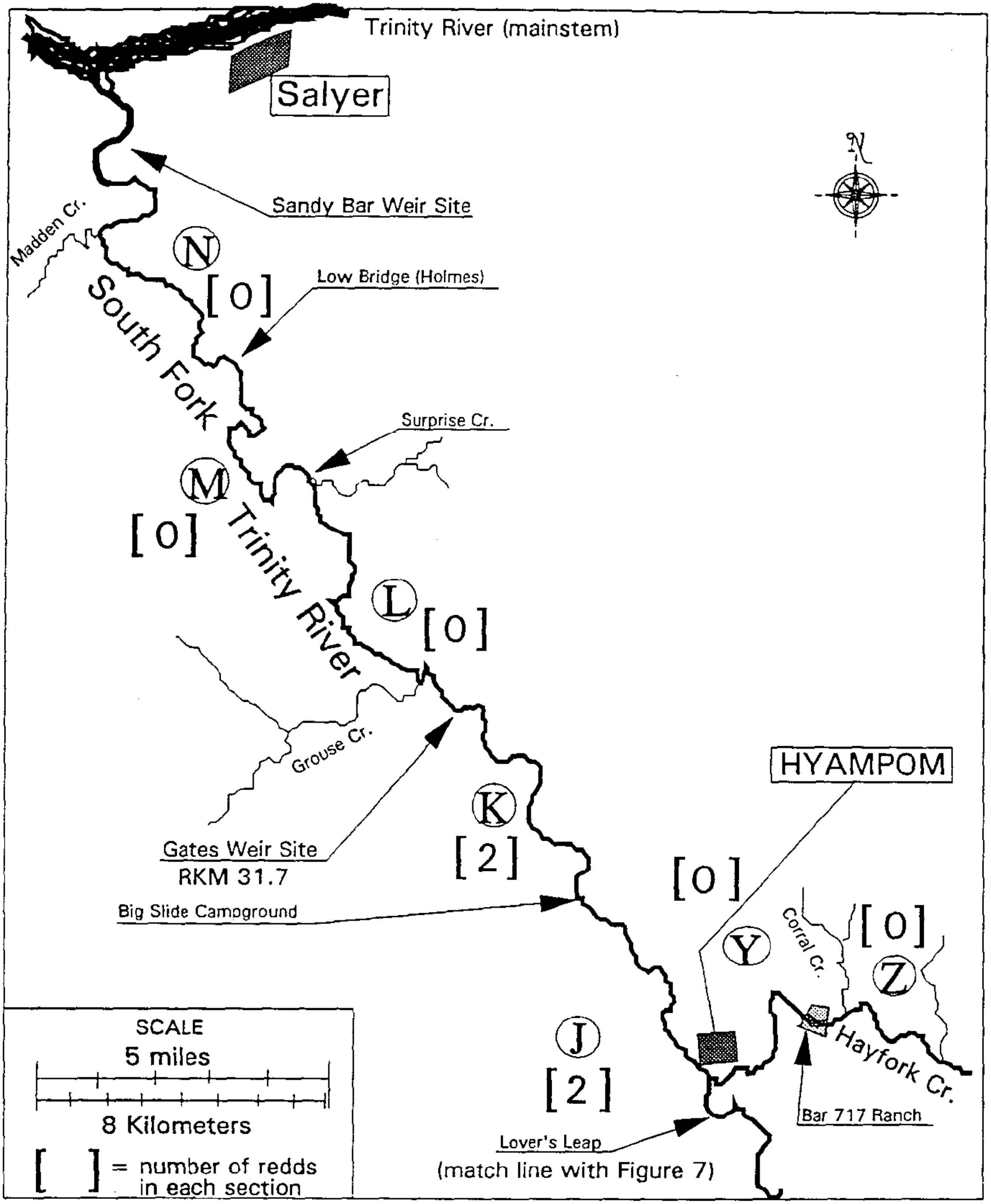


FIGURE 6. Distribution of spring-run chinook salmon redds in the South Fork Trinity River from Hyampom Downstream in 1994 (RKM = river kilometer form the mouth).

