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State of California
The Resources Agency
DEPARTMENT OF FISH AND GAME

ANNUAL REPORT
TRINITY RIVER BASIN SALMON AND STEELHEAD MONITORING PROJECT
1989 - 1990 SEASON

Inland Fisheries Division
1416 Ninth St, Room 1251
Sacramento, Ca. 95814

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Foreword

This is the second annual report to the United States Bureau of Reclamation (USBR) of activities conducted under the terms of Cooperative Agreement Number 8-FC-20-07100, and covers the period July 1, 1989 through June 30, 1990. 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).

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ANNUAL REPORT
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1989-1990 SEASON

CHAPTER I

JOB I
SALMON SPAWNER SURVEYS IN THE UPPER TRINITY RIVER BASIN

by

Mark Zuspan

ABSTRACT

Staff of the California Department of Fish and Game's, Trinity Fisheries Investigations Project conducted a mark-and-recovery, salmon spawner survey of a portion of the mid-Trinity River basin from 18 September 1989 through 26 January 1990. The main-stem Trinity River and its major tributaries were surveyed from the upstream limit of anadromous migration at Lewiston Dam to a point 64.4 km downstream at the confluence of the North Fork Trinity River. We examined 8,785 chinook salmon (*Oncorhynchus tshawytscha*) and 1,369 coho salmon (*O. kisutch*) carcasses during the survey.

Chinook salmon spawning was unevenly distributed in the main-stem Trinity River. We estimate 42% of the chinook salmon spawned in the uppermost 3.2 km just below the dam, followed by 25.7% in the next 7.9 km, 10.5% in the next 9.7 km, 8.0% in the next 10.8 km, and 13.8% in the remaining 31.9 km.

Coho salmon spawning distribution in the main-stem Trinity River was similar to that of chinook salmon. We estimate that 43.9% of the coho salmon spawned in the uppermost 3.2 km just below the dam, followed by 23.5% in the next 7.9 km, 7.7% in the next 9.7 km, 3.6% in the next 10.8 km, and 21.3% in the remaining 31.9 km.

Little chinook salmon spawning occurred in the tributaries we surveyed. The North Fork Trinity River and Canyon Creek had the most spawners, with fewer than 150 fish in each. Only 15 coho were observed in the seven tributaries surveyed. Of these, six were found in Weaver Creek.

The percentage of female chinook salmon which died prior to spawning averaged 62.8% for spring-run and 32.1% for fall-run chinook. The overall female chinook salmon prespawning mortality rate during the survey was 31.3%. This excessively high mortality rate is probably related to stress induced by the limited holding and spawning habitat found in the upper main-stem Trinity River.

Approximately 6.2% of the female coho salmon observed in the main-stem Trinity River died prior to spawning.

Both spring-run and fall-run chinook salmon were recovered in the survey. Spring-run fish dominated recoveries until late October, thereafter fall-run fish were more abundant. Coho salmon were first noted in the main-stem Trinity in late October. Their numbers peaked in early December, and they were essentially gone by late January.

Fork lengths of adult spring-run and fall-run chinook salmon from the main-stem Trinity River averaged 74.5 cm (range: 38-100 cm) and 69.8 cm (range: 36-98 cm), respectively. Adult chinook salmon comprised 98.0% of the spring run and 95.0% of the fall run, with grilse comprising the remainder. Chinook salmon recovered in the tributaries were significantly smaller than main-stem Trinity River fish, and had a lower overall adult percentage of 79.6%. Coho salmon were not measured during the survey.

OBJECTIVES

1. To determine, through a system of spawning ground surveys, the distribution of naturally spawning chinook and coho salmon in the main-stem 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 this area.

3. To determine the size, sex composition and incidence of marked and tagged individuals among the naturally spawning populations in this area.

4. To determine the relative distributions of spawners in different areas of the basin up-stream of, and including 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-second salmon spawner survey conducted in the main-stem 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 eighteen (La Faunce 1965, Rogers 1970, 1973, 1982; Miller 1972, 1973, 1974, 1976, 1978, 1979, 1980, 1981, 1982, 1984, 1985; Smith 1975, Stempel 1988, and Zuspan 1991a) 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 (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, and those scheduled for following years by CDFG's TFIP, 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

Main-stem Trinity River Spawner Survey

Our study area included the main-stem Trinity River from its upstream limit to anadromous fish migration at Lewiston Dam (River km 180.1) to the confluence of North Fork Trinity River, 64.4 km downstream (Figure 1). Previous studies have divided the river

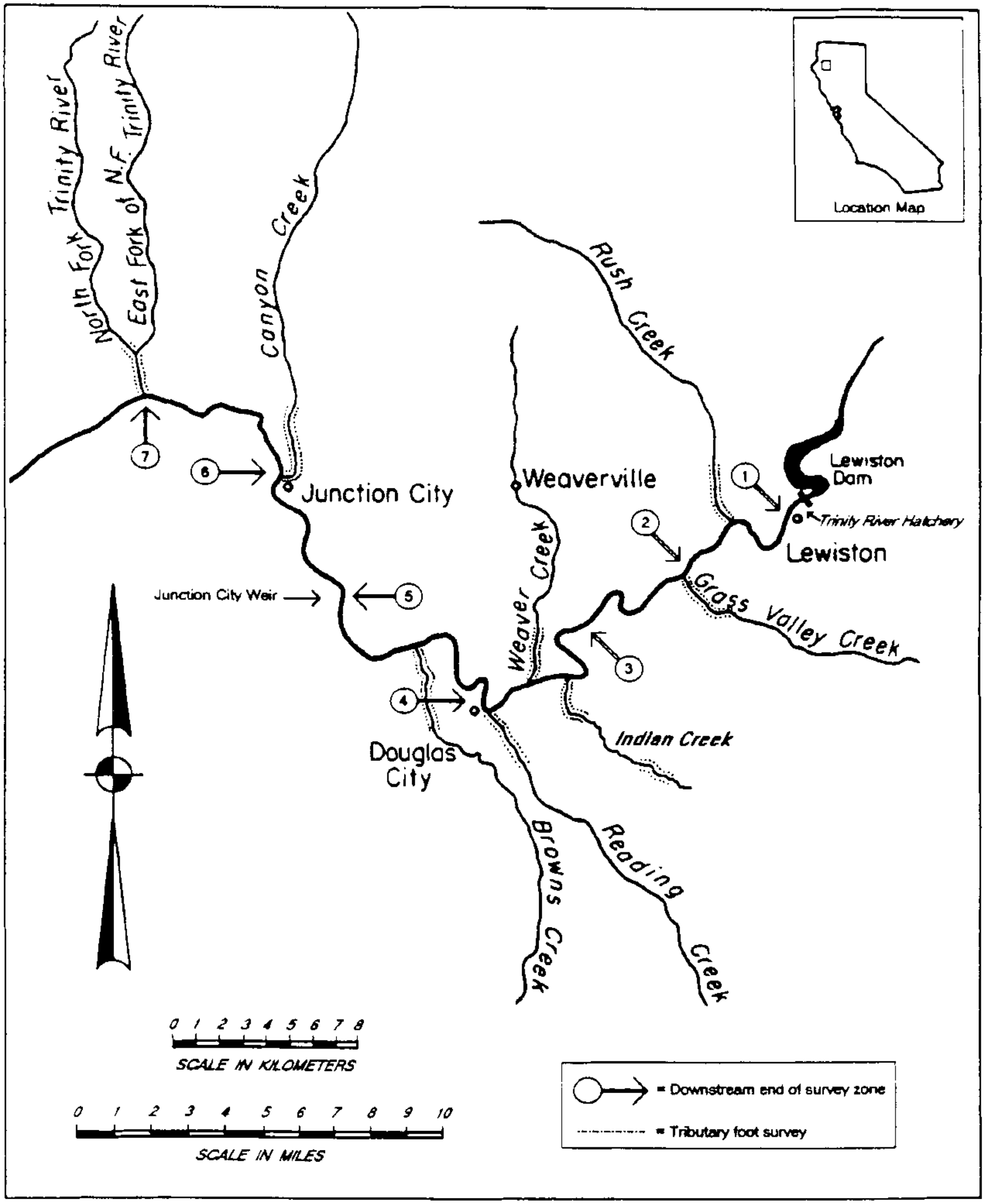

FIGURE 1. Map of the Trinity River basin showing the main-stem spawner survey zones and areas of the tributaries surveyed in the 1989-90 spawner survey (7 zone system - Stempel 1988).

into either a four-or seven-zone system. The seven-zone system was used in 1987 by the United States Fish and Wildlife Service (USFWS) (Stempel 1988) and again in 1988 (Zuspan 1991a) (Table 1). Prior to this, with the exception of Moffett and Smith 1950, all surveys were based on a system utilizing four zones in the river reach below Lewiston Dam (Gibbs 1956; La Faunce 1965; Rogers 1970, 1973, 1982; Miller 1972, 1973, 1974, 1976, 1978, 1979, 1980, 1981, 1982, 1984, 1985; Smith 1975; Weber 1965). Our 1989-1990 data were collected based on both zone systems. We will summarized data in this report based only on the seven-zone system as it allows comparisons of different river sections in finer detail. By recording data also using the four-zone system, we will be able to compare historic and current trends in subsequent reports.

TFIP staff conducted the survey using 12-ft Avon 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 two sections, 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. We surveyed the entire main-stem Trinity River study section once a week throughout the salmon spawning season.

We determined spawning condition in female salmon by direct observation of the ovaries. Fish were classified as either spawned

TABLE 1. Trinity River zones used in the 1989-90 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) - Brown Mtn. Bridge (RKM 169)
3	9.7	Brown Mtn. Bridge (RKM 169) - Steel Bridge (RKM 159.3)
4	10.8	Steel Bridge (RKM 159.3) - Douglas City Camp (RKM 148.5)
5	12.0	Douglas City Camp (RKM 148.5) - Junction City Weir (RKM 136.5)
6	12.6	Junction City Weir (RKM 136.5) - BLM Camp (RKM 123.9)
7	7.2	BLM Campground (RKM 123.9) - mouth of North Fork Trinity (RKM 116.7)

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

or unspawned based on egg retention. Females which retained over 50% of their eggs were classified as unspawned. Male spawning condition was not assessed, as its determination was considered to be too subjective.

All carcasses we observed were identified by species and examined for an adipose fin clip (Ad-clip) indicating the presence of a coded-wire tag (CWT) in their snout. Fish were further examined for the presence of an external tag (spaghetti tag) and an operculum punch, applied as part of an ongoing study by other elements of the CDFG's Klamath-Trinity Program[1/]. Spaghetti tags and operculum punches (Program marks) are placed on returning adult fish by CDFG staff at three trapping and tagging stations downstream of the spawner survey area, to monitor escapement and harvest of returning adult salmonids. The spaghetti-tagged salmon also receive an identifying operculum punch in order to estimate tag shedding rates at the three sites. The first site is located at the mouth of the Klamath River where returning fall-run chinook salmon, coho salmon, and steelhead trout are captured in a seine and tagged. The second site upstream is Willow Creek Weir, located at river km 32.2 on the main-stem Trinity River. The last site is Junction City Weir at river km 136.5 on the main-stem Trinity River. Spring-run and fall-run chinook salmon, coho salmon, and steelhead are trapped and tagged at both Willow Creek and Junction City weirs.

Chinook Salmon

We classified all chinook salmon carcasses as either condition one or two, based on the extent of body deterioration. Condition-one fish were the freshest, having at least one clear eye and a relatively firm body. Condition-one fish were assumed to have died within one week prior to recovery. Condition-two fish were in various advanced stages of decomposition and 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.

All chinook salmon we recovered were further classified into four categories: 1) Ad-clipped fish; 2) Program-marked fish; 3) condition-one, unmarked fish; 4) condition-two, unmarked fish. The category assigned determined what data we collected from each fish.

We sexed and measured Ad-clipped fish to the nearest cm fork length (FL), and determined their condition and spawning success. Heads of Ad-clipped fish were removed and retained for later CWT recovery and decoding.

1/ specifically the CDFG's Trinity River and Klamath River Projects.

Program-marked fish were sexed, measured (cm, FL), and assessed for spawning condition. We removed any spaghetti tags and then cut the fish in half with a machete to prevent recounting in future weeks. Spaghetti tags have a unique number which allowed determination of date and location of tagging.

Condition-one fish which were neither Ad-clipped nor Program-marked were flagged and returned to moving water for subsequent recovery, and a systematically collected subsample of them were measured for FL (cm). Flags consisted of plastic survey tape wrapped tightly around a colored hog ring and affixed to the left mandible of the carcass. The survey 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 at any time. Flag colors were changed weekly so that, on recovery, the week of flagging could be determined. The hog rings used to attach the flagging were color coded to indicate in which zone they were affixed, so that we could determine the incidence of carcasses drifting into another recovery zone. Chinook < 56 cm were preliminarily classified as grilse during the carcass surveys. Actual grilse to adult ratios for the whole population of chinook in this year's run were determined from post-season evaluations of CWT data. Adult and grilse salmon analysis in this report is based on the post-season size determinations.

Condition-two fish which were neither Ad-clipped or Program-marked were checked for the presence of a flag and, if possible, the spawning condition was assessed. If a flag was present, the color of the flagging tape and the underlying ring were recorded, and all fish were then cut in half to prevent later recovery and re-counting of the same fish.

Coho Salmon

All coho salmon collected were checked for the presence of Ad-clips or Program-marks. When possible, sex and spawning condition were determined and then all coho salmon were cut in half to prevent future re-counting. Coho carcasses were not used in the flagging experiment, since they would have required a separate series of flag colors to segregate them from flagged chinook salmon.

Tributary Spawner Surveys

Tributaries to the main-stem Trinity River, specifically Rush Creek, Grass Valley Creek, Indian Creek, Reading Creek, Browns Creek, Weaver Creek, Canyon Creek, and the North Fork Trinity River, were surveyed on foot once a week throughout the chinook salmon spawning season. Sections surveyed for each tributary ranged in length from 2.4 to 4.8 km, and were chosen based on accessibility and their historic use by chinook salmon spawners (Figure 1). The survey began with the onset of chinook salmon spawning in each tributary and continued until spawning ended (Table 2).

We classified all identifiable chinook salmon recovered into the four categories used in the main-stem spawner survey and handled them accordingly (see above). However, sex and prespawning condition was assessed only for fish collected from the main-stem Trinity River, and not its tributaries, because too few fish were observed in the tributaries to compose an adequate sample and most of those observed were condition-one fish which we needed to flag for spawning escapement estimates. Coho salmon were 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 represented by each of our ongoing spawner survey zones. 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 percentage of the total redds occurring in a survey zone during the aforementioned count was assumed to represent the percentage of the total spawning in each tributary that took place within the survey zone.

TABLE 2. Trinity River tributaries surveyed in the 1989-90 spawner survey.

Tributary	Length surveyed (km)	Weeks surveyed	Date		Percent of total[a]
			Start	End	
Rush Creek	3.1	6	11/03/89	12/04/89	100.0
Grass Valley Creek	2.4	6	11/03/89	12/04/89	100.0
Indian Creek	4.8	5	11/10/89	12/07/89	100.0
Reading Creek	2.7	6	11/03/89	12/04/89	100.0
Browns Creek	4.0	7	11/01/89	12/13/89	95.0
Weaver Creek	2.4	6	11/09/89	12/13/89	100.0
Canyon Creek	3.1	6	10/31/89	12/07/89	97.0
North Fork Trinity	2.6	6	10/31/89	12/08/89	20.0

a/ Estimated percent of the total chinook spawning in that tributary that occurred in the survey section.

RESULTS AND DISCUSSION

Numbers Observed

Main-stem Trinity River Spawner Survey

Chinook Salmon. We observed 8,785 chinook salmon during the spawner survey which included 195 Ad-clipped fish (six also program-marked), 218 Program-marked fish (six also Ad-clipped), 4,886 unmarked condition-one fish which we flagged, and 3,495 unmarked condition-two fish (Appendix 1). We recaptured and re-examined 2,270 flagged chinook salmon, but did not see any whole skeletons.

Coho Salmon. We recovered 1,360 coho salmon in the spawner survey, including three Ad-clipped fish and 75 Program-marked fish (Appendix 2), and did not see any whole skeletons.

Tributary Spawner Surveys

Chinook Salmon. We observed 127 chinook salmon in the eight tributaries surveyed this season. Included in the total are 5 Ad-clipped fish, 9 Program-marked fish, 115 unmarked condition-one fish which we flagged, and 12 skeletons (Appendix 3). We recaptured and re-examined 50 flagged fish.

Coho Salmon. We recovered nine coho salmon in the tributaries this season (Appendix 3), but observed no whole skeletons.

Spring and Fall Chinook Salmon Spawning Interval

Only chinook salmon recovered in the main-stem Trinity River were used to determine spring and fall spawning interval. Both spring and fall race chinook salmon were observed in the main-stem survey. A date separating the two races was determined from CWT and Program-marked chinook salmon. Spring-run chinook salmon dominated our recoveries through the fourth week of the survey ending 9 October 1989. Some overlap of spring-run and fall-run chinook salmon occurred during the fifth week ending 16 October. Fall-run chinook salmon became dominant by the sixth week of the survey, which began 23 October. For the purposes of this report, all chinook recovered prior to 23 October 1989 are considered spring race, while those recovered afterwards are considered fall race (Figure 2).

Size Composition

Spring-run Chinook Salmon

Main-stem Trinity River. We measured the size (cm, FL) of 607 spring-run chinook salmon during the survey. Adults (fish >48 cm

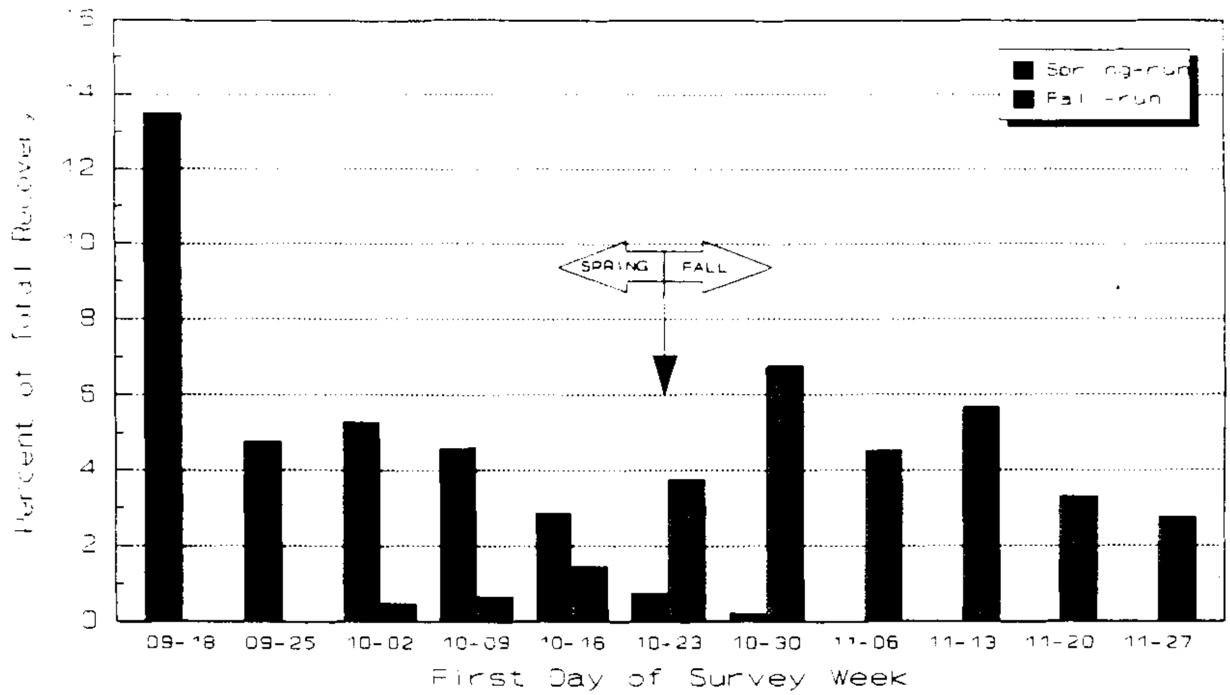

FIGURE 2. Chinook salmon spawning interval determined from weekly carcass recoveries of coded-wire-tagged and Program-marked fish in the 1989-90 Trinity River spawner survey. The arrow indicates the date separating the spring from the fall run.

FL[2/] (Bill Heubach, Assoc. Fishery Biologist, CDFG, pers. commun.) comprised 98.0% (595/607) of the spring-run chinook salmon observed in the spawner survey, while grilse (fish ≤48 cm FL) comprised the remaining 2.0% (12/607) (Table 3, Figure 3). The percentage of spring-run chinook salmon grilse in the survey closely matched that observed at Junction City Weir but varied from that observed at Willow Creek Weir and Trinity River Hatchery (Table 3). The reason for the difference in grilse percentages at the different sites is unknown.

Tributaries. Based on the date at which we first observed spawning activity and the lack of spring-run codes among the CWT recoveries, we assume that no spring-run chinook salmon were observed in the tributaries.

2/ Determined from post-season analysis of length frequency and coded-wire tag recovery.

TABLE 3. Number and percentages of spring-run chinook salmon grilse observed in the spawner surveys and at three fixed locations in the Trinity River basin during the 1989-90 season.

	Willow Creek Weir	Junction City Weir	Trinity River Hatchery	Main-stem spawner survey
Grilse[a]	3	27	17	12
Total	60	1,414	5,000	607
% Grilse	5%	1.9%	0.34%	2.0%

a/ Spring-run chinook salmon ≤48 cm FL are considered grilse based on post-season analysis of coded-wire tag returns.

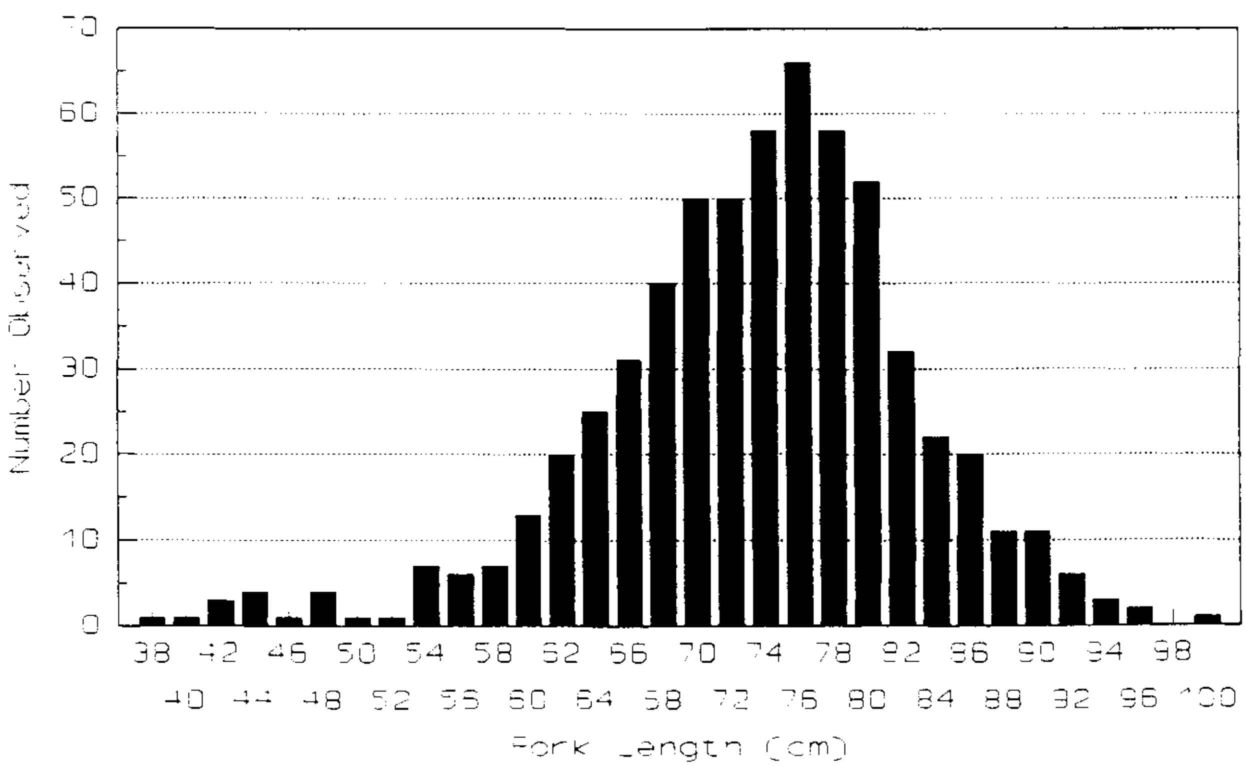

FIGURE 3. Fork length distribution, in 2-cm increments, of spring-run chinook salmon measured in the main-stem Trinity River during the 1989-90 spawner survey (N = 607).

Fall-run Chinook Salmon

Main-stem Trinity River. We measured the FL's of 634 fall-run chinook salmon. Based on a minimum FL[3] of 52 cm for adults (Bill Heubach, Assoc. Fishery Biologist, CDFG, pers. commun.), 99.3% of the fall-run chinook salmon measured were adults and 4.7% were grilse (Table 4, Figure 4). For comparison, the percentage of fall-run chinook salmon grilse at the different sampling sites ranged from 2.1% to 20.2% (Table 4). As with spring-run chinook salmon grilse, the reason for the difference in rates between the sample sites is unknown.

Tributaries. We measured 114 chinook salmon from the tributaries. Adults comprised 79.8% of the chinook observed while grilse comprised the remaining 20.2% (Table 4, Figure 5). The percentage of grilse observed in the tributaries was significantly different (X^2=35.0, df=1, P=.0001) than observed in the main-stem Trinity River spawner survey. The higher percentage of grilse in the tributaries may have been due to competition with larger fish for prime spawning locations in the main-stem Trinity River, or larger fish may have found it harder to enter tributaries during the low flow conditions encountered this year.

Sex Composition

Sex was determined only for fish recovered from the main-stem Trinity River that were either condition-two unmarked fish, Program-marked fish, or flagged fish recaptured in the carcass survey.

TABLE 4. Numbers and percentages of fall-run chinook salmon grilse observed in the spawner surveys and at three fixed locations in the Trinity River basin during the 1989-90 season.

	Willow Creek Weir	Junction City Weir	Trinity River Hatchery	Main-stem spawner survey	Tributary spawner survey
Grilse[a]	87	17	239	30	23
Total	1,356	519	11,371	634	114
% Grilse	6.4%	3.3%	2.10%	4.7%	20%

a/ Fall-run chinook salmon < 52 cm FL are considered grilse based on post-season analyses of coded-wire tag returns.

3/ Determined form post-season analysis of length frequency and coded-wire tag recovery.

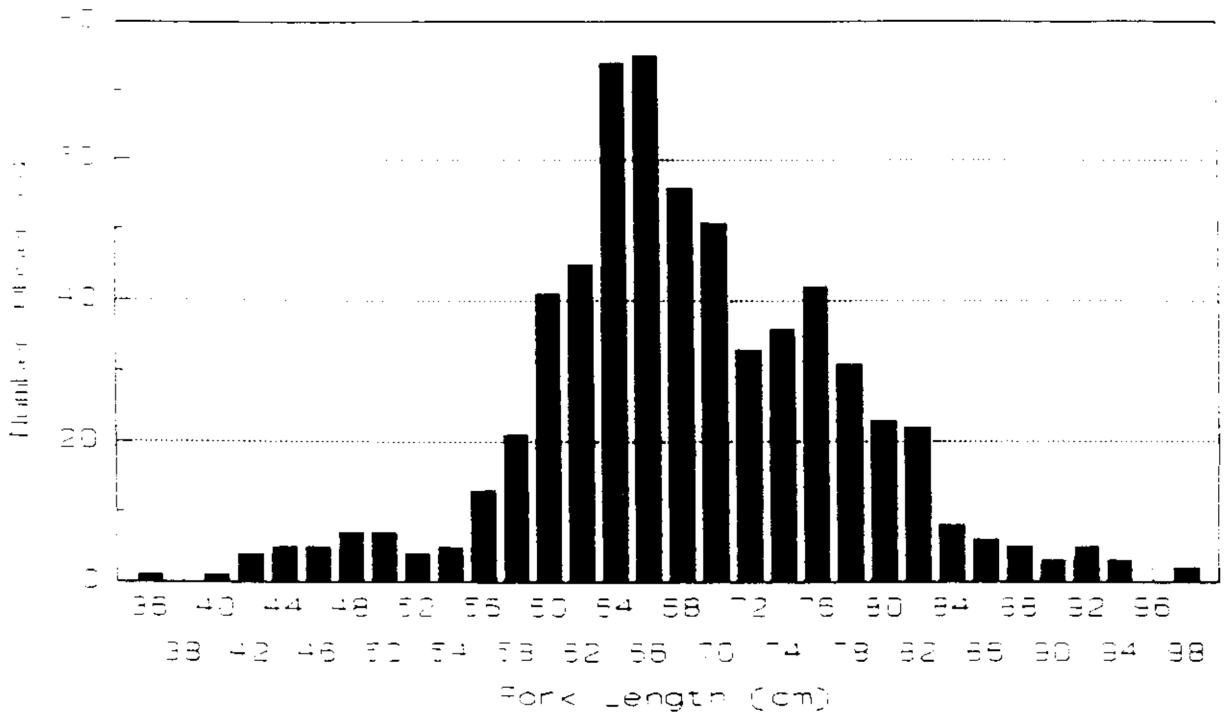

Figure 4. Fork length distribution, in 2-cm increments, of fall-run chinook salmon measured in the main-stem Trinity River during the 1989-90 spawner survey (N = 634).

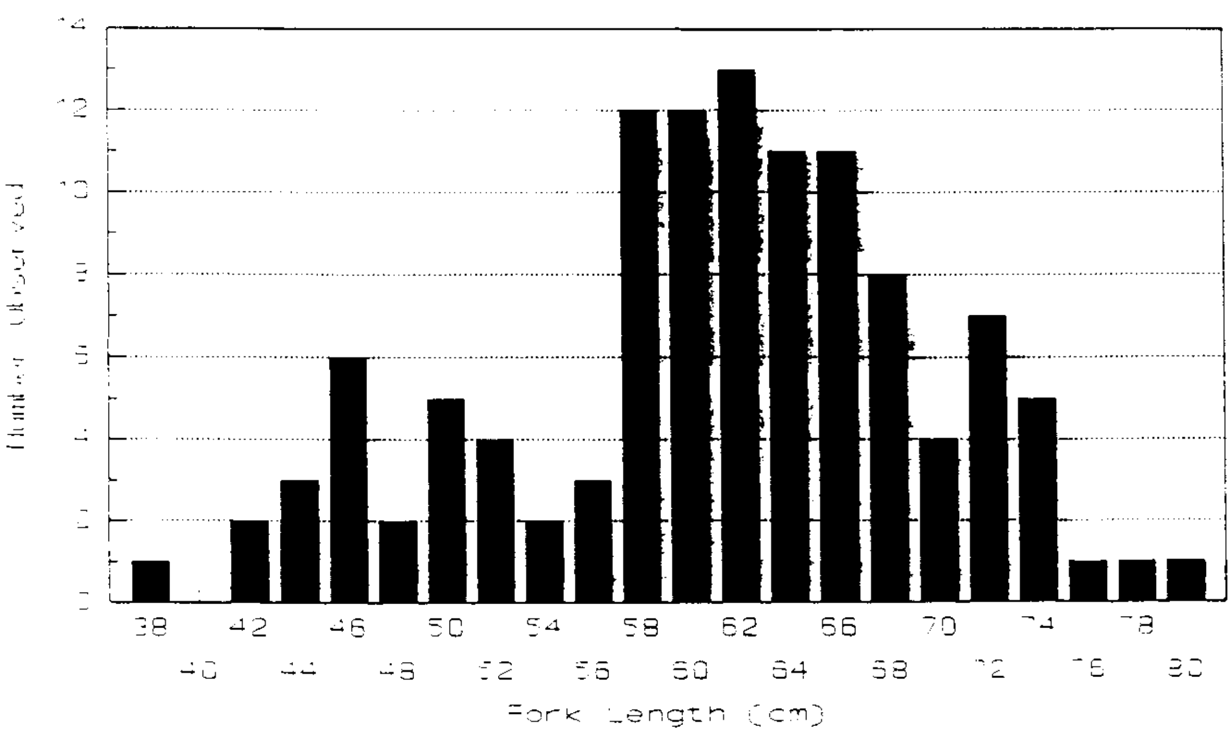

Figure 5. Fork length distribution, in 2-cm increments, of fall-run chinook salmon measured in tributaries to the Trinity River during the 1989-90 spawner survey (N = 114).

Chinook Salmon

We determined the sex of 1,877 adult chinook salmon during the survey (498 spring-run and 1,379 fall-run). Both spring and fall adult chinook salmon runs had more females than males (69.9% and 58.2% females, respectively). The percentage of females in the survey was highest during the early and late weeks of the survey and lowest during the middle weeks (Figure 6). The preponderance of females in the adult run has been noted in all but two of the previous surveys and has ranged from 73.6% to 25.8% (Appendix 4). The predominance of females among adult fish results when males return as grilse, thereby decreasing the number of males left to return as adults.

Coho Salmon

Sex was determined for 1,282 coho salmon, 57.2% (733) of which were females. No attempt was made to differentiate adults from grilse for coho salmon. For comparison, only 42.4% of the coho examined last year were females (Zuspan 1991a). In a pattern similar to that observed for chinook salmon, female coho salmon were most prevalent early and late in the survey (Figure 7).

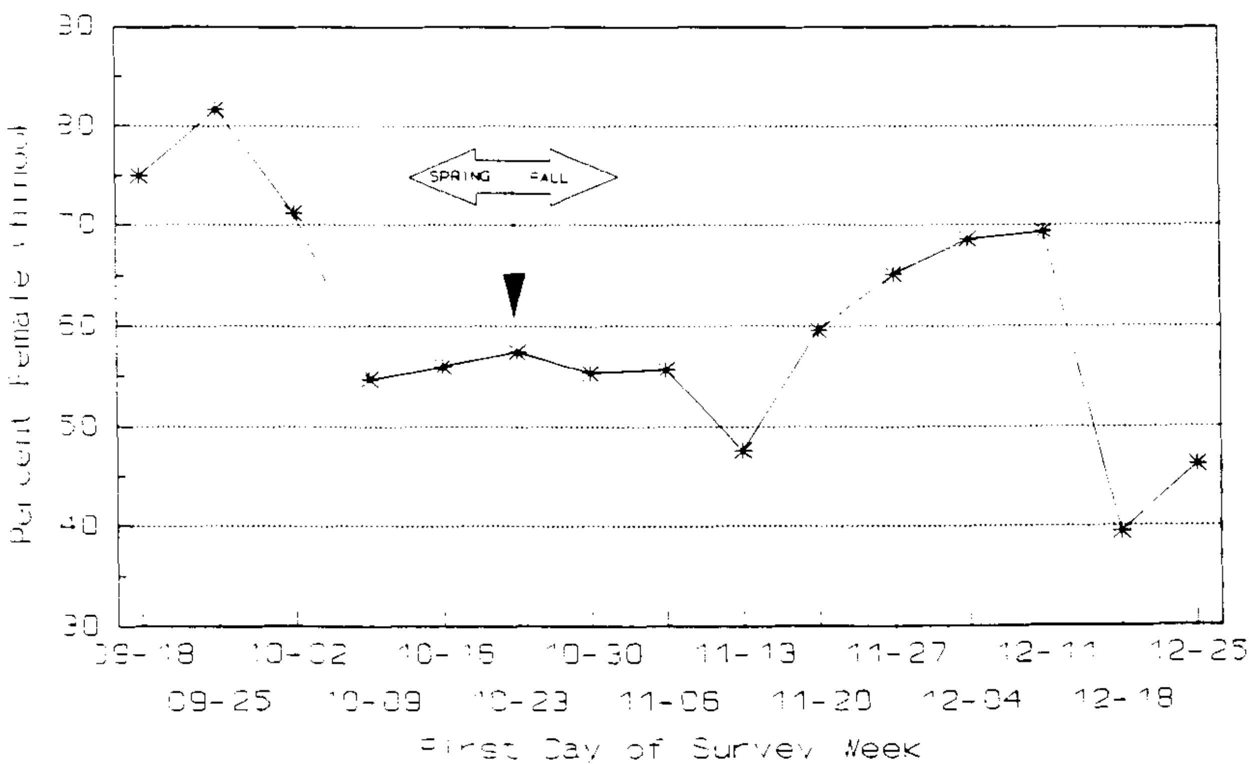

FIGURE 6. Percent female chinook salmon observed in the main-stem Trinity River during the 1989-90 spawner survey. The arrow indicates the date separating the spring from the fall run.

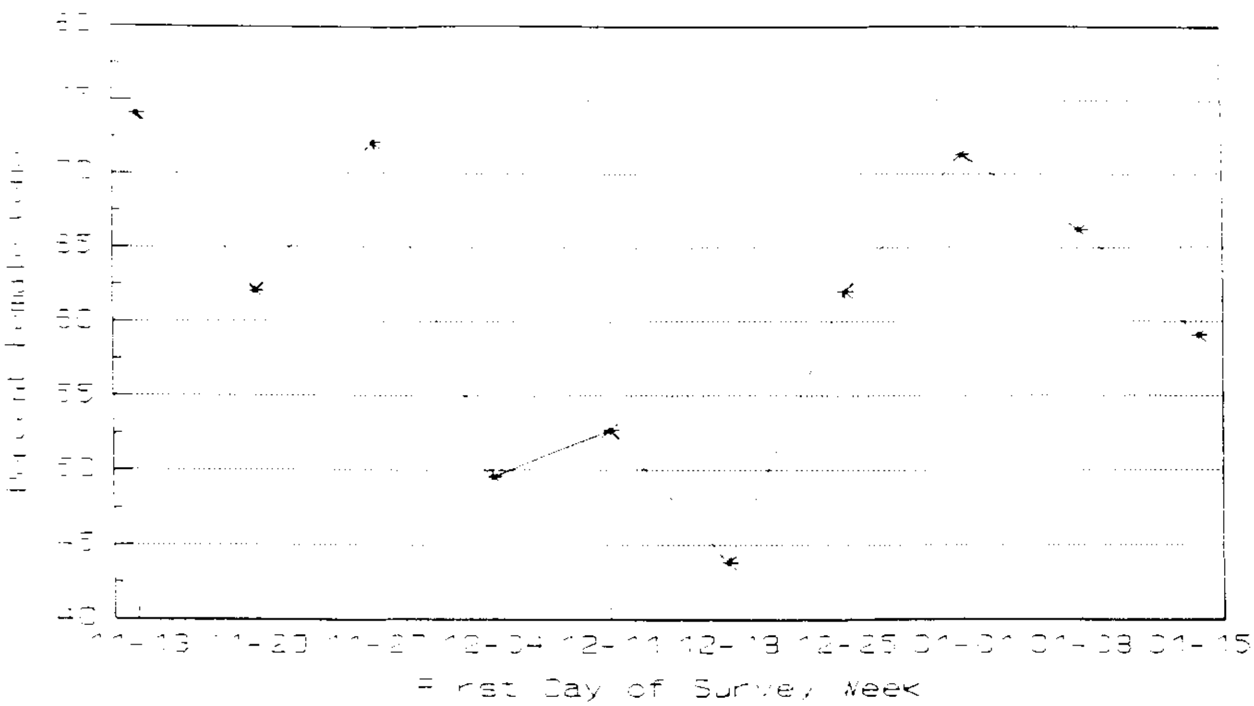

FIGURE 7. Percent female coho salmon observed in the main-stem Trinity River during the 1989-90 spawner survey.

Prespawning Mortality

Prespawning mortality was determined only for fish recovered in the main-stem Trinity River that were either condition-two unmarked fish, Program-marked fish, or flagged fish recaptured in the carcass survey.

Chinook Salmon

We checked the spawning condition of 2,531 adult female chinook salmon this season (521 spring-run and 2,010 fall-run fish). Prespawning mortality was 62.8% and 23.1% for spring-run and fall-run chinook salmon females, respectively. The rate of prespawning mortality decreased through time, starting at 92.2% and gradually decreasing to 11.1% by the end of spawning (Figure 8). The higher prespawning mortality rate for spring-run chinook salmon females is probably related to the added stress imposed by the extended time they spend in the river.

