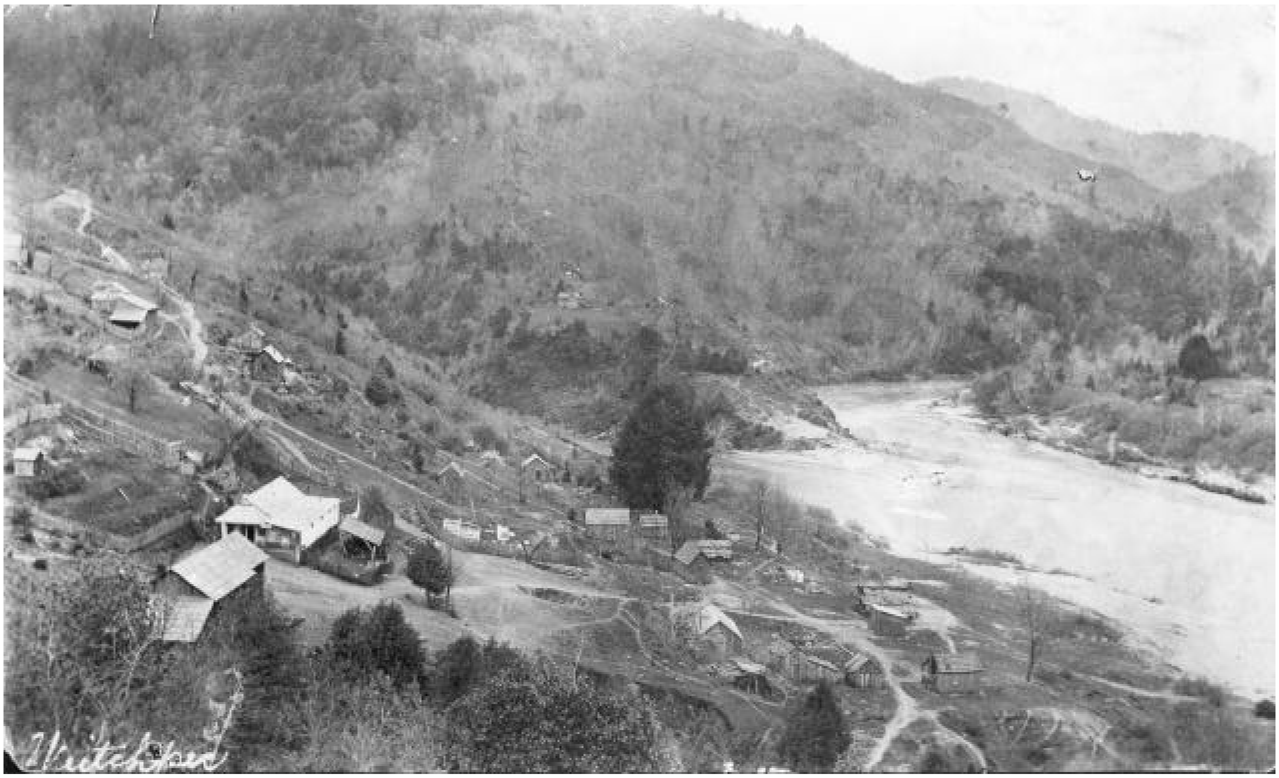
Juvenile Salmonid Emigration Monitoring on the Lower Trinity River, California, 1999-2000



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Acknowledgments

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Executive Summary

In 1999 and 2000, the Yurok Tribal Fisheries Program (YTFP) monitored juvenile salmonid emigration on the lower Trinity River utilizing a rotary screw trap. Trapping efforts in 1999 were conducted between 11 May through 13 Sept, for a total of 126 sampling nights. 2000 trapping efforts were conducted between 21 Apr through 12 Sept, for a total of 144 sampling nights. The lower Trinity River screw trap site was located at river mile 0.25 just upstream from the confluence with the Klamath River, and was operated at this location during both years with minor adjustments due to fluctuating flows.

Moribund chinook were captured throughout the trapping season representing several disease indicators during 1999 and 2000. No evaluations of moribund fish were performed by the USFWS California-Nevada Fish Health Center, although moribund fish did show clinical signs of diseases as in the previous years (Weskamp et al. 1997, 1998). During 2000 CDFG estimated that fish deaths could be as high as 300,000 for chinook 0+ and steelhead fry, parr and smolt. *Ceratommya shasta* and *Flavobacterium columnare* were considered responsible for moribund salmonids (USFWS 2001).

Lower Trinity River 1999

During 1999's trapping efforts 31,719 juvenile chinook salmon (*Oncorhynchus tshawytscha*) were captured for the season including 1,710 adipose fin-clipped chinook. Chinook with adipose fin clips indicated fish with coded-wire tag (CWT) implementation. A subsample of ad-clipped chinook were retained and CWT's were decoded to determine hatchery origin, migration rates and to estimate number of hatchery versus wild chinook emigrants. Trinity River Hatchery (TRH) spring-run accounted for 11% (n=3,469) and TRH fall-run chinook accounted for 28% (n=8,934) and the remaining 61% (n=19,316) fish were assumed to be of wild origin. The 1999 chinook abundance index was calculated to be 296,477 emigrants consisting of TRH spring-run (n=52,403), TRH fall-run (60,259) and the remaining fish assumed to be wild fish (n=183,815). The initial migration rate for TRH fall-run ranged from 2.51-4.82 rm/day and TRH spring-run was estimated at 6.93 rm/day

1,303 juvenile steelhead (*O. mykiss*) were captured during 1999 with several age classes represented. 100% of hatchery steelhead were marked allowing the determination of origin and hatchery/wild composition. 1,044 wild juvenile steelhead were collected consisting of YOY, parr, and smolts. A total of 259 ad-clipped juvenile steelhead made up the remaining total capture.

744 yearling coho (*O. kisutch*) and 99 YOY were captured during the season. Of the 843 coho sampled, 85% (n=720) originated from TRH, wild fish accounted for 2.9% (n=24) and YOY coho accounted for 11.9% of the total capture.

Lower Trinity River 2000

During 2000's trapping efforts 4,076 juvenile chinook salmon were captured for the season including 260 adipose fin clipped chinook. TRH spring run accounted for 20% (n=862) and TRH fall-run chinook accounted for 28% (n=1,126) and the remaining 52% (n=2,123) fish were assumed to be of wild origin. The 2000 chinook abundance index was estimated at 99,505 emigrants consisting of TRH spring run (n=21,407) TRH fall-run (n=26,470), and the remaining fish assumed to be wild fish (n=51,628). The initial migration rate for TRH fall-run ranged from 5.83-7.92 rm/day and the TRH spring run ranged from 7.92-15.83 rm/day.

862 juvenile steelhead were captured during 2000 with several age classes represented. 617 wild steelhead were collected consisting of YOY, parr, and smolts. A total of 245 ad-clipped juvenile steelhead made up the remaining total capture.

582 yearling coho and 13 YOY were captured during the season. Of the 582 yearlings sampled 65% (n=380) originated from TRH, wild fish accounted for 35% (n=202) and YOY accounted for 2.2% of the total capture.

Introduction

The Klamath River Basin historically contained bountiful anadromous fish runs, with annual migrating salmonid populations likely exceeding one million adult fish. These fisheries, including abundant populations of eulachon (*Thaleichthys pacificus*), Pacific lamprey (*Lampetra tridentata*), and green sturgeon (*Acipenser medirostris*) fulfilled cultural, subsistence, and commercial needs of indigenous peoples throughout the region. Current data indicate, however, that native fish populations have declined substantially throughout the Klamath and Trinity Rivers as a result of dam construction, water diversion, intensive logging, and other anthropogenic activities dating from the 1850's.

Dam building has proved particularly deleterious to anadromous fish runs. Lewiston Dam on the Trinity River has blocked fish access to 109 miles of upstream spawning habitat since 1964 (USDOI 1980). At least 80% of the Trinity River's historic annual flow at the Lewiston dam site has been impounded for diversion to the Sacramento River Basin since completion of the Trinity River Diversion. On the Klamath River, access has been blocked at river mile (rm) 198 since 1917 by mainstem hydroelectric dams and seven miles further downstream since 1962 by Iron Gate Dam (Kier and Associates 1991). Prior to construction of Iron Gate Dam, hydroelectric operations resulted in radical flow fluctuations in the mainstem Klamath, with water levels rising or dropping several feet in a twenty-minute period (Kier and Associates 1991). Agricultural diversions from the upper Klamath Basin have significantly altered natural Klamath River flow patterns and water quality since the initiation of the Bureau of Reclamation's Klamath Project in 1906-07 (Balanced Hydrologics, Inc. 1996). Mainstem river habitat loss, degradation of water quality, and an unfavorable alteration of the natural hydrograph are several negative impacts on anadromous fish species that are directly attributable to these water management activities.

In an attempt to restore Trinity River anadromous fish stocks to pre-impoundment levels, Congress enacted the Trinity River Basin Fish and Wildlife Restoration Act (P. L. 99-552) in 1984. A primary goal of this legislation is the restoration of anadromous fish throughout the Trinity and Lower Klamath River Basins (Figure 1). In 1989, the United States Fish and Wildlife Service (USFWS) implemented initial monitoring programs in the Trinity River near Willow Creek (river mile (rm) 21) and in the Klamath River at Big Bar (rm 50) in order to assess juvenile salmonid emigration and long-term population trends of anadromous fish stocks.