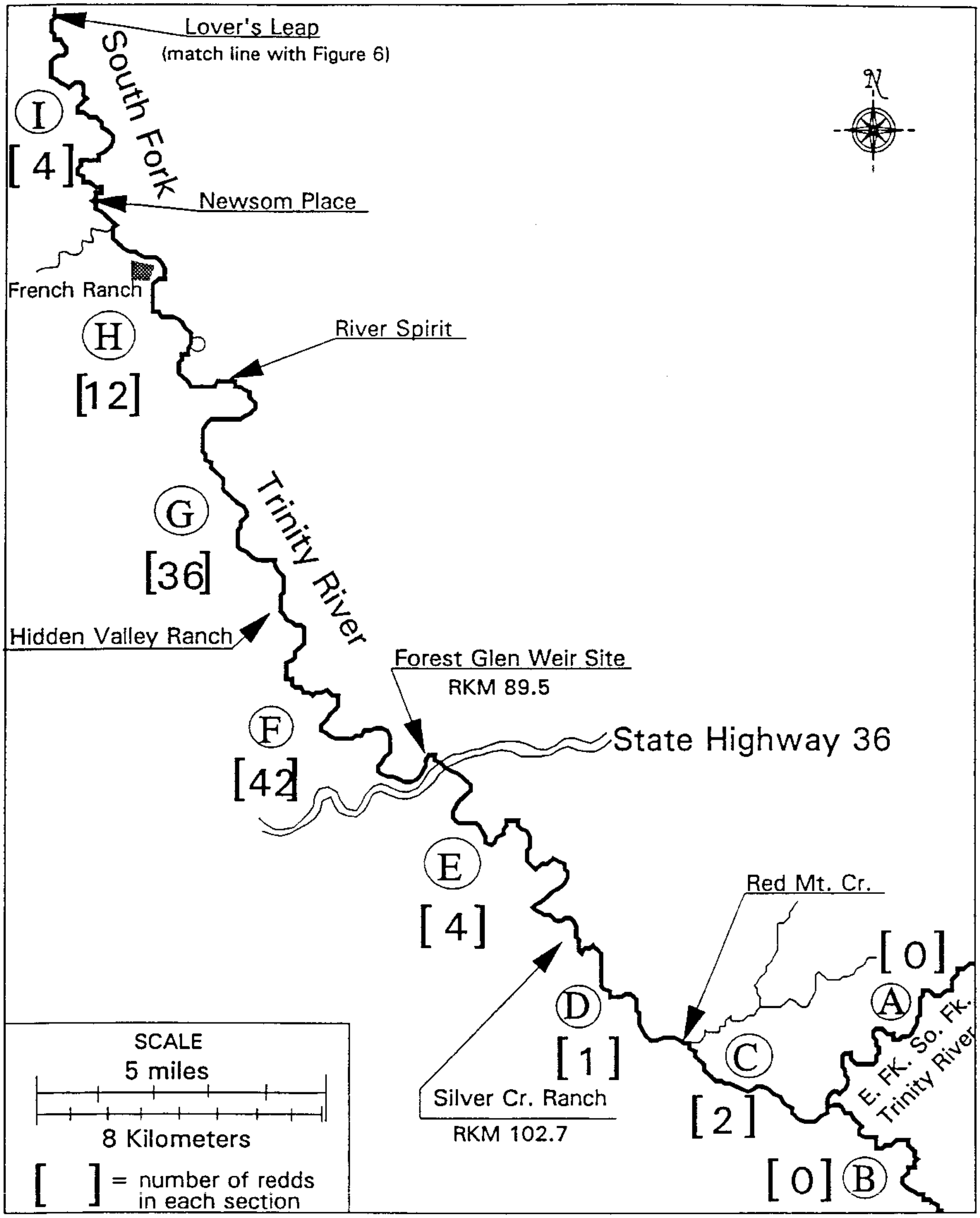


FIGURE 7. Distribution of spring-run chinook salmon redds in the South Fork Trinity River from Hyampom upstream in 1994 (RKM = river kilometers from the mouth).

Most redds were typical for chinook salmon with regard to size, location in the stream, gravel size, current velocity, and water depth (Chapman 1943; Mattson 1948; Cramer and Hammack 1952; Lindsay and Jonasson 1989; Groot and Margolis 1991).

SFTR spring chinook were observed to complete redd construction in 24 to 48 hours, with evidence of false redd activity in many instances. Females could be found in the area of the redd for up to one week after redd completion, and were sometimes seen defending their redd. We observed redd super-imposition (overlap) in two separate locations. We felt that this behavior was the result of significant sedimentation of SFTR spawning gravels.