The overall prespawning mortality rate of both races of female chinook salmon was 31.3%. Overall (spring-run and fall-run) prespawning mortality for female chinook salmon has ranged from 1.5% to 44.9%, averaging 11.7% during previous surveys (Appendix 5).

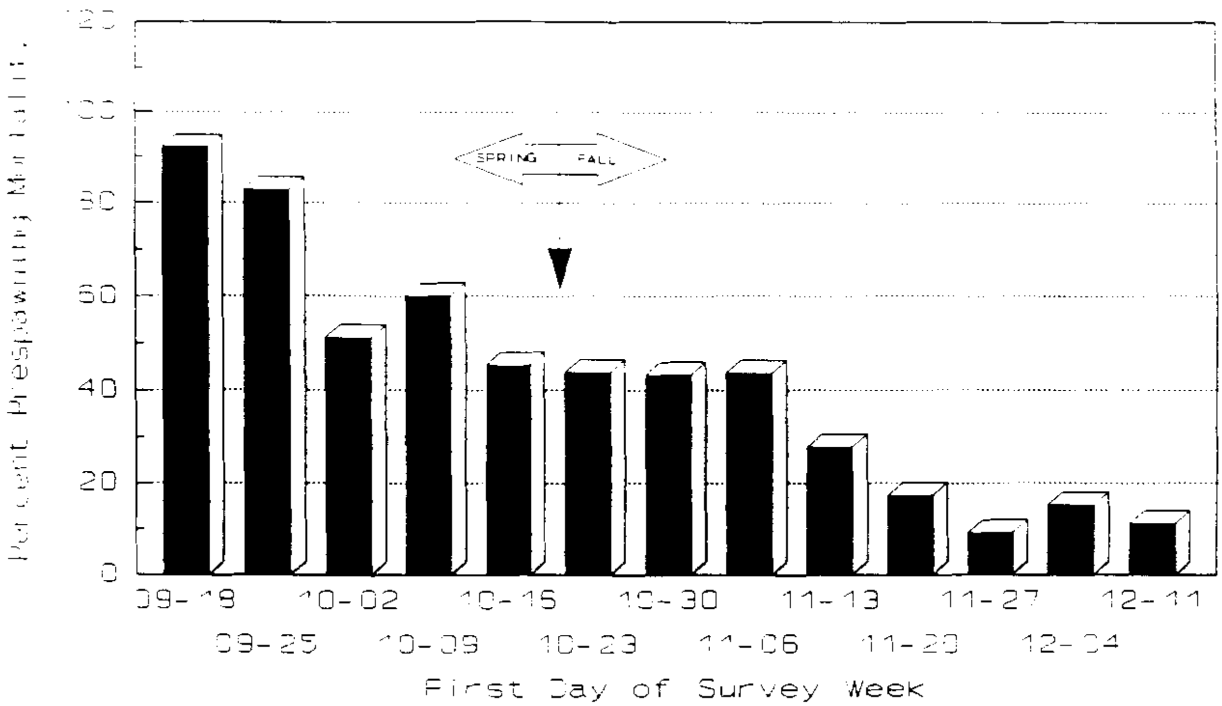

FIGURE 8. Female chinook salmon prespawning mortality observed in the 1989-90 Trinity River spawner survey. The arrow indicates the date separating the spring from the fall run.

Coho Salmon

Spawning condition was determined for 689 adult female coho salmon during the survey. The overall prespawning mortality rate was 6.2% (43/689). In 1988 prespawning mortality for female coho was 25.6% (46/180) (Zuspan 1991a). Coho prespawning rates have not been reported in surveys prior to 1988. The weekly rate of prespawning mortality varied between 20% and 4% during the survey (Figure 9).

Salmon Spawner Distribution

Spawner distribution in the main-stem Trinity River is presented based on the seven-zone system first used in 1987 (Stempel 1988). The results for Zones 5 through 7 were combined this year because too few flagged chinook were recovered in these individual zones to make reliable estimates. Distribution in the tributaries is presented by individual tributary.

Chinook Salmon

Main-stem Trinity River. We observed 8,673 adult chinook salmon this season, excluding flag recoveries. The numbers of chinook salmon spawners were greatest in upstream zones, decreasing from a high of 4,897 fish in Zone 1 to 257 fish in combined Zones 5-7

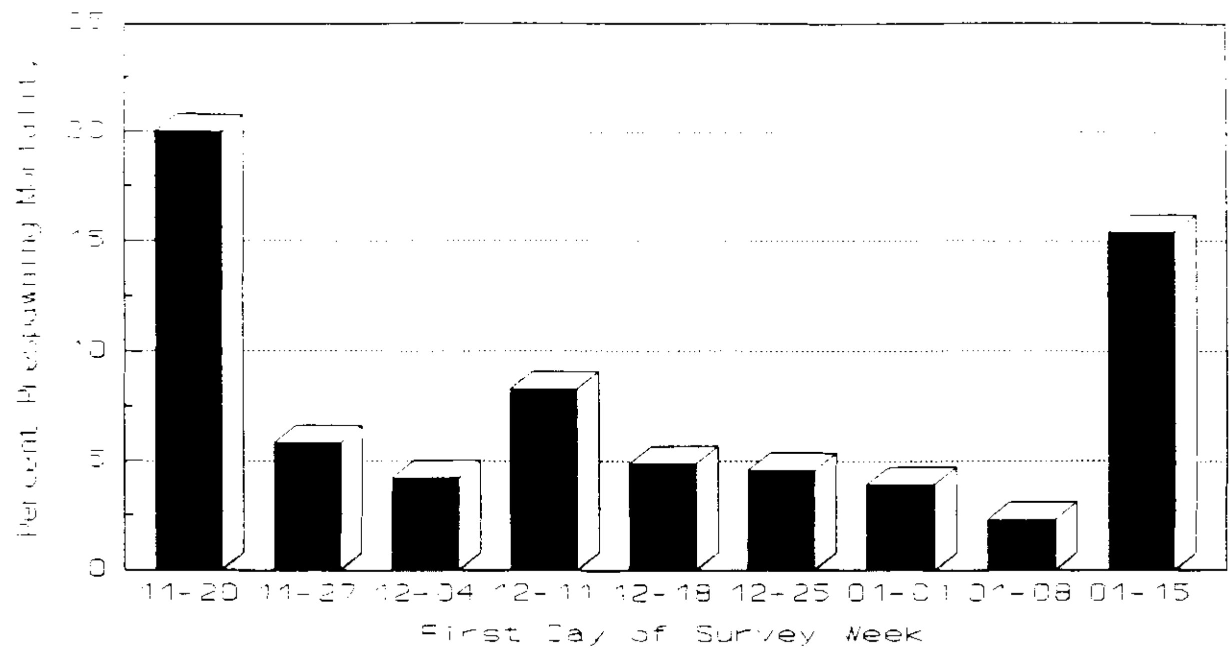

FIGURE 9. Female coho salmon prespawning mortality observed in the 1989-90 Trinity River spawner survey. Calculations were made only for weeks where >10 fish were collected.

(Table 5). We recognize that carcass counts alone cannot be used to accurately describe distribution because recovery efficiency can vary from zone to zone, due to differences in stream morphology. Therefore, the percentage of flags recovered for each zone was used to determine the recovery efficiency of that zone (Table 5). Even based on the total number of chinook salmon recovered divided by the different recovery efficiency rates for each zone, the percent of chinook salmon spawners decreased downstream in successive zones below Zone 1 (Table 5).

As noted last year (Zuspan 1991a), a potential source of error in this estimate is the assumption that flagged chinook salmon carcasses are recovered only in the zone that they were originally flagged. If flagged fish are recovered in downstream zones, it 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 were recorded as such. Of the 2,253 flags recovered this season, only 18 (0.8%) were not flagged in the same zone that they were recovered. This indicates that carcass drifting had a negligible effect on chinook salmon distribution estimates.

TABLE 5. Adult chinook salmon distribution by river zone in the 1989-90 Trinity River spawner survey.

Zone[a]	Total flagged	Flags recovered	% flags recovered	Total unflagged observed[b]	Expanded total[c]	% of expanded total
1	2,533	1,357	53.6%	4,897	9,136	42.0%
2	1,606	792	49.3%	2,761	5,600	25.7%
3	272	50	18.4%	419	2,277	10.5%
4	210	41	19.5%	339	1,738	8.0%
5-7	153	13	8.5%	257	3,024	13.9%
Totals:	4,774	2,253		8,673	21,775	100.0%
Mean:			47.2%			

a/ The Zones are described in Table 1 and Figure 1.
b/ Total includes all adult chinook observed except flagged chinook which were re-examined.
c/ Computed from: (Total observed /(% flags recovered / 100)).

Tributaries. We recovered 127 chinook and 9 coho salmon in the eight tributaries surveyed. The chinook salmon total includes 115 unmarked condition-one fish which we flagged, and 12 skeletons (Appendix 3). We also recaptured and re-examined 50 flagged carcasses. Too few salmon were observed in any of the tributaries to generate escapement estimates based on standard Jolly-Seber or Schaefer (Ricker, 1975) carcass survey models. However a rough estimate can be obtained by using the same method employed to expand the main-stem recoveries. For example, 31 chinook, consisting of 27 flagged fish and 4 skeletons, were observed in Canyon Creek this season. Of the chinook flagged, 5 (18.5%) were subsequently recovered. Adjusting for the 18.5% recovery rate, a total of 168 chinook spawned in the survey area this season. Since the survey area represents 97.0% of the total spawning habitat in the tributary, we estimate 173 chinook spawned in Canyon Creek this season. Using this methodology for the other tributaries surveyed, our results indicate that only Canyon Creek and the North Fork Trinity River had much spawning activity (Table 6), and probably contained 59% of the spawning activity that we estimated to have occurred in all eight tributaries to the upper main-stem Trinity River.

Coho salmon

Main-stem Trinity River. We observed 1,282 coho salmon, most of which were seen in Zones 1 and 2 (Table 7). Expanded spawner estimates, based on the recovery efficiencies developed from chinook salmon flag recoveries, indicate the majority of coho salmon also spawned in these two zones (Table 7).

TABLE 6. Chinook salmon observed and estimated total spawners in tributaries surveyed during the 1989-90 Trinity River spawner survey.

Tributary	Number observed	% flag recovery[a]	Number estimated[b]	% of total spawning[c]	Estimated total spawners[d]
Rush Ck.	29	59.3	49	100.0	49
Grass Valley Ck.	7	14.3	49	100.0	49
Indian Ck.	4	50.0	8	100.0	8
Reading Ck.	4	50.0	8	100.0	8
Browns Ck.	7	28.6	24	95.0	25
Weaver Ck.	37	60.6	61	100.0	61
Canyon Ck.	31	18.5	168	97.0	173
North Fork Trinity R.	8	33.3	24	20.0	120
Totals:	127		391		493

a/ Percent of flagged chinook salmon which were subsequently recovered.
b/ The number of spawners estimated to have occurred in the survey zone computed from 'Number observed' divided by the decimal percentage of '% flag recovery'.
c/ Percent of total spawning in each tributary that occurred in its respective survey zone. Determined from aerial and ground surveys.
d/ The total number of spawners estimated to have occurred in the tributary computed from 'Number estimated' divided by the decimal percentage of '% of total spawning'.

TABLE 7. Coho salmon distribution by river zone in the 1989-90 Trinity River spawner survey.

Zone[a]	Total observed	Observation efficiency[b]	Expanded total[c]	% of Total
1	778	53.6%	1,451	43.9%
2	384	49.3%	779	23.5%
3	47	18.4%	255	7.7%
4	23	19.5%	118	3.6%
5-7	60	8.5%	706	21.3%
Totals:	1,292		3,309	100%
Mean:		47.2%		

a/ Zones described in Table 1, Figure 1.
b/ Observation efficiency equals the total recovery rate of flagged chinook salmon in each zone.
c/ Computed from: Total observed/(observation efficiency/100).

Marked Salmon Recovery

Adipose Fin Clips and Coded-wire Tags

Main-stem Trinity River. We recovered 198 Ad-clipped salmon in the survey, which included 97 spring-run and 98 fall-run chinook salmon, and 3 coho salmon (Appendices 1 & 2). The percentage of Ad-clipped salmon in the survey is best estimated by considering only fish in relatively good condition (condition one), as fin clips are difficult to discern on fish in advanced decay. For condition-one fish, 4.1% of the spring-run chinook salmon, 2.9% of the fall-run chinook salmon, and 0.2% of the coho salmon were Ad-clipped. For comparison, at Junction City Weir, 15.1%, 9.4%, and 9.1% of the spring-run chinook salmon, fall-run chinook salmon, and coho salmon were Ad-clipped, respectively (Table 8).

The difference in Ad-clip percentages between the survey and Junction City Weir results primarily from a failure to identify Ad-clips in the survey. This was made apparent by comparing weir tagging records with survey recoveries. Seventeen chinook which had been identified as Ad-clipped when tagged at the weirs were subsequently recovered as condition-one fish in the survey. Of the 17, only five (29.4%) were correctly re-identified in the survey as being Ad-clipped. For both condition-one and condition-two fish, combined, the recognition rate was 20.0% (5/25). While it may be tempting to adjust the Ad-clip rates in the spawner survey by the apparent recognition rate (29.4%), it would be inappropriate because of the small (17) sample size driving the expansion. A re-evaluation of the 1988-89 data indicates that all condition-one, Program-marked fish were correctly identified upon recapture, that year.

Coded-wire tags were removed and decoded from 169 of the 198 Ad-clipped salmon recovered in the survey. All coded-wire tagged fish we recovered originated from Trinity River Hatchery (Appendix 6).

Tributaries. Of the total 127 chinook salmon recovered, five were Ad-clipped. All five were fall chinook tagged and released from Trinity River Hatchery (Appendix 6).

Program Marks

Main-stem Trinity River. We observed Program marks (spaghetti tags or operculum punches) on 215 chinook and 75 coho salmon during the survey. Most of these fish were tagged at Junction City Weir, followed by Willow Creek Weir, and, last, the seining operation at the mouth of the Klamath River (Table 9).

Tributaries. Program tags were recovered from nine of the 127 chinook salmon observed in the tributaries. Of these, seven were from Willow Creek Weir, one from Junction City Weir, and one from the seining operation at the mouth of the Klamath River.

TABLE 8. Number and percentages of adipose fin-clipped salmon observed in the spawner surveys and at the three fixed locations in the Trinity River basin during the 1989-90 season.

	Spring-run chinook			Fall-run chinook			Coho		
Site	Ad-clips[a]	Total	% Ad-clips	Ad-clips	Total	% Ad-clips	Ad-clips	Total	% Ad-clips
Willow Creek Weir	34	505	6.7	63	946	6.7	36	477	7.6
Junction City Weir	197	1502	13.1	47	546	8.6	60	661	9.1
Trinity River Hatchery	723	5000	14.5	1172	11371	10.3	490	4970	9.9
Main-stem Trinity River spawner survey[b]	82	2022	4.1	91	3154	2.9	3	1316	0.2
Tributary spawner survey	0	0	0	5	115	4.4	0	0	0

a/ Ad-clips = adipose fin-clips.
b/ Only chinook salmon in relatively good condition (condition one) are used in this analysis. For coho, all recoveries, regardless of condition were used in the analysis. Also note there was a significant but unknown number of condition one Ad-clipped fish which were unrecognized in the survey (see text).

TABLE 9. Program tag recoveries during the 1989-90 main-stem Trinity River spawner survey.

Tagging site	Spring-run chinook salmon	Fall-run chinook salmon	Coho salmon
Junction City Weir	72	76	54
Willow Creek Weir	2	54[a]	21
Klamath River Mouth	0	11[b]	0
TOTALS	74	141	75

a/ Includes two tags which were also observed at Junction City Weir, but not included in the Junction City Weir total.
b/ Includes one tag which was also observed at Willow Creek Weir, but not included in the Willow Creek Weir total.

Incidence of Hatchery-produced Salmon

Estimating the ratio of hatchery to naturally produced salmon spawning in the survey area relies entirely on correctly determining the ratio of Ad-clipped to unclipped salmon in the survey. Since, as stated in the section above, we failed to identify the majority of Ad-clips during the survey, even on condition one fish, estimating the incidence of hatchery-produced salmon spawning in the survey area would be inappropriate for this year.

RECOMMENDATIONS

This is the second year of a multi-year Program of spawner surveys in the Trinity River basin below Lewiston Dam. The following recommendations should be considered for inclusion in next year's spawner survey.

1. Spawner survey activities should be continued with current objectives in FY 1990-91.

2. Prespawning mortalities of female chinook salmon should be closely monitored to determine if they are continuing occurrence. The CDFG's fish pathologists should attempt to determine the cause(s) of the mortalities.

3. Survey efforts should be intensified so as to recover a higher proportion of the Ad-clipped salmon. Additional recoveries are necessary to reliably determine the incidence of hatchery-produced chinook salmon spawning naturally. Survey crews should be instructed to recover all fish with marginal or non-standard Ad-clips. Determination of whether these fish are actually Ad-clipped should be made in the lab by passing the fish through a tag-detector to determine if a coded-wire tag is present.

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Appendix 1. Summary of chinook salmon carcasses recovered during the 1989-90 mainstem Trinity River spawner survey.

								Unmarked chinook a/				
									Females			
Survey week	Date begun	Ad-clips c/	Program marks d/	Chinook flagged b/ Adults	Chinook flagged b/ Grilse e/	Flag recovery f/	Males	Spawned	Unspawned	Percent unspawned	Unknown g/	Week totals h/
1	18-Sep	22	16	222	0	0	19	4	53	93.0	195	531
2	25-Sep	21	11	496	7	73	22	13	85	86.7	186	841
3	02-Oct	21	20	423	13	201	47	57	59	50.9	140	780
4	09-Oct	21	18	449	9	187	29	22	13	37.1	79	640
5	16-Oct	12	9	264	14	189	33	24	18	42.9	139	513
6	23-Oct	4	13	257	9	112	29	23	16	41.0	117	468
7	30-Oct	28	21 (2)	487	16	105	84	64	40	38.5	134	872
8	06-Nov	27	29 (3)	803	18	198	97	78	44	36.1	107	1,200
9	13-Nov	30	26 (1)	656	13	254	119	88	20	18.5	72	1,023
10	20-Nov	6	25	538	6	367	44	51	14	21.5	74	758
11	27-Nov	1	17	176	6	346	111	181	26	12.6	111	629
12	04-Dec	2	4	3	1	182	49	75	32	29.9	111	277
13	11-Dec	0	2	0	0	30	11	23	2	8.0	37	75
14	18-Dec	0	1	0	0	23	20	5	8	61.5	41	75
15	25-Dec	0	2	0	0	6	7	4	2	33.3	25	40
16	01-Jan	0	1	0	0	1	3	2	1	33.3	27	34
17	08-Jan	0	0	0	0	2	2	3	0	0.0	14	19
18	15-Jan	0	0	0	0	0	0	0	0		3	3
19	22-Jan	0	0	0	0	0	1	0	0		6	7
Totals:		195	215 (6)	4,774	112	2,276	727	717	433		1,618	8,785
Average:										37.7		

a/ Includes chinook salmon which were not flagged, Ad-clipped, or Program-marked and were chopped in half upon recovery.

b/ Includes chinook salmon which were flagged that week for later recovery.

c/ Adipose fin-clipped fish.

d/ Includes chinook salmon which were previously marked (spaghetti tag/operculum punch) at various sites downstream of the survey area. Numbers in parenthesis were also Ad-clipped.

e/ During the survey, prior to analysis of this year's coded-wire tag data, chinook salmon <56 cm are assumed to be grilse, for tally purposes.

f/ Includes all recoveries that week which were flagged in previous weeks.

g/ Includes chinook salmon of unknown sex.

h/ Includes all newly observed chinook salmon. Does not include flagged fish recoveries which were re-examined that week.

Appendix 2. Summary of coho salmon carcasses recovered during the 1989-90 mainstem Trinity River spawner survey.

Survey week	Date begun	Ad-clips a/	Program marks b/	Males	Female coho: Unknown spawned c/	Female coho: Spawned	Female coho: Unspawned	Female coho: Percent unspawned	Week totals
7	30-Oct	0	0	1	0	0	1	100.0	2
8	06-Nov	0	2	1	5	0	2	100.0	10
9	13-Nov	0	3	7	14	5	1	16.7	30
10	20-Nov	1	2	19	11	16	4	20.0	53
11	27-Nov	2	9	43	7	98	6	5.8	165
12	04-Dec	0	24	129	7	115	5	4.2	280
13	11-Dec	0	15	98	0	100	9	8.3	222
14	18-Dec	0	6	132	0	98	5	4.9	241
15	25-Dec	0	7	54	0	84	4	4.5	149
16	01-Jan	0	5	31	0	74	3	3.9	113
17	08-Jan	0	2	22	0	42	1	2.3	67
18	15-Jan	0	0	9	0	11	2	15.4	22
19	22-Jan	0	0	3	0	3	0	0.0	6
Totals:		3	75	549	44	646	43		1,360
Average:								6.2	

a/ Adipose fin-clipped fish.

b/ Includes coho salmon which were previously marked (spaghetti tag/operculum punch) at various sites downstream of the survey area.

c/ Includes female coho for which spawning condition was not assessed.

Appendix 3. Summary of salmon carcasses and redds observed in tributaries druing the 1989-90 Trinity River spawner surveys.

Tributary	Kilometers surveyed	Percent of total spawning b/	Weeks surveyed	Chinook: Ad-clips c/	Chinook: Program marks d/	Chinook: Flagged fish a/ Adults	Chinook: Flagged fish a/ Grilse e/	Chinook: Flags recovered	Chinook: Skeletons	Chinook: Total f/	Redd count	Coho
Rush Creek	3.1	100	6	0	1	26	1	16	2	29	22	2
Grass Valley Creek	2.4	100	6	1	1	6	1	1	0	7	29	1
Indian Creek	4.8	100	5	0	1	3	1	2	0	4	2	0
Reading Creek	2.7	100	6	1	0	2	2	2	0	4	5	1
Browns Creek	4.0	95	7	0	1	1	6	2	0	7	32	2
Weaver Creek	2.4	100	6	3	2	26	7	20	4	37	36	0
Canyon Creek	3.1	97	6	0	2	21	6	5	4	31	36	1
North Fork Trinity R.	2.6	20	6	0	1	5	1	2	2	8	12	2
Totals:				5	9	90	25	50	12	127	174	9

a/ Chinook salmon carcasses which were flagged and returned to the tributary.

b/ Percent of the total chinook spawning in the tributary that the survey represents. Determined from ground and aerial redd surveys.

c/ Adipose fin-clipped fish.

d/ Includes chinook salmon which were previously marked (spaghetti tag/operculum punch) at various sites downstream of the survey area.

e/ During the survey and prior to analysis of this year's CWT data, chinook salmon < 56 cm are assumed to be grilse, for tally purposes.

f/ Chinook totals include flagged fish, and skeletons. Ad-clipped and Program marked fish are included in the flagged column. Does not include flagged fish recoveries which were re-examined that week.

Appendix 4. Sex compositions of adult chinook salmon observed during mainstem Trinity River spawner surveys from 1942 thorugh 1989.

		Spring-run chinook				Fall-run chinook				Total chinook			
		Males		Females		Males		Females		Males		Females	
Study year	Reference	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)									1,769	49.7	1,789	50.3
1956 a/	Weber (1965)									3,149	46.3	3,657	53.7
1963 a/	LaFaunce (1965)									1,419	41.4	2,008	58.6
1968 a/	Rogers (1970)									1,244	44.5	1,551	55.5
1969 a/	Smith (1975)									1,054	37.0	1,791	63.0
1970 a/	Rogers (1973)									527	48.7	556	51.3
1971 a/	" (1982)									1,704	46.2	1,987	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	1,125	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)									1,182	26.4	3,299	73.6
1988	Zuspan (1991a)	47	30.7	106	69.3	659	39.3	1,016	60.7	706	38.6	1,122	61.4
1989	Current study	150	30.1	348	69.9	577	41.8	802	58.2	727	38.7	1,150	61.3

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

b/ Grilse chinook salmon were included in these counts.

Appendix 5. Female chinook salmon pre-spawning mortality rates observed during mainstem Trinity River spawner surveys from 1942 through 1989.

		Spring-run chinook			Fall-run chinook			Total chinook		
Study year	Reference	Spawned	Unspawned	Percent unspawned	Spawned	Unspawned	Percent unspawned	Spawned	Unspawned	Percent unspawned
1942-1945 a/	Moffett/Smith (1950)									
1955 b/	Gibbs (1956)							2,076	32	1.5
1956 b/	Weber (1965)							3,438	219	6.0
1963 b/	LaFaunce (1965)							4,953	328	6.2
1968 b/	Rogers (1970)							1,494	124	7.7
1969 b/	Smith (1975)							1,889	23	1.2
1970 b/	Rogers (1973)							632	34	5.1
1971 a/	" (1982)									
1972 b/	Miller (1972)							791	110	12.2
1973 b/ c/	" (1973)									12.0
1974 b/ c/	" (1974)									9.1
1976 b/ c/	" (1976)									8.4
1978 b/ c/	" (1978)									7.2
1979 b/ c/	" (1979)									6.0
1980 b/ c/	" (1980)									36.5
1981 b/ c/	" (1981)									2.6
1982 b/ c/	" (1982)									1.5
1984 a/	" (1984)									
1985 a/	" (1985)									
1987 b/	Stempel (1988)			49.9			18.8			30.8
1988	Zuspan (1991a)	11	27	71.1	479	372	43.7	490	399	44.9
1989	Current study	194	327	62.8	1,546	464	23.1	1,740	791	31.3

a/ Pre-spawning mortality rate was not reported during these years.

b/ Spring-run and fall-run chinook salmon were not separated during these years.

c/ Overall pre-spawning mortality rates were reported but not individual counts.

Appendix 6. Release and recovery data for coded-wire-tagged salmon recovered in the 1989-90 mainstem Trinity River spawner survey

	Release Information								
CWT # a/	Species	Race	Brood year	Type b/	Location c/	Date	Number released	Number recovered d/	
06-56-19	Chinook	Fall	1984	Ff	Lime Point	Jun-1985	94,100	1	
06-56-23	Chinook	Fall	1985	Ff	TRH	Jun-1986	196,249	9	(1)
06-56-25	Chinook	Fall	1985	Fy	TRH	Oct-1986	97,368	17	(1)
06-56-26	Chinook	Fall	1986	Ff	TRH	Jun-1987	202,486	4	
06-56-27	Chinook	Fall	1986	Fy	TRH	Sep-1987	100,320	48	(3)
06-56-28	Chinook	Fall	1986	Fy	TRH	Sep-1987	26,730	2	
06-56-29	Chinook	Fall	1986	Ff	Sawmill	Jun-1987	99,118	4	
06-56-30	Chinook	Fall	1986	Ff	Ambrose	Jun-1987	92,351	1	
06-56-31	Chinook	Fall	1987	Fy	Ambrose	Oct-1988	92,300	2	
06-61-27	Chinook	Fall	1984	Ff	TRH	Jun-1985	189,708	1	
06-61-28	Chinook	Fall	1984	Fy	TRH	Sep&Oct-1985	97,070	1	
06-61-42	Chinook	Spring	1985	Sf	TRH	Jun-1986	192,487	10	
06-61-44	Chinook	Spring	1985	Sy	TRH	Oct-1986	101,091	52	
06-61-45	Chinook	Spring	1986	Sf	TRH	May-1987	197,113	1	
06-61-46	Chinook	Spring	1986	Sy	TRH	Sep-1987	101,030	15	
06-61-47	Chinook	Spring	1987	Sy	Sawmill	May-1988	185,718	1	
06-63-10	Chinook	Fall	1986	Fy+	TRH	Feb-1988	26,650	1	
06-56-56	Coho	Fall	1986	Fy+	Sawmill	Mar&Apr-1988	51,721	4	
Total:								174	(5)

a/ Coded-wire tag (CWT) number for the release group.

b/ Hatchery release types include, Fy=fall yearling, Ff=fall fingerling, Fy+ =fall yearling plus, Sy=spring yearling, Sf=spring fingerling.

c/ All release locations are in the mainstem Trinity River. TRH=Trinity River Hatchery.

d/ Numbers in parenthesis represent chinook salmon recovered in tributaries and are included in the "Number recovered" column. All other recoveries were from the mainstem Trinity River.

ANNUAL REPORT
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CHAPTER II

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

by

Mark Zuspan

ABSTRACT

Staff of the California Department of Fish and Game's Trinity Fisheries Investigations Project conducted a trapping and coded-wire tagging operation for naturally produced, juvenile chinook salmon (Oncorhynchus tshawytscha) in the main stem Trinity River below Lewiston Dam from 22 February through 26 June 1990.

We trapped 176,381 juvenile chinook salmon, 31,705 juvenile coho salmon (O. kisutch), and 6,164 juvenile steelhead (O. mykiss) at two sites during the study. At both sites, catch-per-unit-effort of juvenile chinook salmon peaked during the week of 21 May 1990, declining thereafter. Weekly average fork lengths of trapped fish tended to increase throughout the trapping period.

We adipose fin-clipped and implanted coded-wire tags into 140,898 juvenile chinook salmon. After adjusting for tagging mortality, tag shedding, and poor fin clips, we effectively coded-wire tagged and released 112,133 juvenile chinook salmon.

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 or fingerlings in the main stem Trinity River and/or selected Trinity River tributary streams. These fish will be sampled, subsequently, by other projects to determine their survival, 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 spawning escapement of these stocks is crucial to wise management of chinook in the basin.

Recent legislation (Public Law 98-541) has 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 system 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).

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

The current study began in 1989. This is the second annual report on the capture and coded-wire tagging of naturally produced juvenile chinook from the Trinity River system.

METHODS

Use of Standard Julian Week

Weekly sampling data collected by Project personnel at the trapping sites are presented in Julian Week (JW) format. Each JW is one of a consecutive set of 52 7-day periods, beginning 1 January, regardless of the day of the week on which 1 January falls. The extra day in leap years is added to the ninth week, and the last day of the year is included in the 52nd week (Appendix 1). This procedure allows between-year comparisons of identical 7-day periods.

Trapping

Trapping was conducted at two sites in the main stem Trinity River this season. The first site (Lewiston Site) was located at river kilometer (RKM) 175.4, 3.1 km downstream of Lewiston Dam. The second site (Indian Creek Site) was located 21.9 km downstream of the Lewiston Site near Indian Creek at RKM 153.5 (Figure 1).

The Lewiston Site was upstream of any significant tributary and downstream of highly productive chinook spawning beds located in the main-stem Trinity River. The site's location above major tributaries made it relatively immune from large fluctuations in stream flow due to storm events. Trapping at the Lewiston Site began JW 8 (19 February 1990) and continued through JW 26 (25 June 1990).

Trapping at the Indian Creek Site began JW 15 (09 April 1990) and continued to JW 26 (15 June 1990). This site was used when juvenile chinook catches at the Lewiston Site had diminished and the coded-wire tagging program could no longer be effectively continued at that location.

Trapping at both sites was conducted using between one to four fyke nets measuring 3.1 m wide, by 1.2 m high at the opening, by 7.6 m long, tapering to a 0.33-m by 0.3-m exit leading into dual live boxes. Fyke nets were attached, at their mouth, to a 2.5-cm (1-in) diameter galvanized pipe frame of the same dimensions as the net opening, which was connected by ropes to metal posts driven into the stream bed.

The primary objective of the trapping effort was to capture up to 100,000 juvenile chinook for coded-wire tagging. All fish trapped were counted and a sample of each species was measured to the nearest mm of fork length (FL).

Tagging

The tagging sites were located adjacent to the trapping sites. Tagging was conducted inside a 4.9 m x 4.9 m (16 ft x 16 ft) canvas tent. A 3.5-KW portable generator was used to supply the electrical needs of the operation (tagging machines, pumps, lights).

Captured juvenile chinook were anesthetized with tricaine

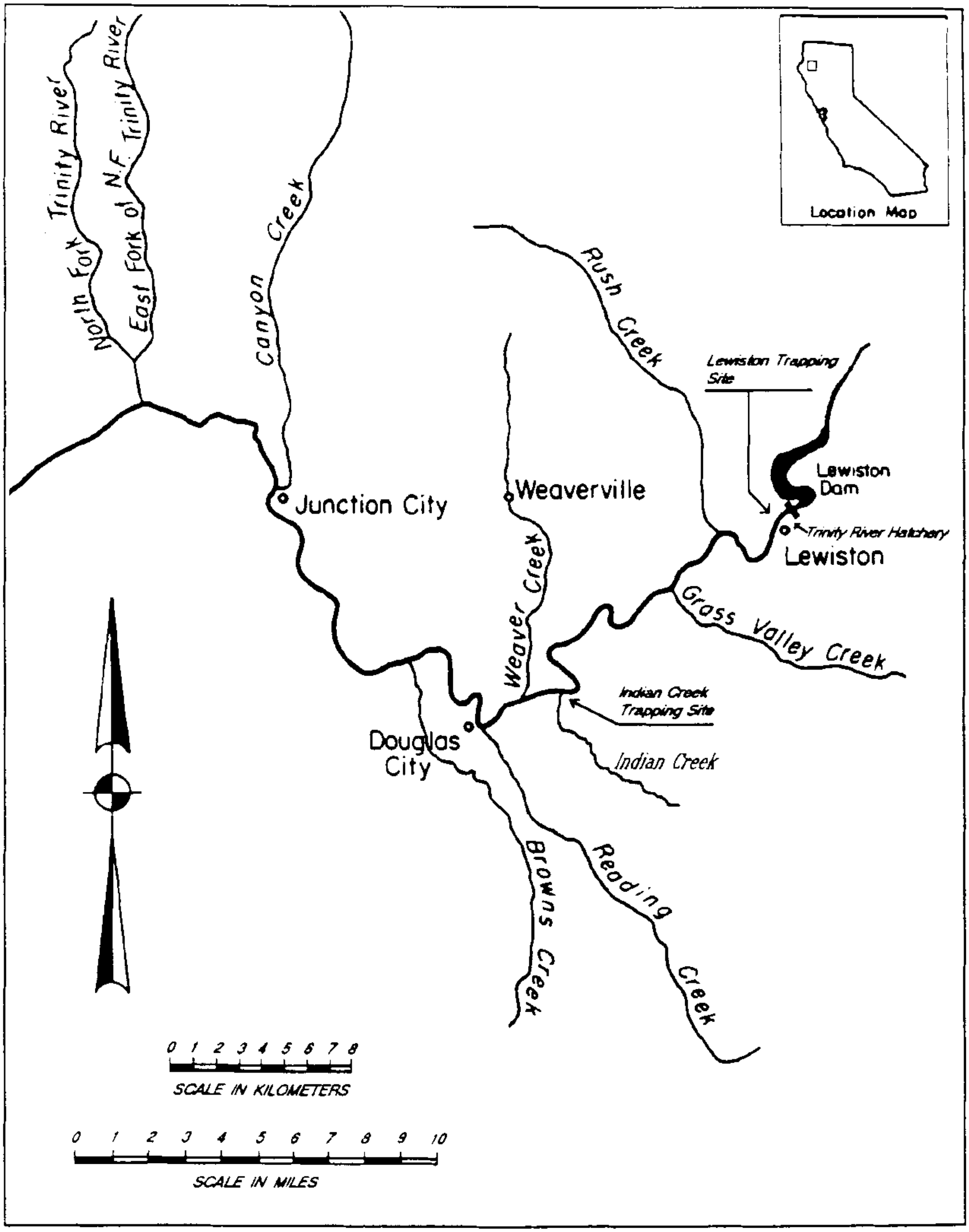

FIGURE 1.. Map of the Trinity River below Lewiston Dam showing the trapping and coded-wire tagging sites used in 1990.

methanesulfonate (MS222)[1/], their adipose fin removed, and a coded-wire tag implanted. Tag injectors and quality control devices used in the operation were purchased from Northwest Marine Technology [1/]. Because of the small size of the fish captured, 1/2-length tags were used. Two tagging stations were normally employed.

A subsample of 100 tagged fish was reserved each day for quality control. All other tagged fish were released throughout the day into the river at the tagging site. Fish in the quality control sample were put into holding cages kept in the river and, after a minimum of 24 hours, checked for mortality, tag retention, and adipose fin-clip (Ad-clip) effectiveness. Tag retention was determined by passing fish through the electronic tag (metal) detector, and Ad-clip effectiveness was determined by direct examination.

RESULTS

Lewiston Site

Trapping

Chinook Salmon. We captured 99,239 juvenile chinook at the Lewiston Site this season. Weekly average catch-per-night peaked in mid-March at 1,974 fish per trap and again in mid-May at 4,656 fish per trap (Figure 2, Appendix 2). The first peak was composed exclusively of naturally produced fish while the second was composed mostly of fish produced at Trinity River Hatchery (TRH). Hatchery fish were identified by the presence an Ad-clip and by the timing of hatchery releases.

Weekly average fork lengths (FLs) of juvenile chinook captured at the Lewiston Site ranged from 36.0 to 86.1 mm through the trapping season (Figure 3, Appendix 2). During the first seven weeks of trapping the average FL remained constant at about 36 mm, ranging from 35.9 to 37 mm (Figure 3, Appendix 2). The constant size indicates little growth was taking place during this time and juvenile chinook were emigrating shortly after emergence.

Other Salmonids. We captured 30,389 juvenile coho salmon and 4,708 juvenile steelhead this season. Juvenile coho salmon weekly average catch-per-night peaked in mid-April at 562 fish per trap. Juvenile steelhead catch was sporadic with a maximum weekly average catch-per-night of 370 fish per trap in late April (Appendix 2). Coho salmon young-of-the-year (YOY) were first noted on 19 March

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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.

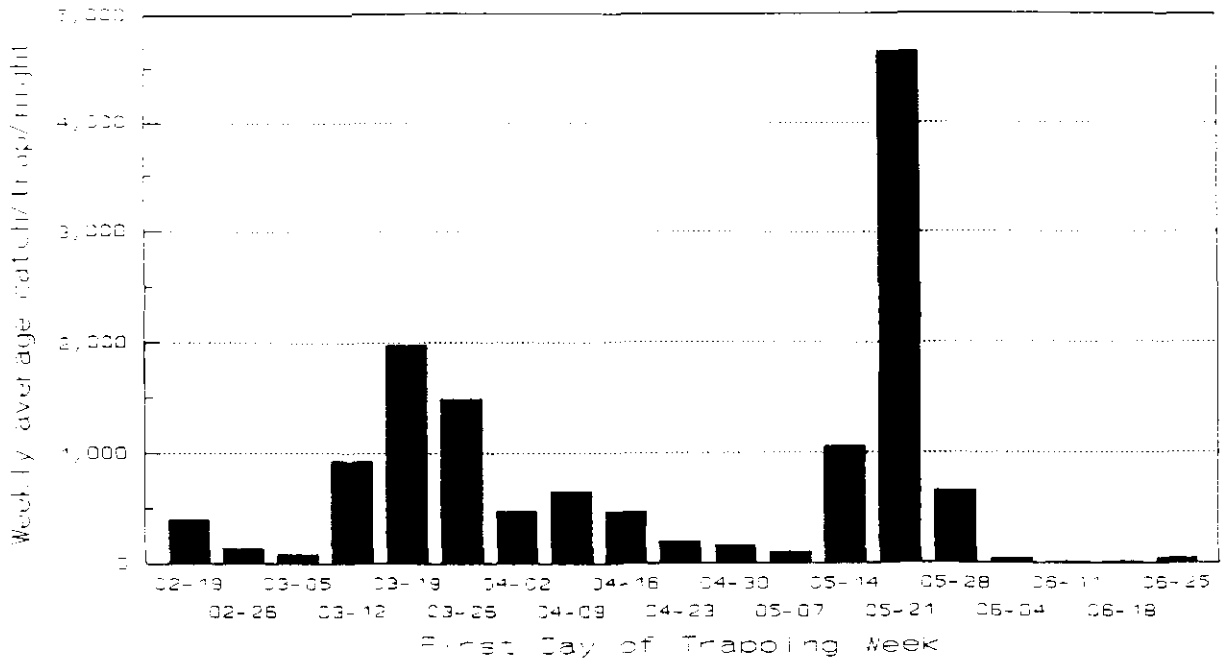

FIGURE 2 Weekly average catch per-trap per-night of juvenile chinook salmon at the Lewiston Site in the main-stem Trinity River during 1990.