In 1997, the Yurok Tribal Fisheries Program (YTFP) installed an outmigrant trap in the Lower Klamath River to enumerate juvenile salmonid emigrants originating throughout the entire Klamath River Basin. This trap location specifically provided the opportunity to assess emigration variation and interaction of the Trinity and Klamath River stocks downstream of the Trinity River confluence (rm 44), but prior to estuarine entry. Two additional outmigrant trap efforts were initiated in the Trinity River during 1998: upstream of the Trinity/Klamath River confluence at Weitchpec, and near Junction City. These trapping efforts, in conjunction with the annual estuarine sampling conducted by the California Department of Fish and Game (CDFG) provide Klamath River Basin fisheries resource managers with the opportunity to monitor juvenile salmonid emigration trends by species and age class, and coordinate activities between successive trap sites throughout the Trinity and Klamath Rivers.

Figure 1. Location of Klamath River basin, California.

Methods and Materials

An eight-foot rotary screw trap was used to collect emigrating salmonids in the lower Trinity River during 1999 and 2000. These two years represent the second and third year of trapping on the lower Trinity River.

Trap Site Description

The lower Trinity River screw trap site was located at rm 0.30 just upstream from the confluence with the Klamath River (Figure 2). The lower Trinity River trap site was moved approximately 500-600 ft. upstream from the 1998 trapping location. This particular trapping location enables the potential capture of emigrants originating throughout the entire Trinity River Basin.

The rotary screw trap was situated in swiftly flowing run habitat and was repositioned periodically throughout the season in response to changing flow conditions and decreases in fish capture. The lower Trinity River trap site was located alongside a bedrock embankment. The lower Trinity River trap access was possible via jet boat and by a foot trail off of Highway 96 in Weitchpec, CA.

Trap Design and Operation

The rotary screw trap is a safe and efficient method to collect outmigrant data while minimizing stress and mortality on captured fish. The trap is designed to function over a wide range of water velocities while maintaining an ability to fully retain captured fish.

The cone was lowered to a depth of 4-feet and sampled a cross sectional area of 7.67ft^2. Flowing water enters the trap cone and strikes the spiral vanes, causing the screw assembly and cone to rotate continuously once deployed. Fish that enter the cone were funneled rearwards into the live box. Captured fish were retained in the live box until sampling crews arrived.

The lower Trinity rotary screw trap (manufactured by E.G. Solutions, Inc., Corvallis, Oregon) is equipped with an 8-foot diameter cone, and is supported by two aluminum-covered foam pontoons measuring 21.9 feet in length. A 4.0-ft x 6.0-ft live box was equipped behind the cone. This larger live box proved beneficial during peak catches for all salmonid species. The lower Trinity trap was positioned 15 feet from the riverbank and held in place by 3/8 inch galvanized steel cable.

Biological Sampling Protocol

Both screw traps were operated 24 hours a day, seven days a week throughout the sampling period with the exception of downtime due to high river flows and/or required repairs. The traps were typically checked once a day in the morning hours. During peak emigration periods, the traps were checked several times during the night and early morning hours to minimize holding density and reduce fish stress.

Batches of 20-30 fish were netted from the live box and placed into five-gallon buckets containing fresh river water. Three to five fish at a time were then placed into a holding tub and anaesthetized with a solution of 0.6 grams of tricane methanesulfonate (MS-222) in 10 liters of water. All captured salmonids were identified to species and age class. A random sample of each salmonid species (up to thirty fish)

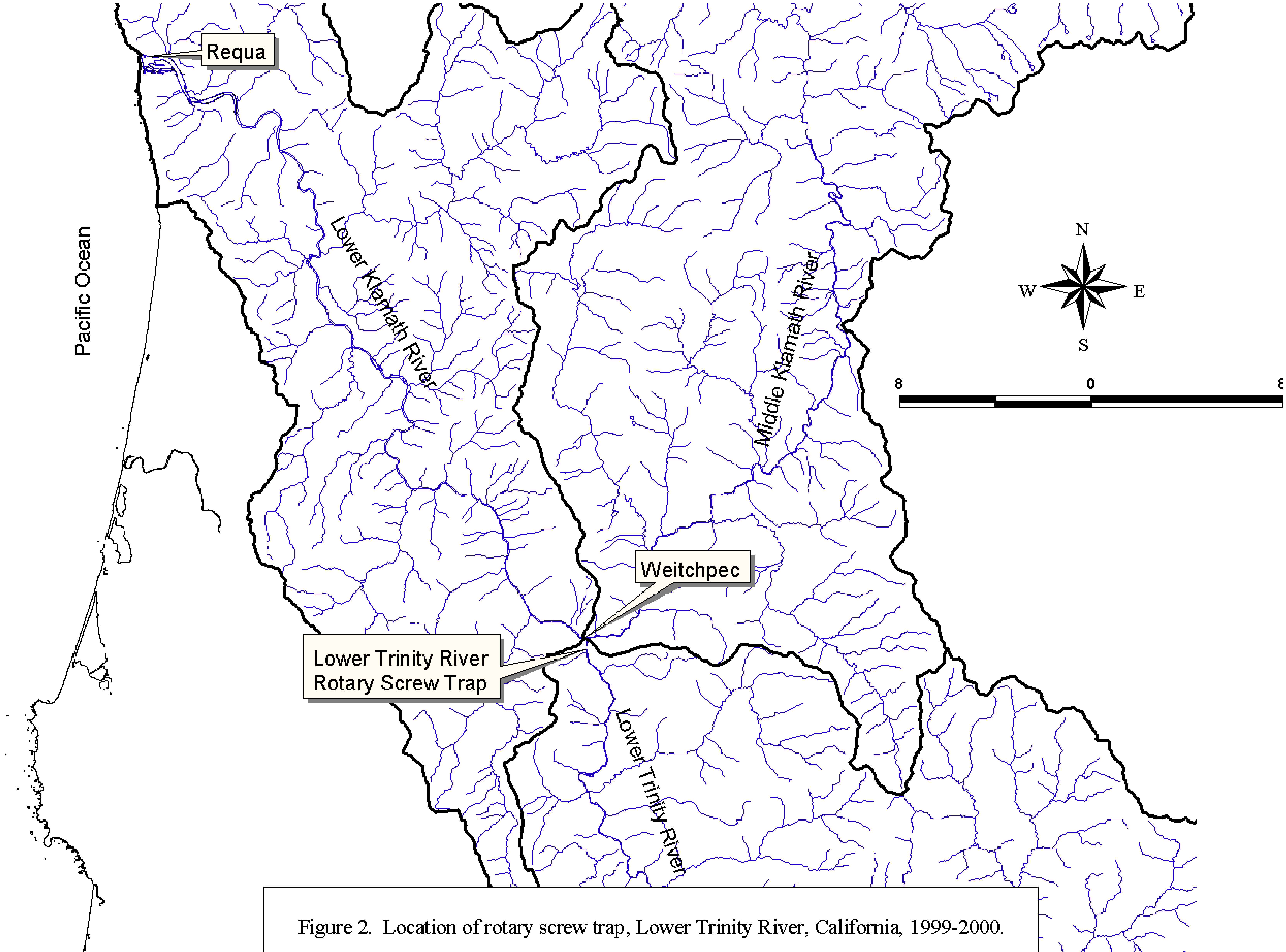

Figure 2. Location of rotary screw trap, Lower Trinity River, California, 1999-2000.