Based on field observations, we estimated that there were between two and three spring chinook per redd. If this estimate was accurate and all redds were seen, then only about 55% of SFTR spring chinook survived the summer to spawn. This correlates well with our conservative estimate of 30 to 45% over-summer mortality.

Rainy weather, high stream-flows, and poor water clarity can make river access difficult, and make finding redds next to impossible. The weather and water clarity were both very good during the 1994 surveys.

<u>Carcass Recovery Surveys.</u> We recovered 12 spring chinook carcasses during redd and carcass surveys, only three of which had been marked at the Gates Weir (all bore an RV-clip but had shed their tags). This was an inadequate number of tag recoveries for a statistically valid run-size estimate.

All carcasses recovered in the fall had apparently spawned successfully. However, this season, we saw evidence of significant pre-spawning mortality as previously discussed. Throughout the summer, a total of twenty-one carcasses were found during snorkel surveys and during pool follow-up investigations. Lindsay and Jonasson (1989) reported average pre-spawning mortality in wild spring chinook of 44% for the Deschutes River (Oregon) from 1977-81, with some years as high as 75%. They also found that fish in the Rogue River (Oregon) experienced an average pre-spawning mortality of 12% during the same years. For comparison, pre-spawning mortality for spring-run chinook in the mainstem Trinity River was 62.8% in 1989, but averaged much lower in other years (Zuspan 1992). Groot and Margolis (1991) reported that much lower values (less than 10%) were more typical.

Trapping and Tagging (Late-entering Portion of the Run)

We did not install the Sandy Bar Weir this season to trap and tag salmonids since we felt water temperatures exceeding 18.5 °C caused unacceptable stress and resulting mortality. Based on thermograph records from previous study years, minimum water temperatures at this site routinely exceeded this value well into September.

However, the Sandy Bar Weir was installed this season by the Natural Stocks Assessment Project (NSAP) on 1 October 1994, after minimum water temperatures dropped below critical levels. Between 1 and 27 October 1994, no salmon were captured which could be classified as spring-run (Larry Hanson, Fishery Biologist, CDFG, personal communication. This weir was used to trap and tag fall-and winter-run steelhead as reported in Chapter III).

Those weir catches and observations during snorkel surveys, pool follow-ups, and redd surveys supported our feeling that very few spring chinook entered the SFTR after mid-July in 1994. This migration pattern contrasts with those observed during the 1992, 1993, and 1995 summers when more spring chinook were observed during the August snorkel surveys than the July surveys (Dean 1995, 1996, Appendix 1).

Based on data from the Project's study years, the SFTR spring chinook run peaks between mid-May and mid-June. In "wet" years like 1993, the run continues through August, actually overlapping the fall chinook run. This year, due to the dry weather conditions, and subsequent low water flows, the run ceased by mid-July. We did not observe a second, late-entering "pulse" of immigrants which was distinct from the early-entering portion of the run. We conclude that spring chinook immigration peaks in late spring, but streamflow and water temperatures determine whether the run continues through the early and late summer.

Life History

Scale Analysis. We interpreted 81 scale sets obtained from immigrant spring chinook captured at the Gates Weir and from recovered carcasses. An ocean-type juvenile life history was recorded for 54 scale sets (67%), while 27 (33%) showed a stream-type juvenile life history. This ratio differs markedly from other SFTR study years, showing a near three-fold increase in stream-type fish returning as adults. The proportion of ocean- versus stream-type life histories represented in 1992 was 90% vs. 10%, and 88% vs. 12% in 1993 (Dean 1995, 1996). This variation may be an indication of the adaptability and plasticity of spring chinook, and the response to some unknown selective factor.

Scale analysis also showed that the 1994 run was composed of 1% two-year-olds (grilse), 16% three-year-olds, 49% four-year-olds, and 34% five-year-olds (Figure 8), a relatively greater proportion of older fish than seen in previous runs. For comparison, the 1993 run was composed of 19% grilse, 55% three-year-olds, 24% four-year-olds, and 2% five-year-olds.