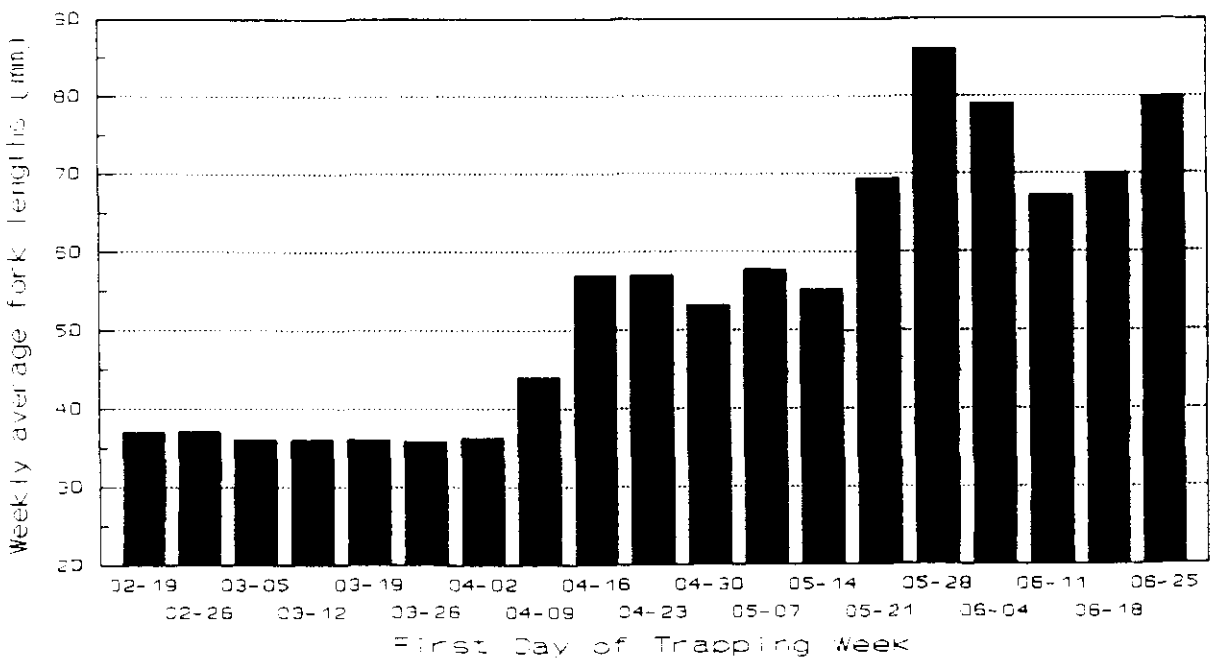

FIGURE 3. Weekly average fork lengths (mm) of juvenile chinook salmon trapped at the Lewiston Site in the main-stem Trinity River during 1990.

1990. Steelhead YOY were first captured 20 April 1990, prior to this only yearling and yearling-plus steelhead were observed.

Coded-wire Tagging

Tagging operations began 19 March and continued through 18 April 1990. Three coded-wire tag groups totaling 81,513 juvenile chinook were tagged and re-released at the Lewiston Site during this period. These fish ranged from 32 to 67 mm FL, averaging 37.2 mm FL.

Independent, non-overlapping estimates of tagging mortality, tag shedding, and poor Ad-clips based on the quality control groups were 2.6%, 14.2%, and 1.2%, respectively. Based on these estimates, we effectively coded-wire tagged and released 66,784 juvenile chinook from the Lewiston Site (Table 1).

TABLE 1. Juvenile chinook salmon coded-wire tagging summary for the main-stem Trinity river during 1990.

Tagging Site	CWT #	No. Tagged	No. that died	Tags shed	Poor Ad-clips	Effectively tagged
Lewiston	06-01-08-01-07	27,287	632	6,642	765	19,248
Lewiston	06-01-08-01-08	30,255	834	3,203	70	26,148
Lewiston	06-01-08-01-09	23,971	683	1,727	173	21,388
Sub-total		81,513	2,149	11,572	1,008	66,784
Indian Ck	06-01-08-01-10	30,207	7,026	2,137	276	20,768
Indian Ck	06-01-08-01-11	29,178	1,791	2,425	381	24,581
Sub-total		59,385	8,817	4,562	657	45,349
Grand total		140,898	10,966	16,134	1,665	112,133

Indian Creek Site

Trapping

Chinook Salmon. We captured 77,142 juvenile chinook at the Indian Creek Site this season. Weekly average catch-per-night peaked in mid-April at 2,225 fish per trap and again in mid-May at 3,203 fish per trap (Figure 4, Appendix 3). The first peak was composed exclusively of naturally produced fish while the second was composed of mostly TRH-produced fish, based on the presence of Ad-clipped fish and the timing of hatchery releases.

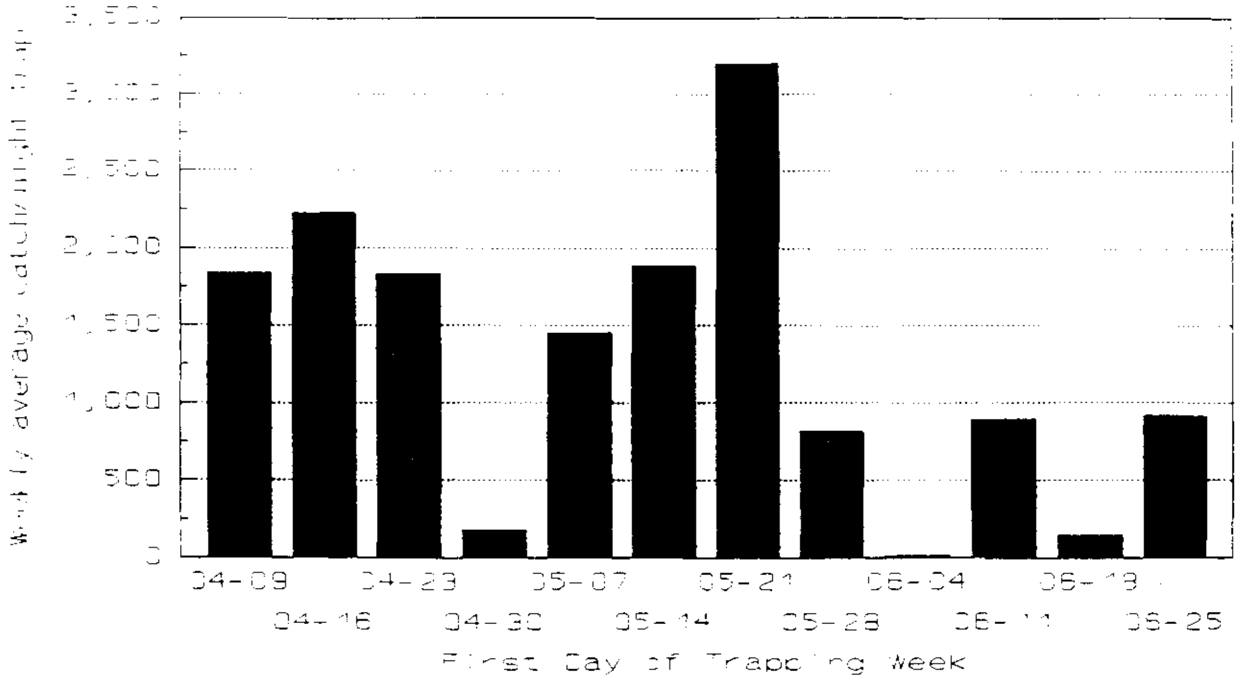

FIGURE 4. Weekly average catch per-trap per-night of juvenile chinook salmon at the Indian Creek Site in the main-stem Trinity River during 1990.

Weekly average FLs of chinook salmon ranged from 47.5 to 79.3 mm through the trapping season at this site (Figure 5, Appendix 3)

Other Salmonids. We captured 1,316 coho salmon and 1,456 steelhead this season. Weekly average catch per-trap per-night of coho salmon peaked in early May at 351 fish per trap. Steelhead catches were relatively low, ranging from 0 to 54 fish per-trap per-night (Appendix 3). Coho salmon YOY were observed from the first day of trapping on 9 April 1990. Steelhead YOY were first captured 1 May 1990, and only yearling and yearling-plus steelhead were seen prior to this.

Coded-wire tagging

Tagging operations began 18 April and continued through 3 May 1990. Two coded-wire tag groups totaling 59,385 juvenile chinook were tagged and released at the Indian Creek Site during this period. These fish ranged from 38 to 73 mm FL, averaging 54.6 mm FL.

Independent, non-overlapping estimates of tagging mortality, tag shedding, and poor Ad-clips based on the quality control groups were 14.8%, 7.7%, and 1.1%, respectively. Based on these estimates, we effectively coded-wire tagged and released 45,349 juvenile chinook at the Indian Creek Site (Table 1).

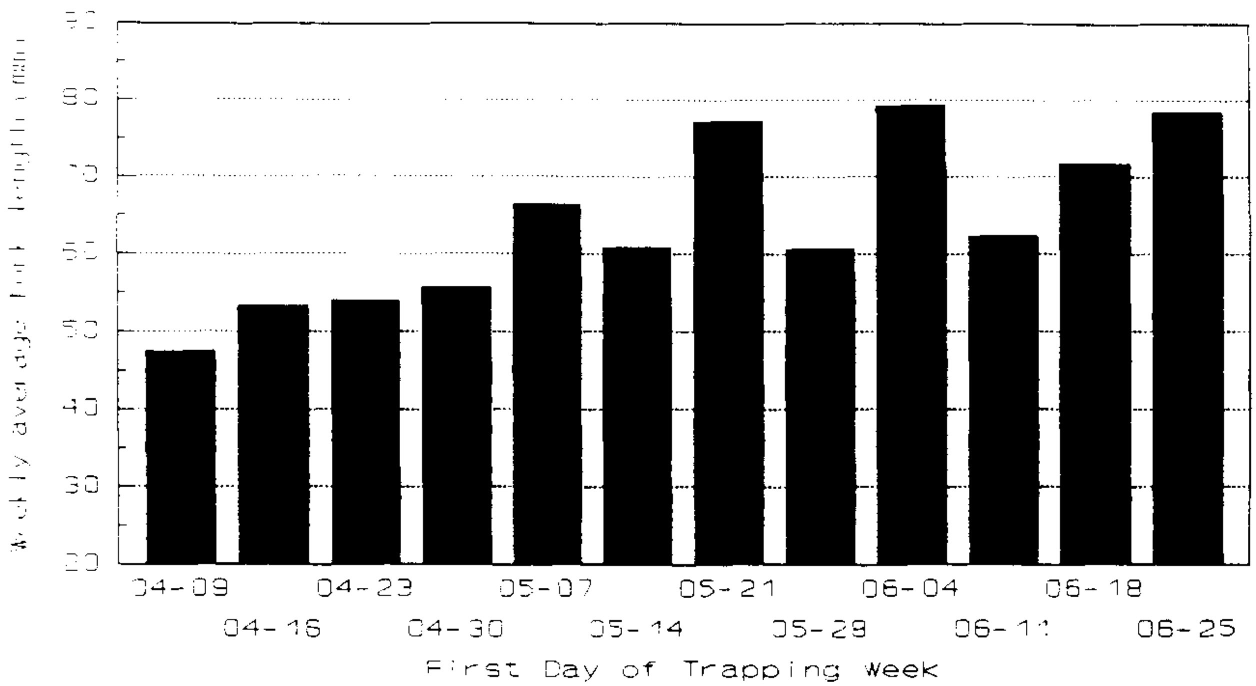

FIGURE 5. Weekly average fork lengths (mm) of juvenile chinook salmon trapped at the Indian Creek Site in the main-stem Trinity River during 1990.

DISCUSSION

Our trapping and coded-wire tagging operations successfully met the goal of tagging 100,000 naturally produced chinook this season.

The choice of trapping sites, with their relative immunity from stream flow fluctuations, was probably responsible for the success of this year's tagging program. Last year, in a similar effort, the trapping site was located downstream of several major tributaries at RKM 130. Spring storms made trapping at that site inefficient or impossible. As a result, only 24,874 chinook salmon were trapped during the 1988-89 season (Zuspan, 1991b).

The small size of fish encountered at the Lewiston Site may pose a potential problem for coded-wire tagging there. Nearly all the juvenile chinook tagged at that site were newly emergent fish averaging about 36 mm FL. This year, most juvenile chinook produced in this area of the river emigrated shortly after emergence. This is probably related to intense competition caused by the large number of fish produced in this small section of the Trinity River. The CDFG estimates that, in 1989, this upper 3.1 km of river accounted for 42.0% of the natural chinook spawning that took place in upper 64.3 km of the Trinity River below Lewiston Dam (Zuspan, 1992). Tagging fish at such a small size may adversely effect their survival. Also, these small, newly emergent fish will not yet have undergone as much naturally imposed mortality as larger, older emigrating fish. A comparison of the survival between the larger chinook tagged at the Indian Creek Site and those tagged at the Lewiston Site will be possible when these fish return as adults in two to five years (most will return in three years).

RECOMMENDATIONS

1. Job 2 activities should be continued in FY 1990-91.

2. Trapping locations used in FY 1989-1990 should be used again in FY 1990-1991.

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

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

a Eight Day week in each year which is divisible by 4.

b Eight day week every year.

Appendix 2. Summary of juvenile salmonid trapping in the Trinity River at the Lewiston Trapping Site, 19 February through 25 June 1990.

Julian week	Date begun	Trap nights a/	Chinook Number	Chinook Avg FL (mm)	Chinook CPUE b/	Coho Number	Coho CPUE b/	Seelhead Number	Seelhead CPUE b/
8	02/19	1	403	37.0	403	0	0	0	0
9	02/26	1	137	37.1	137	0	0	1	1
10	03/05	1	82	36.0	82	0	0	1	1
11	03/12	21	19,593	36.0	933	2,122	101	49	2
12	03/19	11	21,709	36.0	1,974	3,776	343	29	3
13	03/26	12	17,863	35.9	1,489	4,963	414	34	3
14	04/02	33	15,765	36.3	478	7,801	236	2,414	73
15	04/09	19	12,378	44.0	651	6,606	348	726	38
16	04/16	8	3,789	57.0	474	4,493	562	75	9
17	04/23	3	582	57.0	194	548	183	267	89
18	04/30	2	321	53.2	161	44	22	740	370
19	05/07	1	104	57.8	104	0	0	14	14
20	05/14	1	1,059	55.3	1,059	3	3	226	226
21	05/21	1	4,656	69.4	4,656	21	21	50	50
22	05/28	1	660	86.1	660	0	0	10	10
23	06/04	1	43	79.1	43	2	2	53	53
24	06/11	1	5	67.2	5	1	1	11	11
25	06/18	1	17	70.1	17	2	2	1	1
26	06/25	1	73	79.9	73	7	7	7	7
Totals:		120	99,239			30,389		4,708	

a/ Number of trap-nights allocated per week (ie. 2=2 traps/1 night or 1 trap/2 nights).

b/ Weekly average catch per-trap per-night.

Appendix 3. Summary of juvenile salmonid trapping in the Trinity River at the Indian Creek Trapping Site, 25 April through 25 June 1990.

Julian week	Date begun	Trap nights a/	Chinook Number	Chinook Avg FL (mm)	Chinook CPUE b/	Coho Number	Coho CPUE b/	Steelhead Number	Steelhead CPUE b/
17	04/23	17	31,147	54.0	1,832	299	18	618	36
18	04/30	3	546	55.7	182	0	0	93	31
19	05/07	2	2,914	66.4	1,457	701	351	92	46
20	05/14	1	1,883	60.8	1,883	1	1	47	47
21	05/21	2	6,405	77.2	3,203	1	1	50	25
22	05/28	1	817	60.6	817	3	3	1	1
23	06/04	1	15	79.3	15	0	0	0	0
24	06/11	1	894	62.3	894	0	0	0	0
25	06/18	1	149	71.7	149	0	0	2	2
26	06/25	1	917	78.5	917	0	0	1	1
Totals:		30	45,687			1,005		1,277	

a/ Number of trap-nights allocated per week (ie. 2=2 traps/1 night or 1 trap/2 nights).
b/ Weekly average catch per-trap per-night.

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CHAPTER III

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

by

Carrie E. Wilson and Terry J. Mills

ABSTRACT

The California Department of Fish and Game's Natural Stocks Assessment Project monitored adult steelhead (Oncorhynchus mykiss) migration at various weirs to determine an escapement estimate for adult steelhead into the South Fork Trinity River (SFTR) basin during the 1989-1990 season.

Based on the results of our creel survey, we estimate 1,473 anglers fished for adult steelhead within the SFTR basin during the 1989-90 season. We estimate they landed 110 adult, 41 half-pounder and 43 juvenile steelhead. The angler harvest rate, based on adult tag returns, was estimated to be 18%.

During the 1989-90 steelhead spawning season, we conducted adult spawning stock surveys on 22 streams tributary to the SFTR and to Hayfork Creek. These surveys covered 108.0 km, and we observed 26 adult steelhead and 365 redds.

We studied juvenile steelhead habitat utilization in Eltapom Creek, a tributary to the SFTR. We sampled cascade, pool, riffle, and run habitats, and determined the run and riffle areas to be the preferred habitat types.

We monitored juvenile steelhead emigration from the upper SFTR basin and the Hayfork Creek basin, capturing 738 juveniles in the SFTR, and 1,901 juveniles in Hayfork Creek. Peak emigration of Age 0+ steelhead occurred during May 1990, and peak emigration of Age 1+ steelhead occurred a month earlier during April 1990.

One hundred five sets of adult and 464 sets of juvenile steelhead scale samples were read and interpreted for indications of various life history characteristics.

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 parameters and seasonal juvenile steelhead standing crops.

INTRODUCTION

The life histories of steelhead (Oncorhynchus mykiss) populations within the South Fork Trinity River (SFTR) basin are of concern because little data are available regarding juvenile steelhead life history patterns, adult steelhead run sizes, spawner distributions, sport fishery yields and harvest rates. As a result of poor habitat management within the SFTR basin, the 1964 flood severely impacted the area causing spawning and rearing habitats within the basin to be severely damaged or, in some instances, lost through excessive siltation. A combination of human activities (such as road construction, timber harvest, and recreation) exacerbated by natural events (such as wildfire and flooding) continue to curtail steelhead production within the basin by degrading in-stream habitat quality. Restoration of salmon and steelhead habitat within the basin is a high priority of the Trinity River Basin Fish and Wildlife Task Force, the U. S. Forest Service ([USFS] Shasta-Trinity National Forest), and the California Department of Fish and Game (CDFG). These restoration efforts will be guided by knowledge of steelhead habitat requirements and life histories.

METHODS

Staff of the CDFG's Natural Stocks Assessment Project (NSAP) assessed adult steelhead run timing, distribution, and run size within the SFTR basin during the season through the following combination of methods: 1) tagging immigrant fish at two weirs, 2) a creel survey, 3) hook-and-line fishing, 4) electrofishing, 5) weirs and traps for emigrant fish, and 6) spawner surveys. Juvenile steelhead emigration timing and abundance were assessed through weekly trapping of out-migrant fish.

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 7-day periods, beginning 1 January, regardless of the day of the week on which 1 January falls. The extra day in leap years is lumped into the 9th week, and the last day of the year into the 52nd week (Appendix 1). This procedure allows inter-annual comparisons of similar 7-day periods.

Adult Steelhead Run Timing in the SFTR Basin

To assess the timing of the adult steelhead run into the SFTR basin, we trapped and tagged immigrant adult steelhead at two weir sites within the SFTR basin (Figure 1). The Sandy Bar Weir was located on the SFTR at river km (RKM) 2.4, and operated from 14 September through 23 October 1989. The Hyampom Valley Weir was located on Hayfork Creek at RKM 41.0, and operated from 18 October 1989 through 6 January 1990. At each site, Alaskan style weirs were constructed using a series of panels 3.2 m high and 3.0 m long set 2.4 m apart and joined together to block the entire river. Each panel contained 1.9-cm EMT[1/] conduit pickets set 2.9 cm apart (46 per panel), secured through three aluminum channel sections on the face of the weir. A cubic trap consisting of welded conduit panels was constructed in the river thalweg, with an entrance made by opening a portion of the weir and connecting the weir and trap with a fyke entrance.

Each steelhead captured was examined for: 1) fin clips, 2) tags, 3) gill net scars (nicks in the leading edges of dorsal and pectoral fins, sometimes combined with vertical white scars on the head), 4) hook scars (of ocean origin when healed, of freshwater origin when not healed), 5) predator scars (inverted 'V' shaped marks, usually on the underbody), and 6) other scars of unknown origin. Each steelhead was measured to the nearest cm fork length (FL), and its sex recorded. A scale sample was removed from the left side of each weir-caught fish, in an area slightly posterior to the anterior insertion of the dorsal fin, just above the lateral line. Each scale sample was placed between waterproof paper within a coin envelope and labeled with collection date, collection site, method of collection, sex, and FL (cm) of the fish.

All fish captured at the Sandy Bar and Hyampom Valley weirs were marked with a 1/2 left ventral (LV) fin clip. Every third

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1/ electrical metallic tubing.

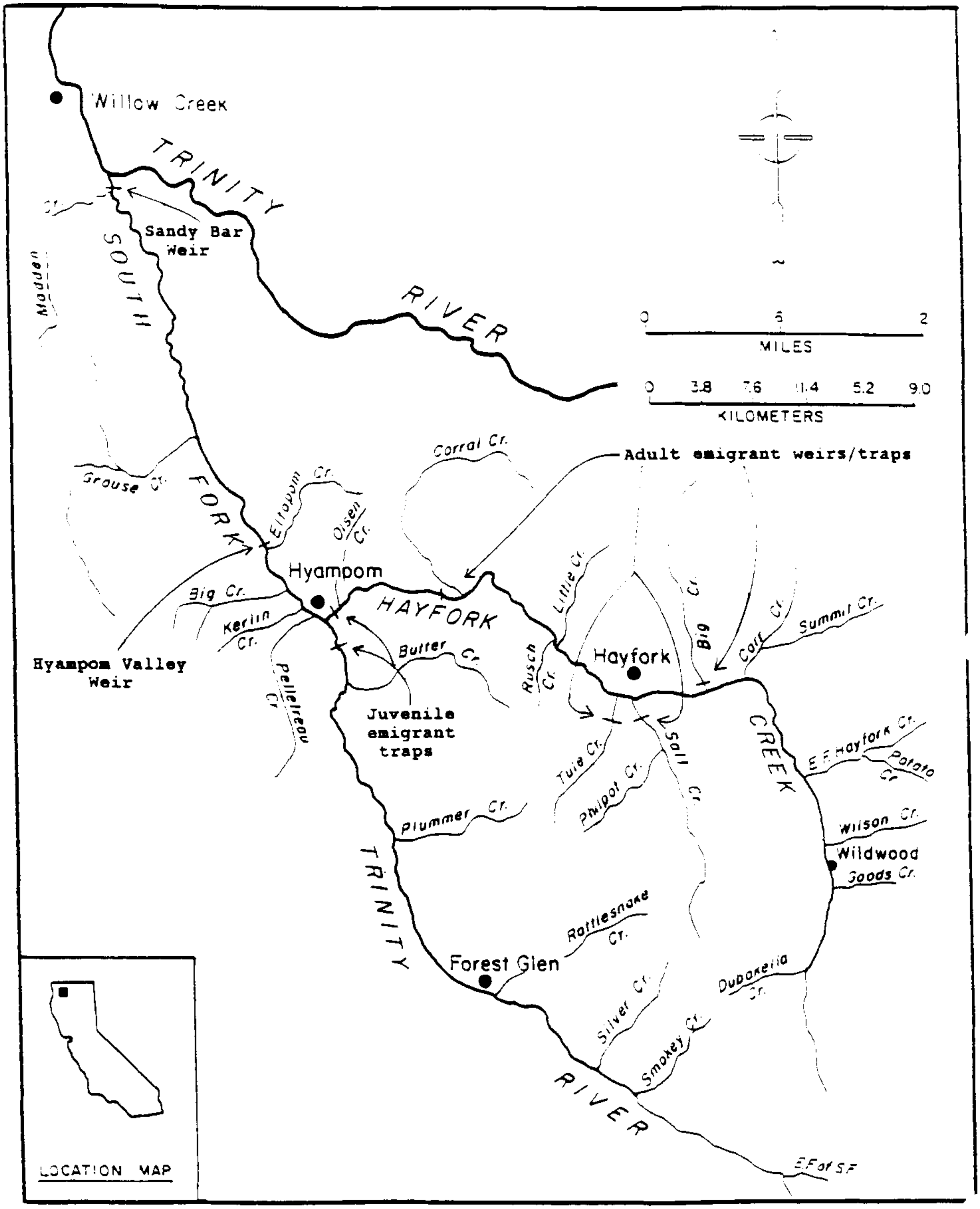

Figure 1. Locations of weirs and traps used to capture immigrant adult steelhead and emigrant adult and juvenile steelhead in the South Fork Trinity River basin during the 1989-90 season.

taggable fish received a discretely numbered $10-reward anchor tag. We did not tag fish which were excessively stressed by the weir capture and handling process, or those which appeared in generally poor physical condition, to avoid excessive tagging mortality. Angler harvest rates were estimated from reward tag returns. The tags and clips were applied with the intention of computing a Petersen population estimate (Ricker, 1975) based on the ratio of tagged to untagged fish observed in later recovery projects (creel census, electrofishing, hook-and-line fishing, weirs and traps for emigrant fish).

South Fork Trinity River Creel Survey

Angler harvest of steelhead within the basin was determined from a systematic stratified creel survey, conducted from 31 October 1989 through 1 April 1990. The creel survey was conducted in two subsections of the lower SFTR basin (Figure 2). The lower survey area extended from the confluence of the SFTR with the main-stem Trinity River upstream for a distance of 22.5 km. The upper, Hyampom, survey area extended through the Hyampom Valley from river km 33.0 to river km 50.7. These two creel survey areas cover the river reaches fished by the majority of anglers, as public access is limited outside of these two areas due to the lack of public roads. Angler access sites in each creel survey area were identified prior to the survey period. The creel survey was further stratified by JW (Appendix 1), day (weekend/weekday), and time periods (am/pm: dawn to noon and noon to dusk, respectively). We extrapolated data for each stratum that was not surveyed by using average values for strata from equivalent sampling periods (ie., for a missing weekday evening survey: the mean of all weekday pm's in that JW). Estimated and actual data were combined for season totals.

During the creel survey, clerks followed a set route based on a predetermined schedule, and examined each access site for anglers. Anglers observed fishing during the survey periods were contacted and interviewed for hours fished that day, success, angling method, and county or state of residence. Sport-caught steelhead we observed were measured (cm FL), and examined for fin clips and external tags. The numbers of any tag observed were recorded, the fish's sex determined, and its spawning condition noted. Scale samples were taken from creeled fish in the same manner as for fish from the Sandy Bar Weir. We classified steelhead < 25 cm (FL) as juveniles, ≥ 25 cm and < 35 cm as half-pounders, and ≥ 35 cm as adults (Kesner and Barnhart, 1972). Water clarity was measured each day with a secchi disk.

Tag Return and Steelhead Harvest Rates

We estimated sport harvest rate from the percent of $10-reward tags returned by anglers, based on the following assumptions: 1) a 100% response rate by anglers, 2) that all tagged fish caught

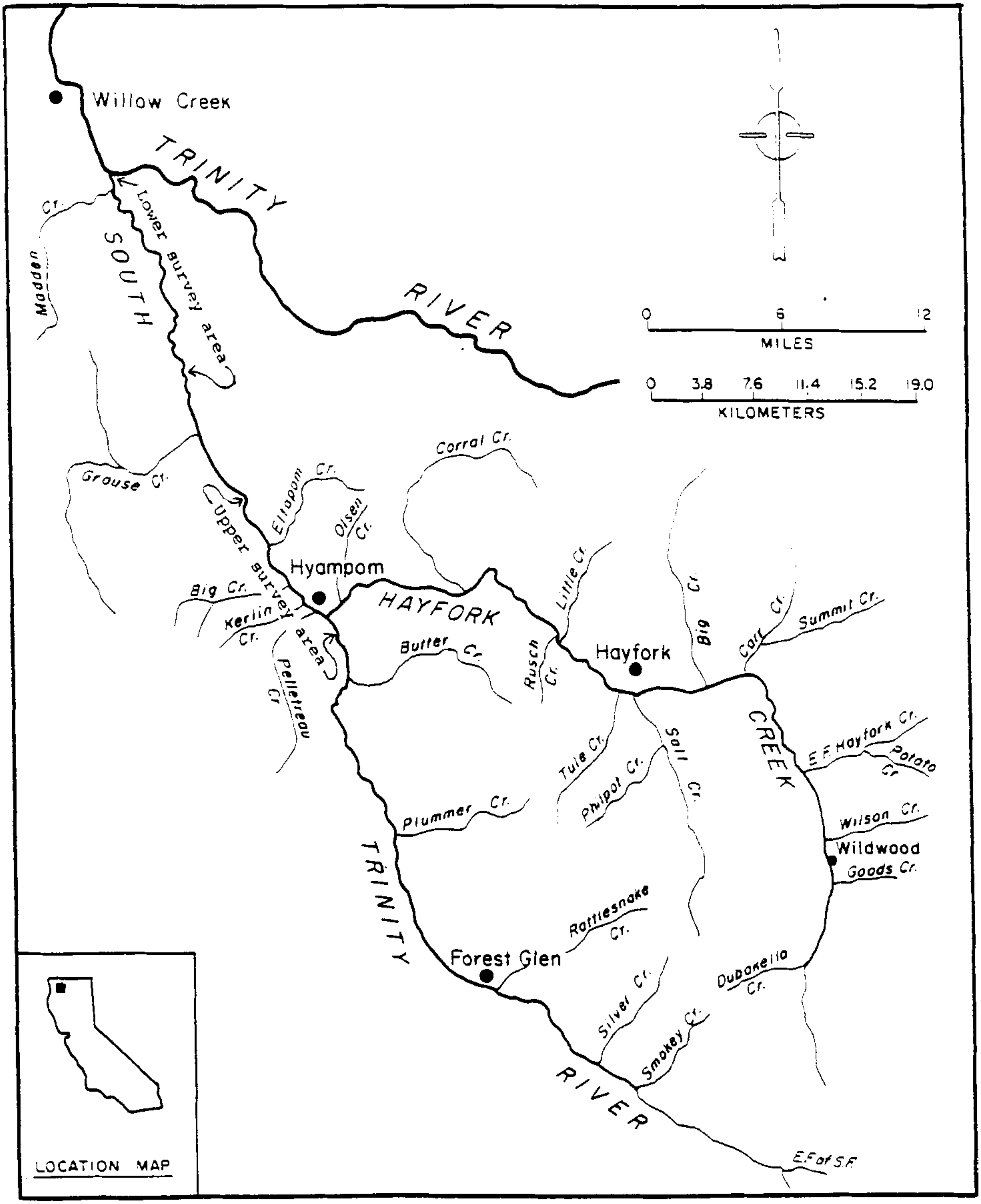

Figure 2. Locations of the two creel survey areas in the South Fork Trinity River basin surveyed during the 1989-90 season.

in the sport fishery were recognized as such by anglers, 3) no tags were shed, and 4) there was no differential mortality between tagged and untagged fish. Tag return rate was determined from the number of tags observed during the creel census divided by the number of observed tags returned. The estimated harvest rate of adult steelhead within the SFTR basin was determined from the number of reward tags returned by anglers divided by the number of tags applied at the weirs.

Adult Steelhead Recovery

Electrofishing and Spawner Surveys

Project personnel conducted surveys, on foot, of tributary streams to the SFTR and Hayfork Creek to document steelhead spawner distribution and tributary entry timing. The surveys were conducted from 19 December 1989 through 19 April 1990. The areas surveyed included: 1) tributaries to the SFTR and to Hayfork Creek in the Hyampom Valley area, 2) tributaries to the SFTR in the upper SFTR basin near the town of Forest Glen, and 3) tributaries to Hayfork Creek near the town of Hayfork and in the upper Hayfork Creek drainage near the town of Wildwood (Figure 1). Specific creeks to be surveyed were selected to include those which historically attracted spawning steelhead, and to replicate areas examined last year (Mills and Wilson 1991) and in previous CDFG surveys (Miller 1975; Rogers 1972, 1973).

During each survey, two people walked designated stream reaches carrying field notebooks to record observed spawning behavior, individual redd number with location, redd site descriptions, and stream conditions. Redds were flagged with surveyors tape attached to nearby structures (such as root-wads, shrubs, or bushes) with the survey date and field notebook description number recorded on the tape. Initially, we also used backpack electrofishers as part of our adult recovery plan to recapture weir-tagged steelhead. Captured fish were measured (cm FL), and examined for tags and marks, then a scale sample was taken and the fish released.

Weirs, Traps and Hook-and-line Fishing

Traps and weirs were assembled on lower Hayfork Creek and on three tributaries to Hayfork Creek (Big Creek, Salt Creek and Tule Creek) to capture post-spawning steelhead emigrating from the basin. We constructed an Alaskan-style weir on Hayfork Creek and constructed weir panel traps on the tributaries. The weir panels were 1.2 m high x 1.5 m wide, and constructed of 1.9-cm EMT conduit with 3.2 cm horizontal bar spacing. The trap size varied with location. All steelhead recovered were measured (cm FL), given a left opercle punch, checked for spawning condition, tags, fin clips, or marks, then a scale sample was taken and the fish released.

Project personnel also used sport fishing equipment to recover adult steelhead via hook and line. All steelhead recovered were processed as stated above.

SFTR Adult Steelhead Escapement Estimate

We attempted to make an escapement estimate using the Petersen method of mark and recapture (Ricker 1975) by marking adult steelhead at the Sandy Bar and Hyampom Valley weirs and recovering them through: 1) traps and weirs for emigrating fish, 2) creel surveys, 3) electrofishing, and 4) hook-and-line fishing.

Juvenile Steelhead Emigration Studies

We monitored juvenile steelhead emigration patterns by systematically trapping at two sites within the SFTR basin; Lower Hayfork Creek, 305 m upstream of its confluence with the SFTR, and in the SFTR upstream of its confluence with Hayfork Creek, within 0.4 km either side of Hyampom Road bridge (Figure 1). Juvenile steelhead were captured using fyke nets attached to trap boxes. The nets were constructed of 1.3-cm nylon mesh, had a 1.8-m x 2.4-m upstream opening and extended 10.1 m to a trap attachment frame at the terminal end. Trap boxes were constructed of marine plywood and hardware cloth, and measured 0.8 m x 1.2 m at the opening and were 0.5 m deep. One or two fyke-net traps were placed in the river or stream overnight, for 16 to 24 hour periods, and examined the following morning.

Captured fish were identified to species and enumerated. Systematic subsamples of 50 individuals, maximum, of each species were measured for FL (mm), and scale samples were systematically taken from a maximum of 10 juvenile steelhead, each sampling day. In each case, respectively, this consisted of the first 50 or 10 individuals removed from the traps each day. Flows through the net were measured and total volume of stream flows were estimated to the nearest 0.3 m/sec using either a pygmy meter or a Marsh-McBirney[2/] flow meter. Water temperatures were monitored using hand-held thermometers or digital recording thermographs. When flow conditions permitted, we trapped on a weekly basis throughout most of the year, but increased trapping frequency to every third night during the spring period of peak juvenile steelhead emergence (17 April to 30 June 1990).

2/ The use of brand names is for identification purposes only, and does not imply the endorsement of any product by the California Department of Fish and Game.

Habitat Use by Juvenile Steelhead

We studied seasonal habitat use by juvenile steelhead in Eltapom Creek (Figure 1). The creek had been surveyed previously and divided into 101 habitat units categorized into four basic habitat types: cascades, pools, riffles and runs (Glase and Barnhart 1989). We used the same habitat unit designations, added two more units, and sampled 52 of the 103 habitat units. Initially, we sampled the first 20 habitat units, beginning at the confluence with the SFTR and working upstream. Later, to reduce sampling effort, we randomly selected 32 of the remaining 83 units, in proportion to the relative numeric abundance of each of the four basic habitat types.

Sample units were isolated using block nets to prevent any immigration or emigration of fish, and then electrofished using either the two-step or the Zippin methods of removal-depletion for population assessment (Hankin 1986, Price 1982). All captured steelhead were counted, measured (mm FL), sampled for scales (first 5 fish per habitat unit), and then released. We took photos of each habitat unit we sampled. We recorded air and water temperatures, and water velocities (to the nearest 0.031 m/sec) for each of the 101 habitat units. Water velocities were measured at 60% of the total depth from the surface along a line transverse to the flow at points 1/4, 1/2, and 3/4 of the way across the stream. Stream length and width were measured to the nearest 0.03 m in each habitat unit.

Steelhead Life History Patterns

Steelhead life history patterns were described from intensive analysis of scales taken from both adult and juvenile fish. Adult steelhead scale samples had been collected from 1981 through 1984 by CDFG personnel who conducted reconnaissance level creel surveys within the SFTR basin, and by CDFG personnel operating the Sandy Bar Weir on the lower SFTR from 1984 through 1989. Additional scales were collected this year through the SFTR creel survey, electrofishing, adult emigrant weirs, and juvenile out-migrant trapping. All scales collected in the field were taken to the lab for processing. Each adult scale sample was cleaned, dried, then mounted between two glass microscope slides. Scale samples from juvenile steelhead did not usually require cleaning. The cleaning process involved soaking scales in distilled water to soften them. Softened scales were rubbed between thumb and forefinger to remove debris. If debris persisted, scales were soaked in a 5% detergent solution made up with distilled water, and then rubbed again as mentioned previously. Softened tissue and debris that continued to adhere to scales after these cleaning processes was peeled off using blunt tipped forceps.

Steelhead scales were examined to determine age, reproductive history, and freshwater life history. Adult steelhead scale samples were read using a microfiche reader with 43 power magnification. Years of freshwater residence, age at ocean entry, and number of ocean annuli, half-pounder checks, and spawning checks were all recorded. Scale measurements were taken to the nearest mm along a line approximately 15 degrees offset from the anterior-posterior axis. Freshwater and ocean growth were distinguished by the close spacing of circuli during the freshwater phase, becoming widely spaced upon ocean entry as growth rate increased. Annuli were determined by the cutting or crossing-over of circuli, incompleteness of circuli, and narrowing of the distance between circuli. A year of growth was considered to be the time from the formation of the last circulus of an annulus to the formation of the last circulus of the succeeding annulus. Circuli between annuli were counted and measured relative to the entire scale length. Scales were examined for half-pounder checks and for spawning checks present at annuli. Spawning checks are apparent when scales display overlapping circuli and areas of moderate to heavy lateral and anterior scale resorption. Small amounts of resorption often occur in the anterior portion of the scale but do not necessarily represent a spawning check. Half-pounder checks are characterized by a zone of closely spaced circuli relatively close to the circuli that distinguished ocean entry, indicating only a short period of time was spent in the ocean prior to re-entering freshwater. Half-pounder checks resemble a spawning check but lack the dense circuli overlap and accompanying resorption of scale edges seen on spawning checks (Hopelain 1987).

We have found the first two years of growth patterns on adult scales hard to interpret. Thus, emphasis was placed on a more intensive study of juvenile scales in order to better understand the patterns of scale development and growth associated with the early life history phase of juvenile fish. This will greatly assist in the interpretation of adult scales. Juvenile steelhead scale samples were read using the Optical Pattern Recognition System (OPRS). The OPRS method digitizes, measures, and records distances for each freshwater circuli on each scale examined. Statistical and graphic software was then used to analyze and provide graphic hard copy of the summarized scale data.