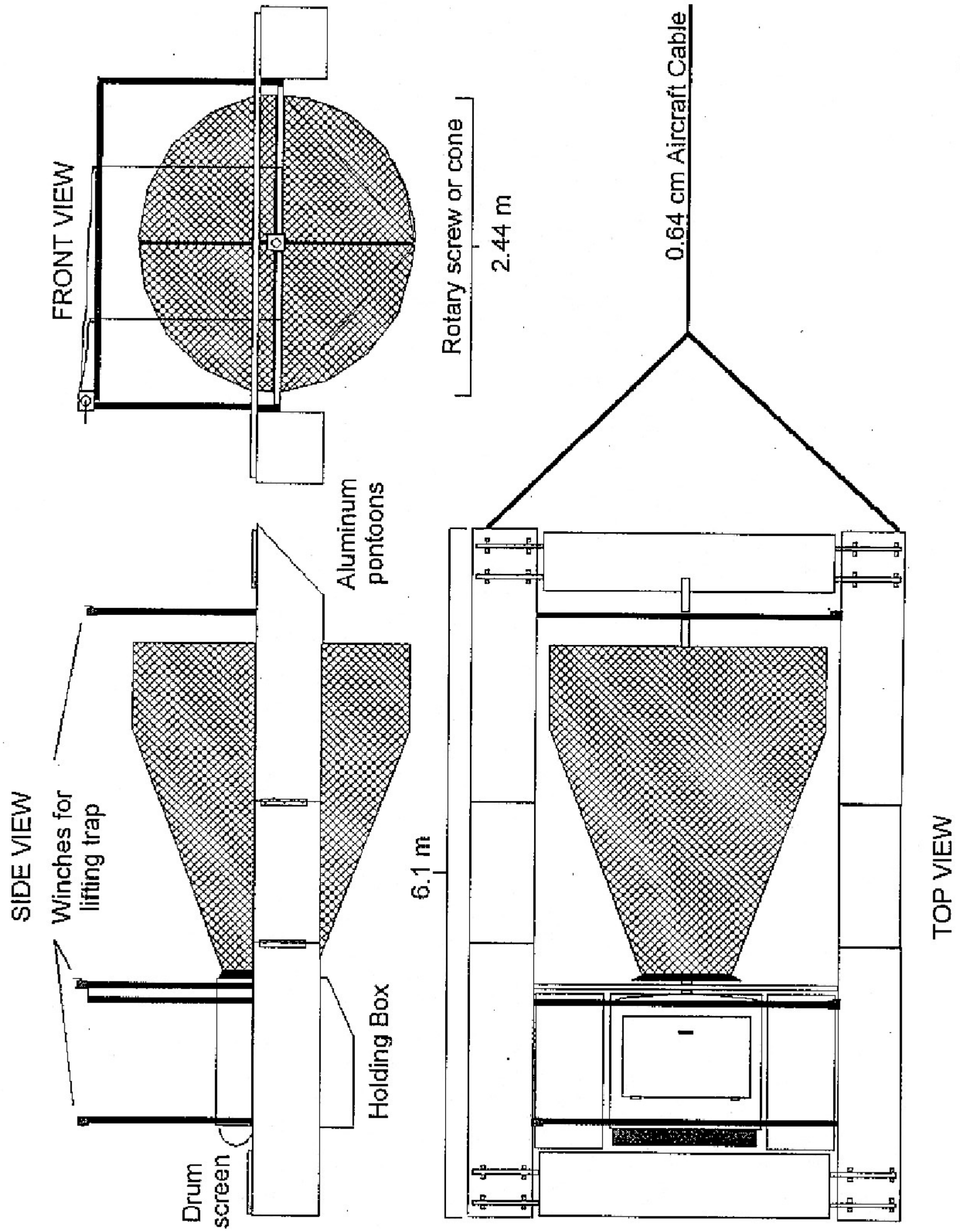

Figure 3. Schematic of the rotary screw trap design (lower Klamath trap only) depicting key components and dimensions.

was measured to fork length (mm). All age 1^+ and older steelhead and cutthroat were qualitatively classified as either parr or smolt based on physical appearance. Condition factors for juvenile chinook were similarly based on observations of degree of smolting. All non-salmonids were identified to species and tallied.

All salmonids were examined for adipose fin clips (ad-clips), marks, scars, disease indicators, or other identifiable features. Chinook with ad-clips were returned to the lab for recovery and decoding of coded wire tags (CWT). When a large number of ad-clipped chinook were captured, a random subsample of up to 30 ad-clipped fish were collected. Decoded CWT's allowed differentiation of origin, mark groups, and release dates. All captured coho were examined for maxillary fin clips. A left maxillary clip was applied to all coho released from Trinity River Hatchery (TRH), and a right maxillary clip was applied to all coho released from Iron Gate Hatchery (IRH). Ad-clipped steelhead were measured and noted as being of hatchery origin. All chinook and steelhead at the Lower Klamath trap were also inspected for partial fin clips (caudal and/or pelvic fin clips) applied at YTFP's Blue Creek and lower Trinity River outmigrant traps.

Scale samples were collected throughout the trapping season from selected steelhead and cutthroat trout (parr/smolt), as well as potential yearling chinook in order to facilitate differentiation between age classes. Scales were mounted and analyzed using methods described in Jearld (1983).

Hatchery/Natural Stocks Estimate

Chinook

The hatchery versus natural stock composition of emigrating chinook salmon was facilitated by the retrieval of CWT's. Ad-clipped chinook analyzed for CWT's were classified as "recovered", "lost", or "no tag". A "lost" tag was defined as located but lost in the retrieval or decoding process. A "no tag" was defined as an ad-clipped chinook that did not contain a tag at time of removal.

An expansion factor (E) was used for each CWT code to correlate recovered, lost, and untagged ad-clipped fish and was calculated with the following equation:

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

Where:

C	= Number of chinook captured
MS	= Number of chinook examined for ad-clips
AD	= Number of ad-clipped chinook captured
H	= Number of ad-clipped chinook collected
T	= Number of chinook containing tags
TR	= Number of tags recovered

Estimates of hatchery and natural chinook composition were determined using CWT recoveries and a production multiplier. The production multiplier is used to account for unmarked chinook in a release group for each given tag code. The production multiplier equation is as follows:

$$P.M. = (r+r_p+r_{nm})/r$$

Where:

r = Number of CWT fish in a release group.
r_p = Number of chinook with ad-clip only in release group.
r_{nm} = Number of unmarked chinook in a release group.

Coho

All TRH coho released during spring 1999 and 2000 were marked with a right maxillary clip. As a result the proportion of hatchery and natural stocks was directly determinable and thus, no estimation was necessary.

Steelhead

All juvenile steelhead released from TRH during 1999 and 2000 were marked with an adipose fin clip. Since all released steelhead from this facility were marked, the proportion of hatchery and natural stocks was directly determinable and thus no estimation was necessary.

Abundance Index

Daily and weekly abundance index values were calculated in a manner to maintain consistent methods with concurrent long-term monitoring efforts outmigrant trapping activities being conducted further upstream in the mainstem Klamath and Trinity Rivers by the U.S. Fish and Wildlife Service (USFWS) (Goldsmith 1994). The abundance index attempts to assess the number of emigrants moving past the trap every night. These index values, however, are a means of monitoring relative abundance and are not intended to be substituted for actual estimates of total emigration. The index values are calculated by expanding the total number of fish captured by the percentage of river discharge sampled by the screw trap.

The percent of river flow sampled was estimated by dividing the daily estimated discharge entering the cone by daily average river discharge. Daily abundance values were measured by dividing total daily salmonid catches by the percent of river flow sampled. A weekly abundance value was calculated by summing daily index values. When the trap was not operated for a seven-day period, total catch was multiplied by the proportion of days sampled during that week.

Migration Rate and Duration

Migration rates for hatchery chinook were determined based on CWT recoveries. Chinook were volitionally released from TRH during 1999 and 2000. Due to extended release periods, the median day of release was used when calculating migration rates. Initial migration rates were calculated for all hatchery tag code groups released in June 1999 and 2000. This rate was derived from the number of elapsed days from release to initial capture for individual tag code groups, divided by total distance in river miles (rm) traveled.

Mean migration rates were calculated for each individual CWT group for chinook unless volitional releases extended over a 5-day period. Mean migration rates for individual CWT's and marked fish were calculated by excluding the first 10% and the last 10% of recovered tags and marked fish for chinook and coho. This method was used to focus on the time period when the majority of the fish migrated. If less then 10-marked/tagged fish from each species/tag group were captured from TRH, then all CWT's and/or marked fish were used in the calculation. Migration rates were calculated with the following variables because of the low percentage of water sampled by the trap, and the possibility that hatchery fish may have passed by the trap before any were captured:

$$\text{Mean Migration Rate} = \frac{\sum (\# \bullet \text{rm/d} \bullet P)}{\sum (\# \bullet P)}$$

Where:

\# = Daily expanded CWT code or fin clip counts

rm/d = Distance traveled divided by number of days taken to reach trap after release date

P = Percent river discharge sampled at trap

Water Temperature

Water temperature was monitored in conjunction with outmigrant trapping activities. An Optic Stow-away temperature logger (Onset Corp. model # WTA08-05+37°C), deployed adjacent to the lower Trinity River trap (rm 0.25), recorded water temperature every thirty minutes throughout the trapping period. Due to the loss of temperature logger during 2000, temperature data from California Data Exchange Center was used to assess water temperatures. A third temperature logger was deployed in the Klamath River just upstream of the Trinity River confluence in order to assess temperature differences in the two mainstem rivers throughout the trapping season.

Flow Measurements

River discharge sampled by the screw trap was estimated daily throughout the season. Daily cone flow estimates were then compared to average daily river discharge data obtained from the USGS “Hoopa” gage in the lower Trinity River (rm 12.6) in order to estimate the proportion of total river flow sampled by the traps each day.

Daily cone flow estimates were made using a Marsh-McBirney Flow-Mate (Model # 2000) current meter. Water velocities were measured at positions 0.61, 1.22, and 1.83 m across the front of the trap opening (Figure 4) and at two depths for each position (0.2 and 0.8 of the depth of the trap opening at each of the three stations) (Goldsmith 1994). These daily measurements were taken using a forty-second interval. Daily cone flow estimates (cfs) were calculated by first measuring the mean velocity (ft/sec.) for each location (left, center, and right), multiplying each measurement by the corresponding cell width and depth, and then summing the estimates from each cell (left, center, and right).

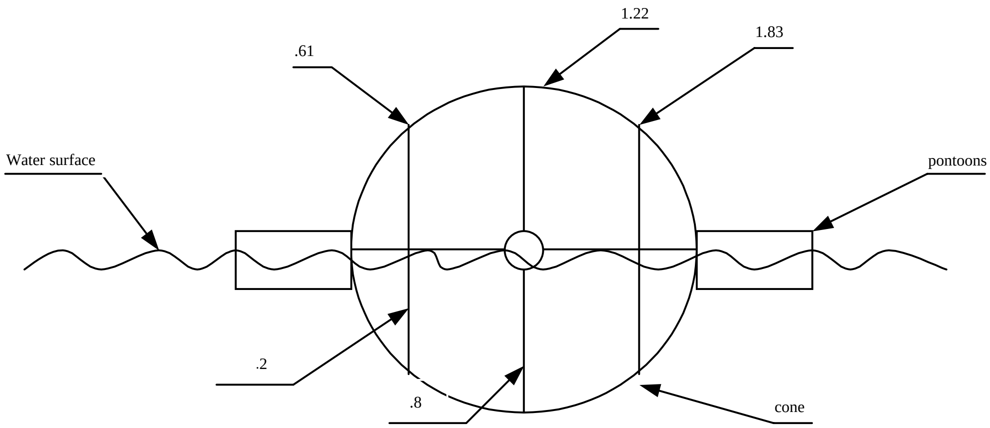

Figure 4. Schematic diagram of river discharge sampling locations on rotary screw traps, lower Trinity River, California, 1999.