To verify our scale analysis we consulted with the Oregon Department of Fish and Wildlife (ODWF). Fishery Biologist Lisa Borgerson and Fish & Wildlife Technician Kanoni Bowden interpret nearly all scales collected by ODFW, and they did not disagree with our scale interpretations for the age composition. Higher proportions of older adults (4- and 5-year-olds) were also observed in scale analysis of John Day River (Oregon) spring chinook by Lindsay (1985). His results showed 1-5% three-year-olds, 54-89% four-year-olds, and 8-44% five-year-olds. Virtually all the fish in his analysis were determined to be stream-type. While the SFTR is somewhat different from the John Day River, the 1994 SFTR spring chinook age composition showed some similarities. It may be that the stream-type juvenile life history in spring chinook, in which a winter is spent in freshwater, might increase the age at which adults return. The increased proportion of the 1994 SFTR run's adults showing they led a stream-type juvenile life history could account for the apparent increased proportion of older age fish.

The overall average FL of 63.4 cm for this year's SFTR spring chinook was 11 cm longer than in 1993. The average FLs for fish returning in 1994 as two-, three-, four-, and five-year-olds were 52.0, 57.9, 63.5, and 68.7 cm, respectively (Figure 8). For comparison, last season's average FLs were 44.6, 56.0, 62.2, and 72.3 cm for the same aged fish. The very low number of grilse (≤53 cm FL) accounted for the larger overall average size of the 1994 run. The near absence of grilse and the apparent older age of this year's run may be indicative of poor ocean conditions, poor recruitment of younger-age fish, or some other selective factor.

SFTR spring chinook exhibited not only the true stream- and ocean-type juvenile life history strategies, but several which appeared to be intermediate. Sullivan (1989) noted similar intermediate life histories in scales of Klamath River fall-run chinook salmon. Based on our scale analysis and juvenile trapping, some juvenile chinook reside in-river through the summer and emigrate in the fall. Our data showed that growth of spring chinook young-of-the-year (YOY) was initially good, but subsequent over-summer growth was poor (see Juvenile Emigrant Trapping). A summer growth check was even evident in some juvenile scales examined. We feel that the poor growth and scale check were the result of high water temperatures significantly stressing over-summering juveniles.