RESULTS AND DISCUSSION

Adult Steelhead Run Timing in the SFTR Basin

We operated two weirs within the SFTR basin during the 1989-90 season, which captured 135 adult steelhead. The Sandy Bar Weir was operated from 14 September through 23 October 1989, trapping 37 adult steelhead (Figure 3). We tagged 18 of these 37 fish

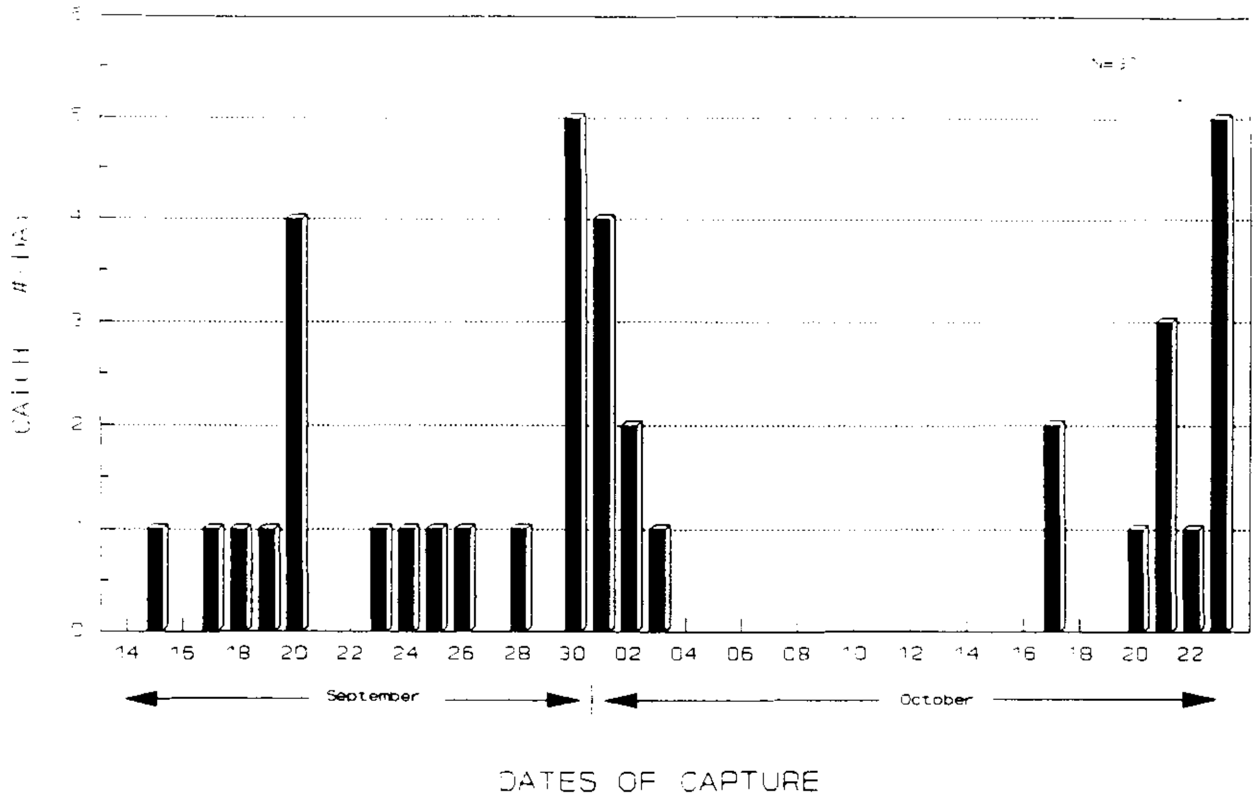

Figure 3. Daily catches of immigrant adult steelhead at the Sandy Bar Weir in the South Fork Trinity River from 14 September through 23 October 1989.

with $10-reward anchor tags and gave all of them a 1/2-LV fin clip. The Hyampom Valley Weir was operated from 18 October 1989 through 6 January 1990, trapping 101 adult steelhead (Figure 4). We tagged 32 of these with $10-reward anchor tags, five carried tags previously applied at the Sandy Bar or Willow Creek weirs, and one had a 1/2-LV fin clip from the Sandy Bar Weir. The remaining 63 steelhead received a 1/2-LV fin clip. Mean FL of the 135 steelhead we examined was 60.2 cm (Figure 5). Predator scars were the most common (45.2%) scar type seen on steelhead trapped at the weirs (Table 1). Three steelhead tagged by CDFG personnel at the Willow Creek Weir (RKM 29.1) on the main-stem Trinity River in 1989 were recaptured 43.3 river km upstream at the Hyampom Valley Weir on the SFTR, then re-released. No Willow Creek Weir-tagged steelhead were recorded at the Sandy Bar Weir. Travel times between the weirs for the three fish ranged from 32 to 84 days (d), averaging 60 d. Three steelhead marked at the Sandy Bar Weir (2 tagged, 1 fin-clipped) were recaptured 38.6 km upstream at the Hyampom Valley Weir.

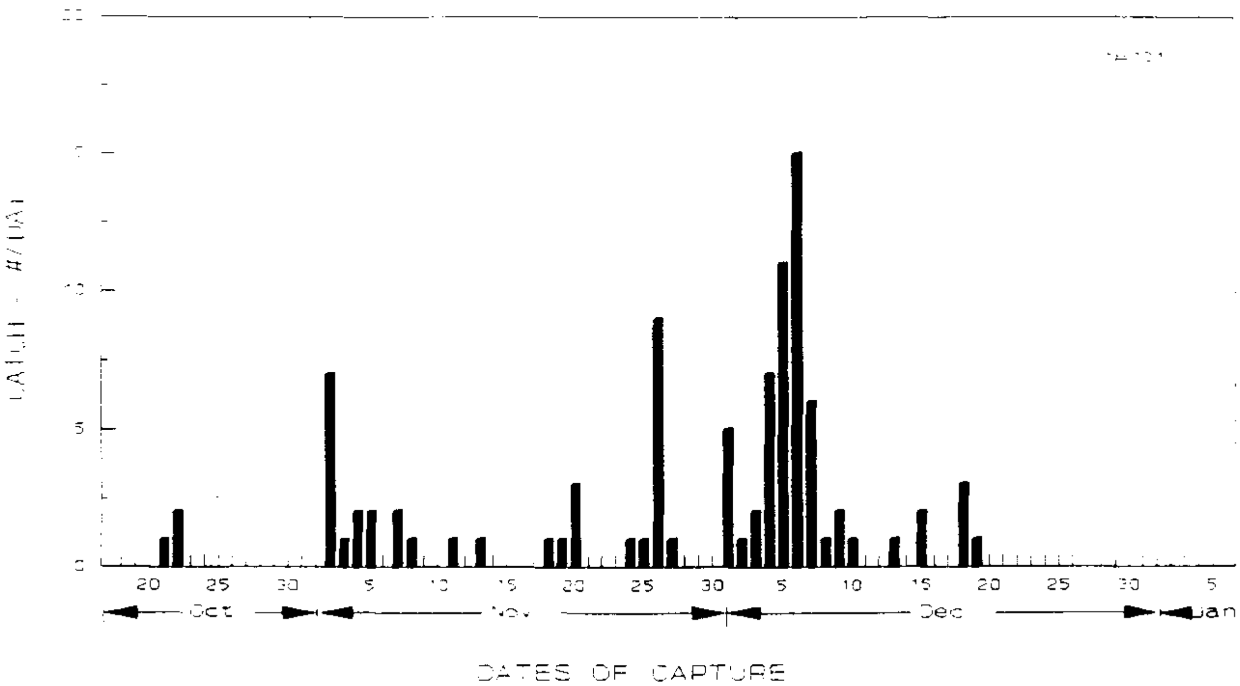

Figure 4. Daily catches of immigrant adult steelhead at the Hyampom Valley Weir in the South Fork Trinity River from 18 October 1989 through 6 January 1990.

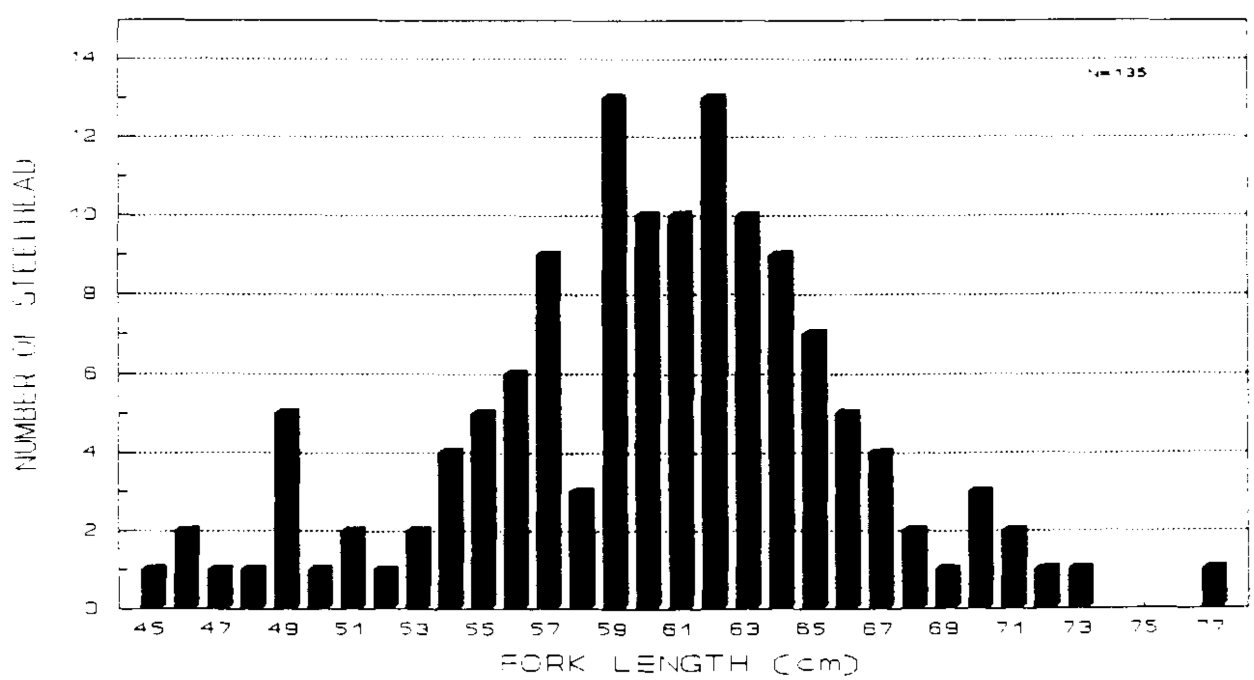

Figure 5. Length frequency distribution of immigrant adult steelhead captured at the Sandy Bar and Hyampom Valley weirs from 14 September 1989 through 6 January 1990.

TABLE 1. Scars and injuries observed on adult steelhead captured at the Sandy Bar and Hyampom Valley weirs in the South Fork Trinity River during the 1989-90 season.

Scar or Injury	Number of fish	Percent of fish	Percent of fish captured
Gill net scars	8	25.8	5.9
Freshwater hook scars	4	12.9	3.0
Ocean water hook scars	0	0.0	0.0
Predator scars	14	45.2	10.4
Unknown origin scars	5	16.1	3.7
Totals	31	100	23.0

Travel times for the two tagged fish were 19 and 31 d, averaging 25 d. The first steelhead of the season was trapped on 17 September 1990 at the Sandy Bar Weir.

South Fork Trinity River Creel Survey

The creel survey was conducted on the SFTR between 31 October 1989 and 1 April 1990, an interval of 153 d. The lower survey section (Figure 2) was monitored for angler activity on 153 d and a creel survey conducted on 83 d of this period. The upper survey section was monitored for 149 d and a creel survey conducted on 99 d of this period. The river in the lower survey section was determined to be "unfishable", based on flow or turbidity observations, for one (1.2%) of the days it was surveyed and the upper section for three (3.0%) of the days it was surveyed.

During the survey period, 286 anglers were interviewed, 60 (21.0%) within the lower section and 226 (79.0%) within the upper section. Peak angling activity (19.5%) was observed within the upper survey section in the lower Hyampom Valley near Big Slide Campground, with the rest of the anglers' effort distributed over a range of other sites (Table 2). Twenty-two adult steelhead were observed in the catch; three in the lower, and 19 in the upper survey section. Ten half-pounder steelhead were also observed; three in the lower, and seven in the upper survey section. Based on extrapolations of the creel survey data, an estimated 419 anglers within the lower section landed 26 adult, 15 half-pounder and 6 juvenile steelhead (Table 3) while an estimated 1,054 anglers in the upper section landed 84 adult,

TABLE 2. Distribution of angler use among the various access sites surveyed in the creel survey of the South Fork Trinity River basin during the 1989-90 season.

Location	River		Angler	
	Km	Mile	Number	Percent
Sandy Bar	1.6	1.0	19	6.3
Madden Creek/Sandy Bar	2.1	1.3	28	9.3
Holmes Farm/Bridge	13.2	8.2	3	1.0
Todd Ranch	18.8	11.7	10	3.3
Surprise Creek Area	22.2	13.8	0	0.0
Swinging Bridge (Gates Rd.)	32.7	20.3	12	4.0
Big Slide Campground	40.2	25.0	59	19.0
Eltapom Creek Area	40.9	25.4	10	3.3
Upper Slide Creek Access	41.0	25.5	4	1.3
Salmon Rock Area	41.7	25.9	6	2.0
Little Rock Campground	42.0	26.1	20	6.6
Mortensen Property	42.6	26.5	9	3.0
Saw Mill Site	43.4	27.0	2	0.7
Way Property	45.1	28.0	4	1.3
Hyampom Airstrip	46.0	28.6	32	10.6
Pelletreau Creek Mouth	46.3	28.8	2	0.7
Old Bridge Site	47.3	29.4	7	2.3
Church Access	47.9	29.8	19	6.3
County Maintenance Yard	48.3	30.0	21	7.0
Hayfork Creek Mouth	48.8	30.3	25	8.3
All Other Areas	--	--	10	3.3
Totals			302	100.0

26 half-pounder and 37 juvenile steelhead (Table 4). Four marked steelhead were observed in the catch. Three had been tagged at the Hyampom Valley Weir, and one had a 1/2-LV fin clip indicating it was marked at either the Sandy Bar or Hyampom Valley weirs. The three tagged fish were captured 0, 1, and 6 d, respectively,

Table 3. South Fork Trinity River creel survey data, and angler use and steelhead harvest estimates for the lower survey section during the 1989–90 season.

Lower Section

Dates	Julian week	Angler numbers Observed	Angler numbers Estimated	Angler hours Observed	Angler hours Estimated	Steelhead harvest: Adults a/ Observed	Adults a/ Estimated	Half-pounders b/ Observed	Half-pounders b/ Estimated	Juveniles c/ Observed	Juveniles c/ Estimated
10/29 – 11/04	44	6	60	5.0	49.0	1	11	0	0	0	0
11/05 – 11/11	45	5	21	4.5	19.0	0	0	0	0	0	0
11/12 – 11/18	46	3	21	3.0	21.0	0	0	0	0	0	0
11/19 – 11/25	47	6	65	3.0	32.5	1	11	0	0	0	0
11/26 – 12/02	48	1	5	0.5	2.5	0	0	0	0	0	0
12/03 – 12/09	49	4	25	4.0	22.5	0	0	2	10	0	0
12/10 – 12/16	50	3	20	1.5	10.0	0	0	0	0	0	0
12/17 – 12/23	51	4	36	2.5	22.5	0	0	0	0	0	0
12/24 – 12/31	52	3	21	1.5	10.5	0	0	0	0	0	0
01/01 – 01/07	1	1	13	0.5	6.0	0	0	0	0	0	0
01/08 – 01/14	2	0	0	0.0	0.0	0	0	0	0	0	0
01/15 – 01/21	3	4	7	10.0	6.5	0	0	0	0	0	0
01/22 – 01/28	4	2	24	3.0	35.5	0	0	0	0	0	0
01/29 – 02/04	5	0	0	0.0	0.0	0	0	0	0	0	0
02/05 – 02/11	6	1	4	0.5	2.0	0	0	0	0	0	0
02/12 – 02/18	7	2	10	3.0	15.0	0	0	0	0	0	0
02/19 – 02/25	8	6	38	11.0	56.0	0	0	0	0	0	0
02/26 – 03/04	9	1	6	1.0	6.0	0	0	0	0	1	6
03/05 – 03/11	10	0	0	0.0	0.0	0	0	0	0	0	0
03/12 – 03/18	11	0	0	0.0	0.0	0	0	0	0	0	0
03/19 – 03/25	12	3	19	10.0	43.0	1	3	0	0	0	0
03/26 – 04/01	13	5	27	4.0	21.5	0	0	1	5	0	0
	Totals	60	419	68.5	381.0	3	26	3	15	1	6

a/. Adult steelhead ≥ 35 cm, FL.
b/. Half-pounder steelhead ≥ 25 cm and < 35 cm, FL.
c/. Juvenile steelhead < 25 cm, FL.

Table 4. South Fork Trinity River creel survey data, and angler use and steelhead harvest estimates for the upper survey section during the 1989–90 season.

Upper Section

Dates	Julian week	Angler numbers		Angler hours		Steelhead harvest: Adults a/		Steelhead harvest: Half–pounders b/		Steelhead harvest: Juveniles c/	
		Observed	Estimated	Observed	Estimated	Observed	Estimated	Observed	Estimated	Observed	Estimated
11/05 – 11/11	45	16	55	21.5	76.5	0	0	1	2	0	0
11/12 – 11/18	46	9	68	12.0	99.5	1	9	1	9	4	35
11/19 – 11/25	47	17	45	20.5	53.0	1	3	0	0	0	0
11/26 – 12/02	48	20	43	26.5	63.5	5	12	2	4	1	2
12/03 – 12/09	49	21	91	29.5	91.5	6	40	0	0	0	0
12/10 – 12/16	50	11	33	14.5	46.5	2	5	0	0	0	0
12/17 – 12/23	51	7	39	8.5	57.0	0	0	0	0	0	0
12/24 – 12/31	52	5	23	3.0	13.5	0	0	0	0	0	0
01/01 – 01/07	1	2	9	1.5	7.0	0	0	0	0	0	0
01/08 – 01/14	2	6	39	4.0	27.0	0	0	0	0	0	0
01/15 – 01/21	3	27	109	25.0	101.5	0	0	0	0	0	0
01/22 – 01/28	4	7	25	6.0	21.5	1	3	0	0	0	0
01/29 – 02/04	5	12	85	8.0	60.0	0	0	0	0	0	0
02/05 – 02/11	6	8	40	8.5	42.0	0	0	0	0	0	0
02/12 – 02/18	7	6	24	8.5	33.5	1	4	0	0	0	0
02/19 – 02/25	8	16	76	32.5	93.5	1	2	0	0	0	0
02/26 – 03/04	9	7	56	6.5	53.0	0	0	0	0	0	0
03/05 – 03/11	10	10	64	21.5	118.0	0	0	0	0	0	0
03/12 – 03/18	11	5	28	6.5	36.5	1	6	0	0	0	0
03/19 – 03/25	12	3	30	4.0	42.0	0	0	0	0	0	0
03/26 – 04/01	13	2	11	1.0	5.5	0	0	0	0	0	0
	Totals	226	1,054	277.5	1,196.5	19	84	7	26	5	37

a/. Adult steelhead ≥ 35 cm, FL.
b/. Half–pounder steelhead ≥ 25 cm and < 35 cm, FL.
c/. Juvenile steelhead < 25 cm, FL.

from the date of tagging. County of origin was tabulated for 292 anglers. The majority (89.0%) of the anglers fishing within the SFTR basin were from Trinity and Humboldt counties (Table 5).

Excluding the unfishable days, water clarity ranged from 15 to 200+ cm in the lower survey section and from 35 to 150+ cm in the upper section. Water temperatures ranged between 4 to 12 °C, and averaged 6 °C in the lower survey section. Temperatures in the upper survey section ranged between 2 to 14 °C, and averaged 7 °C.

Tag Returns and Steelhead Harvest Rates

We observed three Project-applied tags during the creel census, all of which were ultimately returned to CDFG by the anglers. Based on this, we made the assumption that all tags in the possession of anglers during the 1989-90 season were returned, making the tag return rate 100%. The estimated harvest rate of 18% for adult steelhead (95% Poisson confidence interval [C.I.]: 8% to 34%) was determined by dividing the number of tags returned by anglers (9), by the number of reward tags applied (50).

Spawner Surveys and Adult Steelhead Recovery by Electrofishing

We conducted walking surveys of 22 creeks (108.0 km total length) throughout the SFTR basin between 19 December 1989 and 19 April 1990 to document numbers and locations of spawning steelhead (Table 6), and to recover adult steelhead by electrofishing (Table 7). We counted and flagged 365 redds, observed 20 adult steelhead, and captured six other adult steelhead through electrofishing. No marked fish were observed. Redd numbers were low in all tributaries while water temperatures remained low (2-6 °C). Beginning 19-25 March (JW 12), water temperatures warmed (7-10 °C) and spawning fish and fresh redds were sighted almost immediately, thereafter.

Hyampom Valley Area

We surveyed four tributaries to the SFTR and one to Hayfork Creek, all within the Hyampom Valley, between 25 January and 14 April 1990. These surveys covered a total of 10.1 river km, and we observed 65 redds and two live adult steelhead (Tables 6 and 7).

Big Creek. Big Creek, a small tributary to the SFTR (river km 42.8), is located approximately 5.6 km downstream from the town of Hyampom. A natural barrier of cascades exists approximately 0.8 km upstream from the confluence and a hydropower plant is located adjacent to the creek about 30.5 m below the cascades. The creek was surveyed on 8 and 9 March 1990 from the confluence to the barrier. The stream bed contains numerous pools and large

TABLE 5. County of residence for anglers interviewed within the South Fork Trinity River basin during the 1989-90 creel survey.

County of origin	Number	Percent
Contra Costa	2	0.7
Fresno	3	1.0
Humboldt	41	14.0
Kern	2	0.7
Los Angeles	1	0.3
Madera	1	0.3
Nevada	2	0.7
Shasta	13	4.5
Solano	2	0.7
Sonoma	4	1.4
Trinity	219	75.0
Yuba	1	0.3
Out-of-State	1	0.3
Totals	292	100.0

boulders but is lacking in suitable spawning gravels to support much active spawning activity. The only spawning area available is found in the gravels in front of the culvert exiting the powerhouse. One redd was observed there.

Butter Creek. Butter Creek, a tributary to the SFTR (river km 54.2), is located approximately 3.2 km south of the town of Hyampom. This creek contains areas of extreme bank sloughing in the lower 0.4-km section due to early logging activities exacerbated by the floods of 1964 and 1986. However, most of the creek upstream of this area contains large holding pools and some areas of suitable spawning habitat. Butter Creek Falls exists 2.4 km from the confluence creating a natural barrier to anadromous fish passage. We surveyed the lower 2.4 km of the creek on 9 April 1990 and counted 44 steelhead redds.

Eltapom Creek. Eltapom Creek, a tributary to the SFTR (river km 40.9), is located 8.0 km north of the town of Hyampom and flows through a narrow canyon consisting of steep rock and oak

Table 6. Steelhead spawner survey data for the South Fork Trinity River basin from 8 March through 19 April 1990.

Location	Survey dates first	Survey dates last	Number of surveys	Length surveyed km	Length surveyed miles	New redds observed	Redds observed per km	Redds observed per mile	Live steelhead observed
Hyampom Area									
Big Creek	Mar 08	- -	1	0.8	0.5	1	1.2	2.0	0
Butter Creek	Apr 09	- -	1	2.4	1.5	44	18.2	29.3	0
Eltapom Creek	Apr 10	- -	1	1.3	0.8	18	14.0	22.5	2
Olsen Creek	Apr 11	- -	1	4.8	3.0	0	0.0	0.0	0
Pelletreau Ck.	Apr 14	- -	1	0.8	0.5	0	0.0	0.0	0
		Subtotals	5	10.1	6.3	63	- -	- -	2
		Means	- -	- -	- -	- -	6.2	10.0	- -
Hayfork-Wildwood Area									
Big Creek	Mar 26	Apr 01	3	12.6	7.8	35	2.8	4.5	0
Carr Creek	Mar 29	Apr 02	1	5.8	3.6	0	0.0	0.0	0
Dubakella Ck.	Mar 19	Apr 11	3	3.2	2.0	0	0.0	0.0	0
E. Fork of Hayfork Creek	Mar 23	Mar 26	2	7.4	4.6	32	4.3	7.0	0
Hayfork Creek	Mar 19	Apr 19	6	19.0	11.8	30	1.6	2.5	0
Little Creek	Mar 21	Apr 13	2	2.1	1.3	8	3.8	6.2	1
Philpot Creek	Apr 03	- -	1	2.6	1.6	6	2.3	3.8	0
Potato Creek	Apr 06	- -	1	2.4	1.5	5	2.1	3.3	0
Rusch Creek	Mar 12	Apr 11	2	6.4	4.0	2	0.3	1.0	0
Salt Creek	Mar 29	Mar 30	2	10.6	6.6	51	4.8	7.7	3
Tule Creek	Apr 02	- -	1	3.7	2.3	35	9.5	15.2	0
Wilson Creek	Mar 20	- -	1	1.6	1.0	0	0.0	0.0	0
		Subtotals	25	77.4	48.1	204	- -	- -	4
		Means	- -	- -	- -	- -	2.6	4.2	- -
Forest Glen Area									
E. Fork of the South Fork	Apr 05	- -	1	4.8	3.0	38	7.9	12.7	2
Rattlesnake Ck.	Apr 04	- -	1	9.2	5.7	24	2.6	4.2	1
Silver Creek	Apr 09	- -	1	2.4	1.5	4	1.7	2.7	0
Smokey Creek	Apr 10	- -	1	2.4	1.5	16	6.6	10.7	1
		Subtotals	4	18.8	11.7	82	- -	- -	4
		Means	- -	- -	- -	- -	4.4	7.0	- -
	Grand Totals		34	106.4	66.1	349	- -	- -	10
	Combined Means		- -	- -	- -	- -	13.0	21.0	- -

Table 7. Adult steelhead electrofishing survey recovery data for the South Fork Trinity River basin during the 1989–90 season.

Location	Survey dates first	Survey dates last	Number of surveys	Length surveyed km	Length surveyed miles	New redds observed	Redds observed per km	Redds observed per mile	Live steelhead observed	Steelhead captured
Hyampom Area										
Big Creek	Mar 09	– –	1	0.8	0.5	0	0.0	0.0	0	0
Olsen Creek	Jan 26	Mar 01	2	1.6	1.0	2	1.2	2.0	0	0
Pelletreau Creek	Jan 25	Mar 08	2	0.8	0.5	0	0.0	0.0	0	0
		Subtotals	5	3.2	2.0	2	– –	– –	0	0
		Means	– –	– –	– –	– –	0.6	1.0	– –	– –
Hayfork–Wildwood Area										
Big Creek	Dec 19	Mar 21	4	12.6	7.8	1	0.1	0.1	0	0
Carr Creek	Feb 26	Mar 15	4	3.2	2.0	0	0.0	0.0	0	0
E. Fork of Hayfork Creek	Mar 26	Mar 27	2	1.6	1.0	0	0.0	0.0	1	0
Goods Creek	Mar 01	Mar 16	3	1.6	1.0	0	0.0	0.0	0	0
Hayfork Creek	Dec 21	Mar 28	2	1.8	1.1	0	0.0	0.0	3	2
Potato Creek	Feb 28	Mar 07	2	2.4	1.5	0	0.0	0.0	0	0
Rusch Creek	Mar 06	Mar 15	3	3.2	2.0	4	1.2	2.0	2	2
Salt Creek	Jan 23	Jan 26	4	12.9	8.0	6	0.5	0.8	4	0
Tule Creek	Jan 22	Feb 12	3	4.8	3.0	3	0.6	1.0	0	2
		Subtotals	27	44.1	27.4	14	– –	– –	10	6
		Means	– –	– –	– –	– –	0.3	0.5	– –	– –
	Grand	Totals	32	47.3	29.4	16	– –	– –	10	6
	Combined	Means	– –	– –	– –	– –	0.3	0.5	– –	– –

covered slopes which were badly damaged by the fire of 1987. Pools and spawning habitat are very common throughout, with spawning gravels in the upper reaches being less compacted and more suitable for spawning than those in the middle and lower reaches. Pools are numerous and pool cover consists mostly of root-wad and bedrock structures. Riparian vegetation is fair with creek canopy consisting mainly of alders. A waterfall exists 1.3 km from the confluence creating a natural barrier to anadromous fish passage. We surveyed the lower 1.3 km of the creek on 10 April 1990, counted 18 redds, and observed two adult steelhead.

Olsen Creek. Olsen Creek, a tributary to Hayfork Creek (river km 0.6.), is located just east of the town of Hyampom. The USFS has put in numerous habitat improvement structures in this system but spawning habitat is limited. The upper 2.4-km section runs through a steep narrow canyon containing numerous falls ranging between 1.1 and 4.6 m which may be natural barriers to anadromous fish passage, and two debris blockages were found in the lower 0.8 km section which are believed to be complete barriers except during very high flow conditions. We surveyed 4.8 km of the creek between 26 January and 11 April 1990 and observed two redds.

Pelletreau Creek. Pelletreau Creek, a tributary to the SFTR (river km 46.7), is located west of the town of Hyampom. Only the uppermost section contains adequate holding pools while the remainder of the creek is composed mainly of a cemented gravel substrate, unsuitable for spawning. This creek was severely damaged by the 1964 flood and is reported to have 10.7 m of gravel sitting on top of the original creek bed in this lower section. Pelletreau Creek contains a cascade barrier to anadromous fish passage 0.8 km upstream from its mouth. Although this is a perennial stream, complete water diversion during summer months leaves the lower 0.3-km section dry. We surveyed 0.8 km of the creek on 25 January, 8 March, and 14 April 1990 and observed no redds.

Hayfork Creek Basin Near Hayfork and Wildwood

We surveyed 13 tributaries to Hayfork Creek, plus parts of the main-stem of Hayfork Creek between 19 December 1989 and 19 April 1990. These surveys covered a total of 79.0 km, and we captured six adult steelhead, observed 218 redds, and counted 10 other adult steelhead (Tables 6 and 7).

Big Creek. Big Creek, a major tributary to Hayfork Creek (river km 43.8), is located in the Hayfork Valley east of the town of Hayfork. This creek has been very productive in the past with spawning gravel fairly abundant in the middle and upper survey sections, pools are common and riparian vegetation is medium to dense. California Conservation Corps (CCC) crews and the USFS have installed numerous habitat enhancement structures.

During the winter months the habitat is excellent, however, a property owner diverts most of the creek for watering livestock pastures the rest of the year. The water diversions are located 2.4 km and 4.8 km upstream from the confluence with Hayfork Creek, and limit the habitat for fish in this lower section. We surveyed 12.6 km of the creek between 19 December 1989 and 1 April 1990 and counted 36 redds.

Carr Creek. Carr Creek, a tributary to Hayfork Creek (river km 47.8), flows partly through the upper Hayfork Valley. This valley section is heavily impacted by livestock, the riparian zone is heavily grazed, and cattle crossings are numerous, causing heavy suspended sediment throughout the section. Beaver dams are numerous throughout the creek, with one causing a total fish passage barrier below the Double G Ranch. Spawning habitat is limited, pools are small (most less than 1.0 m deep) and several low-water barriers exist. We surveyed 5.8 km of Carr Creek between 26 February and 2 April 1990, observing no redds or adult steelhead.

Dubakella Creek. Dubakella Creek, a tributary to upper Hayfork Creek (river km 78.4), is located south of the town of Wildwood. The upper 2.1 km section flows through a steep narrow canyon containing mostly cascades with accompanying high velocity flows. The slope gradient levels out in the lower 1.1-km section but available spawning gravel sections are limited. Large and small woody debris cover is abundant throughout this stream system and the riparian zone vegetation consists primarily of alders. We surveyed 3.2 km of the creek between 19 March and 11 April 1990 and observed no redds or adult steelhead.

East Fork of Hayfork Creek. The East Fork of Hayfork Creek, a major tributary to Hayfork Creek (river km 58.2), is located north of the town of Wildwood. The creek is very rocky in many areas but does contain areas of good spawning habitat, mainly where the CCC crews have built spawning gravel recruitment structures. Most of the noted spawning activity has occurred in the latter areas. The upper 3.2-km section contains numerous pools and riffles, and spawning gravel areas are abundant. The remaining 4.2 km from the East Fork Road bridge to the confluence with Hayfork Creek is a steady declining gradient containing fast moving water and little spawning habitat. The primary riparian zone consists of alders and willows. Secondary growth consists of cedars, firs and pines. Most of the basin has been hydraulically mined. These operations are most evident in the main basin in the form of large tailing piles. In general, nearly all of the East Fork of Hayfork Creek drainage has been altered from its natural topography. We surveyed 7.4 km of the East Fork of Hayfork Creek on 23 and 26 March 1990 from the confluence with Hayfork Creek to the confluence of the North Fork of the East Fork of Hayfork Creek, observing 32 redds and one live adult steelhead.

Goods Creek. Goods Creek, a tributary to Hayfork Creek (river km 45.6), is located in Wildwood. Steelhead habitat was poor due to the low flow conditions, spawning areas were limited, creek sedimentation was heavy and a beaver dam caused a barrier to anadromous fish migration. We surveyed 1.6 km of the creek on 1 and 16 March 1990 and observed no redds.

Hayfork Creek. Hayfork Creek is the major tributary to the SFTR (river km 30.1). Most of the creek above the Hayfork Valley is composed of boulders and large rubble unsuitable for spawning. Some upper reaches of Hayfork Creek contain a few areas of suitable spawning habitat, but beaver dams are creating a serious siltation and sedimentation problem resulting in cemented gravels. The section flowing through the Hayfork Valley contains a fair amount of spawning gravel but the habitat is poor with little or no cover, very few pools, and warm water temperatures in the summer. We surveyed sections from the upper Hayfork Valley at the Dubakella Creek confluence to the lower Hayfork Valley in those areas that were accessible and where we knew spawning habitat existed. We surveyed 19.0 km of the creek between 19 March and 19 April 1990, counted 30 redds, captured two adult steelhead, and observed three other adult steelhead.

Little Creek. Little Creek, a tributary to Hayfork Creek (river km 29.0), is located west of Hayfork. The USFS has constructed habitat improvement structures in the stream, and there are areas of suitable spawning habitat. A complete barrier exists 1.6 km from the confluence. We surveyed 2.1 km of the creek between 21 March and 13 April 1990, counted eight redds, and observed one adult steelhead.

Philpot Creek. Philpot Creek, a tributary to Salt Creek (river km 11.1), is located in the Hayfork Valley. It is composed of long stretches of bedrock substrate and contains some areas of suitable spawning gravels. A dense canopy of riparian vegetation makes walking the stream in its lower section impossible. We surveyed 2.6 km of the creek on 30 April 1990 and counted six redds.

Potato Creek. Potato Creek, a tributary to East Fork Hayfork Creek (river km 3.1), lies in an extremely steep-sided basin. We surveyed the lower 2.4 km of the creek on 28 February, 7 March, and 6 April 1990, found good steelhead habitat, and observed five redds in the upper part of the section.

Rusch Creek. Rusch Creek, a tributary to Hayfork Creek (river km 28.5), is located west of the town of Hayfork. This is a perennial stream running through mountainous terrain with fairly dense shade canopy provided by Douglas fir, yew trees, big leaf maple, and alder. The creek contains numerous habitat improvement structures for bank stabilization, pool scouring and spawning gravel recruitment, but spawning habitat is very limited. The upper 3.2 km are very steep with many cascades and no spawning habitat present. Steelhead rearing habitat was fair throughout the creek. Pools were primarily boulder and log formed with pool cover provided mostly by rock and woody debris. Several complete and low flow barriers were noted 6.0 km from the confluence. We surveyed 6.4 km of the creek between 6 March and 11 April 1990, counted six redds, observed two adult steelhead, and captured two other adult steelhead through electrofishing.

Salt Creek. Salt Creek, a major tributary to Hayfork Creek (river km 37.0), runs through the Hayfork Valley. The lower section flows through pasture land where the creek is very open and exposed and steelhead habitat is poor. Some pools are present but are lacking in cover with the riparian vegetation consisting of alders and willows. The upper and middle sections contain better habitat with deeper pools and a denser canopy. Spawning habitat exists, but many of these areas are located within pastures and contain numerous cattle crossings, disturbing available spawning areas. Riparian vegetation is also heavily grazed, reducing cover and increasing sun exposure. We surveyed Salt Creek for 17.6 km between 22 January and 30 March 1990, counted 57 redds, and observed seven adult steelhead.

Tule Creek. Tule Creek, a tributary to Hayfork Creek (river km 35.9), flows through the Hayfork Valley. Spawning habitat in the lower section is poor due to a clay hardpan substrate, but the upper section contains many large deep pools and spawning habitat is more readily available. Primary riparian cover is alders and oaks. A beaver dam is located in the lower 4.0 km and was a barrier at the time of the surveys. We surveyed 3.7 km of the creek on 22 January, 12 February, and 2 April 1990, observed 38 redds, and captured two adult steelhead through electrofishing.

Wilson Creek. Wilson Creek, a tributary to Hayfork Creek (river km 70.6), is located in Wildwood. It is a very small creek with no adult habitat, very limited spawning habitat, numerous debris jams, and heavy sedimentation resulting from heavy clear-cut logging in the drainage. The lower section is heavily influenced by human activities and domestic water supply demands. We surveyed Wilson Creek for 1.6 km on 20 March 1990 but observed no redds.

Upper SFTR Basin Near Forest Glen

We surveyed four tributaries to the SFTR in the upper SFTR basin area between 4 and 10 April 1990. These surveys covered a total of 18.8 km, and we observed 82 redds and four live fish (Table 6).

East Fork of SFTR. The East Fork of the SFTR (beginning at river km 118) is located in the Yolla Bolla region south of Highway 36. The upper 3.2-km section flows through a rugged, steep-sided canyon and is comprised mostly of riffles and runs, while the lower section levels out into a low gradient stream configuration and is comprised predominantly of cascades and large, deep pools. Spawning gravels were found throughout the surveyed section. We surveyed 4.8 km of the East Fork on 5 April 1990, counted 38 redds, and observed two live steelhead.

Rattlesnake Creek. Rattlesnake Creek, a tributary to the SFTR (river km 91.7), is located in the Forest Glen area. The upper and middle sections contain spawning habitat, but the lower section is comprised of mainly cascades and very large pools. We surveyed 9.2 km of the creek on 4 April 1990, counted 24 redds, and observed one adult steelhead.

Silver Creek. Silver Creek, a tributary to the SFTR (river km 102.7), is located south of Forest Glen in a very steep-sloped mountainous region. Spawning habitat is not abundant, but juvenile steelhead habitat is good throughout the survey reach. High gradient cascades are prevalent in the lower section. We surveyed 2.4 km of the creek on 9 April 1990 and observed four steelhead redds.

Smokey Creek. Smokey Creek, a tributary to the SFTR (river km 104.1), is located south of Forest Glen. Smokey Creek is characterized as a wide floodplain with abundant spawning habitat and large pools. We surveyed 2.4 km of the creek on 10 April 1990, and observed 16 redds and one adult steelhead.

Adult Steelhead Recovery

Traps and Weirs

Project personnel operated three traps and one Alaskan weir during the season to recover post-spawning, emigrant adult steelhead. The traps were operated on Big Creek, Salt Creek and Tule Creek for 94 d from 31 January through 4 May 1990 (Figure 1). The Alaskan weir with a downstream trap was operated for 90 d, from 24 February through 27 May 1990, on Hayfork Creek, 9.6 river km from its confluence with the SFTR (Figure 1).