Results and Discussion

The 1999 outmigrant trapping effort began on 11 May and continued through 13 Sep for a total of 126 sampling nights. The trap was pulled for the season because of a significant reduction in captured salmonids. A total of 31,719 juvenile chinook emigrants were sampled throughout the trapping season (Table 1). Juvenile steelhead (n=1,303) and coho salmon (n=843) were also enumerated during the 1999 trapping effort.

Water Temperature Monitoring

At the lower Trinity River rotary trap site, daily average water temperatures ranged from 51°F to 73°F during the 1999 trapping period (Figure 5). A season maximum water temperature of 73° F occurred on 13 Jul 1999. Although daily average temperatures never reached upper lethal limits for salmonids (76-78°F) as identified by Bell (1991), they did exceed the preferred temperature range for migrating chinook and coho salmon (67°F). Daily average temperatures exceeded this preferred temperature beginning 9 Jul, and remained above this level throughout the remaining trapping season.

River Flow

Daily average river flow during the trapping season ranged from 6,315 cfs on the first day of operation (11 May) to 528 cfs when the trap was pulled on 13 Sep (Figure 6). A peak flow of 7,470 cfs occurred on 25 May 1999, while the season low flow of 514 cfs occurred on 12 Sep 1999.

River discharge entering the screw trap cone averaged 110 cfs throughout the season. Percent of total river discharge sampled ranged from 1.25% to 19.9% with a season average of 9.5%. As total river discharge progressively decreased throughout the season, percent discharge sampled progressively increased (Figure 6).

Fish Health

An increase in captured moribund chinook occurred beginning the week of 9 Jul 1999. The increase occurred simultaneously with the increase in water temperatures (Figure 5). Water temperatures exceeded the preferred temperatures for migrating chinook during this period, which can also accelerate disease symptoms in infected fish. In 1998 clinically diseased juvenile salmonids collected throughout the Lower Klamath Basin were reported with infections of columnaris (*Flexibacter columnare*). Columnaris infections are associated with high water temperatures and low dissolved oxygen levels, and studies have shown that water temperatures above 64°F cause increased mortality among infected chinook juveniles (Holt et al. 1975; Piper et al. 1982; Post 1987). Although no evaluations of moribund chinook were performed on fish collected in the 1999 lower Trinity River screw trap, virtually all chinook mortalities showed several disease indicators upon capture.

Table 1. Total number of juvenile salmonids, green sturgeon, and Pacific Lamprey captured by week in the rotary screw trap, lower Trinity River, California, 1999.

Week Ending	# Days Sampled	Week Avg. Flow (cfs)	% Flow Trapped	Chinook No Clip	Chinook Ad-Clip	Chinook Total	Steelhead YOY	Steelhead Wild Parr	Steelhead Wild Smolt	Steelhead TRH Parr	Steelhead TRH Smolt	Steelhead Total	Coho YOY	Coho Yearling Wild	Coho Yearling TRH	Coho Total	Green Sturgeon	Pacific Lamprey Adult	Pacific Lamprey Ammocoete
5/16/99	6	6,763	1.53	12	0	12	2	10	32	9	69	122	11	2	94	107	0	2	15
5/23/99	7	6,442	1.47	11	0	11	1	13	26	1	44	85	9	5	106	120	0	2	33
5/30/99	7	6,798	1.42	9	0	9	0	9	34	0	70	113	6	2	158	166	0	3	34
6/6/99	7	4,924	2.11	5	0	5	1	6	32	0	16	55	20	6	107	133	0	3	26
6/13/99	7	3,600	3.08	22	0	22	2	10	23	0	31	66	15	4	157	176	0	2	34
6/20/99	7	3,490	3.60	800	41	841	11	5	16	2	14	48	5	4	81	90	0	2	9
6/27/99	7	2,923	4.42	1,445	175	1,620	8	0	6	0	3	17	3	1	15	19	1	1	12
7/4/99	7	2,360	4.88	569	60	629	12	4	2	0	0	18	11	0	1	12	0	1	6
7/11/99	7	1,880	5.37	550	61	611	32	1	0	0	0	33	7	0	1	8	0	2	14
7/18/99	7	1,644	5.15	360	23	383	26	6	3	0	0	35	1	0	0	1	0	1	16
7/25/99	7	1,141	9.98	9,190	539	9,729	46	0	1	0	0	47	0	0	0	0	0	0	3
8/1/99	7	799	14.40	8,409	452	8,861	49	3	0	0	0	52	3	0	0	3	0	0	0
8/8/99	7	745	16.37	3,841	172	4,013	224	3	0	0	0	227	3	0	0	3	1	0	3
8/15/99	7	709	16.82	1,532	69	1,601	161	0	0	0	0	161	0	0	0	0	2	0	28
8/22/99	7	626	17.96	1,137	58	1,195	55	0	3	0	0	58	2	0	0	2	2	2	23
8/29/99	7	586	19.28	955	33	988	36	3	0	0	0	39	1	0	0	1	0	0	5
9/5/99	7	562	18.97	830	14	844	76	2	6	0	0	84	0	0	0	0	0	0	3
9/12/99	7	526	20.38	310	13	323	38	1	1	0	0	40	2	0	0	2	0	0	4
9/19/99	1	528	19.48	22	0	22	2	1	0	0	0	3	0	0	0	0	0	0	1
Total:	126			30,009	1,710	31,719	782	77	185	12	247	1,303	99	24	720	843	6	21	269

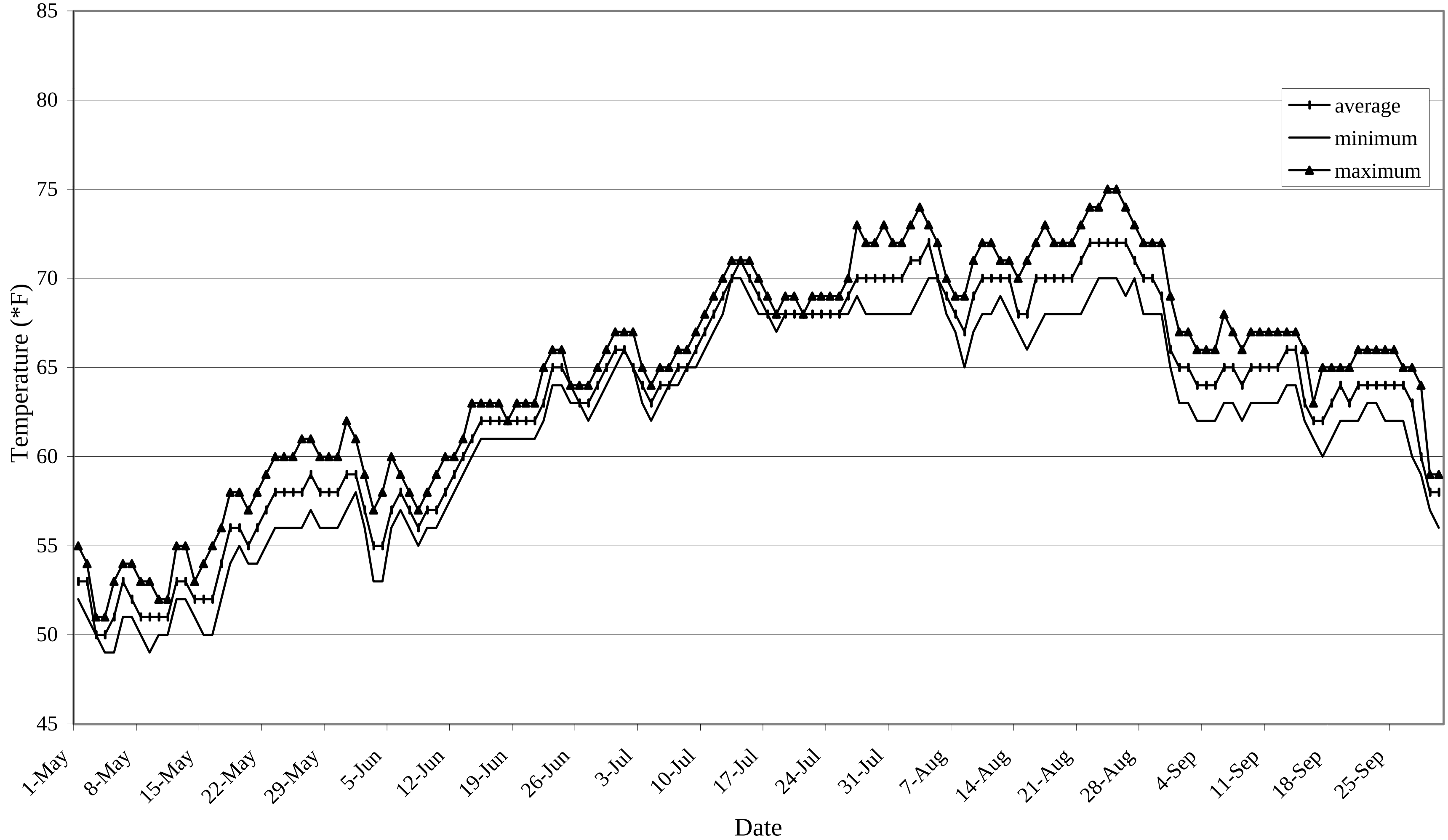

Figure 5. Average, minimum and maximum daily water temperatures, lower Trinity River near Wetichpec, California, May-September, 1999.