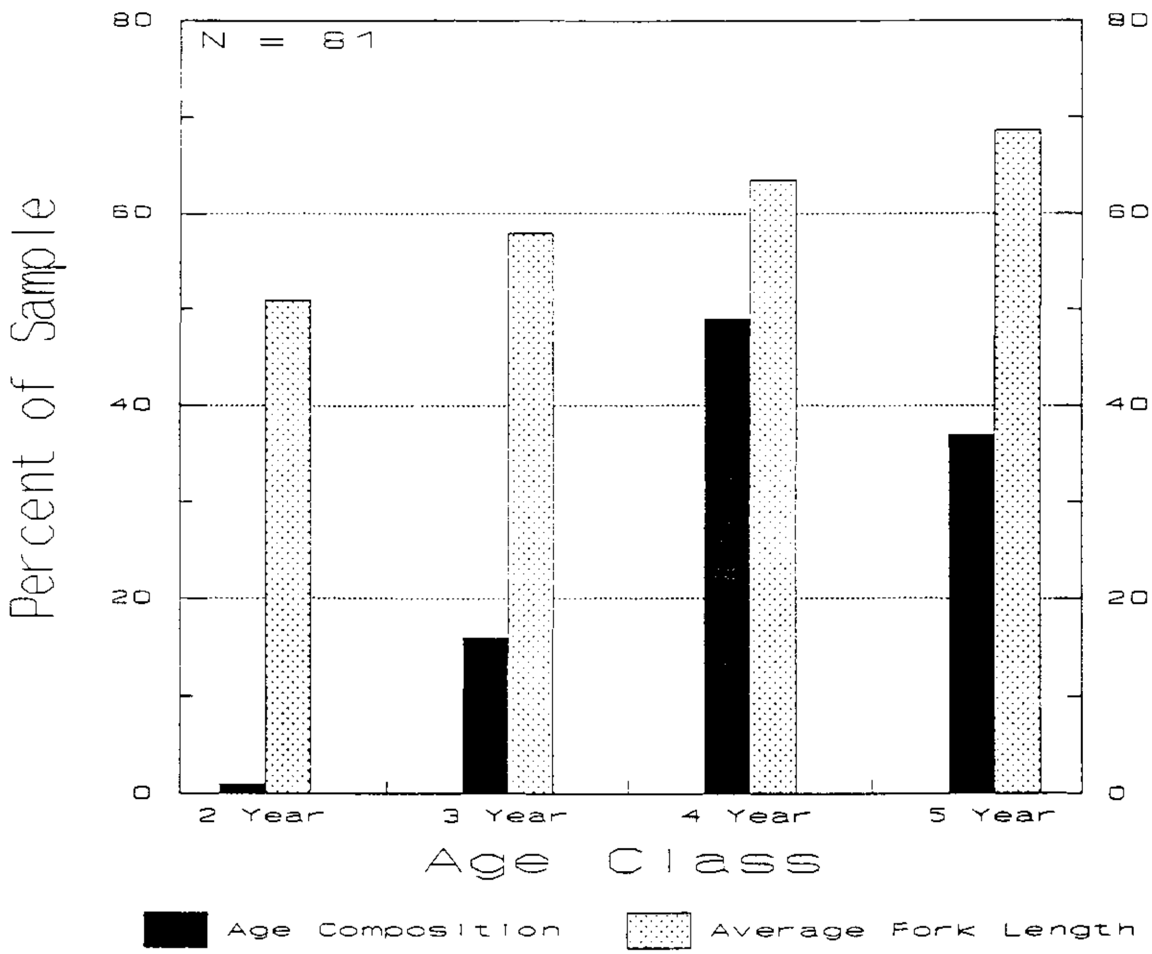


FIGURE 8. Age composition and average fork length of each age-class in the spring chinook salmon run in the South Fork Trinity River during 1994, as determined from scale analysis.

Summer rearing habitat for juvenile salmon appears to be a significant limiting factor in the SFTR. Sedimentation has reduced the overall complexity of several habitat types, and food-web complexity and food abundance appeared to be correspondingly lowered. Therefore, over-summer survival appears low for those spring chinook which exhibit a stream-type juvenile life history, and for those juveniles that over-summer in-river and emigrate in the fall. The apparent high variation in the ratio of stream-type to ocean-type fish returning as adults may be an indication of the marginal nature of SFTR juvenile rearing habitat.

<u>Juvenile Emigrant Trapping.</u> We trapped at Forest Glen in July 1994 for two nights to document the completion of the "spring" segment of the juvenile spring chinook emigration. No juvenile chinook and 67 juvenile steelhead were captured in this effort.

We also trapped at two sites farther downstream in the SFTR between 26 September and 8 December 1994. We trapped at Hyampom (RKM 48.6) for nine nights capturing 34 juvenile chinook and 45 juvenile steelhead, and at Sandy Bar (RKM 1.6) for three nights capturing three juvenile chinook and five juvenile steelhead. The juvenile chinook captured ranged in size from 68 to 104 mm FL, and some appeared to be in poor health. This size range is almost identical to the size range seen among chinook captured earlier in the year at Forest Glen. These data support our hypothesis that SFTR spring chinook grow little in summer, and that intermediate life histories exist. Juvenile chinook larger than 120 mm FL have never been captured, or seen in snorkel surveys, during any of the past year's monitoring. This may indicate that there is a maximum size after which all juvenile salmon leave the system regardless of time of year.

<u>Direct Snorkel Observations.</u> Juvenile spring chinook exhibiting a stream-type and intermediate life histories over-summer in the SFTR both upstream and downstream of Forest Glen, and to a limited extent in the cooler tributaries. During mainstem SFTR snorkel surveys, chinook juveniles were seen in the greatest numbers upstream of Forest Glen, but significant numbers were also seen in those two sections immediately downstream (Sections F & G). They were usually found beneath large rocks, in caves, in pools below the thermocline, or near cool, sub-surface springs. Such cool water refugia may be critical to the over-summer survival of SFTR spring chinook, especially in dry years.