We captured 12 steelhead (three in Big Creek, nine in Salt Creek) during operation of the three smaller traps. We trapped 91 adult steelhead at the lower Hayfork Creek Weir (Figure 6), including seven steelhead previously trapped in Big Creek and Salt Creek. The remaining 84 steelhead were unmarked. The average size of steelhead trapped at the Hayfork Creek Weir was 62.7 cm FL (Figure 7). Of the 96 fish trapped at the three emigrant traps and the weir within the Hayfork Creek drainage, 37 were male and 59 were female. Mean FL for males was 65.1 cm, (range: 53-79 cm), and 61.2 cm for females (range: 47-78). We did not recapture any of the Project-tagged or fin-clipped steelhead

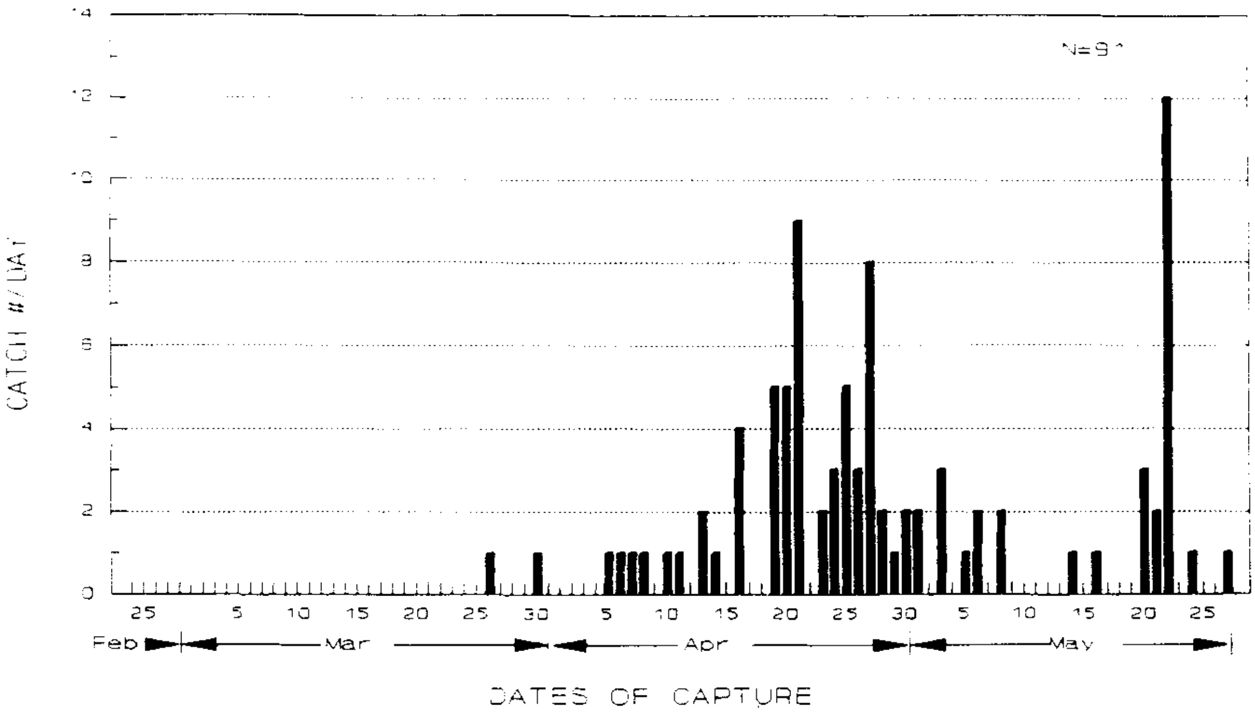

Figure 6. Daily catches of post-spawning, emigrant adult steelhead at the Hayfork Creek Weir in the South Fork Trinity River basin from 24 February through 27 May 1990.

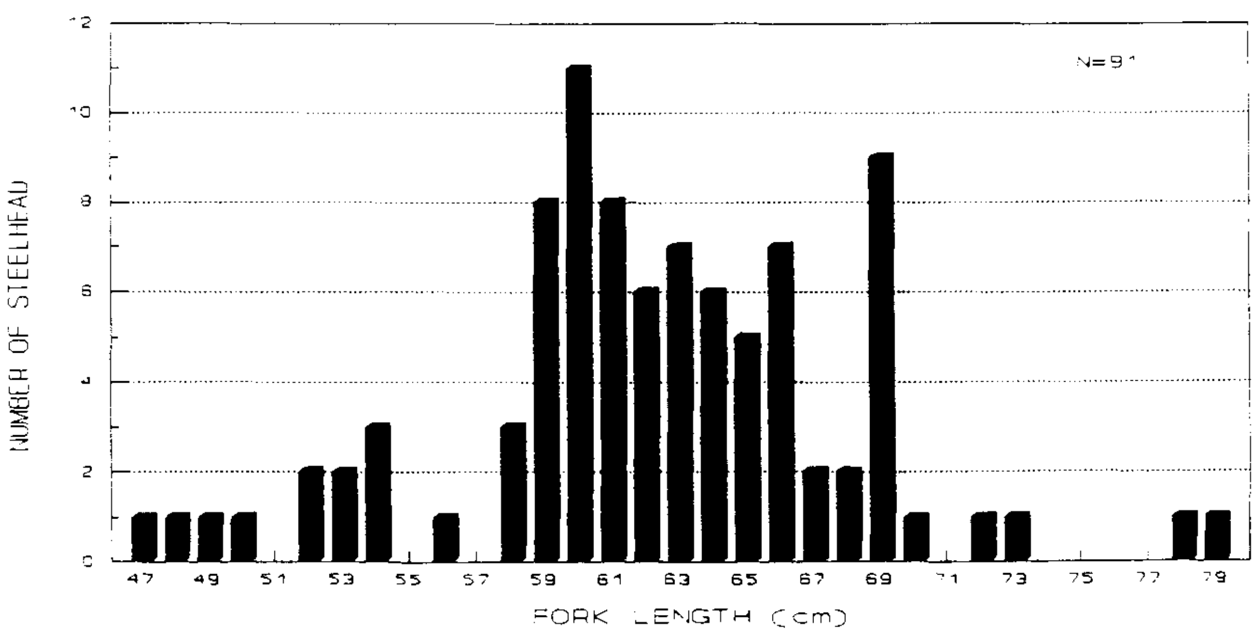

Figure 7. Length frequency distribution of post-spawning, emigrant adult steelhead trapped at the Hayfork Creek Weir in the South Fork Trinity River basin from 24 February through 27 May 1990.

marked at the Sandy Bar and Hyampom Valley Weirs, earlier in the season.

Hook-and-line Sampling

Project personnel also used sport fishing rods and reels to recover nine unmarked adult steelhead in the middle Hayfork Creek drainage and the SFTR in the Hyampom Valley.

SFTR Adult Steelhead Escapement Estimate

Of the 135 steelhead tagged or fin-clipped at the Sandy Bar and Hyampom Valley weirs between 14 September 1989 and 6 January 1990, only seven marked steelhead were recovered (five tagged and two 1/2-LV fin-clipped). Three marked fish from Sandy Bar Weir were observed and re-released at the Hyampom Valley Weir. Four other marked fish (three tagged and one 1/2-LV fin-clipped) were recovered through the creel census surveys, with the last recovery being made on 10 December 1989. We recovered 127 unmarked steelhead through the following methods: 9 by hook-and-line fishing, 6 by electrofishing, 12 through emigrant trapping in tributaries to Hayfork Creek, 84 at the Hayfork Creek Weir, and 16[3/] through the creel census surveys.

A valid Petersen estimate of escapement is based upon certain assumptions being met, including random mixing of both marked and unmarked fish, and random and unbiased sampling for mark recoveries (Ricker 1975). Unfortunately, despite our intensive mark and recovery efforts, we do not feel we can make a valid 1989-90 SFTR basin adult steelhead escapement estimate, primarily because of low recoveries of marked fish and weather-induced alterations in our sampling design.

Timing of Marking vs. Recoveries

Since tagging was not possible at the Sandy Bar Weir after October 23, 1989 or at the Hyampom Valley Weir after 6 January 1990, we feel we may have missed the opportunity to mark a considerable portion of the run. Subsequent studies showed SFTR steelhead continued immigrating into the basin throughout the spring. For example, very few redds were seen until mid-March. Additional immigration of fish into the basin may have affected our ability to randomly distribute marked fish throughout all segments of the steelhead run. We feel the steelhead marked at the two weirs in the lower SFTR basin probably constituted the

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3/ Two of the 18 fish seen in the creel census were caught at the confluence of the main-stem Trinity River and the SFTR, so they could not necessarily be assumed to be immigrants to the basin and were excluded from recapture totals used for escapement estimates.

early portion of the winter run, while much of our recovery effort probably targeted later elements of the run. Thus, our marking and many of our recovery efforts may have been widely separated in time.

Ineffective Recapture Techniques

Our last steelhead was tagged 4 January, prior to the destruction of the Hyampom Valley Weir on 7 January 1990 by a heavy storm. In spite of a variety of intensive recovery efforts throughout the rest of the season, all marked fish were recovered in the creel census during December 1989. Electrofishing was intended as our primary recovery method, and began on 19 December 1989 continuing intensively for the next three months. However, it proved to be very ineffective because few fish were ever seen or captured during the process. In retrospect, the electrofishing method had a low probability of success when we first attempted it, due to high flows and physical inaccessibility to many tributaries. Our traps and weirs for emigrant adult steelhead in the Hayfork Creek basin were operated between 29 January to 6 May 1990 (JWs 5-18), but captured only a few untagged fish. Weather conditions also prevented us from conducting our various recapture efforts on a continuous basis during equivalent (simultaneous/overlapping) time periods. This would have been necessary if we were to use combined totals of all fish recovered by the various techniques in one Petersen estimate of escapement.

Distribution of Sampling Effort

Fish may have used the upper SFTR drainage more heavily than expected, while recovery efforts were disproportionately centered in the Hayfork Creek drainage due to access problems within the upper SFTR.

Differential Mortality, Harvest or Recapture of Tagged Fish

Marked fish may have had higher mortality (natural or fishing) or emigrated out of the SFTR basin prior to the bulk of our recovery efforts, which would also account for low recoveries. Only the creel survey recovered any marked fish, and we would have expected to see more fish with only a 1/2-LV fin clip, since we marked more fish in this manner than with the double mark of an anchor tag and 1/2-LV fin clip.

Partial Escapement Estimates

The only escapement estimates that we can make, therefore, are for the early portion of the steelhead run. We estimate that 969 adult steelhead (95% Poisson C.I.: 396 to 2,422) migrated past Sandy Bar Weir through 23 October 1989, based on recoveries at the Hyampom Valley Weir, which was 38.6 km upstream from the tagging site. This is similar to our second estimate that 571 adult steelhead (95% Poisson C.I.: 255 to 1,428) migrated past Sandy Bar and Hyampom Valley Weirs through 6 January 1990, based on recoveries in the creel census. This second estimate is less reliable, since it is based on tagging at two different weirs, both of which cannot necessarily be assumed to have had equal capture efficiencies, and thus to have marked equal proportions of the steelhead run past each weir.

Juvenile Steelhead Emigration Studies

From 1 July 1989 through 30 June 1990, we captured 2,386 Age 0+, 225 Age 1+, and 28 Age 2+ steelhead and 2,172 juvenile chinook salmon at the Hayfork Creek and SFTR juvenile out-migrant trapping sites (Figure 1, Table 8). The peak emigration of Age 0+ steelhead and Age 0+ chinook salmon occurred during May 1990, and the peak emigration of Age 1+ steelhead occurred during April 1990. Age 0+ steelhead were more abundant in Hayfork Creek and chinook salmon were slightly more abundant in the SFTR (Table 8). The mean FL of Age 0+ steelhead from the 1989 Brood Year (BY) increased from 55.4 mm to 96.0 mm by early December 1989, and mean FL of Age 0+ steelhead from the 1990 BY increased from 28.3 mm to 55.9 mm by June 1990 (Table 9). Mean FL's of Age 1+ steelhead ranged from 89.0 to 153.3 mm, and Age 2+ steelhead ranged from 163.0 to 190.0 mm (Table 9). Mean FL's of chinook salmon from the 1989 BY ranged from 52.0 to 83.8 mm (Table 9).

Habitat Use by Juvenile Steelhead

We evaluated juvenile steelhead utilization of the various habitat types in Eltapom Creek from 20 through 28 September 1989. We sampled 52 (50%) of the 103 habitat units identified by Glase and Barnhart (1989) [3 cascades, 17 pools, 12 riffles, and 20 runs], capturing 1,079 juvenile steelhead. Runs were the predominant habitat type within the creek (47% of total area), but fish density was highest in riffles, and secondarily in pools (Table 10).

Steelhead Life History Patterns

To date, we have examined 105 adult steelhead scale samples. The majority of these fish had spent 2 years in fresh water prior to smolting, the rest smolted at Age 3 (Figure 8). Most spent only one year in the ocean (Ocean Age 1) (Figure 9). Half-pounder checks were apparent on 41 (39%) of the samples examined. Most scale samples were from maiden spawners (Figure 10). We made circuli counts on 104 of the adult steelhead scale samples and the mean number of freshwater circuli was 35. Mean circuli counts to the first and second freshwater annulus were 12 and 25, respectively, for Age 1+ and Age 2+ fish.

Juvenile steelhead scale analysis was conducted using the OPRS machine. We concentrated, primarily, on scale samples of

Table 8. South Fork Trinity River basin juvenile salmonid trapping summary for the 1989–90 season.

			NUMBERS TRAPPED							
			Hayfork Creek				South Fork Trinity River			
			Steelhead			Chinook	Steelhead			Chinook
Year	Dates	Julian week a/	Age 0+	Age 1+	Age 2+	Age 0+	Age 0+	Age 1+	Age 2+	Age 0+
1989	07/02 – 07/08	27	175	1	0	3	–	–	–	–
	07/09 – 07/15	28	29	0	0	0	–	–	–	–
	07/16 – 07/22	29	–	–	–	–	–	–	–	–
	07/23 – 07/29	30	–	–	–	–	–	–	–	–
	07/30 – 08/05	31	–	–	–	–	–	–	–	–
	08/06 – 08/12	32	–	–	–	–	–	–	–	–
	08/13 – 08/19	33	–	–	–	–	–	–	–	–
	08/20 – 08/26	34	–	–	–	–	–	–	–	–
	08/27 – 09/02	35	–	–	–	–	–	–	–	–
	09/03 – 09/09	36	–	–	–	–	–	–	–	–
	09/10 – 09/16	37	–	–	–	–	2	1	2	0
	09/17 – 09/23	38	4	0	0	0	28	0	0	0
	09/24 – 09/30	39	2	0	0	0	6	0	0	0
	10/01 – 10/07	40	2	0	0	0	10	1	0	0
	10/08 – 10/14	41	0	0	0	0	1	–	2	–
	10/15 – 10/21	42	1	0	0	0	2	0	0	0
	10/22 – 10/28	43	–	–	–	–	–	–	–	–
	10/29 – 11/04	44	10	0	0	0	–	–	–	–
	11/05 – 11/11	45	1	0	0	0	1	0	0	0
	11/12 – 11/18	46	0	0	0	0	4	3	5	0
	11/19 – 11/25	47	3	0	0	0	5	0	0	0
	11/26 – 12/02	48	5	0	0	0	3	2	2	0
	12/03 – 12/09	49	2	0	0	0	2	0	0	0
	12/10 – 12/16	50	0	0	0	0	0	0	0	0
	12/17 – 12/23	51	1	0	0	0	2	0	0	0
	12/24 – 12/31	52	4	0	0	0	0	0	0	0

Table 8. South Fork Trinity River basin juvenile salmonid trapping summary for the 1989–90 season (continued).

			NUMBERS TRAPPED							
			Hayfork Creek				South Fork Trinity River			
			Steelhead			Chinook	Steelhead			Chinook
Year	Dates	Julian week a/	Age 0+	Age 1+	Age 2+	Age 0+	Age 0+	Age 1+	Age 2+	Age 0+
1990	01/01 – 01/07	1	2	0	0	0	1	0	0	0
	01/08 – 01/14	2	–	–	–	–	–	–	–	–
	01/15 – 01/21	3	19	0	0	0	–	–	–	–
	01/22 – 01/28	4	11	0	0	0	–	–	–	–
	01/29 – 02/04	5	6	0	0	0	–	–	–	–
	02/05 – 02/11	6	0	0	0	0	–	–	–	–
	02/12 – 02/18	7	0	0	0	0	0	0	0	0
	02/19 – 02/25	8	0	0	0	0	1	0	0	0
	02/26 – 03/04	9	–	–	–	–	–	–	–	–
	03/05 – 03/11	10	–	–	–	–	–	–	–	–
	03/12 – 03/18	11	0	5	0	0	–	–	–	–
	03/19 – 03/25	12	0	17	0	0	–	–	–	–
	03/26 – 04/01	13	0	16	0	0	–	–	–	–
	04/02 – 04/08	14	0	12	0	16	–	–	–	–
	04/09 – 04/15	15	0	7	1	66	1	8	0	71
	04/16 – 04/22	16	56	58	6	171	17	9	0	69
	04/23 – 04/29	17	22	32	4	498	122	31	1	379
	04/30 – 05/06	18	177	10	3	108	2	6	0	135
	05/07 – 05/13	19	99	0	0	38	41	2	1	118
	05/14 – 05/20	20	500	1	0	83	178	2	0	160
	05/21 – 05/27	21	360	4	0	33	–	–	–	–
	05/28 – 06/03	22	–	–	–	–	–	–	–	–
	06/04 – 06/10	23	53	0	0	0	–	–	–	–
	06/11 – 06/17	24	106	0	0	0	19	0	1	3
	06/18 –06/24	25	65	0	0	0	70	0	0	1
	06/25 – 07/01	26	11	0	0	0	142	1	0	220
		Totals	1,726	163	14	1,016	660	66	14	1,156

Table 9. Fork lengths of juvenile steelhead and chinook salmon captured within the South Fork Trinity River basin during the 1989–90 season.

			Steelhead												Chinook Salmon			
			Age 0+				Age 1+				Age 2+							
		Julian week a/		Fork length (mm)				Fork length (mm)				Fork length (mm)				Fork length (mm)		
Year	Date	interval	N	mean	min	max	N	mean	min	max	N	mean	min	max	N	mean	min	max
1989	07/02 – 07/15	27–28	190	55.4	35	84	1	153.0	153	153	0	--	--	--	5	84.8	78	92
	07/16 – 07/29	29–30	ns a/	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
	07/30 – 08/12	31–32	ns	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
	08/13 – 08/26	33–34	ns	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
	08/27 – 09/09	35–36	ns	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
	09/10 – 09/23	37–38	34	66.0	48	87	1	133.0	133	133	2	178.0	176	180	0	--	--	--
	09/24 – 10/07	39–40	20	65.3	53	93	1	142.0	142	142	0	--	--	--	0	--	--	--
	10/08 – 10/21	41–42	4	90.8	80	115	0	--	--	--	2	178.0	176	180	0	--	--	--
	10/22 – 11/04	43–44	10	92.5	75	112	0	--	--	--	0	--	--	--	0	--	--	--
	11/05 – 11/18	45–46	8	69.3	58	84	3	153.3	147	160	5	190.0	183	204	0	--	--	--
	11/19 – 12/02	47–48	16	94.4	68	118	2	139.0	133	145	2	163.0	157	169	0	--	--	--
	12/03 – 12/16	49–50	4	98.0	83	114	0	--	--	--	0	--	--	--	0	--	--	--
	12/17 – 12/31	51–52	7	79.7	56	114	0	--	--	--	0	--	--	--	0	--	--	--
1990	01/01 – 01/14	01–02	3	89.7	75	114	0	--	--	--	0	--	--	--	0	--	--	--
	01/15 – 01/28	03–04	30	83.0	51	102	0	--	--	--	0	--	--	--	0	--	--	--
	01/29 – 02/11	05–06	6	82.5	60	94	0	--	--	--	0	--	--	--	0	--	--	--
	02/12 – 02/25	07–08	1	57.0	57	57	--	--	--	--	0	--	--	--	0	--	--	--
	02/26 – 03/11	09–10	ns	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
	03/12 – 03/25	11–12	0	--	--	--	22	89.0	61	123	0	--	--	--	0	--	--	--
	03/26 – 04/08	13–14	0	--	--	--	26	103.3	71	139	0	--	--	--	18	54.3	48	62
	04/09 – 04/22	15–16	56	28.3	25	30	99	102.6	65	144	7	161.1	150	178	275	52.0	34	72
	04/23 – 05/06	17–18	89	32.3	26	47	50	102.8	78	145	8	161.5	153	170	224	58.1	36	79
	05/07 – 05/20	19–20	353	37.5	25	57	5	118.4	72	144	1	160.0	160	160	331	60.9	39	105
	05/21 – 06/03	21–22	50	44.1	26	55	4	116.8	100	125	0	--	--	--	33	69.4	50	83
	06/04 – 06/17	23–24	163	52.8	40	78	0	--	--	--	1	160.0	160	160	3	68.7	67	70
	06/18 – 07/01	25–26	233	55.9	25	81	0	--	--	--	0	--	--	--	101	63.8	71	95

a/. ns = Not sampled

TABLE 10. Juvenile steelhead habitat utilization in Eltapom Creek between 20 and 28 September 1989.

Habitat types	Number of habitat units	Total available habitat (m^2)	Area of habitat sampled (m^2)	Number of fish observed	Sampled fish density (#/m^2)	Estimated fish per available area
Cascades	14	5,180.7	1,253.7	27	0.022	112
Pools	35	15,835.3	7,066.2	312	0.044	699
Riffles	16	10,633.7	5,840.8	327	0.056	595
Runs	38	28,247.2	15,269.5	413	0.027	764
Totals:	103	59,896.9	29,430.3	1,079	0.037	2,196

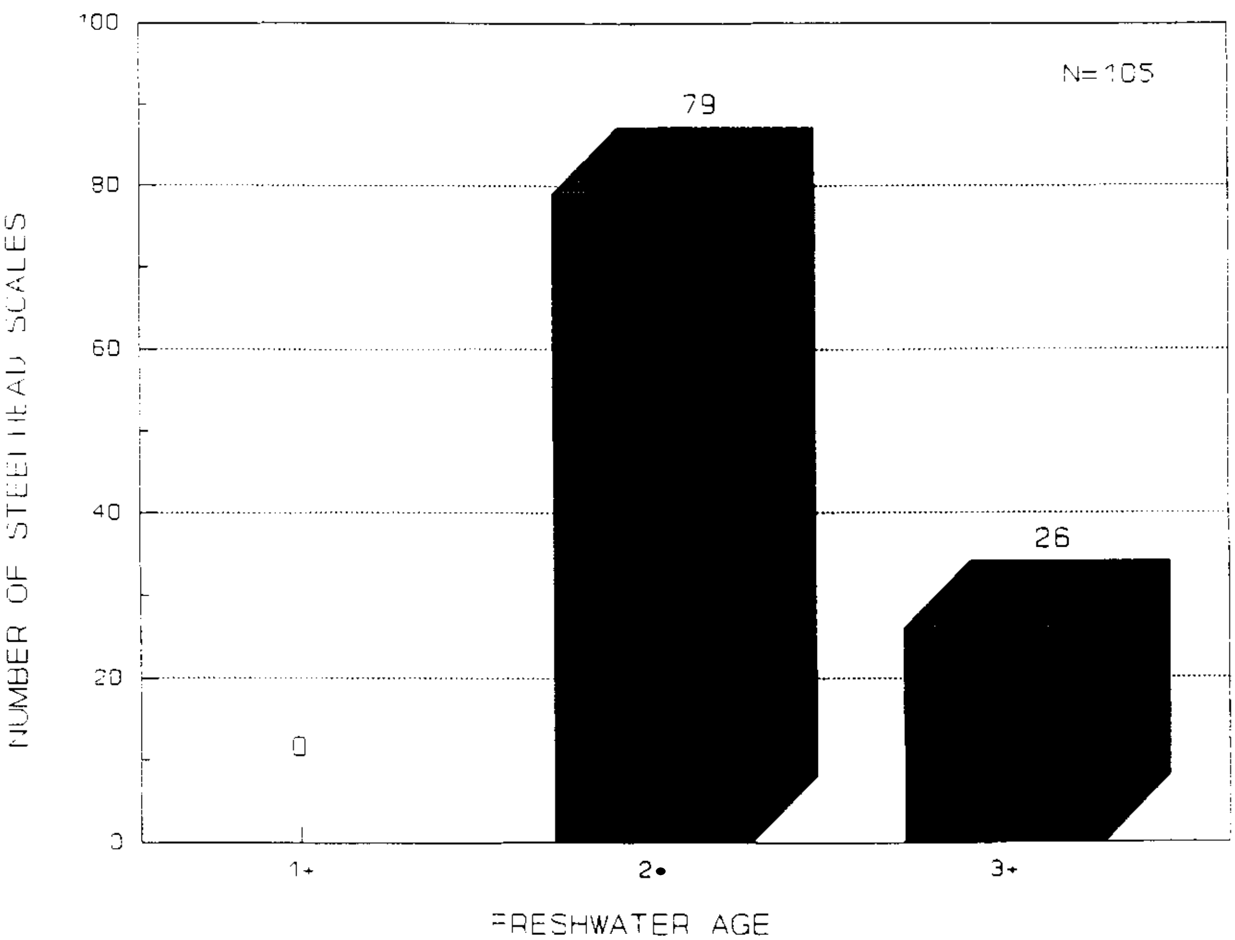

Figure 8. Freshwater life history information from analyses of scales taken from adult steelhead captured in the South Fork Trinity River basin during the 1989-90 season.

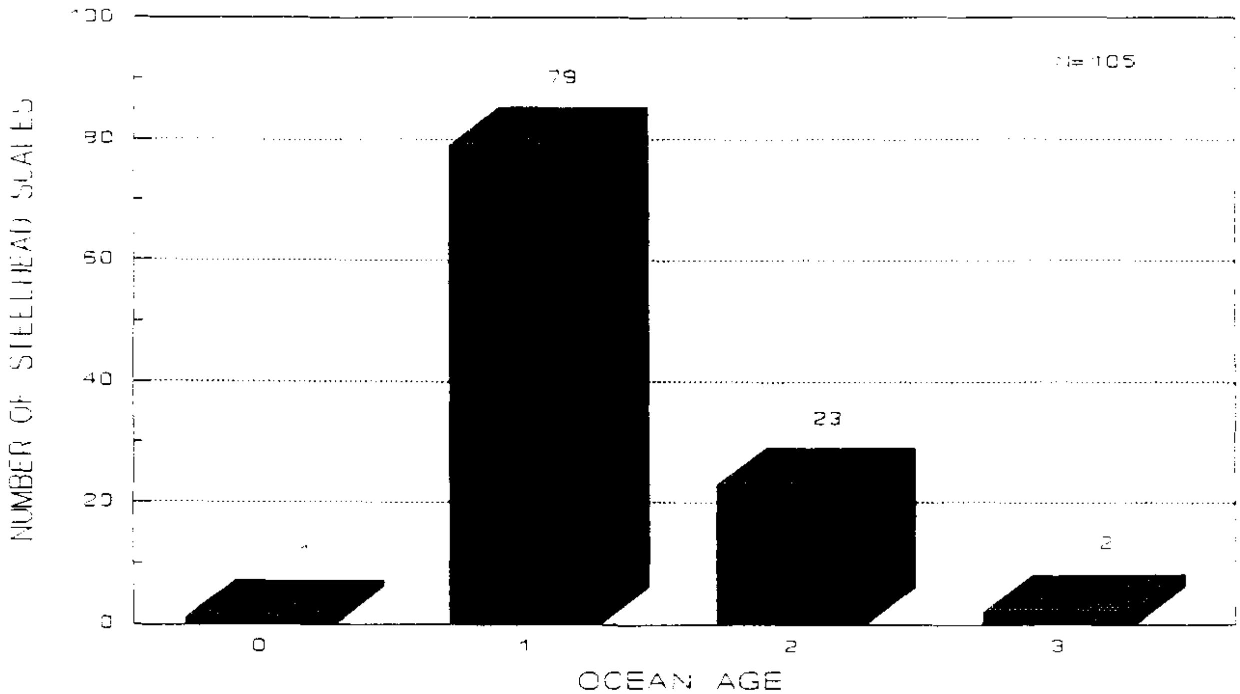

Figure 9. Ocean life history information from analyses of scales taken from adult steelhead captured in the South Fork Trinity River basin during the 1989-90 season.

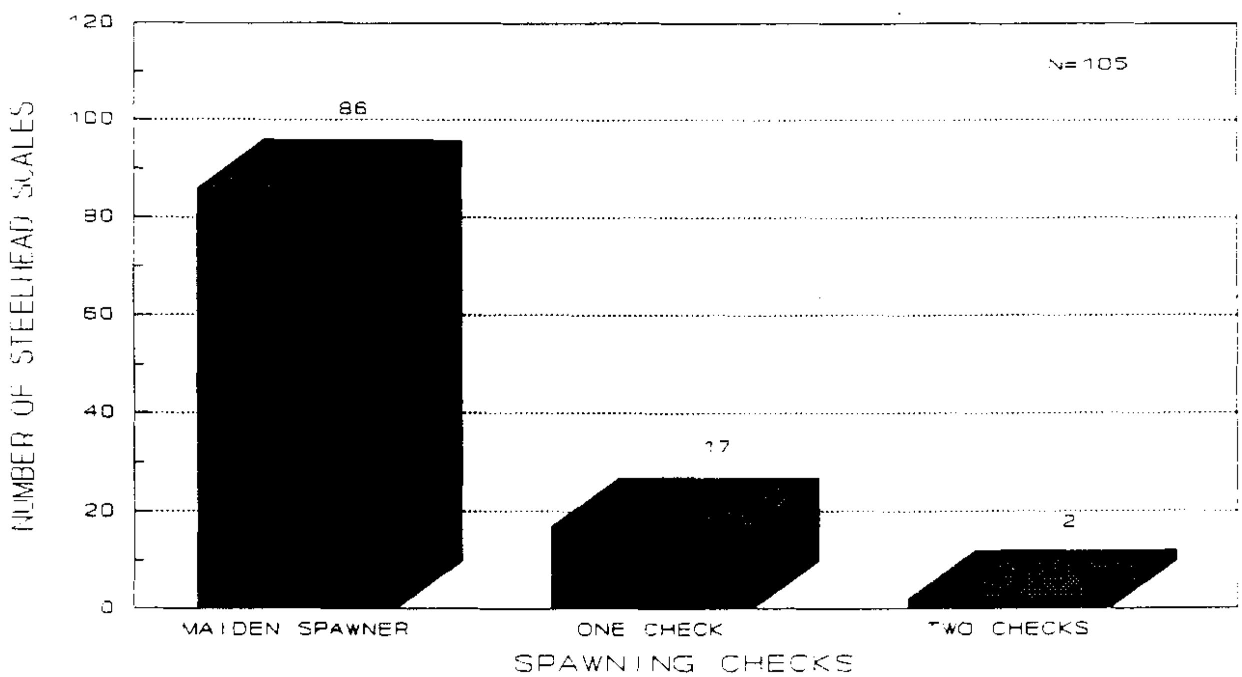

Figure 10. Spawning life history information from analyses of scales taken from adult steelhead captured in the South Fork Trinity River basin during the 1989-90 season.

juvenile Age 1+ fish to help clarify the location of the first annulus in adult scales, and have read scales from Age 0+ through Age 2+ fish to further describe juvenile steelhead life history. To date, we have read 464 sets of juvenile steelhead scales, most of which were Age 0+ fish (Table 11). Mean circuli counts to the first and second freshwater annulus for juvenile steelhead scales were greater than the equivalent counts on adult scales (19 and 35 vs. 12 and 25, respectively). Currently, we have no explanation for these observed differences but are evaluating several alternatives.

RECOMMENDATIONS

1. The operation of the Hyampom Valley Weir to capture adult steelhead should be discontinued due to high bed-load movement during storm events. All adult steelhead tagging should be carried out at the Sandy Bar Weir.

2. While the creel survey showed low angler harvest of the SFTR basin steelhead stocks during Fiscal Year (FY) 1989-90, the creel survey should continue during FY 1990-91 to document angler harvest and as a means of adult steelhead tag recovery.

3. Adult steelhead spawner surveys should begin by 1 March on streams tributary to the South Fork Trinity River and Hayfork Creek, weather permitting.

4. Electrofishing to recover adult steelhead was found to be labor intensive and unproductive. Electrofishing efforts should be discontinued.

5. The operation of the Alaskan weir and traps in the Hayfork Creek drainage to capture emigrant, post-spawning adult steelhead was effective and should continue. Next year, a similar weir should be installed in the upper SFTR drainage above Hayfork Creek, if a suitable site can be located.

6. Juvenile out-migrant steelhead traps need to be thoroughly evaluated by marking and releasing groups of Age 0+ and 1+ steelhead and chinook salmon above the trapping sites, and using mark recovery data to assess trapping success.

7. Juvenile steelhead habitat utilization studies should continue next year, with studies conducted both in the spring as well as the fall to compare seasonal habitat use.

8. Steelhead life history studies through scale analysis should continue next year with continued emphasis on the juvenile freshwater phase of the scale using the OPRS.

TABLE 11. Fork lengths and circuli counts of juvenile steelhead collected during the 1989-90 season, stratified by age and collection location.

Collection location	Age	Sample size	Circuli count			Fork length (mm)	
			Mean	Range	S.D.	Mean	Range
	0+	86	10	6-15	3.4	74	58-93
SFT[a]	1+	91	19	11-34	4.6	104	85-169
	2+	7	34	27-41	4.9	176	153-193
	0+	120	8	5-13	5.9	67	58-85
HFC[b]	1+	62	19	10-36	4.9	107	80-153
	2+	0	--	--	--	--	--
	0+	80	9	4-16	3.2	68	59-84
DIV[c]	1+	14	22	12-30	5.7	121	87-150
	2+	4	37	22-46	9.0	209	166-248
	0+	286	10	4-16	2.5	76	58-93
All sites	1+	167	19	10-36	5.8	107	80-169
	2+	11	35	22-46	7.1	188	153-248

a/ South Fork Trinity River above the mouth of Hayfork Creek.
b/ Mouth of Hayfork Creek in Hyampom Valley.
c/ Steelhead recovered in irrigation diversions within Hayfork Valley.

9. We should determine whether tagging weirs are our only means of assessing steelhead run-size and run-timing. Unpredictable weather and high river flows make weir operations in the winter impossible during most normal water years. Since our weirs cannot be operated under high flow conditions, we may not be able to monitor the entire run.

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

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

a Eight Day week in each year which is divisible by 4.

b Eight day week every year.

ANNUAL REPORT
TRINITY RIVER BASIN SALMON AND STEELHEAD MONITORING PROJECT
1989-1990 SEASON

CHAPTER IV

JOB IV
RUN-SIZE, ANGLER HARVEST, AND SPAWNER ESCAPEMENT OF CHINOOK AND COHO SALMON IN THE TRINITY RIVER BASIN

by

Bill Heubach, Michael Lau, and Morgan Boucke

ABSTRACT

The California Department of Fish and Game's Trinity River Project conducted tagging and recapture operations from June 1989 through April 1990 to obtain chinook and coho salmon run-size, in-river harvest, and spawning 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 1,575 spring-run and 1,933 fall-run chinook salmon (*Oncorhynchus tshawytscha*), and 1,131 coho salmon (*O. kisutch*).

Based on tagged fish recovered at Trinity River Hatchery and on the return of reward tags by anglers, we estimate 26,306 spring chinook salmon migrated into the Trinity River basin upstream of Junction City Weir and that 2,630 (10.0%) were caught by anglers, leaving 23,676 fish as potential spawners. We estimate 46,622 fall-run chinook salmon migrated past Willow Creek Weir and that 29,716 of these fish continued up the Trinity River past Junction City Weir. Anglers harvested an estimated 3,263 (7.0%) of the fall-run chinook salmon that passed Willow Creek Weir, leaving 43,359 fish as potential spawners.

The coho salmon run in the Trinity River basin upstream of Willow Creek Weir was 18,752 fish of which 12,625 continued their migration past Junction City Weir. Anglers harvested an estimated 300 (1.6%) of the coho salmon that migrated by Willow Creek Weir, leaving 18,452 fish as potential spawners.

JOB OBJECTIVES

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

2. To determine the angler harvest and spawning escapement of Trinity River chinook and coho salmon.

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 in the main-stem Trinity River. This effort determined the composition (species, race, & proportion of marked[1/] or tagged[2/] fish), distribution, and timing of the chinook and coho salmon 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 run.

This is a continuation of studies that began in 1977 with the trapping, tagging, and recapture of fall-run chinook (fall chinook) and coho salmon (coho) 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).

The earlier studies were funded by the U.S. Bureau of Reclamation (USBR) and Anadromous Fish Act funds administered by the National Marine Fisheries Service. Funding for the present program was through the Anadromous Fish Act monies from 1 July through 30 September 1989 and the USBR (PL 98-541) from 1 October 1989 through 30 June 1990.

Prior to the current program, all efforts to measure salmon and steelhead populations in the Trinity River basin had been restricted to various portions of the upper main stem Trinity River and certain of its tributaries, and/or the South Fork Trinity River and 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 use the main stem and tributaries of the lower Trinity River or attempt to determine the proportion of hatchery fish in the runs and the rates at which various runs contribute to the fisheries. To develop a comprehensive management plan for the Trinity River basin, all salmon runs utilizing the

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1/ Marked = adipose fin-clipped and coded-wire tagged (Ad+CWT) hatchery produced fish.

2/ Spaghetti tags applied by CDFG personnel.

basin must be considered.

METHODS

Trapping and Tagging

Trapping Locations and Periods

Trapping and tagging operations were conducted by TRP personnel at two temporary weirs in the main stem Trinity River. The downstream site, Willow Creek Weir (WCW), was located 6.7 km upstream of the town of Willow Creek, 46.8 km upstream of the Trinity River's confluence with the Klamath River, and 132.0 km downstream from Trinity River Hatchery (TRH) (Figure 1). The upstream site, Junction City Weir (JCW), was located 6.4 km upstream of the town of Junction City, 136.4 km upstream from the Klamath River confluence, and 42.4 km downstream of TRH (Figure 1).

The WCW is used to obtain run-size and angler harvest estimates of fall chinook and coho in the Trinity River basin 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 relatively high spring flows. We continued to operate the JCW through December to obtain run-size estimates of fall chinook and coho in the upper Trinity River basin.

We trapped at the JCW from 4 June through 20 December 1989, except from 3 through 9 September and 23 October through 5 November when high flows or flow-induced weir damage prevented operation. We trapped at the WCW from 22 August through 20 October 1989 when storms caused high flows which severely damaged the weir and forced its removal for the season.

At both sites, we attempted to fish four nights per week, from approximately mid-afternoon on Monday through noon on Friday. We trapped and tagged fish only at water temperatures <21 °C to avoid severely stressing the fish.

Weir and Trap Design

We used the Bertoni (Alaskan) weir design at both weir sites (Figure 2). The weir was supported by wooden tripods set 2.4 m apart. The weir panels were composed of 2.4-m X 2.54-cm (8-ft. X 1-in.) electrical conduit with the centers spaced 5.4 cm apart. The conduit was supported by three pieces of aluminum channel arranged 0.92 m apart, that connected to the supporting tripods. We anchored the tripods with 1.8-m stakes driven into the stream bottom. The weir conduits were angled, with the top of the weir standing 1.8 m above the river bottom (Figure 2).