Disease symptoms/indicators observe included:

- Gill deterioration with heavy mucous and secretion
- Blood at base of anal and pectoral fins
- Open wounds with fungal growth

These symptoms were similar to symptoms that were recognized in fish captured in previous trapping years (lower Klamath 1997-1998 and lower Trinity 1998) (Weskamp et al. 1997, 1998). In 1997, samples of moribund chinook analyzed by the USFWS California-Nevada Fish Health Center (CNFHC) indicated that chinook had expired due to a moderate to severe infection of the myxozoan parasite *Ceratomyxa shasta* (True 1997). *C. shasta* can cause necrosis of the gastrointestinal tract and can result in high mortality rates of juvenile salmonids (Noga 1996). This parasite typically occurs seasonally (May-Nov) when water temperature is at or above 50°F, with an increase of diseased fish during elevated water temperature periods (Lasee 1995). In 1998 CNFHC also examined moribund chinook and found they were infected with columnaris (*Flexibacter columnare*) (Willamson and Foott 1998). Chinook collected during 1997 and 1998 trapping efforts in the lower Klamath and Trinity River also tested positive for minimal to severe infections of *Aeromonas* and *Pseudomonas* species.

<u>Lower Trinity River Rotary Screw Trap 1999</u>

<u>Chinook salmon</u>

<u>Capture Summary</u>

The first chinook emigrant was captured on 12 May, with small capture numbers of chinook observed through the week of 13 Jun (Table 1). After this date, numbers of captured chinook steadily increased with variable fluctuations for a period of eight weeks. The weekly peak capture of 9,729 chinook occurred during the week ending 25 Jul, with the largest single night capture (n=2,181) taking place on 22 Jul. Following the peak capture period there was a steady decrease in chinook numbers for the remainder of the season. The last week of sampling concluded with a total of 22 chinook captured.

The first adipose-clipped chinook was captured on 14 Jun, with all chinook captured prior to this date assumed to be of natural origin. The increase in captured chinook emigrants correlated with hatchery releases from TRH, which occurred between 1 June and 7 Jun 1999 (Table 2).

Peak capture of hatchery chinook occurred between the weeks ending 7 Jul and 8 Aug, with TRH fall-run and TRH spring-run representing 29% and 6% of total fish captured, respectively (Table 3). USFWS operated a rotary screw trap in the Trinity River near Willow Creek (rm 21) during 1999. The peak chinook capture at the Willow Creek trap occurred during the weeks ending 22 Jul- 5 Aug (Craig 1999). This peak capture simultaneously occurred with their second peak capture of ad-clipped chinook. YTFP peak counts of TRH fall-run chinook occurred approximately one week later then the Willow Creek trap.

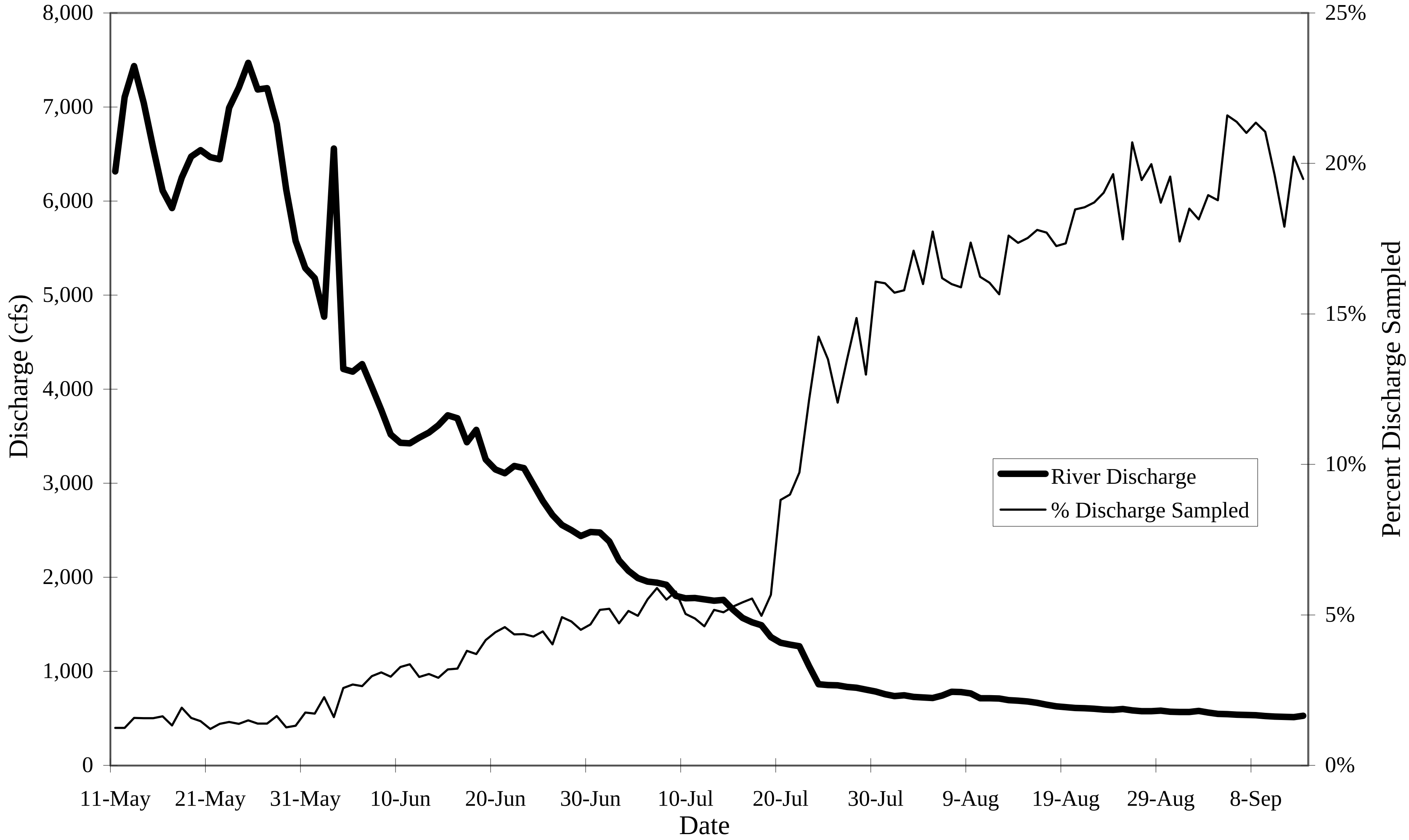

Figure 6. Average daily discharge at USGS "Hoopa" gage (13.04rm) and percent river discharge sampled at rotary screw trap, lower Trinity River, California, 1999.

Table 2. Coded wire tag information for Trinity River Hatchery juvenile chinook salmon release groups, Klamath River Basin, California, 1999.

Trinity River Hatchery: Fall Chinook (06-52-42)

Total # Tagged	# Poor Tags	# Unmarked Fish	Production Multiplier	Brood Year	Release Date
46,399	2,545	472,137	11.23	1998	June 1-7, 1999

Trinity River Hatchery: Fall Chinook (06-52-43)

Total # Tagged	# Poor Tags	# Unmarked Fish	Production Multiplier	Brood Year	Release Date
42,659	2,531	434,317	11.23	1998	June 1-7, 1999

Trinity River Hatchery: Fall Chinook (06-52-44)

Total # Tagged	# Poor Tags	# Unmarked Fish	Production Multiplier	Brood Year	Release Date
49,332	802	478,342	10.71	1998	June 1-7, 1999

Trinity River Hatchery: Fall Chinook (06-52-45)

Total # Tagged	# Poor Tags	# Unmarked Fish	Production Multiplier	Brood Year	Release Date
46,391	2,961	475,620	11.32	1998	June 1-7, 1999

Trinity River Hatchery: Spring Chinook (06-52-47)

Total # Tagged	# Poor Tags	# Unmarked Fish	Production Multiplier	Brood Year	Release Date
54,378	8,125	322,222	7.08	1998	June 1-7, 1999

Trinity River Hatchery: Spring Chinook (06-52-48)

Total # Tagged	# Poor Tags	# Unmarked Fish	Production Multiplier	Brood Year	Release Date
61,516	2,563	324,970	6.32	1998	June 1-7, 1999

Trinity River Hatchery: Spring Chinook (06-52-49)

Total # Tagged	# Poor Tags	# Unmarked Fish	Production Multiplier	Brood Year	Release Date
61,074	2,811	323,780	6.35	1998	June 1-7, 1999

Hatchery/Natural Estimation

During 1999 juvenile chinook were released from Trinity River Hatchery. Four groups of fall-run chinook and three groups of spring-run chinook were volitionally released from TRH between 1-7 Jun 1999 (Table 2). A total of 59 chinook were captured prior to the arrival of the first ad-clipped chinook on 14 Jun. No determination of origin was possible for these fish, and hence they were assumed to be wild fish.

From the total of 31,719 chinook sampled during the trapping season, 1,710 fish (5.4%) possessed ad-clips. A total of 889 chinook were collected for coded wire tag (CWT) retrieval, with 770 CWT's ultimately recovered for determination of the origin and release group. Based on these tag recoveries, the weekly expansion factor (E) was utilized together with the production multiplier (PM) for each tag group to determine the origin of the unmarked portion of the capture (Appendix A).

Chinook captures continued to follow the same trend line as the previous years of trapping, with low numbers of chinook captured until the release of TRH chinook. TRH chinook were captured during a period of twelve weeks from the week of 20 Jul through 5 Sep, peaking during the week of 25 Jul (Table 3).