In cooperation with NSAP, we conducted a minimum of two snorkel surveys of all major SFTR tributaries to determine juvenile chinook usage. We found that only Rattlesnake Creek was used to any significant extent. Juvenile chinook counts were as high as 320 fish per kilometer in this stream. Fairly high densities of juvenile chinook were also seen in Madden Creek, along with juvenile coho and steelhead. We had anticipated seeing juvenile chinook in many of the cooler tributaries, but in most cases saw none. Plummer Creek has been described as prime juvenile chinook habitat, but we never saw more than a dozen chinook in the 2.5 km of stream surveyed between 15 July and 1 September 1994. A few juvenile chinook were also seen in Butter Creek. However, many hundreds of juvenile chinook were seen in the mainstem SFTR during snorkel surveys. This is strong evidence that although juvenile chinook do use some of the tributaries, the mainstem is far more important for juvenile rearing.

Direct snorkel observation of emergent juvenile chinook in late winter and early spring was not conducted this reporting period.

<u>Adult Straying.</u> Throughout the entire study duration (spring 1991 through spring 1995), we have never discovered a spring chinook with a mark indicating it originated outside the SFTR

(e.g. hatchery fin-clips, coded-wire tags, brands, etc.). Project personnel conscientiously looked for such marks during all phases of SFTR spring chinook trapping, observation, and recovery. That we found no evidence of spring chinook strays from other rivers possibly means that the genetic integrity of the SFTR spring chinook stock remains relatively intact.

Angler Harvest

Over the seasons that this project conducted creel surveys, we were unable to document any legal harvest of SFTR spring chinook. However, we had many anecdotal reports, and some direct evidence, of the poaching of spring chinook in the SFTR, especially from summer holding pools. We feel that poaching is a significant factor in the SFTR, and that its impact is increased in dry years due to the concentration of fish in holding pools. We conducted comprehensive public outreach and education efforts, and organized a "neighborhood watch" program for SFTR spring chinook in an effort to curtail poaching. We achieved some success in this effort but such a program must be ongoing to be truly effective.

Adult Trapping

Due to the termination of this project, we were unable to conduct any trapping or tagging of SFTR spring chinook in 1995. However, as mentioned earlier, snorkel and redd surveys were conducted during the summer and fall of 1995 through a private contract, and the write-up of that work (Dean, Appendix 1) is referenced for additional information.

RECOMMENDATIONS

1. Since both spring chinook and spring (summer) steelhead runs in the SFTR remain critically low, it is essential that monitoring be continued.

2. Monitoring efforts should be expanded to include a juvenile production estimate for SFTR spring chinook.

3. Major and minor landslides, as well as some land-use activities, are adversely affecting juvenile rearing habitat in the SFTR. Studies are needed to quantify these effects, and to determine corrective actions.

4. Monitoring efforts for SFTR spring-run (summer) steelhead should be expanded into a more comprehensive program.

5. Poor spawning gravel permeability and bedload movement may be affecting spring chinook egg and alevin survival. Additional studies are needed in this area.

LITERATURE CITED

Chapman, W. M. 1943. The spawning of chinook salmon in the main Columbia River. Copeia. 1943: 168-170.

Cramer, F. K. and D. F. Hammack. 1952. Salmon research at Deer Creek, California. United States Fish and Wildlife Service. Special Scientific Reports, Fish. No. 67. 16 p.

Dean, M. 1994. Life history, distribution, run size, and harvest of spring chinook salmon in the South Fork Trinity River Chapter VII. Job VII. pp. 191-227. In: K. Urquhart and R. M. Kano (eds.). Annual Report of the Trinity River Basin Salmon and Steelhead Monitoring Project, 1991-1992 Season. February 1994. 235 p. Available from Calif. Dept. of Fish and Game, Inland Fish. Div., 1416 Ninth Street, Sacramento, CA 95814.

_______. 1995. Life history, distribution, run size, and harvest of spring chinook salmon in the South Fork Trinity River Chapter VII. Job VII. pp. 187-226. In: R. M. Kano (ed.). Annual Report of the Trinity River Basin Salmon and Steelhead Monitoring Project, 1992-1993 Season. March 1995. 235 p. Available from Calif. Dept. of Fish and Game, Inland Fish. Div., 1416 Ninth Street, Sacramento, CA 95814.

_______. 1996. Life history, distribution, run size, and harvest of spring chinook salmon in the South Fork Trinity River. Chapter VII. Job VII. p. 191-228. In: R. M. Kano (ed.). Annual Report of the Trinity River Basin Salmon and Steelhead Monitoring Project, 1993-1994 Season. February 1996. 266 p. Available from Calif. Dept. of Fish and Game, Inland Fish. Div., 1416 Ninth Street, Sacramento, CA 95814.