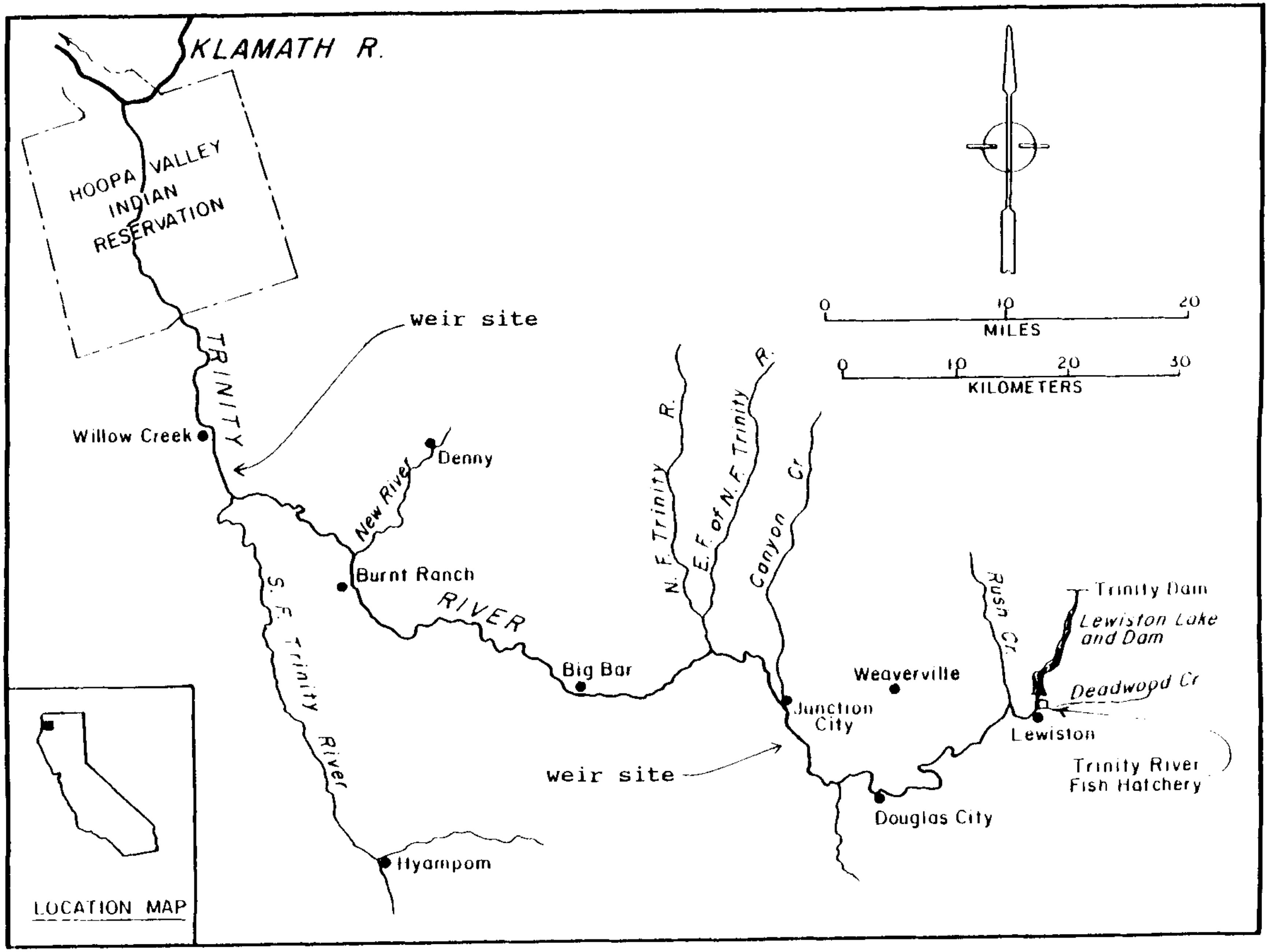

Figure 1. Locations of trapping and tagging weirs for anadromous salmonids near ' llow Creek and Junction City on the main stem Trinity River.

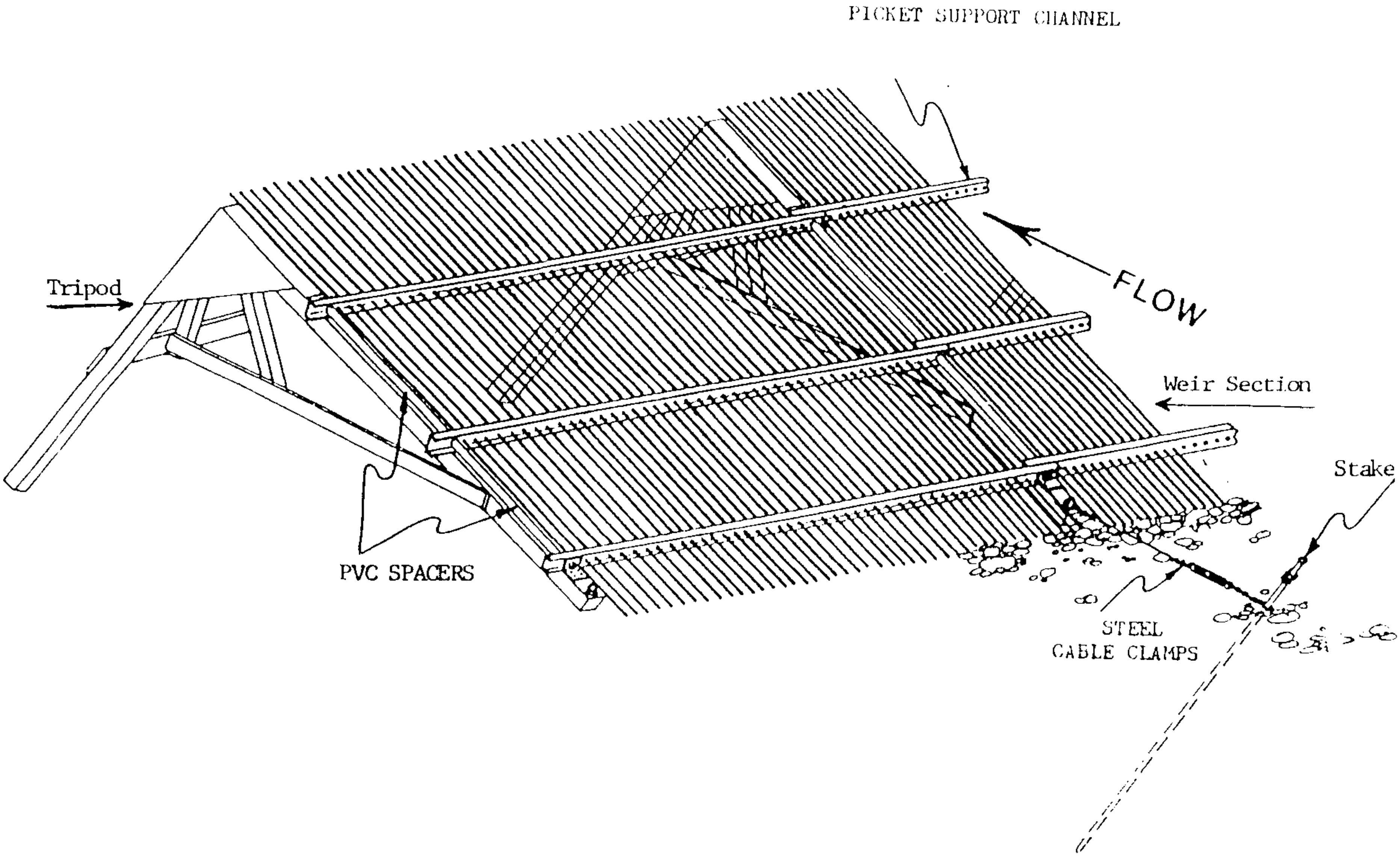

Figure 2. Schematic diagram of an Alaskan weir section, showing the arrangement of the tripod and weir paneling, as used on the Trinity River during the 1989-90 season.

The weir guided fish toward a fyke leading to a trap which measured 2.4 m square and 1.2 m high and was covered with wood panels to prevent the fish from jumping out of the trap. The trap sides and fyke leading into the trap consisted of 2.54-cm (1.0-in.)electrical conduit welded into panels. The conduit centers were spaced 5.4 cm apart, the same space as the weir panels. The trap entrance was created by elevating the weir conduit allowing fish to enter the fyke and trap.

Processing of Fish

At both weirs, we identified all trapped salmonids to species, measured them to the nearest cm of fork length (FL), and examined them for hook and gill-net scars, hatchery marks (fin clips), and tags. All untagged salmonids judged not to be moribund or to have spawned were tagged with a serially numbered FT-4[3/] spaghetti tag (Project-tagged). To determine angler harvest rates, 33% of the taggable spring chinook from JCW, and 22% of the taggable fall chinook and 27% of the taggable coho from WCW were systematically tagged with a $10-reward version of the spaghetti tag. Remaining fish received a non-reward version of the spaghetti tag. All spaghetti tags (both reward and non-reward) applied at WCW were brown, whereas all those applied at JCW were blue.

To determine tag shedding rates, we removed one-half of the left ventral fin from approximately every third spring chinook tagged at JCW. We gave all fall chinook and coho tagged at WCW a single 6.4-mm (0.25-in) puncture through the opercle bone of the left operculum, while those tagged at JCW received two punctures in the same area. We released all fish at their respective capture sites immediately after processing.

Separation of Spring- and Fall-run Chinook Salmon at the Weirs

Each year there is a temporal overlap in the annual spring and fall chinook salmon runs in the Trinity River. Since the timing of each run varies among years, we assign a specific date each season separating the two runs so that numbers of spring and fall chinook can be determined for the run-size and angler harvest estimates. In 1989, we selected the date separating the runs based on changes in the ratio of spring to fall chinook of hatchery origin which were spaghetti tagged at the weirs, and later recovered dead during the salmon spawner survey or at TRH. Only doubly tagged fish (Project-applied spaghetti tag and hatchery-applied coded-wire tag) were used for this evaluation. The race of these fish and the specific date that they were caught at the weirs could be identified because they were both coded-wire tagged (CWT) and Project-tagged fish, respectively. We also used the fish's

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3/ References to specific brand name equipment or supplies does not imply their official endorsement by the CDFG.

coloration as a subjective indicator of the length of time it had been in the river. During the transition period of the run from spring to fall chinook, dark colored fish were considered to be late-migrating spring chinook, while bright colored fish were considered to be recently migrating fall chinook. We determined that the spring run was over at both weirs when bright-colored fish clearly outnumbered dark-colored fish and carcass recoveries of double tagged fish (Project-tagged and CWT) indicated that fall chinook dominated the run.

Separation of Spring- and Fall-run 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 entering TRH, we expanded the numbers of tags recovered from each returning CWT group by the ratio of CWT to untagged chinook salmon that occurred when they were originally released (same strain, brood year, release site, and date). For example, 100,320 fall chinook of CWT code 6-56-27, plus 735,955 unmarked fall chinook were released directly from TRH in September 1987. Since there were 7.34 unmarked chinook salmon released for every CWT chinook salmon released (735,955 unmarked/100,320 marked = 7.34), we multiplied the total number of chinook salmon of CWT group 6-56-27 by 7.34 to estimate the number of the unmarked fish of that release group that returned to TRH each day. We assumed that return rates of both CWT and unmarked salmon 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 spring-run or fall-run fish in the same proportions that were determined by the expansion of the CWT groups.

Separation of 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, evaluated against length data obtained from groups of CWT fish that entered TRH whose exact age was known. Daily chinook salmon FL data from TRH was assigned to either spring or fall chinook when the CWT extrapolations indicated $\geq$90% of the chinook entering TRH were either spring-run or fall-run fish. Daily FL data from TRH was not used when CWT extrapolations indicated the chinook salmon entering TRH were <90% of a specific run.

The length data collected at the weirs and TRH were smoothed with a moving average of five, 1-cm FL increments to determine the nadir separating grilse and adults. In the 1989-90 season, no coho grilse were trapped at either weir so we based the coho grilse vs.

adult separation on length frequency data from those fish entering TRH.

Recovery of Tagged Fish

River Surveys

As part of the JCW operations, we surveyed the river by raft each week from June through August to recover dead salmonids. We surveyed a 12.1 km stretch from the Douglas City Camp at river km 148.5 downstream to the weir at river km 136.4. We examined dead salmonids for tags, fin clips, sex, spawning condition, and measured them to the nearest cm FL. Heads of adipose fin-clipped (hatchery-marked) fish were removed for recovery of the CWT. After examination, the carcasses were cut in half to prevent recounting. We did not survey the river between WCW and JCW in 1989, because we saw few dead fish at WCW. All tagged and untagged salmonids recovered dead at both weirs were examined and processed similarly to those on the river survey.

Tagging Mortalities

We defined all tagged salmonids recovered dead within 30 days (d) after tagging, which had not spawned, as tagging mortalities. Tagged fish that had spawned, regardless of the number of days after tagging they were recovered, and those recovered dead >30 d after tagging were not considered tagging mortalities.

Angler Tag Returns

We used Project tags returned by anglers to assess sport-harvest rates. If not provided with the original tag return, we requested anglers to provide the date and location of their catch in a follow-up thank-you letter. The letter informed them of the fish's tagging date and location.

Salmon Spawner Surveys

The Trinity Fisheries Investigations Project (TFIP), another element of the CDFG's Klamath-Trinity Program, conducted salmon spawner surveys in the main stem Trinity River and its spawning tributaries from Lewiston to the confluence of, and including the North Fork Trinity River, from 18 September 1989 to 14 January 1990 (Figure 1). TFIP personnel routinely provided us records of the species, tag number, date, and recovery location of Project-tagged fish.

Trinity River Hatchery

The TRH fish ladder was opened from 8 September 1989 through 17 March 1990. Hatchery personnel conducted fish sorting and spawning operations two to three days per week depending on the numbers of fish entering per day. We considered the initial day a fish was observed during sorting as the day it entered the hatchery.

On sorting days, salmon entering TRH were identified to species, sexed, and examined for tags, fin clips, and the secondary tagging mark. We measured all marked salmon to the nearest cm FL, except those that were Project-tagged fish from the weirs. We took FL measurements on 38% and 93% of randomly selected, unmarked chinook and coho salmon, respectively. Project-tagged salmon recovered at TRH were assigned the original FL recorded for them at the weir where they were originally tagged. Salmon with a secondary tagging mark but no tag were measured to the nearest cm FL and sexed. At the end of the season, we assigned these secondarily marked salmon which had shed their tags, a tag number from a fish of the same species, FL, and sex that had been captured at the same weir where they were originally tagged.

We removed the heads of hatchery-marked (Ad+CWT) salmon and placed them in zip-lock bags with serially numbered tabs noting the date and location of recovery, species, sex, and FL. Salmon heads were given to the CDFG's Ocean Salmon Project for tag recovery and decoding. The Ocean Salmon Project provided us with a computer file of CWTs recovered for editing and analysis.

Statistical Analyses

Effectively Tagged Fish

We estimated the numbers of 'effectively tagged' fish by subtracting tagging mortalities of unspawned fish recovered at the weirs and in the river surveys, dead tagged fish reported by anglers, and tagged fish recovered or reported downstream of the tagging site from the total numbers of each species tagged at the respective tagging sites.

Run-size Estimates

We determined the run-size estimates for salmon migrating into the Trinity River basin above WCW and JCW in 1989-90 by using Chapman's version[4/] of the Petersen Single Census Method (Ricker 1975):

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

N = estimated run size, M = the number of 'effectively tagged' fish, C = the number of fish examined at TRH, and R = the number of tags recovered (including fish with a secondary tagging mark and no tag) in the hatchery sample.

4/ Chapman, D.G. 1951. Some properties of the hypergometric distribution with applications to zoological sample censuses. Univ. Calif. Publ. Stat. 1:131-160.; as cited in Ricker (1975).

We attempted to effectively tag and recover enough tagged fish to obtain 95% confidence limits of ±10% of the run-size estimate. Confidence limits were determined according to the criteria established by Chapman (1948). In this analysis, the type of confidence interval estimate used is based on the number of tags recovered and the ratio of tagged to untagged fish in the recovery sample.

For the run-size estimate, we assumed 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 (entering TRH); 3) all Project tags and secondary tag marks 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 recovered all tagging mortalities.

Angler Harvest Rates

Only the $10 reward tags returned by anglers were used to determine angler harvest rates. The angler harvest rate estimate was the number of reward tags returned by anglers divided by the number of effectively reward-tagged fish released.

The assumptions for the numbers of effectively reward-tagged fish released was the same as those for determining the run-size estimate (See Run-size Estimates, above). In addition, the number of effectively reward-tagged fish released was corrected for tag shedding by multiplying that total by the percentage of tagged fish recovered at TRH that had not shed tags.

The confidence limits surrounding the point harvest rate estimate was determined by tables for the binomial distribution. We attempted to effectively reward tag enough fish to obtain 95% confidence limits of ≤ ±5.0% of the angler harvest estimate.

Angler Harvest Estimates

We estimated the numbers of spring chinook upstream of JCW, and fall chinook and coho upstream of WCW harvested by anglers by multiplying the run-size estimate above the respective weir site by the harvest rate estimate.

The absolute numbers of fall chinook and coho harvested by anglers in the Trinity River upstream of JCW were determined by multiplying the percentages of all Project-tagged fish that were reported as being caught upstream of the JCW by the total angler harvest estimates upstream of WCW[5/].

5/ Number (#) of fish harvested by anglers above WCW x (# of Project-tagged fish caught above JCW/total # of Project-tagged fish caught)

Other Analyses

The mean FLs of samples were compared statistically using a Student's t-test. We analyzed the percentages or ratios of adults and grilse, and marked and unmarked fish (etc.) in samples by Chi-square. A continuity correction (Yates correction) was used for contingency tables of one degree of freedom (Dixon and Massey 1969).

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 7-day periods, beginning 1 January, regardless of the day of the week on which 1 January falls. The extra day in leap years is lumped into the 9th week and the last day of the year into the 52nd week. This procedure allows interannual comparisons of similar 7-day periods (Appendix 1).

RESULTS AND DISCUSSION

Trapping and Tagging

Spring-run Chinook Salmon

Run Timing. We captured 150 spring chinook salmon during the first night of trapping at JCW, indicating the run was well underway on 4 June, when trapping began. Over 300 chinook were trapped the first and third weeks of the survey, but catches declined by the fifth week (Table 1). The spring run at JCW appeared to peak during JW 25 (18-24 June), then catches generally declined through the end of the run in JW 37 (10-16 Sept.) (Figure 3). We trapped 1,512 spring chinook salmon at JCW during the 1989-90 season.

The high initial catches at JCW during the first week of trapping may have been due to reaction of the spring chinook to a sudden decrease in discharge below Lewiston Dam from approximately 56.7 m/s that occurred through 23 May, to 28.4 m/s through 29 May, and down to 9.9 m/s in June, when trapping began. Spring chinook in the Trinity River apparently migrate faster in response to lower flows or coincident higher water temperatures and decrease their migration rate during higher flows resulting in generally lower water temperatures (Schaffter, Heubach and Hubbell, 1979, Heubach 1984).

Only 63 spring chinook were trapped at WCW, and represent fish that remained in the Klamath or lower Trinity rivers during the summer (Table 1), since they had the darkened coloration which indicated they had been in freshwater for some time.

Table 1 Weekly summary of spring-run and fall-run chinook salmon trapped in the Trinity River at Junction City and Willow Creek weirs during the 1989-90 season.

	Junction City Weir a/					Willow Creek Weir b/				
		Numbers trapped					Numbers trapped			
Julian week	Nights trapped	Grilse	Adults	Total	Fish/ night	Nights trapped	Grilse	Adults	Total	Fish/ night
					Spring-run chinook c/					
23 6/4-6/10	4	0	304	304	76.0					
24 6/11-6/17	4	0	115	115	28.8					
25 6/18-6/24	4	1	305	306	76.5					
26 6/25-7/1	4	3	219	222	55.5					
27 7/2-7/8	4	0	68	68	17.0					
28 7/9-7/15	4	1	89	90	22.5					
29 7/16-7/22	4	8	64	72	18.0					
30 7/23-7/29	4	5	83	88	22.0					
31 7/30-8/5	4	0	40	40	10.0					
32 8/6-8/12	4	2	81	83	20.8					
33 8/13-8/19	4	4	48	52	13.0					
34 8/20-8/26	4	1	41	42	10.5	4	3	44	47	11.8
35 8/27-9/2	4	2	13	15	3.8	1	0	16	16	16.0
36 9/3-9/9	0	-	-	-	-					
37 9/10-9/16	4	1	14	15	3.8					
Sub-total	56	28	1,484	1,512		5	3	60	63	
Mean					27.0					12.6
					Fall-run chinook d/					
35 8/27-9/2	-	-	-	-	-	3	7	52	59	19.7
36 9/3-9/9	-	-	-	-	-	3	10	93	103	34.3
37 9/10-9/16	-	-	-	-	-	4	39	313	352	88.0
38 9/17-9/23	4	1	15	16	4.0	3	10	452	462	154.0
39 9/24-9/30	4	2	54	56	14.0	4	4	214	218	54.5
40 10/1-10/7	4	7	115	122	30.5	4	13	86	99	24.8
41 10/8-10/14	4	5	236	241	60.3	4	3	60	63	15.8
42 10/15-10/21	4	1	84	85	21.3	4	4	32	36	9.0
43 10/22-10/28	0 e/	-	-	-	-					
44 10/29-11/4	0 e/	-	-	-	-					
45 11/5-11/11	4	0	7	7	1.8					
46 11/12-11/18	4	1	8	9	2.3					
47 11/19-11/25	4	0	4	4	1.0					
48 11/26-12/2	4	0	0	0	0.0					
49 12/3-12/9	4	0	0	0	0.0					
50 12/10-12/16	4	0	1	1	0.3					
51 12/17-12/20	3	0	0	0	0.0					
Sub-total	47	17	524	541		29	90	1,302	1,392	
Mean					11.5					48.0
GRAND TOTAL	103	45	2,008	2,053		34	93	1,362	1,455	
COMBINED MEAN					19.9					42.8

a/ Trapping at Junction City Weir took place from Julian Week 23 (4 June) through Julian Week 51 (20 December) of 1989.
b/ Trapping at Willow Creek Weir took place from Julian Week 34 (21 August) through Julian Week 42 (20 October) of 1989.
c/ Spring-run chinook salmon grilse are <48 cm FL, adults are >48 cm FL.
d/ Fall-run chinook salmon grilse are <52 cm FL, adults are >52 cm FL.
e/ Junction City Weir was unfishable due to high flows and weir damaage.

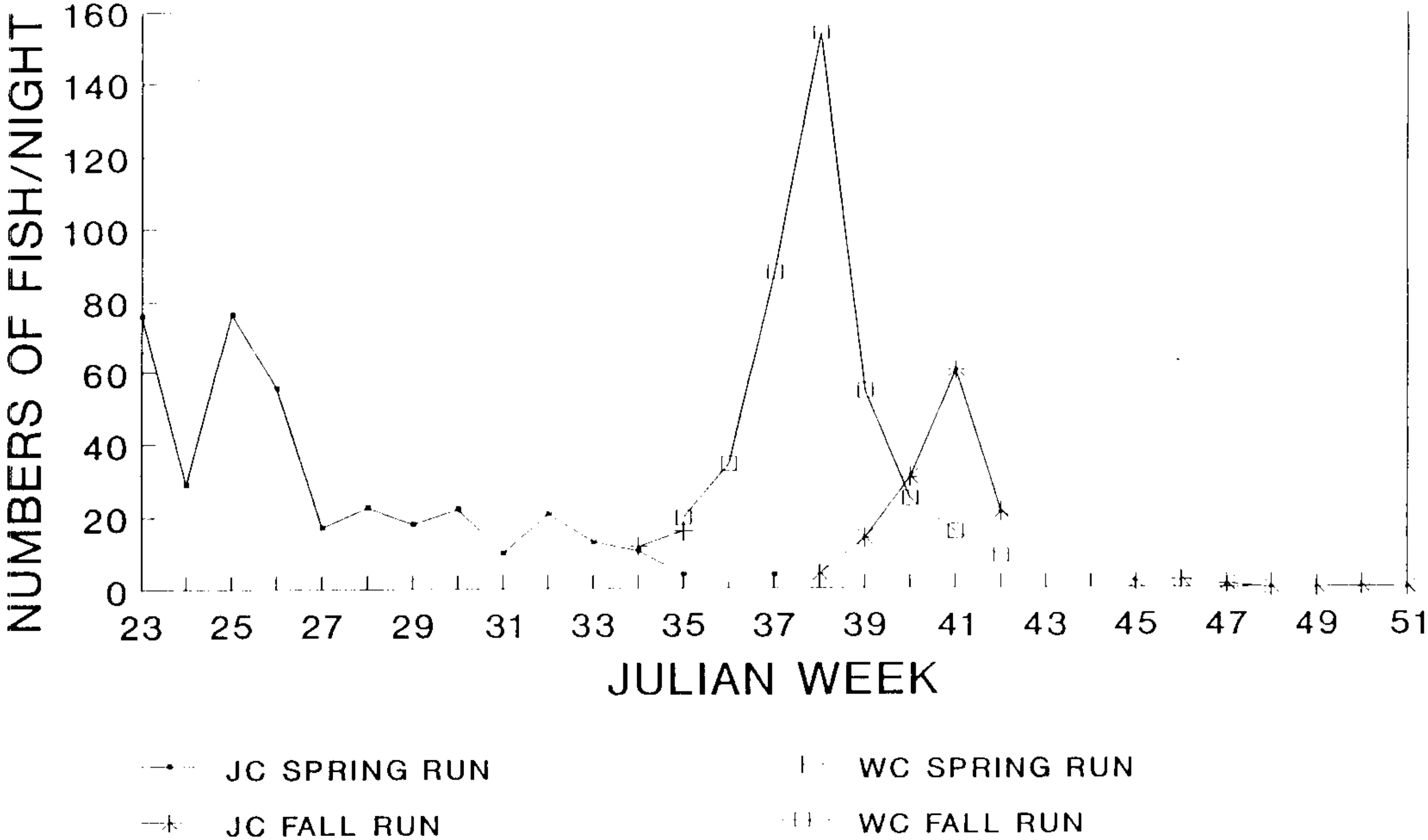


Figure 3. Numbers of spring- and fall-run chinook salmon trapped per night in the Trinity River at Junction City (JC) and Willow Creek (WC) weirs during the 1989-90 season. Trapping at Junction City Weir took place from Julian Week 23 through 51, except for Julian Weeks 36, 43 and 44. Trapping at Willow Creek Weir took place from Julian Week 34 through 42.

Size of Trapped Fish. The size of spring chinook trapped at JCW ranged from 41 to 92 cm FL, averaging 67.6 cm FL, while those trapped at WCW ranged from 44 to 83 cm FL and averaged 69.5 cm FL (Table 2). The difference in the mean size of spring chinook trapped at the two weirs was not statistically significant (t=1.8, p=.09).

The nadir in the length frequency separating grilse and adult spring chinook trapped at JCW appeared to be 48 cm FL (Figure 4). Too few grilse were trapped at WCW to distinguish the nadir. However, 48 cm FL is the size separating known-age, hatchery-marked (Ad+CWT) grilse and adult spring chinook that entered TRH. For the 1989-90 season, we considered spring chinook in the Trinity River basin ≤48 cm FL to be grilse, while adults were >48 cm FL. During the 1989-90 season, only 28 or 1.6% of the spring chinook trapped at JCW and three (4.7%) of those trapped at WCW were grilse (Table 2). Too few fish were tagged at WCW to test for differences between sites in the ratio of grilse to adults.

Incidence of Tags and Hatchery Marks. Tagging operations in the lower Klamath River and at WCW did not begin until the spring run was essentially past JCW. Consequently, no tagged fish from these sites were recaptured at JCW during the spring run of 1989.

We trapped 198 hatchery-marked (Ad+CWT) spring chinook at JCW in 1989, which comprised 13.1% of all the fish caught there. The mean FL of the hatchery-marked fish was 68.1 cm, similar to the mean for all spring chinook (Table 2).

Only five (7.9%) of the 63 spring chinook trapped at WCW during the 1989-90 season were hatchery-marked fish, and all were adults, as at JCW (Table 2).

Forty-eight hatchery-marked spring chinook, representing four CWT groups, were spaghetti-tagged at JCW and subsequently recovered either dead in the spawning survey, or at TRH. All but seven of them were fish from the 1985 or 1986 BYs which had been released as yearlings (Table 3). Two fish that had shed their CWT were also recovered.

Two hatchery-marked spring chinook, which were spaghetti-tagged at WCW and subsequently recovered in the spawner survey, were from the 1986 BY and had been released as yearlings (Table 3).

Incidence of Gill-net and Hook Scars. Two hundred seventeen (14.4%) of the spring chinook trapped at JCW had gill-net scars. These fish ranged in size from 53 to 82 cm FL and averaged 67.2 cm FL, similar to the average for all spring chinook trapped at JCW (67.6 cm).

We attempted to evaluate the tagging mortality rates of gill-net scarred and non-gill-net-scarred spring chinook to determine if the

Table 2. Fork lenghts of spring-run chinook salmon trapped and tagged in the Trinity River at Junction City and Willow Creek weirs, and recovered at Trinity River Hatchery during the 1989-90 season.

	Junction City Weir a/				Willow Creek Weir b/			
Fork length (cm)	Total trapped	Ad-CWT c/	Effectively d/ tagged	TRH e/ recovery	Total trapped	Ad-CWT c/	Effectively d/ tagged	TRH e/ recovery
41	3		3					
42	3		3					
43	4		4	1				
44	4		3	0	1		1	
45	2		2	1	0		0	
46	6		6	0	1		1	
47	3		3	1	0		0	
48	3		3	1	1		1	
49	4		4	1	0		0	
50	4		4	0	0		0	
51	3		7	2	0		0	
52	3		3	1	0		0	
53	9	3	9	2	0		0	
54	15	1	13	4	0		0	
55	26	3	26	13	1		1	
56	17	2	16	2	0		0	
57	37	6	37	10	0		0	
58	41	9	38	9	2		2	
59	44	7	42	9	1		1	
60	49	6	46	11	0		0	
61	53	8	50	17	3		3	1
62	52	8	51	13	1		1	0
63	43	5	41	12	4		4	0
64	55	6	50	10	3		3	1
65	69	10	65	8	3		3	1
66	76	12	67	12	4		4	0
67	67	8	63	11	1		1	0
68	77	9	73	9	3		3	0
69	70	9	67	11	1	1	1	0
70	76	9	69	8	0	0	0	0
71	81	8	73	11	4	1	4	1
72	77	12	74	12	4	0	3	0
73	72	12	65	9	1	0	1	1
74	86	10	81	13	3	0	3	2
75	44	2	40	6	2	0	2	0
76	50	5	47	9	2	1	2	0
77	48	7	46	4	4	0	4	1
78	39	6	36	7	2	0	2	0
79	22	2	18	0	3	0	3	0

(continued on next page)

Table 2. Fork lenghts of spring-run chinook salmon trapped and tagged in the Trinity River at Junction City and Willow Creek weirs, and recovered at Trinity River Hatchery during the 1989-90 season (continued).

Fork length (cm)	Junction City Weir a/ Total trapped	Ad-CWT c/	Effectively d/ tagged	TRH e/ recovery	Willow Creek Weir b/ Total trapped	Ad-CWT c/	Effectively d/ tagged	TRH e/ recovery
80	16	2	16	2	1	0	1	0
81	12	4	12	1	3	1	3	1
82	10	1	10	1	2	1	2	2
83	5	1	5	3	1		1	
84	4	0	3	0				
85	5	2	4	2				
86	6	1	5	0				
87	7	0	7	1				
88	3	1	2	0				
89	0	0	0	0				
90	1	1	1	0				
91	0		0	0				
92	1		1	1				
TOTALS	1,512	198	1,414	268	63	5	61	11
Mean FL	67.6	68.1	67.6	66.2	69.5	75.8	69.2	73.1
Grilse f/	28	0	27	4	3	0	3	0
Adults	1,484	198	1,387	264	60	5	58	11

a/ Trapping at Junction City Weir took place from Julian Week 22 (4 June) through Julian Week 51 (20 December) of 1989. Only chinook salmon trapped through 16 September are considered spring-run chinook. See Table 4 for fork lenghts of chinook salmon trapped after 16 September.

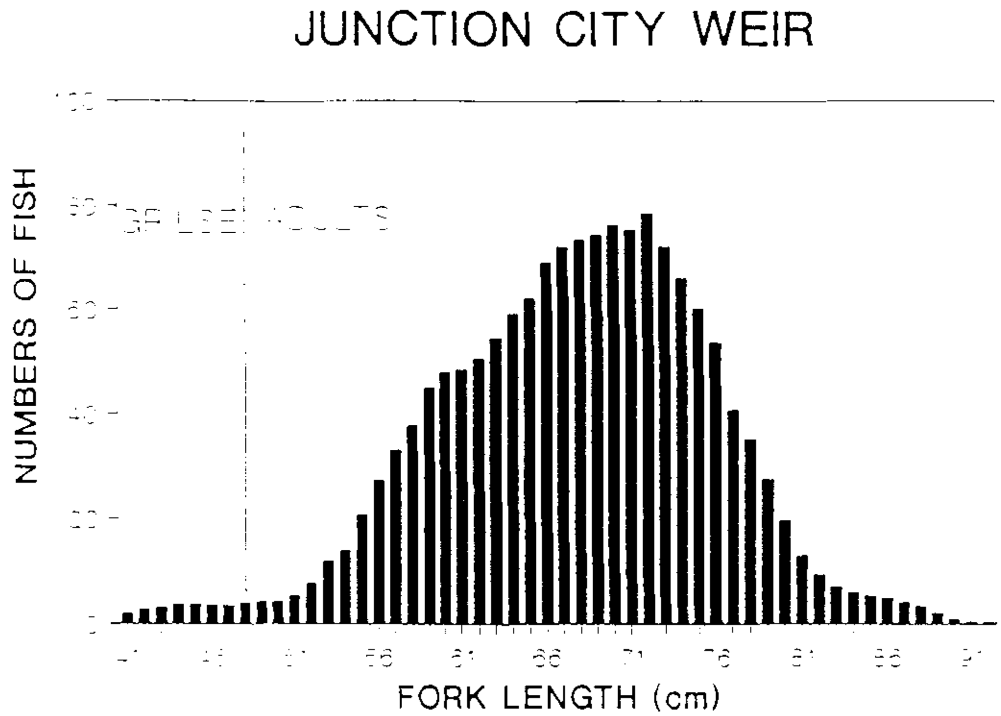
b/ Trapping at Willow Creek Weir took place from Julian Week 34 (22 August) through Julian Week 42 (20 October) of 1989. Only chinook salmon trapped through 29 August are considered spring-run chinook. See Table 4 for fork lengths of chinook salmon trapped after 29 August.

c/ Coded-wire tagged and released from Trinity River Hatchery during previous years.

d/ Corrected for fish not tagged and tagging mortalities.

e/ Trinity River Hatchery.

f/ Spring-run chinook salmon grilse are <48 cm FL; adults are >48 cm FL.



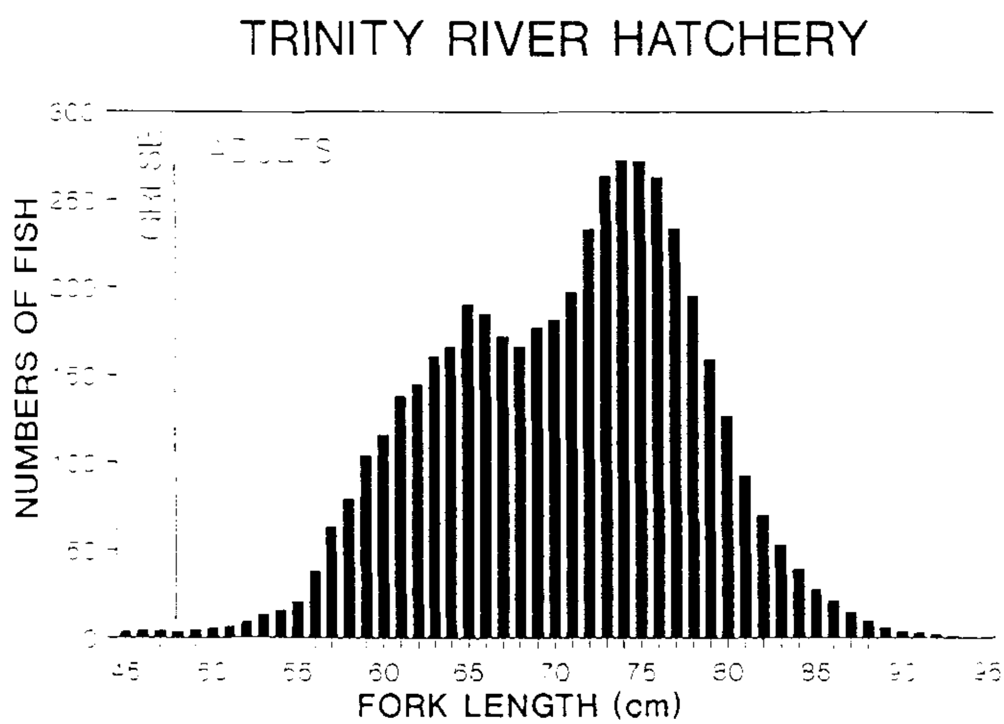


Figure 4. Fork lengths of spring-run chinook salmon trapped in the Trinity River at Junction City Weir from 4 June through 16 September 1989, and that entered Trinity River Hatchery from 8 through 28 September 1989. The FLs are smoothed by a moving average of five, 1-cm size increments. The line points to the nadir at 48 cm FL separating grilse and adult spring-run chinook salmon.

TABLE 3. Release and recovery data of Trinity River Hatchery-produced coded-wire-tagged chinook and coho salmon that were trapped and tagged in the Trinity River at Junction City and Willow Creek weirs, and recovered on spawning surveys or at Trinity River Hatchery during the 1989-90 season.

Release data						Tagging site	
CWT a/ number	Brood year	Species/race	Date	Release age b/	Number	Willow Creek Weir	Junction City Weir
6-61-43	84	Spring-run chinook	10/02/85	Y	99,586	0	0
6-61-42	85	Spring-run chinook	06/02/86	F	192,437	6	0
6-61-44	85	Spring-run chinook	10/03/86	Y	101,091	20	0
6-61-45	86	Spring-run chinook	05/28/87	F	197,113	1	0
6-61-46	86	Spring-run chinook	09/24/87	Y	101,030	21	2
6-61-47	87	Spring-run chinook	05/23/88	F	185,718	0	0
Shed tag c/						2	0
6-61-27	84	Fall-run chinook	06/10/85	F	189,708	0	0
6-61-28	84	Fall-run chinook	10/10/85	Y	97,070	0	0
6-61-24	84	Fall-run chinook	02/28/86	Y+	102,512	0	0
6-56-23	85	Fall-run chinook	06/19/86	F	196,249	0	0
6-56-25	85	Fall-run chinook	10/24/86	Y	97,368	8	2
6-56-26	86	Fall-run chinook	06/11/87	F	202,486	0	0
6-56-29	86	Fall-run chinook	06/11/87	F	99,118	0	2
6-56-30	86	Fall-run chinook	06/27/87	F	92,351	0	0
6-56-27	86	Fall-run chinook	09/21/87	Y	100,320	22	21
6-56-28	86	Fall-run chinook	09/24/87	Y	26,730	0	1
6-63-10	86	Fall-run chinook	02/29/87	Y+	26,650	0	0
6-56-33	87	Fall-run chinook	06/02/88	F	172,980	0	0
6-56-31	87	Fall-run chinook	10/28/88	Y	93,300	0	0
Shed tag c/						3	1
6-56-56		Coho	03/08/88	Y+	57,721	11	29
						0	4
TOTAL						46	110

a/ Coded-wire tag.

b/ Y=yearling, F=fingerling, Y+=yearling plus.

c/ No tag was recovered from the fish.

added stress of the trapping and tagging process affected the survival of gill-net scarred fish. We recovered the carcasses of 6.7% (14/207) of the gill-net scarred and 3.0% (38/1,259) of the non-gill-net-scarred spring chinook tagged at JCW during the 1989-90 season. The difference in the carcass recovery rates of gill-net scarred and non-gill-net-scarred fish was statistically significant (X^2=4.1, p=0.04), and may imply that the added stress of the trapping and tagging process adversely affected the survival of spring chinook which had previously encountered a gill net.

The recovery rate at TRH of effectively tagged, gill-net scarred (18.6%) and non-gill-net-scarred (18.2%) spring chinook was essentially the same, after correcting for initial tagging mortality. Therefore, the survival of gill-net scarred spring chinook salmon after the initial tagging mortality, was similar to non-gill-net-scarred fish in 1989.

Seventy-four (4.9%) of the spring chinook trapped at JCW had hook scars, 30 (2.0%) were healed scars indicating they were from the ocean fishery, and 44 (2.9%) were fresh scars probably acquired in the freshwater fishery. Spring chinook with ocean hook scars averaged 70.4 cm FL, and those with freshwater hook scars averaged 69.8 cm FL, both similar to the mean Fl of all spring chinook trapped at JCW (67.6 cm FL).

Fall-run Chinook Salmon

Run Timing. The 1989 fall chinook run appeared to start at WCW on 30 August (JW 35). Fall chinook catches increased gradually each week, peaked JW 38 (17-23 Sept.), and gradually decreased through JW 42 (15-21 Oct.), when the weir was washed out (Table 1) (Figure 3). We trapped 1,392 fall chinook at WCW during the 1989-90 season.