TRH spring-run chinook were the first ad-clipped chinook captured for the trapping season. The initial capture of spring run chinook took place on 14 Jun, with the first peak occurring on the week of 27 Jun (n=968) (Table 3), according to CWT expansions. Capture numbers declined for three weeks until a second peak capture occurred during week ending 25 Jul. This second peak occurred during the same time period as the total chinook peak capture. Spring run chinook were captured for a total of eleven weeks with the last of these chinook captured during the week of 29 Aug.

TRH fall-run chinook were initially captured for eleven weeks from 27 Jun through 5 Sep, with the peak capture occurring on the week of 25 Jul (n=3,181) according to CWT expansions. Large numbers of fall-run chinook were captured for two more weeks, with numbers tapering off after the week of 15 Aug (Table 2). From CWT expansions it was estimated that TRH spring-run chinook accounted for 11% (n=3,469) and TRH fall chinook accounted for 28% (n=8,934) of total chinook (n=31,719) captured during the trapping season (Table 3).

Wild chinook emigrated throughout the trapping season with a weekly peak capture occurring during the week ending 25 Jul (Table 2). Wild fish accounted for a total of 61% (n=19,316) of the total chinook captured (31,719) during the trapping season. Peak capture coincided with capture of TRH fall-run, while the first peak of captured TRH spring-run occurred four weeks earlier (Table 3). The larger size of spring-run chinook likely accounted for the faster migration rate, which lessons the competition with natural fish in the system.

Abundance Index

Before the first ad-clipped fish was captured, cumulative chinook abundance was estimated at 3,129 fish, all of which were assumed to be of wild origin (Table 4). The increase in abundance index values in late June was a direct response to hatchery-released chinook from TRH (Table 4, Figure 7;8). The peak

Table 3. Total number of juvenile salmonids with CWT expansions, green sturgeon, and Pacific Lamprey captured by week in the rotary screw trap, lower Trinity River, California, 1999

Week Ending	# Days Sampled	Week Avg. Flow (cfs)	% Flow Trapped	Chinook* Wild	Chinook* Spring	Chinook* Fall	Chinook* Total	Steelhead Wild YOY	Steelhead Wild Parr	Steelhead Wild Smolt	Steelhead TRH Parr	Steelhead TRH Smolt	Steelhead Total	Coho YOY	Coho Yearling Wild	Coho Yearling TRH	Coho Total	Green Sturgeon	Pacific Lamprey Adult	Pacific Lamprey Ammocoete
5/16/99	6	6,763	1.53	12	0	0	12	2	10	32	9	69	122	11	2	94	107	0	2	15
5/23/99	7	6,442	1.47	11	0	0	11	1	13	26	1	44	85	9	5	106	120	0	2	33
5/30/99	7	6,798	1.42	9	0	0	9	0	9	34	0	70	113	6	2	158	166	0	3	34
6/6/99	7	4,924	2.11	5	0	0	5	1	6	32	0	16	55	20	6	107	133	0	3	26
6/13/99	7	3,600	3.08	22	0	0	22	2	10	23	0	31	66	15	4	157	176	0	2	34
6/20/99	7	3,490	3.60	627	214	0	841	11	5	16	2	14	48	5	4	81	90	0	2	9
6/27/99	7	2,923	4.42	641	968	11	1,620	8	0	6	0	3	17	3	1	15	19	1	1	12
7/4/99	7	2,360	4.88	70	317	242	629	12	4	2	0	0	18	11	0	1	12	0	1	6
7/11/99	7	1,880	5.37	294	213	104	611	32	1	0	0	0	33	7	0	1	8	0	2	14
7/18/99	7	1,644	5.15	227	45	111	383	26	6	3	0	0	35	1	0	0	1	0	1	16
7/25/99	7	1,141	9.98	5,245	1,053	3,431	9,729	46	0	1	0	0	47	0	0	0	0	0	0	3
8/1/99	7	799	14.40	5,619	621	2,621	8,861	49	3	0	0	0	52	3	0	0	3	0	0	0
8/8/99	7	745	16.37	2,227	233	1,553	4,013	224	3	0	0	0	227	3	0	0	3	1	0	3
8/15/99	7	709	16.82	943	105	553	1,601	161	0	0	0	0	161	0	0	0	0	2	0	28
8/22/99	7	626	17.96	617	94	484	1,195	55	0	3	0	0	58	2	0	0	2	2	2	23
8/29/99	7	586	19.28	642	30	316	988	36	3	0	0	0	39	1	0	0	1	0	0	5
9/5/99	7	562	18.97	468	0	376	844	76	2	6	0	0	84	0	0	0	0	0	0	3
9/12/99	7	526	20.38	323	0	0	323	38	1	1	0	0	40	2	0	0	2	0	0	4
9/19/99	1	528	19.48	22	0	0	22	2	1	0	0	0	3	0	0	0	0	0	0	1
				- Trap Pulled on 9/13/99 Due to Low Fish Numbers -																
Total:	126			18,024	3,893	9,802	31,719	782	77	185	12	247	1,303	99	24	720	843	6	21	269

* Chinook numbers were estimated from CWT expansions.

Table 4. Weeky abundance index estimates for juvenile salmonids captured in the the rotary screw trap, lower Trinity River, California, 1999.

Week Ending	# Days Sampled	Chinook Wild	Chinook Spring	Chinook Fall	Chinook Total	Steelhead YOY	Steelhead Wild Parr	Steelhead Wild Smolt	Steelhead TRH Parr	Steelhead TRH Smolt	Steelhead Total	Coho YOY	Coho Yearling Wild	Coho Yearling TRH	Coho Total
5/16/99	6	780	0	0	780	125	719	2,193	672	4,563	8,272	755	144	6,094	6,993
5/23/99	7	729	0	0	729	72	897	1,845	72	3,076	5,963	715	295	7,333	8,343
5/30/99	7	654	0	0	654	0	679	2,384	0	4,961	8,024	512	79	11,228	11,819
6/6/99	7	240	0	0	240	39	255	1,476	0	758	2,528	975	223	4,493	5,691
6/13/99	7	726	0	0	726	65	318	752	0	998	2,132	485	133	5,143	5,761
6/20/99	7	16,580	5,224	0	21,804	278	136	430	48	407	1,299	158	108	2,336	2,601
6/27/99	7	14,583	22,294	228	37,105	179	0	142	0	69	389	75	22	345	442
7/4/99	7	6,185	6,504	242	12,931	247	85	38	0	0	371	230	0	21	252
7/11/99	7	5,726	3,793	1,963	11,482	588	17	0	0	0	605	130	0	20	150
7/18/99	7	4,678	907	1,933	7,518	500	116	59	0	0	674	19	0	0	19
7/25/99	7	44,868	9,745	33,223	87,836	462	0	10	0	0	473	0	0	0	0
8/1/99	7	40,112	4,415	17,961	62,488	352	19	0	0	0	371	21	0	0	21
8/8/99	7	13,557	1,431	9,440	24,428	1,384	18	0	0	0	1,402	18	0	0	18
8/15/99	7	5,710	650	3,356	9,716	950	0	0	0	0	950	0	0	0	0
8/22/99	7	3,439	519	2,710	6,668	309	0	17	0	0	326	6	0	0	6
8/29/99	7	3,336	154	1,647	5,137	187	15	0	0	0	202	6	0	0	6
9/5/99	7	3,766	0	773	4,539	408	33	10	0	0	451	0	0	0	0
9/12/99	7	1,583	0	0	1,583	183	5	5	0	0	193	10	0	0	10
9/19/99	1	113	0	0	113	10	5	0	0	0	15	0	0	0	0
-Trap Pulled on 9/13/99 Due to Low Fish Numbers-															
Total:	126	167,365	55,636	73,476	296,477	6,337	3,317	9,362	793	14,831	34,640	4,113	1,005	37,013	42,131

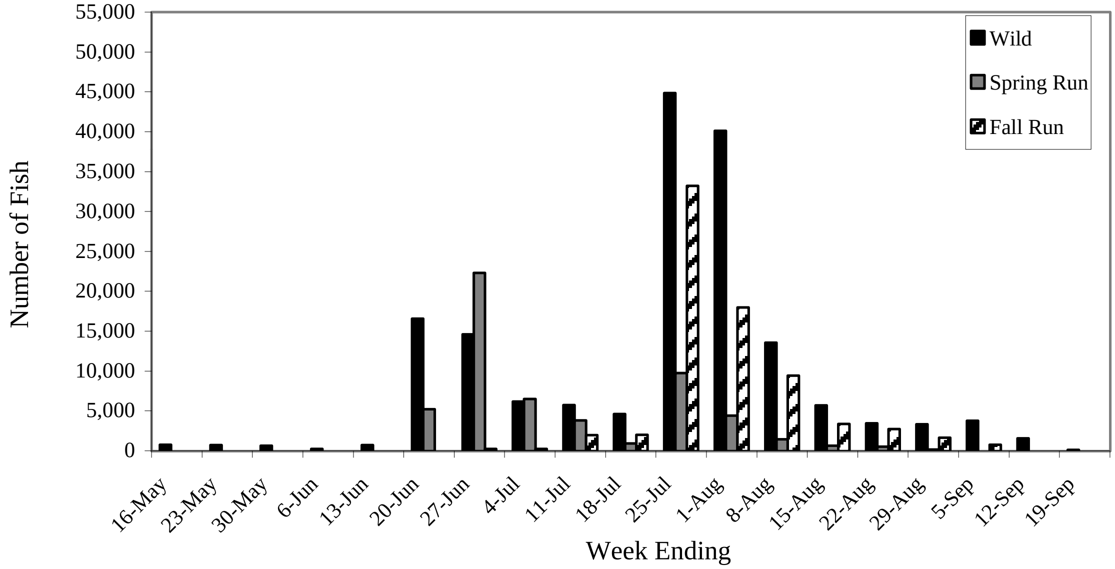

Figure 7. Estimated weekly chinook abundance by origin, lower Trinity River, California, 1999.