Gilbert, Charles H. 1914. Age at maturity of the Pacific Coast salmon of the genus *Oncorhynchus*. U.S. Bur. Fish., Bull. 32: 1-22.

Groot, C., and L. Margolis. 1991. Pacific Salmon Life Histories. UBC Press. University of British Columbia. Vancouver, B.C., Canada. 564 p.

Hillemeier, David. 1995. Summer habitat utilization by adult spring chinook salmon and summer steelhead, South Fork Trinity River, California. Master's Thesis and Final Report. Available from Humboldt State University. Arcata, California. 60 p.

LaFaunce, D. A. 1967. A king salmon spawning survey of the South Fork Trinity River. Calif. Dept. of Fish and Game, Mar. Res. Admin. Rep. No. 67-10, 1964. 13 p.

Lindsay, R. B. 1985. Study of wild spring chinook salmon in the John Day River system. Oregon Dept. of Fish and Wildlife. Available from Bonneville Power Administration, Div. of Fish and Wildlife, P.O. Box 3621, Portland, Oregon 97208. 119 p.

Lindsay, R. B., and B. Jonasson. 1989. Spring chinook salmon in the Deschutes River, Oregon. Oregon Dept. of Fish and Wildlife. Fish. Div. Information Reports, 89-4. 92 pp.

Mattson, C. 1948. Spawning ground studies of Willamette River spring chinook salmon. Oregon Fish Commission Resource Briefs. (12): 21-32.

Mills, T. 1986. Juvenile life history patterns of South Fork Trinity River chinook salmon as determined by adult scale analysis. Calif. Dept. of Fish and Game, Anad. Fish. Br. Admin. Rep. No. 86- . 1986. 20 p.

Ricker, W. E. 1975. Computation and Interpretation of Biological Statistics of Fish Populations. Bull. Fish. Res. Bd. Can. No. 191. 382 p.

Snyder, J. O. 1931. Salmon of the Klamath River, California. Calif. Dept. of Fish and Game, Vol. 10, No. 4, p. 163-172.

Sullivan, C. 1989. Juvenile life history and age composition of mature fall chinook salmon to the Klamath River, 1984-1986. Master's Thesis. Humboldt State University, Arcata, California 95521. 69 p.

APPENDIX 1. Other sources of data.

Dean, M. 1995. Survey Report. Snorkel and redd surveys for spring chinook salmon in the South Fork Trinity River (1995 Season). Unpublished report for Huber, Harpham, and Associates. December, 1995. 18 p. Available from Natural Resources Conservation Service, Weaverville, CA 96093.

Fox, C. 1972. Report to supervisor, United States Forest Service, Shasta-Trinity National Forest. 2 August 1972. 15 p. (memo). Available from TFIP, P.O. Box 1185, Weaverville, Ca. 96093.

Freese, L. 1979. Summary report for survey of the South Fork Trinity River, Shasta-Trinity National Forest, USFS 2 October 1979. 93 p. (memo). Available from TFIP, P.O. Box 1185, Weaverville, Ca. 96093.

_________. 1982. Personal communication to E. Gerstung, Region I, California Department of Fish and Game, 27 February 1982. 2 p. (memo). Available from TFIP, P.O. Box 1185, Weaverville, Ca. 96093.

Gerstung, E. 1990. Observations of summer steelhead and spring chinook in the Forest Glen area, 8 October 1985. 3 p. (file memo). Available from TFIP, P.O. Box 1185, Weaverville, Ca. 96093.

Healy, T. 1969. Letter to Fisheries Management Supervisor, Region I, Calif. Dept. of Fish and Game, 29 September 1969. 1 p. (memo). Available from TFIP, P.O. Box 1185, Weaverville, Ca. 96093.

LaFaunce, D. A. 1980. Letter to Fisheries Management Supervisor, Region I, Calif. Dept. Fish and Game, 20 August 1980. 1 p. (memo). Available from TFIP, P.O. Box 1185, Weaverville, Ca. 96093.

Lee, D. 1976. Letter to Fisheries Management Supervisor and file, Region I, Calif. Dept. of Fish and Game, 25 October 1976. 1 p. (memo). Available from TFIP, P.O. Box 1185, Weaverville, Ca. 96093.