The fall run began at JCW during JW 38, three weeks after it began at WCW. Catches of fall chinook gradually increased each week and peaked JW 41 (7-14 Oct.), again, three weeks after the peak at WCW (Figure 3), then decreased substantially during JW 42. When we resumed trapping operations at JCW during JW 45 (5-11 Nov.), after the late October storms, the major portion of the fall run had passed the weir site (Figure 3). The last fall chinook was trapped at JCW on December 12 (JW 49), about two weeks before the weir was removed for the season. We trapped 541 fall chinook at JCW during the 1989-90 season (Table 1).

Size of Fish Trapped. Fall chinook trapped at WCW ranged in size from 40 to 88 cm FL and averaged 65.4 cm FL (Table 4). Fall chinook captured at JCW ranged from 40 to 111 cm FL and averaged 65.9 cm FL, essentially the same as at WCW.

Table 4. Fork lengths of fall-run chinook salmon trapped and tagged in the Trinity River at Junction City and Willow Creek weirs, and recovered at Trinity River Hatchery during the 1989-90 season.

	Junction City weir a/				Willow Creek Weir b/			
Fork length (cm)	Total trapped	Ad-CWT c/	Effectively d/ tagged	TRH e/ recovery	Total trapped	Ad-CWT c/	Effectively d/ tagged	TRH e/ recovery
40	1		1		1		1	
41	1		1		0		0	
42	0		0		1		1	
43	0		0		2		2	
44	1		1		1		1	
45	1		1		4		4	1
46	2		2		8		8	0
47	2		2	1	11	1	10	0
48	1		1	0	14	0	13	0
49	1		1	0	17	1	17	2
50	0		0	1	12	1	12	0
51	3		0	0	8	0	7	0
52	4		4	1	11	1	11	2
53	0		0	0	10	0	10	4
54	5		4	1	10	0	9	1
55	3		3	0	13	0	12	3
56	9	1	8	4	23	1	21	5
57	9	0	9	4	31	2	31	9
58	12	2	12	3	54	3	53	16
59	17	1	16	8	64	5	63	22
60	34	3	33	12	58	5	57	20
61	35	4	33	13	48	7	47	15
62	36	4	35	13	93	9	92	28
63	44	4	43	21	98	4	94	22
64	39	3	37	16	85	5	84	31
65	30	2	29	10	73	6	70	19
66	28	0	28	10	67	4	67	19
67	32	1	31	12	63	7	62	15
68	24	4	23	10	62	6	60	10
69	26	7	25	13	56	1	55	17
70	14	1	14	8	33	3	33	7
71	14	2	13	4	40	3	37	7
72	18	3	17	5	49	3	47	10
73	13	1	13	6	35	3	35	7
74	8	0	8	4	40	6	37	5
75	19	1	17	2	32	0	31	2
76	7	0	7	1	34	2	32	6
77	9	1	9	3	38	0	37	6
78	8	0	7	0	25	0	25	5
79	4	1	4	4	18	2	18	4

(continued on next page)

Table 4. Fork lengths of fall-run chinook salmon trapped and tagged in the Trinity River at Junction City and Willow Creek weirs, and recovered at Trinity River Hatchery during the 1989-90 season (continued).

	Junction City Weir a/				Willow Creek Weir b/			
Fork length (cm)	Total trapped	Ad-CWT c/	Effectively d/ tagged	TRH e/ recovery	Total trapped	Ad-CWT c/	Effectively d/ tagged	TRH e/ recovery
80	7	0	6	3	11	2	11	2
81	5	1	5	2	8	1	8	2
82	5		5	2	6	0	6	1
83	3		3	1	8	0	8	1
84	1		0		7	1	7	2
85	2		1		4		4	1
86	1		1		2		2	1
87	0		0		1		1	
88	1		1		3		3	
89	0		0					
90	0		0					
91	1		1					
92	0		0					
-								
111	1		1					
TOTAL	541	47	519	198	1,392	95	1,356	328
Mean FL	65.9	66.2	65.8	65.7	65.4	65.6	65.4	64.9
Grilse f/	17	0	17	3	90	4	87	5
Adults	524	47	502	195	1,302	91	1,269	323

a/ Trapping at Junction City Weir took place from Julian Week 23 (4 June) through Julian Week 51 (20 December) of 1989. Only chinook salmon trapped after 16 September are considered fall-run chinook. See Table 2 for fork lenghts of chinook trapped through 16 September.

b/ Trapping at Willow Creek Weir took place from Julian Week 34 (21 August) through Julian Week 42 (20 October) of 1989. Only chinook salmon trapped after 29 August are considered fall-run chinook. See Table 2 for fork lengths of chinook trapped through 29 August.

c/ Coded-wire tagged and released from Trinity River Hatchery during previous years.

d/ Corrected for fish not tagged and tagging mortalities.

e/ Trinity River Hatchery.

f/ Fall-run chinook salmon grilse are <52 cm FL; adults are >52 cm FL.

The size separating grilse and adults was 52 cm FL at both weirs and TRH (Figure 5). Therefore, this season, we consider all fall chinook ≤52 cm FL to be grilse, and those >52 cm FL to be adults. Grilse comprised 6.5% (90/1,392) of the fall chinook trapped at WCW, but only 3.1% (17/541) of those trapped at JCW. However, the difference in the composition of grilse and adult fall chinook at the two weirs was not statistically significant (X^2=1.09, p=0.30).

Incidence of Tags and Hatchery Marks. Five fall chinook tagged by other CDFG projects at two locations in the lower Klamath River were recaptured at WCW. Two fish tagged at the Klamath River mouth were recaptured 12 d and 13 d after tagging. Three fish tagged at river km 5.1 were at liberty from 7 to 10 d, averaging 8 d. The mean migration rate for all five fish was 13.8 km/d.

Four fall chinook tagged at Klamath River km 5.1 were recaptured at JCW. They had been at liberty for 15 d to 30 d, averaging 25 d, for a mean migration rate of 7.7 km/d.

Twenty-three fall chinook tagged at WCW were recaptured at JCW. These fish took from 10 d to 35 d to migrate to JCW, averaging 21 d, for a mean migration rate of 6.9 km/d. The mean number of days it took for WCW-tagged fall chinook to migrate to JCW agrees with the fall run beginning and peaking at JCW three weeks after it began and peaked at WCW.

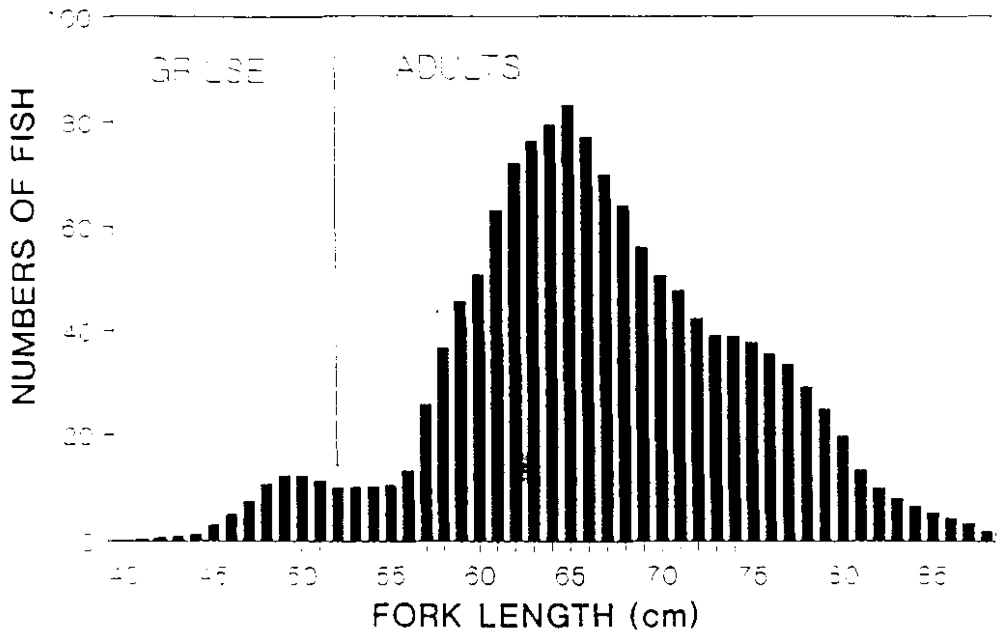
Ninety-five (6.8%) of the fall chinook trapped at WCW were hatchery-marked fish (Ad+CWT), whereas at JCW, 47 (8.6%) of the fall run were marked (Table 4). The difference in the proportion of hatchery-marked chinook between the two sampling sites was not statistically significant (X^2=0.89, p=0.35). The mean FLs of hatchery-marked fall chinook were 65.2 cm and 66.2 cm at WCW and JCW, respectively, similar to the average size for all fish trapped at the respective trapping sites (Table 4).

Coded-wire tags were recovered from 30 TRH-produced chinook salmon trapped at WCW, indicating they were from two release groups of yearling fall chinook (Table 3). In addition, three chinook were recovered that had shed their CWT.

Coded-wire tags were recovered from 26 fish trapped at the JCW Weir, which indicated they were from one smolt and three different yearling release groups of TRH-produced chinook salmon (Table 3). An additional hatchery-marked chinook had shed its CWT.

Incidence of Gill-net and Hook Scars. At both WCW and JCW, exactly 15.3% of the fall chinook we trapped had gill-net scars. These fish ranged from 46 cm to 84 cm FL at WCW, averaging 63.4 cm FL, and ranged from 57 cm to 85 cm FL at JCW, averaging 68.6 cm FL.

WILLOW CREEK WEIR



TRINITY RIVER HATCHERY

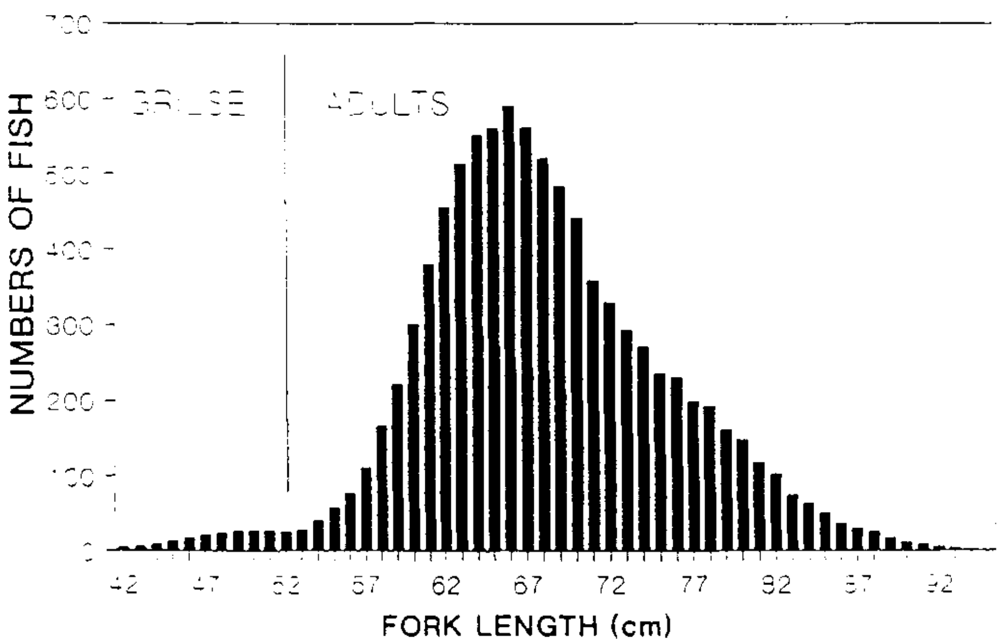


Figure 5. Fork lengths of fall-run chinook salmon trapped in the Trinity River at Willow Creek Weir from 29 August through 20 October 1989, and that entered Trinity River Hatchery from 10 October through 18 December 1989. The FLs are smoothed by a moving average of five, 1-cm size increments. The line points to the nadir at 52 cm FL separating grilse and adult fall-run chinook salmon.

One hundred twenty-one (8.7%) of the fall chinook trapped at WCW had hook scars, 60 (4.3%) were fresh scars received in the freshwater fishery, and 61 (4.4%) were healed scars acquired in the ocean fishery. Forty-nine (9.1%) of the fall chinook trapped at JCW had hook scars, 37 (6.8%) were of freshwater origin, and 12 (2.3%) were of ocean origin. In contrast, only 2% of the spring chinook trapped at JCW had ocean hook scars, and only 2.9% of them had freshwater hook scars.

Coho Salmon

Run Timing. We trapped the first coho at WCW on 25 September 1989 (JW 39). The coho run at WCW increased the next week and appeared to peak during JW 41 (8-14 Oct.) (Table 5). The coho run still appeared strong at WCW when the weir was washed-out and damaged by the late October storms (JW 43) (Figure 6). We trapped 471 coho at WCW during the 1989-90 season.

The first coho was trapped at JCW on 10 October (JW 41), approximately two weeks after the coho run appeared at WCW. The number of coho trapped increased the next week and continued to increase after the two week hiatus in trapping in late October (JW 43 & 44). The coho run at JCW peaked during JW 46 (12-18 Nov.) and declined steadily thereafter (Figure 6). The last coho was trapped at JCW on 12 December 1989, approximately a week before we removed the weir for the season. We trapped 660 coho at JCW during the 1989-90 season (Table 5).

Size of Fish Trapped. Coho trapped at WCW ranged in size from 48 cm to 76 cm FL, for a mean of 65.4 cm FL. Coho trapped at JCW were similar to those trapped at WCW, ranging in size from 52 cm to 78 cm FL, for an average of 66.0 cm FL (Table 6).

We used length data from hatchery-marked (Ad+CWT) coho entering TRH to establish the size separating grilse from adults for all fish as 46 cm (Figure 7). Therefore, in this report all coho $\leq$46 cm FL are considered grilse, whereas larger coho are adults.

We did not trap grilse coho at either weir. Possible explanations are that there were few coho grilse in the 1989 run, or small coho did not enter the trap. We do not believe the conduit spacing on the weir or trap allowed small coho to escape as we trapped a number of salmonids as small as 40 cm FL.

Incidence of Tags and Hatchery Marks. No coho tagged in the lower Klamath River were recaptured at WCW, but one was recaptured at JCW. It had been at liberty for 36 d. Three coho tagged at WCW were recaptured at JCW. The mean liberty time was 18 d for a mean migration rate of 4.8 km/d.

Table 5. Weekly summary of coho salmon trapped in the Trinity River at Junction City and Willow Creek weirs during the 1989-90 season.

	Junction City a/					Willow Creek b/				
		Numbers trapped					Numbers trapped			
Julian Week	Nights trapped	Grilse c/	Adults	Total	Fish/ night	Nights trapped	Grilse c/	Adults	Total	Fish/ night
22-38 6/4-9/23	60	0	0	0	0.0	18	0	0	0	0.0
39 9/24-9/30	4	0	0	0	0.0	4	0	19	19	4.8
40 10/1-10/7	4	0	0	0	0.0	4	0	60	60	15.0
41 10/8-10/14	4	0	9	9	2.3	4	0	230	230	57.5
42 10/15-10/21	4	0	61	61	15.3	4	0	162	162	40.5
43 10/22-10/28	0 d/	-	-	-	-					
44 10/29-11/4	0 d/	-	-	-	-					
45 11/5-11/11	4	0	138	138	34.5					
46 11/12-11/18	4	0	189	189	47.3					
47 11/19-11/25	4	0	146	146	36.5					
48 11/26-12/2	4	0	78	78	19.5					
49 12/3-12/9	4	0	36	36	9.0					
50 12/10-12/16	4	0	3	3	0.8					
51 12/17-12/23	2	0	0	0	0.0					
TOTAL e/	34	0	660	660		16	0	471	471	
MEAN e/					19.4					29.4

a/ Trapping at Junction City Weir took place from Julian Week 23 (4 June) through Julian Week 51 (20 December) of 1989.

b/ Trapping at Willow Creek Weir took place from Julian Week 34 (21 August) through Julian Week 51 (20 December) of 1989.

c/ Coho salmon griles are <46 cm FL; adults are >46 cm FL.

d/ The Junction City Weir was unfishable due to high flows and weir damage.

e/ Based on computations made from the first Julian Week coho salmon were trapped through the end of the sampling period.

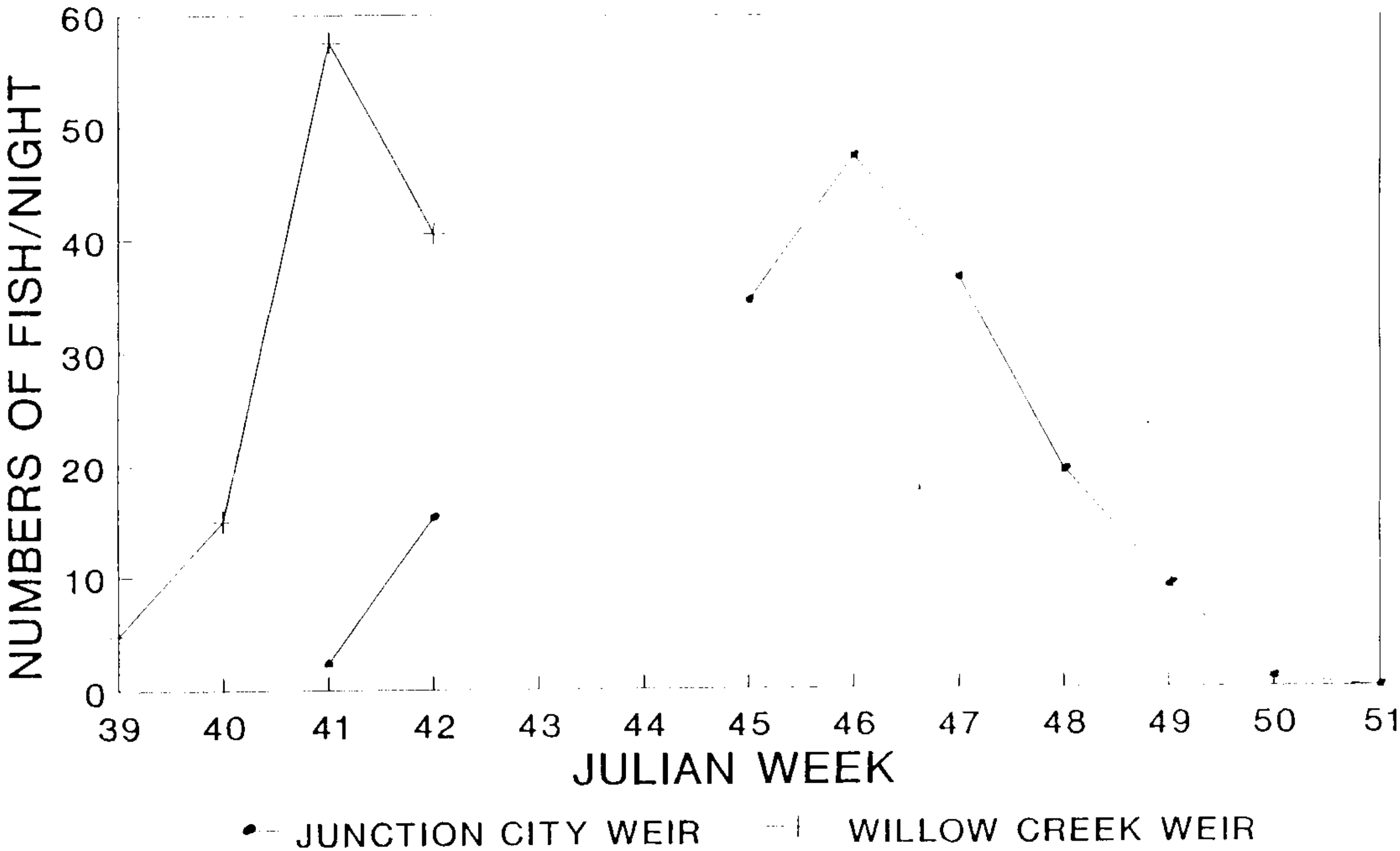


Figure 6. Numbers of coho salmon trapped per night in the Trinity River at Junction City and Willow Creek weirs during the 1989-90 season. Trapping at Junction City Weir took place from Julian Week 23 through 51, except for Julian Weeks 36, 43 and 44. Trapping at Willow Creek Weir took place from Julian Week 34 through 42.

Table 6. Fork lenghts of coho salmon trapped and tagged in the Trinity River at Junction City and Willow weirs, and recovered at Trinity River Hatchery during the 1989-90 season.

Fork length (cm)	Junction City Weir a/ Total trapped	Ad-CWT c/	Effectively d/ tagged	TRH e/ recovery	Willow Creek Weir b/ Total trapped	Ad-CWT c/	Effectively d/ tagged	TRH e/ recovery
48					1		1	
49					1		1	1
50					1		1	0
51					0		0	0
52	4		3	2	1		1	0
53	1		1	0	3		3	1
54	1		1	0	2		2	1
55	0		0	0	1		1	1
56	6		6	2	2		2	0
57	4		3	0	2		2	2
58	4		4	2	8		8	0
59	9	1	8	4	10	1	10	3
60	11	1	11	4	13	3	13	1
61	27	1	25	10	20	0	20	7
62	25	3	23	10	24	0	24	7
63	50	2	47	20	36	4	36	7
64	69	7	65	25	35	2	34	5
65	58	6	57	21	47	3	45	12
66	79	12	79	31	69	6	68	27
67	87	12	85	39	53	4	53	10
68	66	5	65	25	53	1	52	11
69	58	6	57	19	34	5	33	9
70	36	3	36	17	25	2	24	7
71	25	0	24	3	15	3	15	7
72	17	2	17	8	12	1	11	2
73	12		12	6	1		1	
74	3		3	1	0		0	
75	4		4	2	1		1	
76	2		2		1		1	
77	1		1					
78	1							
TOTAL	660	61	639	251	471	35	463	122
Mean FL	66.0	66.1	66.1	66.0	65.4	66.2	65.4	65.4
Grilse f/	0	0	0	0	0	0	0	4
Adults	660	61	639	251	471	35	463	308.4

a/ Trapping at Junction City Weir took place from Julian Week 23 (4 June) through Julian Week 51 (20 December) of 1989.

b/ Trapping at Willow Creek Weir took place from Julian Week 34 (21 August) through Julian Week 42 (20 October) of 1989.

c/ Coded-wire tagged and released from Trinity River Hatchery in 1988.

d/ Corrected for fish not tagged and tagging mortalities.

e/ Trinity River Hatchery.

f/ Coho salmon grilse are <46 cm FL; adults are >46 cm FL.

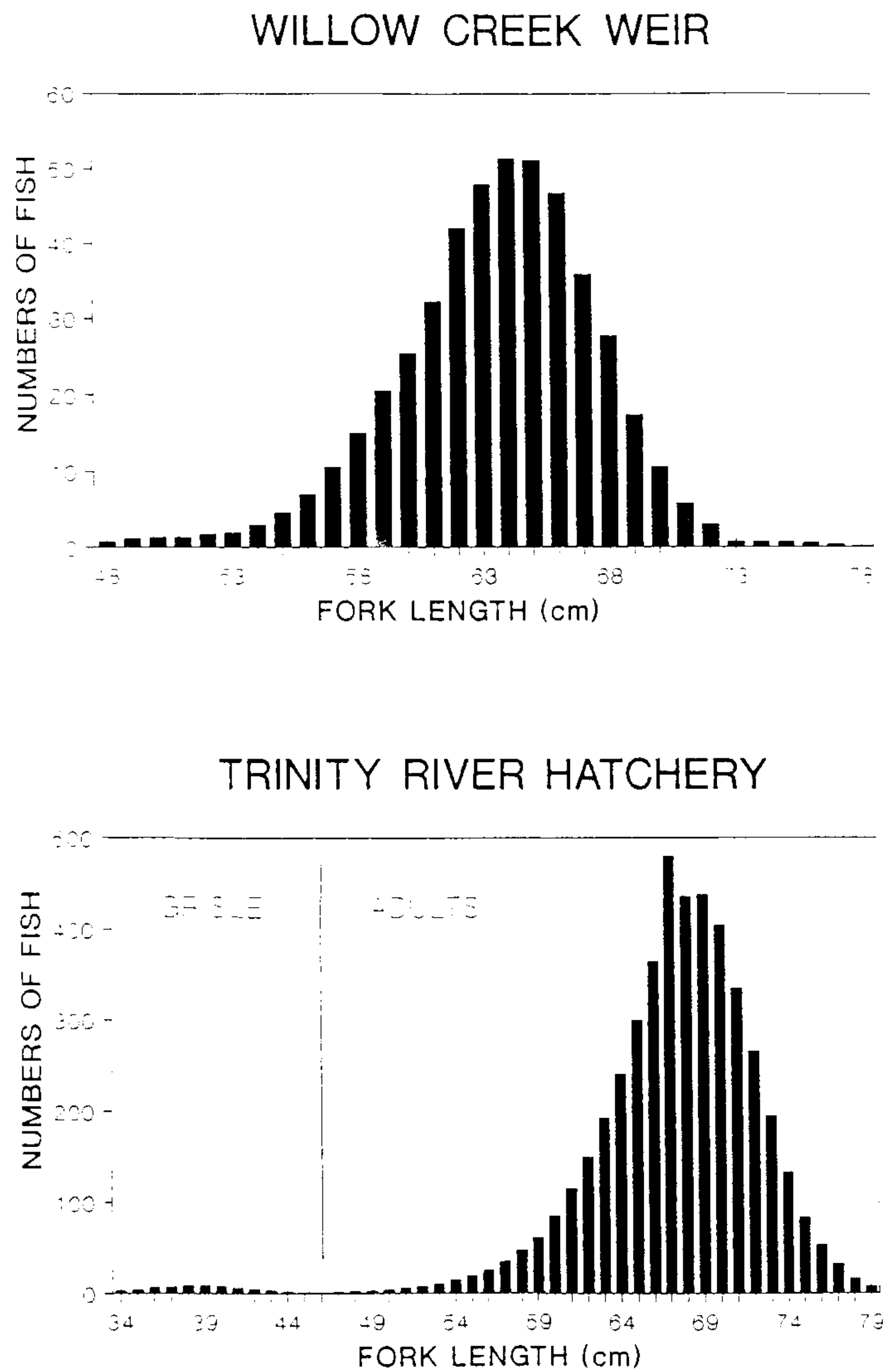


Figure 7. Fork lengths of coho salmon trapped in the Trinity River at Willow Creek Weir from 24 September through 20 October 1989, and that entered Trinity River Hatchery from 12 October 1989 through 8 January 1990. The FLs are smoothed by a moving average of five, 1-cm size increments. The line points to the nadir at 46 cm FL separating grilse and adult coho salmon.

Hatchery-marked (Ad+CWT) fish comprised 24% and 9.1% of the coho trapped at WCW and JCW, respectively (Table 6). Hatchery-marked coho trapped at both weirs ranged from 59 to 72 cm FL for similar mean sizes of 61.1 cm FL (WCW) and 66.2 cm FL (JCW) (Table 6). Assuming there were no stray coho trapped at either weir, all of these hatchery-marked fish were coho of the 1986 BY released from TRH in March, 1988. We recovered 11 of the hatchery-marked coho tagged at WCW and 29 of those tagged at JCW (Table 3).

Incidence of Gill-net and Hook Scars. Gill-net scars were observed on 11.6% and 3.5% of the coho trapped at WCW and JCW, respectively. We cannot explain why the proportion of gill-net scarred coho was so much lower at JCW than at WCW (X^2=27, p<0.01). Gill-net scarred coho from both weirs ranged from 60 to 76 cm FL, for a mean of 67.9 cm FL, which appeared to be slightly larger than the unscarred coho trapped at either site (Table 6).

Hook scarred fish comprised 8.9% of the coho trapped at WCW and 4.1% of the coho trapped at JCW. Fish with hook scars of ocean origin comprised 2.6% of all coho trapped at WCW and 1.5% of those trapped at JCW, and 6.3% and 2.6% of the fish from each site, respectively, had freshwater hook scars.

Recovery of Tagged Fish

Tagging Mortalities

Spring-run Chinook Salmon. We trapped 1,512 spring chinook at JCW, and released 46 of them untagged. Fifty-two (3.5%) of the 1,466 fish we tagged were recovered dead at the weir and in the river surveys, or were reported as such by anglers. Therefore, 1,414 spring chinook (27 grilse and 1,387 adults) were effectively tagged at JCW during the 1989-90 season, including 462 fish with reward tags (21 grilse and 441 adults). The mean FL of those fish recovered or reported dead was 67.2 cm, essentially the same size as the fish we originally trapped at the weirs (Table 2).

Fall-run Chinook Salmon. We trapped 1,392 fall chinook at WCW, 26 of which were released untagged and 10 (1.9% of those tagged) were later recovered dead at the weir or reported as dead by anglers. Therefore, 1,356 fall chinook (87 grilse and 1,269 adults) were effectively tagged at WCW in the 1989-90 season, including 300 fish with reward tags (38 grilse and 262 adults). The mean FL of fish categorized as tagging mortalities was 65.5 cm, similar to the fall chinook we trapped at the weirs (Table 4).

We trapped 541 fall chinook at JCW, 21 were released untagged, and one (<1%) tagged fish was recovered dead. Therefore, 519 fall chinook (17 grilse and 502 adults) were effectively tagged and released at JCW.

Coho Salmon. We trapped 471 adult coho at WCW, released six untagged, and 2 (<1.0%) were recovered dead. Thus 463 adult coho were effectively tagged at WCW, including 125 reward tagged fish.

At JCW, we trapped 660 coho, released 21 fish untagged, and there were no tagging mortalities. Thus, 639 adult coho were effectively tagged at JCW.

Reward Tag Returns by Anglers

Spring-run Chinook Salmon. Anglers returned 46 reward tags (4 grilse and 42 adult) of 462 effectively reward-tagged spring chinook (21 grilse and 441 adults), for an overall harvest rate of 10%. The harvest rate of grilse appeared to be over twice that of adults, but so few grilse were reward tagged and harvested that the difference was not statistically significant (X^2=0.9, p=0.35).

The mean FL of the spring chinook caught by anglers was 63.9 cm FL slightly smaller than those effectively reward tagged (65.4 cm FL).

The number of days between tagging and reported recapture ranged from 3 to 86 d, for a mean of 32 d.

Fall-run Chinook Salmon. Anglers returned 21 tags (2 grilse and 19 adults) of 300 effectively reward tagged fall chinook (38 grilse and 262 adults) for a harvest rate of 7.0%.

The mean FL of the 21 harvested fall chinook was 64.6 cm FL, slightly larger than the 300 effectively reward tagged fish (63.6 cm FL).

The time between tagging and recapture for sport-caught fall chinook ranged from 3 to 48 d for a mean of 19 d.

Capture locations for fall chinook tagged at WCW were reported by 65 anglers, and 26 anglers (40%) indicated they had caught their fish upstream of JCW. Therefore, we assume 40% of all the fall chinook migrating past WCW which were later caught by anglers, were caught upstream of JCW.

Coho Salmon. Only two reward tags from the 125 effectively tagged adult coho were returned by anglers for a harvest rate of 1.6%. These fish were 53 cm and 65 cm FL, and had been at liberty for 18 d and 16 d, respectively.

Two reward and two non-reward tags from coho were returned by anglers, one of which was from a fish caught upstream of JCW. Therefore, we assume 25% of all the coho migrating past WCW which were later caught by anglers, were caught upstream of JCW.

Salmon Spawner Survey

Spring-run Chinook Salmon. Personnel of the TFIP recovered 86 Project-tagged spring chinook, 83 of which were tagged at JCW and three at WCW. The recovery rates in the spawner survey of JCW- and WCW-tagged spring chinook were 5.9% and 4.9%, respectively.

The sizes of the fish recovered from JCW ranged from 46 to 82 cm FL and averaged 67.6 cm FL, almost identical to the mean FL of all effectively-tagged fish (67.5 cm FL).

The WCW-tagged spring chinook were recovered in the spawner survey from 63 to 70 d after tagging, for a mean of 66 d, whereas JCW-tagged spring chinook were recovered in the survey from 30 to 197 d after tagging, for a mean of 95 d.

Fall-run Chinook Salmon. Personnel of the TRIP recovered 121 Project-tagged fall chinook, 53 of which had been tagged at WCW and 68 at JCW. One of these fish was tagged at WCW on 14 September 1989, recovered and rereleased at JCW on 3 October, and subsequently found in the spawner survey on 7 November 1989. The recovery rates of Project-tagged fall chinook in the spawner survey were 3.9% and 13.1% for fish trapped at WCW and JCW, respectively.

The WCW-tagged fish recovered in the spawner survey ranged from 43 to 82 cm FL and averaged 66.6 cm FL, whereas those from JCW ranged from 40 to 111 cm FL and averaged 66.5 cm FL. The mean FLs of the two groups of spaghetti-tagged chinook salmon recovered in the spawner survey were approximately 1 cm greater than the original groups of effectively tagged fish from each respective weir (Table 4).

Fall chinook from WCW were recovered in the spawner survey from 25 to 101 d after being trapped and tagged, averaging 53 d. Those from JCW were recovered from 6 to 77 d after trapping and tagging, averaging 32 d. The 21 d difference in the mean number of days between tagging and recovery for each of the two weirs is the same as the mean number of days it took fall chinook to migrate between WCW and JCW.

Coho Salmon. Spawner survey personnel recovered 100 Project-tagged coho, 29 of which were tagged at WCW and 71 at JCW. One of these coho was trapped at WCW on 29 September 1989, recovered and rereleased at JCW on 19 October, and found in the spawner survey 15 November 1989. Recovery rates of WCW- and JCW-tagged coho in the spawner survey were 6.3% and 11.2%, respectively.

The WCW-tagged coho recovered in the spawner survey ranged from 58 to 76 cm FL, averaging 65.9 cm FL, whereas JCW-tagged coho were from 57 to 75 cm FL, averaging 66.7 cm FL. The mean FLs of the recovered fish were similar to the averages for all fish effectively tagged at each respective weir (Table 6).

The WCW-tagged coho were recovered in the spawner survey 20 to 70 d after trapping, for a mean of 44 d. Tagged coho from JCW were recovered from 6 to 55 d after being tagged, for a mean of 24 d.

Trinity River Hatchery

Spring-run Chinook Salmon. On the first day that fish were sorted at TRH, 901 of 919 chinook salmon entering the hatchery were spring chinook (based on CWT data). On all sampling days in September 1989, >90% of the chinook salmon entering TRH were spring chinook. The median entry date of spring chinook at TRH occurred on 21 September 1989 (Table 7). Spring and fall chinook each comprised approximately 50% of the chinook that entered TRH on 2 and 5 October. Thereafter, >90% of the chinook that entered TRH were fall chinook (Figure 8). The last spring chinook entered the hatchery on 19 October 1989. We estimate 5,000 spring chinook (17 grilse and 4,983 adults) entered TRH during the 1989-90 season.

We recovered 268 spring chinook at TRH that were spaghetti-tagged at JCW (4 grilse and 264 adults). Their median arrival date was 21 September 1989, the same as the arrival date for all spring chinook combined (Table 7). We also recaptured 11 spring chinook (all adults) at TRH that had been tagged at WCW. Their median arrival date was 10 October 1989. None of the spring chinook tagged at either weir had shed their spaghetti tag. We also recovered one spring chinook that had been tagged in the lower Klamath River. The recovery rates at TRH of WCW- and JCW-tagged spring chinook were 18.0% and 19.0%, respectively.

The sizes of the JCW-tagged spring chinook entering TRH ranged from 43 to 92 cm FL for a mean of 66.2 cm FL, 1.4 cm less then the mean FL of all effectively-tagged spring chinook from JCW (Table 2). However, the difference was not statistically significant ($t=1.4$, $p>0.10$).

The JCW-tagged spring chinook were recaptured at TRH from 16 to 116 d after they were tagged and released, for a mean of 73 d. In contrast, the spring chinook tagged at WCW were at liberty from 33 to 60 d, for a mean of 45 d. The WCW fish migrated at an average rate of 4.7 km/d. No migration rate was computed for JCW-tagged spring chinook, since these fish may have been holding in the river around JCW rather than actively migrating upstream as they were past WCW, which is lower in the system.

We recovered 671 CWTs from 723 hatchery-marked (Ad+CWT) spring chinook that entered TRH during the 1989-90 season. Fish from the 1985 and 1986 BY release groups of yearlings comprised 88% of the CWT spring chinook we recaptured (Table 8). The median entry date of the hatchery-marked spring chinook was 21 September 1989, the same as that for all spring chinook combined (Table 8).

Table 7. Total numbers and numbers of project-tagged chinook and coho salmon that entered Trinity River Hatchery during the 1989-90 season a/

	Chinook salmon								Coho salmon			
		Spring run			Fall run							
		Source of tag recoveries								Source of tag recoveries		
Entry b/ date	Number c/ entering TRH	Junction City Weir	Willow Creek Weir	Lower d/ Klamath	Junction City Weir	Willow Creek Weir	Lower d/ Klamath	Number c/ entering TRH	Junction City Weir	Willow Creek Weir	Lower d/ Klamath
09/11	919	30									
09/14	152	11									
09/19	921	40									
09/21	1,076 *	49									
09/25	836	63 *	1			1					
09/28	696	40	1		1	1					
10/02	623	34	1		1	1					
10/05	390	9	2	1	3	5	1				
10/10	1,050	4	2 *		14 (1)5/	26	1				
10/12	749	5	2		11 (1)	16	3	1			
10/16	2,129	3	1		36 (3)	48	10	5	1		
10/19	561		1		17	21	2	2	0		
10/23	822				29 (1)*	21	3	10	1		
10/26	1,038 *				24 (1)	31 *	3 *	34	2		
10/30	1,288				26 [1]6/	41	12	103	3	5	
11/02	1,122				21 (1)[1]	44	9	102	3	4	
11/06	1,042				7	44	5	238	1	12	
11/09	476				3	19	3	255	4	11	1
11/13	310				0	4		375	14 (1)	18	0
11/16	106				0	4		479	19	13 *	1 *
11/20	27				2	3		638	20	15	0
11/22	20				1			625 *	43 *	18	0
11/27	11				0			475	33	7	0
11/30	2				1			355	20	4	1
12/04	2				0			370	28	4	
12/07	2				0			200	11	1	
12/11	0				0			307	22	5	
12/14	0				0			179	11	0	
12/18	1				1			159	5	3	
12/21								127	7	2	
12/26								55	1		
12/28								28	0		
01/02								29	1		
01/04								11			
01/08								8			
TOTAL	16,371	268	11	1	198 (9)[2]	330	52	4,970	251 (1)	122	3

a/ The fish ladder was open 11 September 1989 through 17 March 1990.

b/ Entry date is considered the date the fish were initially sorted, although they may have entered the fish ladder any time after the previous sorting period.

c/ Numbers shown include tagged fish recovered the same day. TRH=Trinity River Hatchery.

d/ Tagged and released in the Klamath River near the mouth (river km 0.2) or the highway 101 bridge (river km 5.1) by other projects.

e/ Figures in parenthesis are fish taggged and released at the Willow Creek Weir and recaptured and rereleased at the Junction City Weir which subsequently entered Trinity River Hatchery. They are included in the totals shown.

f/ Figures in brackets are fish taggged and released in the lower Klamath River and recaptured and rereleased at the Junction City Weir which subsequently entered Trinity River Hatchery: They are included in the totals shown.

* Median entry date. The first and second astericks on the numbers shown for chinook salmon are the estimated median entry dates of spring-run and fall-run chinook salmon, respectively.