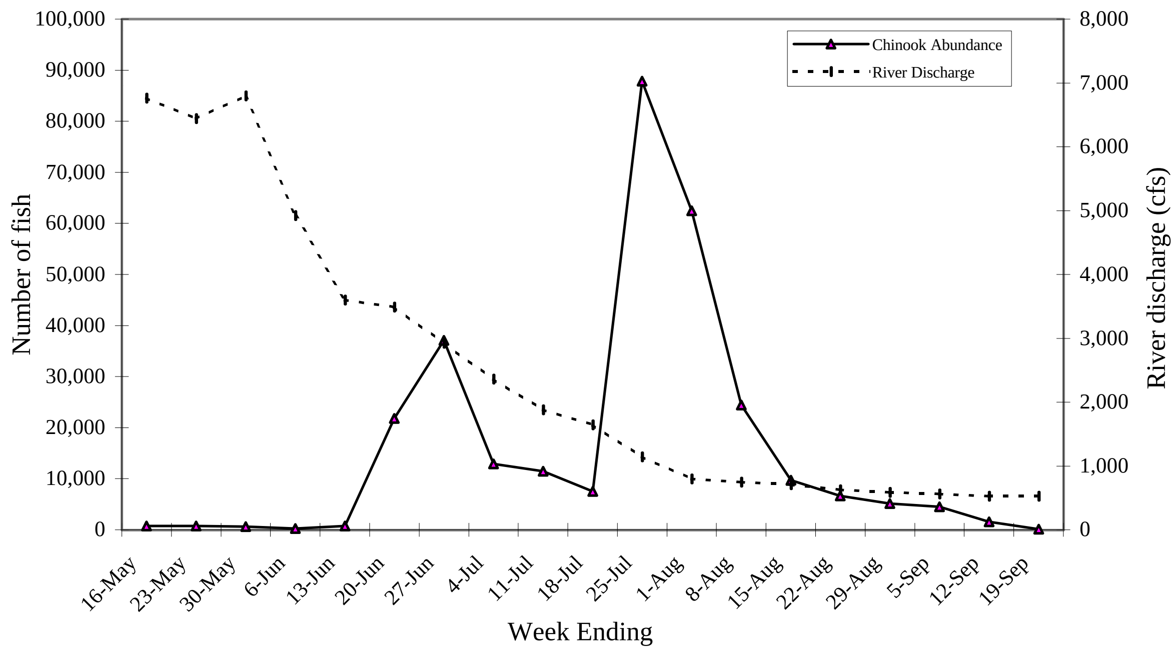

Figure 8. Estimated total chinook abundance and river discharge by week, lower Trinity River, California, 1999.

weekly abundance value occurred during the week ending 25 Jul (n=87,836), with the peak daily abundance occurring on 22 Jul (n=22,414). The total chinook abundance index for the entire trapping season was estimated at 296,477 emigrants.

Wild chinook comprised the largest proportion of the total season abundance value. Out of the 296,477 emigrants, 52,403 chinook (18%) were TRH spring-run, 60,259 (20%) were TRH fall-run fish (Table 4). The remaining 183,815 (62%) of the emigrants were wild fish.

The overall abundance index for 1999 (n=296,477) was comparable to 1998's abundance index, estimated at 318,982 (Weskamp et al. 1998). Although, the total abundance values were similar for 1998 and 1999, there were differences between the wild versus hatchery estimates. 1999's total wild abundance value was significantly lower (n=57,047) then 1998's abundance value (n=167,365) while the TRH spring capture during 1999 was estimated at 221,387 compared to 55,636 TRH spring chinook during 1998. In 1998 the weekly peak abundance value occurred two weeks earlier then in 1999 and was significantly higher then 1999's weekly peak abundance value.

Chinook Size

A total of 2,756 chinook out of the 31,719 fish captured during the trapping season were measured to fork length (FL) (Figure 9). Juvenile chinook size throughout the trapping season ranged from 31-122 mm, with a season mean length of 91 mm. Initial captures of young-of-the-year (YOY) chinook occurred in May, immediately after trap deployment, with a mean fork length 42 mm. Increase in mean fork length (92 mm) occurred the following month. The first ad-clipped chinook was captured 14 Jun and the increase in chinook fork length is due to the presence of Trinity River Hatchery chinook. Mean fork lengths for the month of Jul and Aug were 88 mm and 92 mm respectively (Figure 10). An increase in mean length (101 mm) occurred during the month of Sep.

One juvenile chinook measuring 121 mm was captured on 14 May 1999 and assumed to be a yearling chinook. Yearling chinook have been captured in previous years by both YTFP and USFWS in the Klamath River during this time but represent only a small fraction of emigrants. It was hypothesized that these may be hatchery chinook released during the previous fall from IGH and Klamath rearing ponds (Goldsmith 1994).

Migration Rate and Duration

Trinity River: Spring Chinook

TRH spring chinook were volitionally released between 1-7 Jun, 1999. 4 Jun was used as the release date in estimating the mean migration rate, while 1 Jun was used for calculating the initial rate (Table 5). Although a mean migration rate was calculated, these rates should be viewed with caution due to the extended period of the volitional release. Three separate tag codes were released during this period and

All three groups were captured 16 days after initial release based on the first day of hatchery release. The resulting initial migration rates were estimated to be 6.93 rm/day for each tag code. TRH spring run

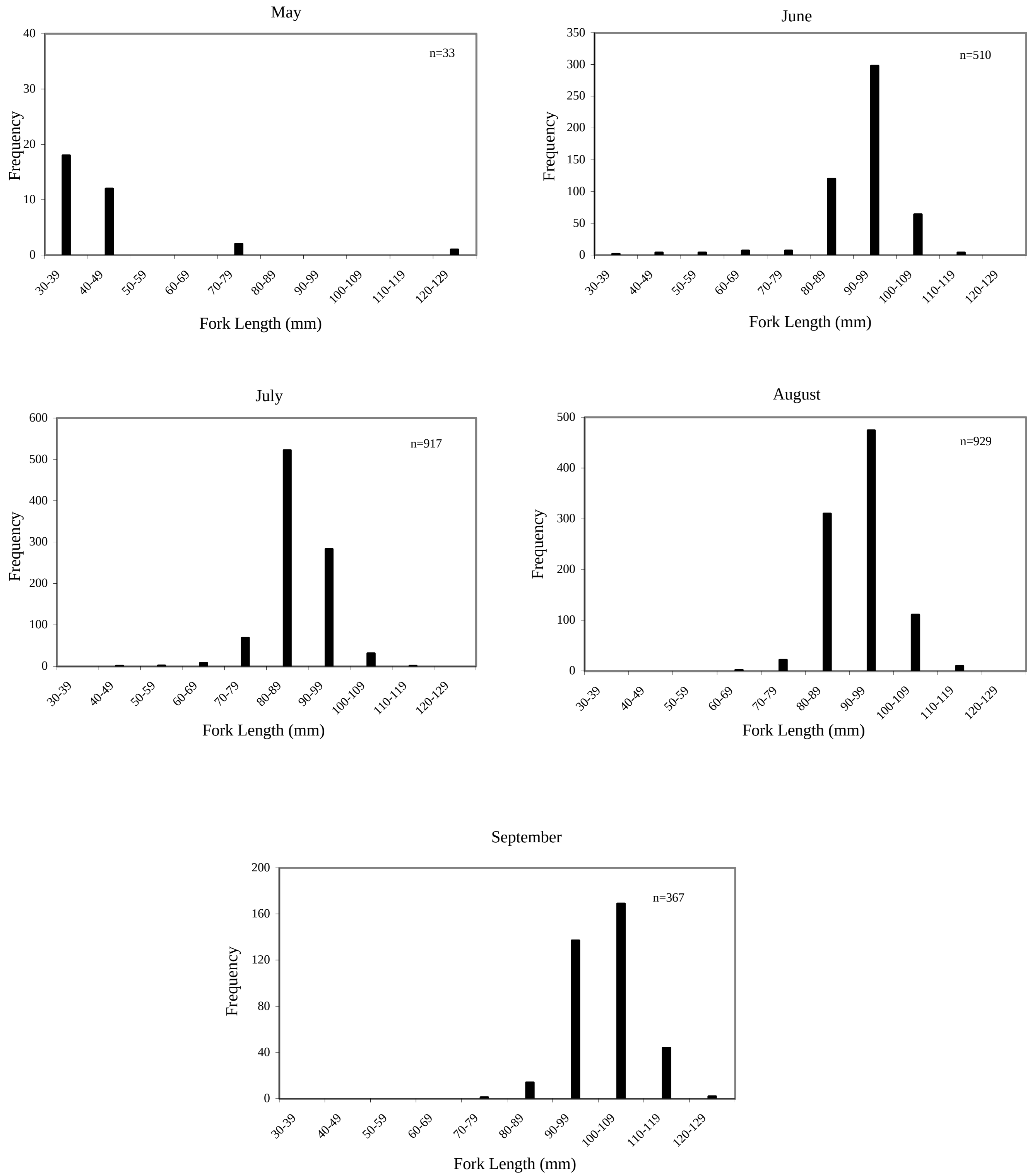

Figure 9. Length-frequency of juvenile chinook sampled in the rotary screw trap lower Trinity River, California, 1999.