Miller, E. 1974. Letter to Associate Biologist LaFaunce, Region I, Calif. Dept. of Fish and Game, 23 September 1974. 4 p. (memo with maps). Available from TFIP, P.O. Box 1185, Weaverville, Ca. 96093.

_________. 1975. Letter to Associate Biologist LaFaunce, Region I, Calif. Dept. of Fish and Game, 26 August 1975. 6 p. (memo with maps). Available from TFIP, P.O. Box 1185, Weaverville, Ca. 96093.

Mitchell, W. 1985. 1984 salmonid survey for the South Fork Trinity River. Letter to project coordinator, USFS. 2 p. (memo). Available from TFIP, P.O. Box 1185, Weaverville, Ca. 96093.

Rogers, D. 1970. Letter to Associate Biologist LaFaunce, Region I, Calif. Dept. of Fish and Game, 2 August 1970. 1 p. (memo). Available from TFIP, P.O. Box 1185, Weaverville, Ca. 96093.

__________. 1971. Letter to Associate Biologist LaFaunce, Region I, Calif. Dept. of Fish and Game, 26 August 1971. 1 p. (memo). Available from TFIP, P.O. Box 1185, Weaverville, Ca. 96093.

Ross, C., and H. Hawks. 1975. Report to supervisor, Shasta-Trinity National Forest, USFS, 12 June 1975. 5 p. (memo with forms and map). Available from TFIP, P.O. Box 1185, Weaverville, Ca. 96093.

Strate, B., and T. Underwood. 1982. Report to supervisor, Yolla Bolla Ranger District, USFS, 7 July 1982. 8 p. (memo with survey forms and map). Available from TFIP, P.O. Box 1185, Weaverville, Ca. 96093.

Wood, R. 1989. Letter to Associate Fishery Biologist Phil Baker, Region I, Calif. Dept. Fish and Game, 9 September 1989. 2 p. (memo). Available from TFIP, P.O. Box 1185, Weaverville, Ca. 96093.

Zustak, J. 1986. Letter to USFS Fisheries Planning Unit, Shasta-Trinity National Forest, 22 September 1986. 2 p. (memo). Available from TFIP, P.O. Box 1185, Weaverville, Ca. 96093.

APPENDIX 2. List of Julian weeks and their calendar date equivalents.

Julian week	Calendar dates: Start	Calendar dates: Finish	Julian week	Calendar dates: Start	Calendar dates: Finish
1	01-Jan	07-Jan	27	02-Jul	08-Jul
2	08-Jan	14-Jan	28	09-Jul	15-Jul
3	15-Jan	21-Jan	29	16-Jul	22-Jul
4	22-Jan	28-Jan	30	23-Jul	29-Jul
5	29-Jan	04-Feb	31	30-Jul	05-Aug
6	05-Feb	11-Feb	32	06-Aug	12-Aug
7	12-Feb	18-Feb	33	13-Aug	19-Aug
8	19-Feb	25-Feb	34	20-Aug	26-Aug
9 a/	26-Feb	04-Mar	35	27-Aug	02-Sep
10	05-Mar	11-Mar	36	03-Sep	09-Sep
11	12-Mar	18-Mar	37	10-Sep	16-Sep
12	19-Mar	25-Mar	38	17-Sep	23-Sep
13	26-Mar	01-Apr	39	24-Sep	30-Sep
14	02-Apr	08-Apr	40	01-Oct	07-Oct
15	09-Apr	15-Apr	41	08-Oct	14-Oct
16	16-Apr	22-Apr	42	15-Oct	21-Oct
17	23-Apr	29-Apr	43	22-Oct	28-Oct
18	30-Apr	06-May	44	29-Oct	04-Nov
19	07-May	13-May	45	05-Nov	11-Nov
20	14-May	20-May	46	12-Nov	18-Nov
21	21-May	27-May	47	19-Nov	25-Nov
22	28-May	03-Jun	48	26-Nov	02-Dec
23	04-Jun	10-Jun	49	03-Dec	09-Dec
24	11-Jun	17-Jun	50	10-Dec	16-Dec
25	18-Jun	24-Jun	51	17-Dec	23-Dec
26	25-Jun	01-Jul	52 b/	24-Dec	31-Dec

a/ Eight-day week in each year divisible by 4.
b/ Eight-day week every year.