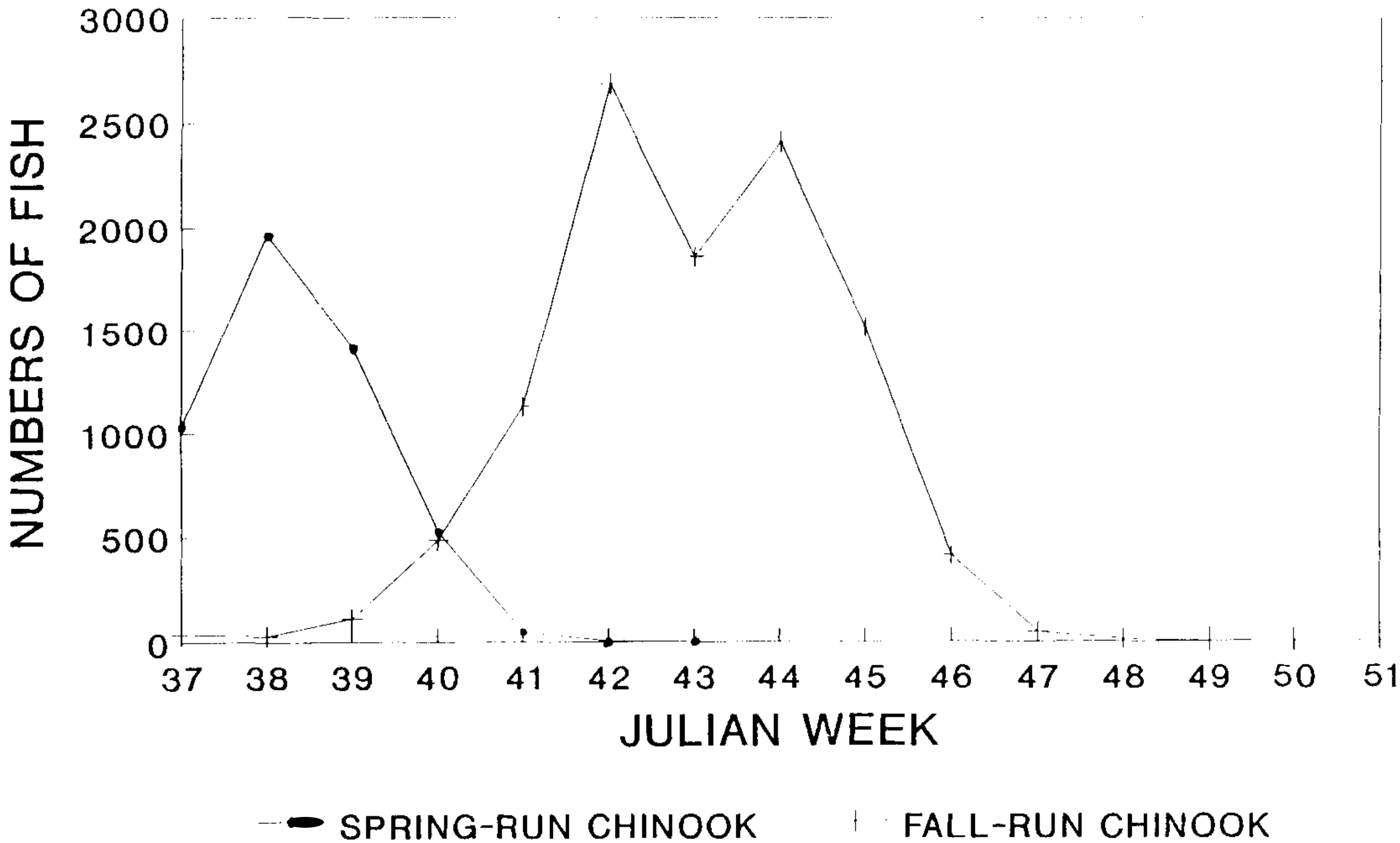


Figure 8. Estimated numbers per Julian Week of spring- and fall-run chinook salmon that entered Trinity River Hatchery during the 1989-90 season. The fish ladder was open from Julian Week 37 of 1989 through Julian Week 11 of 1990.

Table 5. Entry dates of coded-wire-tagged (Ad+CWT), Trinity River-strain, spring-run chinook salmon recovered at Trinity River Hatchery during the 1989-90 season. a/

Entry date c/	Tag code number 06-61-43 Brood year 1984 Release date 10/02/85	06-61-42 1985 06/02/85	06-61-44 1985 10/03/86	06-61-45 1986 05/28/87	06-61-46 1986 09/24/87	06-61-47 1987 05/23/88	No tag b/	Total
09/11		7	54	2	41		17	121
09/14		1	14	0	2	1	2	20
09/19	2	15	62	3	70	1	10	163 *
09/21	0	12	81	5	55	1	9	163
09/25	0	8	49	2	42	2	3	106
09/28	1	5	29	1	36	1	5	78
10/02	0	2	10	1	20		3	36
10/05	0	3	6	0	11		3	23
10/10	1		3	1	4			9
10/12					3			3
10/16					0			0
10/19					1			1
TOTAL	4	53	308	15	285	6	52	723

a/ The fish ladder was open from 11 September 1989 through 17 March 1990.

b/ No tag was recovered from the fish. All chinook salmon with a shed tag recovered from 11 September through 5 October are considered spring-run chinook; chinook salmon with a shed tag recovered after 5 October are considered fall-run chinook.

c/ Entry date is considered the date the fish were initially sorted, although they may have entered the fish ladder any time after the previous sorting period.

* Median entry date.

Fall-run Chinook Salmon. Based on our analysis of CWTs, a few fall chinook were recovered during the first sampling day at TRH and throughout September, but they did not begin to enter TRH in large numbers until 2 October 1989 (Figure 8). We estimate the median entry date of fall chinook occurred on 26 October, and the last chinook salmon entered TRH on 18 December 1989 (Table 7 . We estimate 11,371 fall chinook (239 grilse and 11,132 adults) entered TRH during the 1989-90 season.

Three hundred thirty fall chinook tagged at WCW (5 grilse and 325 adults) entered TRH, which equaled 24.3% of those we effectively tagged at that site. This total included two fish that shed their spaghetti tag. The median entry date of the tagged fish was 26 October 1989, the same as the median entry date for all fall chinook combined.

The WCW-tagged fall chinook entering TRH ranged from 45 to 86 cm FL, for a mean of 65.0 cm FL, similar to the mean size (65.4 cm) of all fish effectively tagged at WCW (Table 4).

Fall chinook tagged at WCW entered TRH from 12 to 71 d after they had been tagged and released, for a mean of 36 d. Their mean migration rate upstream of WCW was 3.7 km/d, slightly slower than the spring chinook tagged at WCW. The faster migration rate of spring chinook is not surprising, since they begin spawning before fall chinook.

We recaptured 198 fall chinook (3 grilse and 195 adults) at TRH that had been tagged at JCW, including nine fish that had originally been tagged at WCW, and two that had originally been tagged in the lower Klamath River. Thus, 38.2% of the fall chinook tagged at JCW were recaptured at TRH. The median entry date of fish tagged at JCW was the same as that for all fall chinook combined, 23 October 1989.

Fall chinook tagged at JCW and recaptured at TRH ranged from 40 to 111 cm FL, for a mean of 65.7 cm FL, which was almost identical to the average for all fall chinook effectively tagged at JCW (Table 4).

Fall chinook tagged at JCW were recovered from 6 to 42 d later at TRH, for a mean of 14 d for migration between the two points. Their mean migration rate was 3.2 km/d, slightly slower than the fall chinook tagged at WCW. The mean number of days it took fall chinook from JCW to enter TRH was three weeks less than it took fall chinook from WCW. The latter difference is equal to the mean migration time for fall chinook between WCW and JCW.

We also recovered 52 fall chinook that had been tagged in the lower Klamath River, 18 at the mouth and 34 at river km 5.1. Collectively, fall chinook tagged in the lower Klamath River took from 30 to 71 d to reach TRH, for a mean of 45 d. Their mean migration rate over the 248.5 km between the river mouth and the hatchery was 5.5 km/d.

We recovered CWTs from 1,120 of the 1,170 marked (Ad+CWT) fall chinook that entered TRH (Table 9). As with spring chinook, yearling releases of the 1985 and 1986 BYs comprised 89% of the CWT fall chinook recovered. The median entry date of the marked fall chinook was 26 October 1989, the same as for all fall chinook combined (Table 7).

Coho Salmon. Coho began entering TRH on 12 October 1989. The numbers of coho entering the hatchery increased through 22 November, the median entry date, and then decreased through the end of the run on 8 January 1990 (Table 7). We recovered 4,970 coho entering TRH during the 1989-90 season.

We recovered 122 coho (all adults) at TRH that had been tagged at WCW, which equals 26.3% of the total coho effectively tagged at WCW (Table 6). Their median entry date at TRH was approximately a week before that of all coho combined, and was probably due to the WCW Weir being removed before the completion of the coho run, which prevented us from distributing tagged coho into the latter part of the run (Figure 6). One tagged coho had shed its spaghetti tag. The WCW-tagged coho we recaptured at TRH ranged from 49 to 72 cm FL, for a mean of 65.4 cm FL, equal to the average size of all fish effectively tagged at WCW (Table 6).

Coho tagged at WCW took from 18 to 69 d to enter TRH, for a mean of 37 d. Their mean migration rate upstream of WCW was 3.6 km/d, similar to the rate of the WCW-tagged fall chinook.

We recaptured 251 coho (all adults) at TRH that had been tagged at JCW, which equals 39.3% of the total coho effectively tagged at JCW. Their median entry date to TRH was the same as for all coho combined, 22 November 1989. None of these coho had lost their spaghetti tag.

The JCW-tagged coho recaptured at TRH ranged from 52 to 75 cm FL, for a mean of 66.0 cm FL, similar to the average size of all coho effectively tagged at JCW (Table 6).

The JCW-tagged coho took from 3 to 71 d to migrate from the weir to TRH, for a mean of 13 d and a mean migration rate of 3.5 km/d, similar to the migration rate of coho tagged at WCW. Some of these fish moved very quickly, as four coho were recaptured at TRH three days after tagging at JCW and had migrated at a mean pace of 15 km/d.

Three coho tagged in the lower Klamath River at river km 5.1 were recaptured at TRH. They had been tagged and released from 50 to 58 d earlier, for a mean of 55 d and a mean migration rate of 4.4 km/d.

Table 9. Entry dates of coded-wire-tagged (Ad-CWT), Trinity River-strain, fall-run chinook salmon recovered at Trinity River Hatchery during the 1989-90 season. a/

	Tag code number														
	06-61-27	06-61-28	06-56-24	06-56-23	06-56-25	06-56-26	06-56-29	06-56-30	06-56-27	06-56-28	06-63-10	06-56-33	06-56-31	No tag b/	Total
	Brood year														
	1984			1985		1986						1987			
	Release date														
Entry date c/	06/10/85	10/10/85	02/27/86	06/19/86	10/24/86	06/11/87	06/11/87	06/27/87	09/21/87	09/24/87	02/29/88	06/02/88	10/28/88		
09/11					3										3
09/14					1										1
09/19					1										1
09/21				1	2										3
09/25				0	4										4
09/28				1	3				1						5
10/02				0	13	2			6						21
10/05				0	5	0			2						7
10/10			1	7	24	3	2		42	3					82
10/12	1	1	1	4	18	0	0		30	3		1	2	6	67
10/16			1	7	36	2	0		104	7		2	1	6	166
10/19			1	1	8	3	1		41	1		0	0	6	62
10/23			0	3	13	1	0	1	58	8	2	1	1	8	96
10/26			1	6	16	1	0	2	86	5	0	1	0	2	120 *
10/30			1	5	26	3	2	1	109	3	0	1	2	6	159
11/02				1	12	2	0	5	100	9	2	0	1	3	135
11/06				3	8	2	2	1	90	7	5	3	3	4	128
11/09				1	3		1	2	29	2	1	1	0	4	44
11/13					1		0	1	15	4	1		0	4	26
11/16					1		1	0	8	0	2		1	1	14
11/20					1			0	12	2	1				16
11/22					0			0	2	1					3
11/27					2			1	2						5
11/30					1				1						2
TOTAL	1	1	6	40	202	19	9	14	738	55	14	10	11	50	1,170

a/ The fish ladder was open from 11 September 1989 through 17 March 1990.

b/ No tag was recovered from the fish. All chinook salmon with a shed tag recovered after 5 October are considered fall-run chinook; chinook salmon with a shed tag recovered from 11 September through 5 October are considered spring-run chinook.

c/ Entry date is considered the date the fish were initially sorted, although they may have entered the hatchery any time after the previous sorting period.

* Median entry date.

We recovered 421 CWTs from 492 marked (Ad+CWT) coho at TRH (Table 10). The median entry date of marked coho was 22 October 1989, the same as for all coho combined. All of the CWT coho recovered, and probably even those that had shed tags, were fish from the 1986 BY released in March 1988.

Run-size, Angler Harvest, and Spawner Escapement Estimates

Run-size estimates of spring chinook upstream of JCW and fall chinook and coho upstream of both WCW and JCW were not stratified as grilse or adults this year, because too few tagged grilse were recaptured at TRH to have grilse estimates with 95% confidence limits within ±10% of the run-size estimate. Therefore, we used the proportions of grilse and adult chinook salmon in each run trapped at the respective weirs for the grilse/adult compositions of the spring run upstream of JCW and the fall run above WCW and JCW. Since no grilse coho were trapped at either weir, we assumed the grilse/adult composition of the coho runs above both weirs to be the same as the grilse/adult composition of the coho that entered TRH.

Spring-run Chinook Salmon

We estimate 26,306 spring chinook (including those eventually harvested) migrated into the Trinity River basin upstream of JCW during the 1989-90 season (Table 11), and that 10% (2,630) of the spring run was caught by anglers (Table 12). Thus, the spawning escapement above JCW was 23,676 fish, including the 5,000 spring chinook that entered TRH (Table 12).

We made no attempt to determine the run size and angler harvest of spring chinook upstream of WCW because the fish trapped there represented a very small segment of the run.

Fall-run Chinook Salmon

We estimate that 46,622 fall chinook (including those eventually harvested) migrated into the Trinity River basin upstream of WCW during the 1989-90 season, and 29,716 of these fish continued their migration upstream of JCW (Table 11). We estimate that 3,263 (7%) of the fall chinook passing WCW were harvested by anglers, and 1,308 of these fish were caught upstream of JCW (Table 12). Therefore, we assume that 43,359 fall chinook spawned in the Trinity River basin upstream of WCW, and that 28,408 of those fish spawned in the Trinity upstream of JCW, including the 11,371 fall chinook that entered TRH (Table 12).

Coho Salmon

We estimate that 18,752 coho (including those eventually harvested) migrated into the Trinity River basin upstream of WCW during the 1989-90 season, and 12,625 of these fish continued their migration

Table 10. Entry dates of coded-wire-tagged (Ad+CWT) coho salmon recovered at Trinity River Hatchery during the 1989-90 season. a/

	Tag code number		
	06-56-56	Shed tag b/	Total
	Brood year		
	1986		
	Release date		
Entry date c/	03/02/88		
10/12	1		1
10/16	0		0
10/19	0		0
10/23	0		0
10/26	2	1	3
10/30	10	5	15
11/02	5	1	6
11/06	16	5	21
11/09	20	2	22
11/13	22	5	27
11/16	42	7	49
11/20	34	4	38
11/22	56	12	68 *
11/27	40	6	46
11/30	35	3	38
12/04	23	7	30
12/07	23	3	26
12/11	38	1	39
12/14	16	4	20
12/18	9	3	12
12/21	18	0	18
12/26	6	2	8
12/28	2		2
01/02	3		3
TOTAL	421	71	492

a/ The fish ladder was open from 11 September 1989 through 17 March 1990.

b/ No tag was recovered from the fish.

c/ Entry date is considered the date the fish were initially sorted, although they may have entered the fish ladder any time after the previous sorting period.

* Median entry date.

Table 11. Trinity River basin chinook and coho salmon run-size estimates during the 19989-90 season.

Species/ race	Area of estimate	Size class	Number effectively tagged a/	Number examined for tags	Number of tags in sample	Run-size estimate	Confidence limits 1-P = 0.95
Spring-run chinook	Trinity River basin above Junction City	Grilse b/	27	17	4	502	
		Adults	1,387	4,983	264	25,804	
	Weir	Total	1,414	5,000	268	26,306	23,430 - 29,558 c/
Fall-run chinook	Trinity River basin above Willow Creek	Grilse d/	87	239	5	2,991	
		Adults	1,269	11,132	325	43,631	
	Weir	Total	1,356	11,371	330	46,622	41,749 - 51,748 e/
Fall-run chinook	Trinity River basin above Junction City	Grilse d/	17	239	3	973	
		Adults	502	11,132	195	28,743	
	Weir	Total	519	11,371	198	29,716	25,751 - 33,945 e/
Coho	Trinity River basin above Willow Creek	Grilse f/	0	77	0	290	
		Adults	463	4,893	122	18,462	
	Weir	Total	463	4,970	122	18,752	15,612 - 22,157 e/
Coho	Trinity River basin above Junction City	Grilse f/	0	77	0	196	
		Adults	693	4,893	251	12,429	
	Weir	Total	693	4,970	251	12,625	11,199 - 14,243 c/

a/ Corrected for shed tags and tagging mortalities.
b/ Spring-run chinook salmon grilse are <49 cm FL; adults are >48 cm FL.
c/ Confidence limitis were estimated by normal approximation.
d/ Fall-run chinook salmon grilse are <52 cm FL; adults are >52 cm FL.
e/ Confidence limits were estimated by Poisson approximation.
f/ Coho salmon grilse are <46 cm FL; adults are >46 cm FL.

Table 12. Trinity River basin chinook and coho salmon run-size, angler harvest, and spawner escapement estimates during the 1989-90 season.

Species/ race	Area of estimate	Size class	Run-size	Angler harvest	(%)	Spawner escapement: Natural	Spawner escapement: Trinity River Hatchery	Spawner escapement: Total
Spring-run chinook	Trinity River basin above Junction City Weir	Grilse a/	502	50		435	17	452
		Adults	25,804	2,580		18,241	4,983	23,224
		Total	26,306	2,630	(10.0)	18,676	5,000	23,676
Fall-run chinook	Trinity River basin above Willow Creek Weir	Grilse b/	2,991	209		2,543	239	2,782
		Adults	43,631	3,054		29,445	11,132	40,577
		Total	46,622	3,263	(7.0)	31,988	11,371	43,359
Fall-run chinook	Trinity River basin above Junction City Weir	Grilse b/	973	43		691	239	930
		Adults	28,743	1,265		16,346	11,132	27,478
		Total	29,716	1,308	(4.4)	17,037	11,371	28,408
Coho	Trinity River basin above Willow Creek Weir	Grilse c/	290	5		208	77	285
		Adults	18,462	295		13,274	4,893	18,167
		Total	18,752	300	(1.6)	13,482	4,970	18,452
Coho	Trinity River basin above Junction City Weir	Grilse c/	196	1		118	77	195
		Adults	12,429	75		7,461	4,893	12,354
		Total	12,625	76	(0.6)	7,579	4,970	12,549

a/ Spring-run chinook salmon grilse are <48 cm FL; adults are >48 cm FL.
b/ Fall-run chinook salmon grilse are <52 cm FL; adults are >52 cm FL.
c/ Coho salmon grilse are <46 cm FL; adults are >46 cm FL.

upstream of JCW (Table 11). We estimate that 300 (1.6%) of the coho were harvested by anglers upstream of WCW, 76 of which were caught upstream of JCW (Table 12). Thus, the spawning escapement estimate for coho upstream of WCW was 18,452 fish, including 12,549 fish that spawned upstream of JCW, 4,970 of which entered TRH (Table 12).

RECOMMENDATIONS

1. Tag and recapture operations of adult spring-run and fall-run chinook and coho salmon being conducted in the Trinity River basin should be continued during the 1990-91 migration season, using the capture sites near Willow Creek and Junction City.

2. In addition to chinook and coho salmon, steelhead trout should be added to the tag and recapture studies during the 1990-91 season.

3. A portion of the chinook and coho salmon, and steelhead trout trapped at Willow Creek Weir should be tagged with $20 reward tags to determine the extent of angler non-response of $10 reward tags.

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

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

a Eight Day week in each year which is divisible by 4.

b Eight day week every year.

ANNUAL REPORT
TRINITY RIVER BASIN SALMON AND STEELHEAD MONITORING PROJECT
1989-1990 SEASON

CHAPTER V

JOB V
SURVIVAL AND CONTRIBUTION TO THE FISHERIES AND SPAWNER ESCAPEMENT MADE BY CHINOOK SALMON PRODUCED AT TRINITY RIVER HATCHERY

by

Bill Heubach and Morgan Boucke

ABSTRACT

Between 1 July 1988 and 30 June 1990, staff of the California Department of Fish and Game's Trinity River Project marked and released four groups of chinook salmon (*Oncorhynchus tshawytscha*) totaling 584,424 fish. The total included 285,233 spring-run and 299,191 fall-run chinook salmon. Each fish had its adipose fin clipped, was binary coded-wire tagged, and then released into the Trinity River below the Trinity River Hatchery. In addition to these efforts, Trinity River Hatchery personnel tagged and released two lots of fall-run chinook salmon totaling 46,365 fish.

Recovery operations at Trinity River Hatchery recaptured 2,385 adipose fin-clipped chinook and coho salmon (*O. kisutch*), and 2,211 coded-wire tags were recovered from 671 spring-run chinook, 1,120 fall-run chinook, and 421 coho salmon.

JOB OBJECTIVES

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

INTRODUCTION

During the period 1 July 1989 through 30 June 1990, the California Department of Fish and Game's (CDFG) Trinity River Project marked (adipose fin-clipped and coded-wire tagged [Ad+CWT]) and released chinook salmon smolts and yearlings produced at Trinity River Hatchery, and recaptured fish from previously marked brood years (BY) returning to the hatchery. Similar marking studies began at Trinity River Hatchery (TRH) in 1978, with the marking of fall-run chinook salmon from the 1976 BY. Beginning with the 1977 BY, representative marked subsets of TRH-produced fish have been included in all releases of smolt and yearling chinook salmon released from TRH and at other, off-site locations.

These earlier studies were funded by the U.S. Bureau of Reclamation (USBR) and Anadromous Fish Act funds administered by the U.S. Fish and Wildlife Service. The current program was funded by Anadromous Fish Act Funds from 1 July through 30 September 1989, and by the USBR from 1 October 1989 through 30 June 1990.

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

METHODS

Fish Marking and Release

Chinook salmon selected for marking at TRH were crowded into a small area beneath a marking shed situated over their rearing pond. After crowding, the fish were dip-netted into a 152.4 X 61.0 X 76.2-cm wooden holding tank in the tagging shed, through which pond water was circulated. We dip-netted approximately 25 fish at a time from the holding tank into pans containing an anesthetic solution of tricaine methanesulfonate (MS-222[1/]). Once anesthetized, we marked the fish by removing their adipose fin and injecting a coded-wire tag (CWT) into their rostrum.

In September and October 1989, we tagged yearling chinook salmon with a NMT MK2A[1/] tagging unit, using whole CWTs, whereas we tagged chinook salmon smolts in March and April 1990 with a NMT MK4[1/] tagging unit, using half-length CWTs.

After tagging, we dropped the fish into a funnel supplied with running water that lead to a quality control device. The quality control device magnetized the CWT and tallied the tagged fish. Tagged fish continued through the funnel and dropped into a rearing pond situated next to the pond containing the untagged fish. If a fish did not receive a CWT, the quality control device gave a warning signal and diverted the fish into a funnel leading to a rejection bucket. Periodically, fish in the rejection bucket were re-anesthetized, tagged, and dropped into the funnel leading to the quality control device. Periodically during the marking period, we inspected samples of fish for the depth of CWT insertion and quality of the fin clip.

All tagged fish from a particular tagging group were held in separate rearing ponds until release. Immediately before the marked chinook salmon were released, a systematic sample of 200 to 800 fish from each group was examined for CWT retention and the quality of the adipose fin clip, and measured to the nearest mm fork length (FL).

The total number of "effectively marked" (properly tagged and fin-clipped) fish released was based on the total number of fish in each group released minus dead fish recovered during and after tagging operations, and the number of fish we estimated had shed CWTs or were improperly fin-clipped.

All tagged fish of a particular CWT group were released concurrently with unmarked fish of the same strain, BY, and size in the river below TRH.

Coded-wire Tag Recovery

The TRH fish ladder was open from 8 September 1989 through 17 March 1990. Hatchery personnel conducted fish sorting and spawning operations two to three days per week, depending on the numbers of fish available each day.

1/ Brand names are mentioned for identification purposes only and does not imply their endorsement by the CDFG.

We examined all salmon entering TRH for an adipose fin clip, determined their species and sex, measured them to the nearest cm FL, and removed the heads of all salmon bearing an adipose fin clip. Each salmon head was frozen in a plastic bag with a serially numbered tab noting the date and location captured, species, sex, and FL of the fish. The salmon heads and data were given to the CDFG's Ocean Salmon Project for CWT retrieval, decoding, and data entry. Ocean Salmon Project personnel provided us a computer file of the CWT recovery data for editing and data analysis.

RESULTS

Fish Marking and Release

Four groups of chinook salmon reared at TRH, totaling 584,424 fish, were marked (Ad+CWT) and released into the Trinity River below the hatchery during October 1989 and May 1990 (Table 1). The yearling chinook salmon released in October 1989 consisted of one group each of spring- and fall-run fish from the 1988 BY. The chinook salmon smolts released in May 1990 consisted of one group each of spring- and fall-run fish from the 1989 BY. All groups of Ad+CWT chinook salmon were released concurrently with unmarked fish of the same BY, strain and size. These releases were made as part of an ongoing program to monitor relative return rates, and contributions to the spawning escapements and the fisheries made by salmon produced at TRH.

In addition to this study's marked salmon releases, TRH personnel marked (Ad+CWT) and released two groups of fall-run chinook salmon yearlings from the 1988 BY (46,365 fish) as part of a feed experiment (Table 1).

Coded-Wire Tag Recovery

We recaptured 2,385 marked (Ad+CWT) chinook and coho salmon at TRH during the 1989-90 season and recovered CWTs from 671 spring-run and 1,120 fall-run chinook salmon, and 421 coho salmon. Yearlings from the 1985 and 1986 BYs comprised 88% and 84%, respectively, of the CWT spring- and fall-run chinook salmon we recovered this season (Appendix 1). All of the CWT coho salmon recovered, and probably all of the marked coho that had shed their CWTs, represented fish of the 1986 BY released in March 1988. No stray CWT chinook or coho salmon were recovered at TRH during the 1989-90 season.

Yearling fish released this season (1988-89) are expected to begin returning to TRH during the 1990-91 season, whereas smolts released this season should begin returning to TRH during the 1991-92 season. Thus, we will be reporting on the return to TRH, survival, and contributions to spawner escapements and the

Table 1. Coded-wire-tagged and unmarked chinook salmon releases from Trinity River Hatchery from 1 July 1989 through 30 June 1990. a/

CWT code b/	Brood year	Strain	Total number tagged	Mortality c/	Extrapolated tags shed/poor fin clip (%) d/		Numbers of tagged fish released e/	Release date	Release size No/kg	Release size FL(mm)	Unmarked fish released
06-61-48	1988	Spring-run chinook	104,538	27 (.03)	5,691	(5.4)	98,320	10/24/89	29.3	140.1	509,760
06-56-32	1988	Fall-run chinook	100,213	19 (.02)	2,625	(2.6)	97,569	10/27/89	34.1	163.3	968,475
06-55-22 f/	1988	Fall-run chinook	22,407	11 (.05)	162	(0.7)	22,234	11/01/89	15.6	179.8	162
06-55-23 f/	1988	Fall-run chinook	24,553	6 (.02)	416	(1.7)	24,131	11/01/89	17.8	167.3	416
	Yearling subtotals		251,711	63	8,894		242,754				1,478,813
6-1-4-1-2	1989	Spring-run chinook g	211,334	3,886 (1.8)	21,035	(10.1)	136,413	05/18,21/90	189.6	74.2	1,538,824
6-1-4-1-1	1989	Fall-run chinook g/	222,411	3,716 (1.7)	17,073	(7.8)	201,622	05/18/90	343.2	64.2	2,548,152
	Smolt subtotals		433,745	7,602	38,108		388,035				4,086,976
	GRAND TOTALS		685,456	7,665	47,002		630,789				5,565,789

a/ All releases were into the Trinity River directly below the hatchery.

b/ CWT=coded-wire tag.

c/ Absolute number followed by percent in parenthesis.

d/ Based on the total number of fish tagged minus mortality; absolute number followed by percent in parenthesis.

e/ Total fish tagged minus mortality and fish that shed tags or had poor fin clips.

f/ Marked and released by Trinity River Hatchery personnel as part of a feed experiment.

g/ Exposed to Enteric Red Mouth Disease.

fisheries of fish released this year in the 1990-91 and later year's annual reports.

RECOMMENDATIONS

1. Marking (Ad+CWT) of smolt and yearling chinook salmon should be continued during the 1990-91 season.

2. Marking (Ad+CWT) of yearling+ coho salmon should be added to the program, beginning in the 1990-91 season.

Appendix 1. Release and 1989–90 season recovery data of coded–wire–tagged chinook and coho salmon produced at Trinity River Hatchery during the 1984–85 through 1988–89 seasons. a/

Release data								Trinity River Hatchery Recovery data			
CWT code b/	Species/ race	Egg source	Brood year	Date	Number	Size (#/kg)	Site	Season recovered	CWT recoveries b/	Mean fork length (cm) Male	Mean fork length (cm) Female
06–61–43	Spring–run chinook	TRH	1984	10/02/85	95,568	29.7	TRH	86–87	109	43 (108) c/	50 (1)
								87–88	769	62 (532)	62 (237)
								88–89	232	74 (98)	71 (134)
								89–90	4	84 (1)	80 (3)
06–61–42	Spring–run chinook	TRH	1985	06/02/86	192,487	154.0	TRH	87–88	68	49 (67)	67 (1)
								88–89	382	69 (177)	66 (205)
								89–90	53	78 (25)	75 (28)
06–61–44	Spring–run chinook	TRH	1985	10/03/86	101,091	27.7	TRH	87–88	51	44 (51)	(0)
								88–89	1,026	66 (650)	63 (376)
								89–90	308	77 (170)	71 (138)
06–61–45	Spring–run chinook	TRH	1986	05/28/87	197,113	165.4	TRH	88–89	7	50 (7)	(0)
								89–90	15	69 (10)	66 (5)
06–61–46	Spring–run chinook	TRH	1986	09/24/87	101,030	39.6	TRH	88–89	48	45 (47)	44 (1)
								89–90	285	65 (210)	64 (75)
06–61–47	Spring–run chinook	TRH	1987	05/23/88	185,718	187.0	TRH	89–90	6	50 (6)	(0)
100000 d/	Spring–run chinook e/							89–90	52	75 (25)	71 (27)
06–61–27	Fall–run chinook	TRH	1984	06/10/85	189,708	116.6	TRH	86–87	178	50 (175)	50 (3)
								87–88	226	66 (95)	67 (131)
								88–89	28	72 (6)	74 (22)
								89–90	1	68 (1)	(0)
06–61–28	Fall–run chinook	TRH	1984	10/10/85	97,070	24.2	TRH	86–87	126	44 (125)	49 (1)
								87–88	608	61 (435)	62 (173)
								88–89	173	72 (60)	73 (113)
								89–90	1	80 (1)	(0)
06–56–24	Fall–run chinook	TRH	1984	02/27,28/86	102,512	12.3	TRH	86–87	161	38 (159)	38 (2)
								87–88	1,359	59 (1,048)	60 (311)
								88–89	337	74 (100)	72 (237)
								89–90	6	(0)	76 (6)
06–56–23	Fall–run chinook	TRH	1985	06/19/86	196,249	156.2	TRH	87–88	272	51 (271)	50 (1)
								88–89	492	68 (232)	68 (260)
								89–90	40	79 (14)	78 (26)

(continued on next page)

Appendix 1. Release and 1989–90 season recovery data of coded–wire–tagged chinook and coho salmon produced at Trinity River Hatchery during the 1984–85 through 1988–89 seasons (continued). a/

		Release data						Trinity River Hatchery Recovery data			
CWT code b/	Species/ race	Egg source	Brood year	Date	Number	Size (#/kg)	Site	Season recovered	CWT recoveries b/	Mean fork length (cm) Male	Mean fork length (cm) Female
06–56–25	Fall–run chinook	TRH	1985	10/24/86	97,368	29.7	TRH	87–88	93	46 (92) c/	66 (1)
								88–89	812	65 (593)	65 (249)
								89–90	202	78 (79)	75 (123)
06–56–26	Fall–run chinook	TRH	1986	06/11,17/87	202,486	195.8	TRH	88–89	20	49 (20)	(0)
								89–90	19	65 (13)	68 (6)
06–56–29	Fall–run chinook	TRH	1986	06/11/87	99,118	182.6	Sawmill Pond	88–89	3	52 (3)	(0)
								89–90	9	62 (2)	64 (7)
06–56–30	Fall–run chinook	TRH	1986	06/27/87	92,351	151.8	Ambrose Pond	88–89	7	51 (7)	(0)
								89–90	14	65 (9)	67 (5)
06–56–27	Fall–run chinook	TRH	1986	09/21/87	100,320	41.8	TRH	88–89	424	49 (415)	49 (9)
								89–90	738	65 (422)	65 (316)
06–56–28	Fall–run chinook	TRH	1986	09/24/87	26,730	24.2	TRH	88–89	45	50 (40)	51 (5)
								89–90	55	64 (26)	64 (29)
06–63–10	Fall–run chinook	TRH	1986	02/29/88	26,650	19.8	TRH	89–90	14	60 (7)	60 (7)
06–56–33	Fall–run chinook	TRH	1987	06/22/88	172,980	257.4	TRH	89–90	10	51 (10)	(0)
06–56–31	Fall–run chinook	TRH	1987	10/28/88	93,300	19.6	TRH	89–90	11	47 (11)	(0)
100000 d/	Fall–run chinook f/							89–90	50	73 (24)	68 (26)
06–56–56	Coho	TRH	1986	03/08/88	51,721	30.8	TRH	88–89	44	43 (44)	(0)
								89–90	421	67 (210)	67 (211)
100000 d/	Coho							89–90	71	67 (40)	66 (31)

a/ Only coded–wire–tagged groups that entered Trinity River Hatchery during the 1989–90 season are listed.
b/ CWT = coded–wire tag.
c/ Sample size is in parenthesis.
d/ 100000 = no coded–wire tag was found or it was lost during recovery.
e/ Assumed to be spring–run chinook salmon by entry date into Trinity River Hatchery.
f/ Assum[illegible] to be fall–run chinook salmon by entry date into Trinity River Hatchery.

ANNUAL REPORT
TRINITY RIVER BASIN SALMON AND STEELHEAD MONITORING PROJECT
1989-1990 SEASON

CHAPTER VI

JOB VI

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

by

Bernard C. Aguilar

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 5 February to 3 April 1990. Unique combinations of fin clips were given to each group of fish to permit identification of brood year and release type upon recapture. We fin-clipped 405,997 yearlings, 50,490 two-year-olds, and 144,800 holdover yearling steelhead this season. Holdovers will be released next year after they have reached the minimum release length of 152 mm fork length.

We checked 900 steelhead for fin-clip accuracy, and all were found to have been properly clipped.

JOB OBJECTIVES

1. To determine relative return rates, and contributions to spawning escapements and the fisheries made by steelhead produced at Trinity River Hatchery.

2. To evaluate experimental hatchery management practices aimed at increasing adult returns.

INTRODUCTION

The completion of the Trinity River Division of the Central Valley Project (15 May 1963) blocked access to a significant part of the historic steelhead spawning and rearing habitat in the Trinity River basin, and resulted in significant downstream flow reductions. These project-induced reductions in fishery habitat have resulted in the decline of annual runs of steelhead.

In October 1984, Public Law 98-541 was passed by Congress to mitigate for Trinity project-induced fish and wildlife losses. This act, commonly referred to as the Trinity River Basin Fish and Wildlife Restoration Act, authorizes the expenditure of $57 million over a 10-year period to implement a program to restore fish and wildlife populations to pre-dam conditions.

One of the major goals of the California Department of Fish and Game's (CDFG) Klamath-Trinity Program is to develop fishery harvest management recommendations which are compatible with the goal of restoring full, natural salmon and steelhead production in the Trinity River and its tributaries downstream from Lewiston Dam. Knowledge of hatchery and naturally produced steelhead escapements into the Trinity River is a necessary component both for making recommendations and determining the effectiveness of those recommendations. All steelhead reared at Trinity River Hatchery from 1978 through 1981 were systematically fin clipped before being released. Fin clipping of steelhead in the Trinity River basin have been sporadic to non-existent at Trinity River Hatchery since 1981. 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).

This year, staff of CDFG's Trinity Fisheries Investigations Project (TFIP) marked steelhead produced at Trinity River Hatchery (TRH) as part of the first phase in meeting the Job Objectives. The second phase will include the monitoring of adult returns beginning in the winter of 1990, and will be discussed in future annual reports.

METHODS

Marking Operations

Staff of CDFG's TFIP marked steelhead at TRH inside a 3-m X 3-m wooden shed positioned directly over the hatchery pond. Positioning the shed over the pond allowed easy access for a crew of four markers to effectively net fish into the shed.

Marking steelhead involved anaesthetizing them with tricaine methanesulfonate (MS-222[1/]), removing one or more of their fins by clipping, and releasing them into a pond reserved for marked fish. A combination of right or left ventral fin and adipose fin clips was used to differentiate each fish's brood year and release type.

Counts of marked fish which were released were made by TRH personnel doing standard weight counts on a subsample of the marked fish at the time of their release.

Quality Control

To determine fin-clip accuracy, a sample of 900 fish was selected just prior to release. Fish were anaesthetized with MS-222, measured to nearest mm fork length (FL), and checked for proper fin clips. Male steelhead were also checked for signs of precocious sexual development, which was determined by the extrusion of milt when each fish was squeezed.

RESULTS AND DISCUSSION

Marking Operations

We marked three groups of steelhead this season. Two-year-olds from the 1988 brood year (BY), released in 1990; yearlings from the 1989 BY, released in 1990; and holdovers from the 1989 BY, to be released in spring 1991 (Table 1).

Two-year-old steelhead were marked from 5 February through 15 February 1990; yearling steelhead from 15 February through 18 March 1990; and holdover steelhead from 18 March through 3 April 1990, when marking operations were curtailed. Marking operations were halted on that date because of rising water temperature which could have lead to increased mortalities. An estimated 110,000 holdovers remain to be fin-clipped at a later date. Holdovers which had been clipped were moved to holding ponds at the Old Sawmill Site on the outskirts of Lewiston, (river km 175.4) because of a lack of space at TRH. These fish are scheduled to be released in April 1991.

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

TABLE 1. Sum   of steelhead fin-clipping operations at Trinity River Hatche   from 5 February to 3 April 1990.

Brood year	Number clipped	Clip Type[1/]	Date released	Size (#/lb)
1988	50,490	RV	03-15-90	1.6/lb
1989	257,997	LV	04-06-90	9/lb
1989	148,000	LV	04-23-90	10/lb
1989	144,8[illegible]	RV/AD	2/	

1/ Fin clip t   s are right ventral (RV), left ventral (LV), and right ver   al and adipose fin clip (RV-AD).
2/ Release date scheduled sometime in April, 1991.

All steelhead released appeared to be in good condition, and we noted no apparent deformations or pathological conditions.

Quality Control

We measured the FL's of 300 two-year-old steelhead on 7 March 1990, and checked them for fin-clip accuracy. Average FL was 26.6 cm, and they ranged from 16 to 40 cm FL (± 4.77 s.d.). We observed eight precocious males (2.7% of the subsample), and did not find any fish with poor fin clips.

We measured the FL's of 600 yearling steelhead (BY 89) on 30 March 1990 and checked them for fin-clip accuracy. Their average FL was 159.2 mm (± 18.4 mm s.d.), and they ranged from 107 to 230 mm FL. Of the 600 fish checked, 31.8% (191/600) were smaller than our target of a 152-mm minimum-release size. We did not observe any fish with poor fin clips.

Quality control for the holdovers will not be done until marking for these fish is completed, probably in October 1990.

Recovery Operations

Juvenile steelhead migrate out to sea after spending one to three years in fresh water. They usually stay one to two years in salt water, and then return to freshwater to spawn when they are 38 to 69 cm in total length. Life history patterns of steelhead are variable, however, and growth rates may vary (Moyle 1976). However, 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 as half-pounders after several months (Hopelain 1987).

Recovery operations at TRH are scheduled to begin during spring 1991 when fin-clipped fish from the 1988 and 1989 BY's are first expected to return, and will be discussed in next year's annual report.

RECOMMENDATIONS

Personnel should be increased from one crew of four to two crews of four persons and two marking sheds should be used for marking next year, in order to speed up the marking process and increase the numbers of steelhead that can be marked within the allotted time.

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