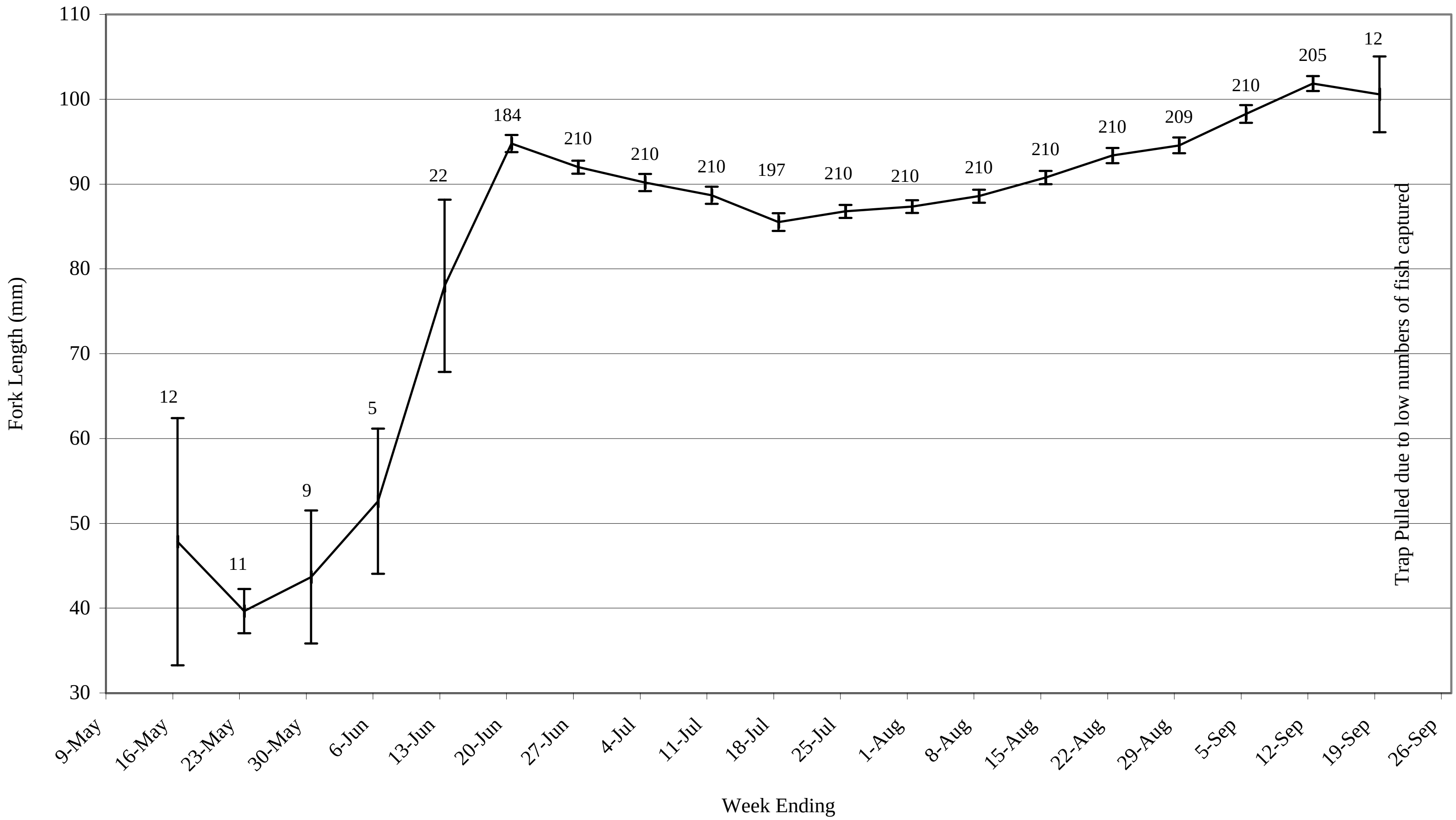

Figure 10. Mean weekly fork length (+/- 95% CI) and sample size of juvenile chinook sampled in the rotary screw trap, lower Trinity River, California, 1999.

chinook weighed an average of 3.69 grams more than TRH fall-run chinook, and were also 3.61 rm/day faster then TRH fall-run fish.
The initial migration rate for 1999 was slightly faster then 1998, with TRH spring run traveling 4.11 rm/day. The 1998 spring run were also slightly larger fish which averaged 9.26 grams compared to 1999

TRH spring run that averaged 7.36 grams. The mean river flow during 1999 was lower during this migration period in comparison to flows during 1998 (Weskamp et al. 1998).

Trinity River: Fall Chinook

TRH fall-chinook were released during the same period as TRH spring-run chinook (Jun 1-7) (Table 5). Four separate tag groups were released during this period and were all captured later then the TRH spring-run chinook. Initial migration rates ranged from 2.51-4.82 rm/day for the four separate tag groups. The size of chinook released ranged from 3.22-4.28 grams, with the larger fish exhibiting a faster initial migration rate, except for tag code 06-52-44. This tag group exhibited a slightly slower initial migration rate of 2.51 rm/day, but was slightly larger in weight at 3.66 grams. The 1999 TRH fall-run initial migration rates were slightly faster compared to the 1998 fall-run fish. The average weight of 1998 TRH fall-run were slightly larger (4.50 gms) then 1999 TRH fall-run fish (3.68 gms). The mean river flow during the 1998 TRH fall-run fish migration was slightly larger then the mean river flow during the 1999 migration period.

It is expected that larger fish would emigrate at a faster rate during higher river flows compared to smaller fish and lower river flows. This, however was not the case when comparing 1998 and 1999 chinook migrational rates. During 1998 juvenile chinook were slightly larger then juvenile chinook released in 1999. Estimated river flows during peak migration ranged from 6,457-9,403 cfs for 1998 compared to 3,019-4,050 cfs during 1999 (Table 5). One possible explanation for the slower migration in 1998 was that the river flows were at higher then normal rates causing juvenile fish to seek refuge along the margins of the slower edgewater until river levels subsided to favorable conditions.

Table 5. Estimated migration rates for TRH chinook captured in rotary screw trap, lower Trinity River, California, 1999.

Tag Code	Release Location and Group	Release Date	Weight (gms)	Initial Rate (rm/day)	Mean Rate (rm/day)	10-90% Duration	Mean River Flow (cfs)	Number Sampled
06-52-42	TRH:Fall	1-7, June 1999	4.28	4.82	1.95	31	3,677	122
06-52-43	TRH:Fall	1-7, June 1999	3.84	3.26	1.88	27	3,365	124
06-52-44	TRH:Fall	1-7, June 1999	3.36	2.51	1.82	34	3,019	114
06-52-45	TRH:Fall	1-7, June 1999	3.22	3.82	1.87	30	3,556	101
06-52-47	TRH:Spring	1-7, June 1999	8.25	6.93	3.41	42	4,050	101
06-52-48	TRH:Spring	1-7, June 1999	7.09	6.93	2.75	45	4,050	153
06-52-49	TRH:Spring	1-7, June 1999	6.77	6.93	2.55	51	4,050	128

Coho Salmon

Capture Summary

A total of 744 yearling coho and 99 YOY were captured during the trapping season (Table 1-2). Coho yearlings were captured immediately upon trap installation (11 May). Peak yearling captures occurred between 23 May and 13 Jun 1999 with TRH fish accounting for 97% (n=528) of the total catch (545) during this period. A total of 17 wild coho yearlings (3%) were captured during this peak period. A total of 24 wild coho were captured during the season. The last wild yearling coho was captured during the week of 27 Jun, with the peak capture of six fish during the week of 6 Jun. A large decline in total coho capture occurred after 20 Jun and zero fish were captured after 12 Sep 1999.

Peak captures for yearling coho at the USFWS rotary screw trap in Willow Creek occurred during 13 May –17 Jun, with TRH yearling coho accounting for 95% (n=1,116) of the total capture (n=1,176) with wild coho accounting for 1.6% (n=19) and YOY coho accounting for the remaining capture 3.4% (n=41) (Mcleod 1999).

Hatchery and Natural Stock

A right maxillary clip was applied to 100% of all TRH coho released during 1999. A total of 519,273 yearling coho were volitionally released from TRH from 15 Mar through 22 Mar. Of the season total capture (n=843), 85.4% (n=720) were from TRH, wild yearlings accounted for 2.9% (n=24) and wild YOY coho accounted for 11.7% (n=99) (Table 1-2). TRH coho were captured over a period of 9 weeks and wild coho were captured for 7 weeks, with no wild and TRH yearling coho were captured after this period (Table 3). YOY coho were captured throughout the trapping season, with the largest percentage of fish captured during the 5 weeks of the trapping season. This timing suggests that yearling coho were actively emigrating through May and June, while YOY coho may just be displaced downstream from upstream spawning and rearing areas throughout the trapping season.

Abundance Index

Total coho abundance was estimated at 42,131 fish for the 1999-trapping season (Table 4). TRH coho abundance values comprised 87.8% (n=37,013) of the total season abundance index. Wild coho abundance values comprised 2.4% (n=1,005). YOY coho comprised 9.8% for an abundance value of 4,113 fish.

Peak abundance values occurred between 16 May and 13 Jun totaling 38,607 fish (Figure 4). TRH accounted for 88.8% (n=34,291), wild fish accounted for 2.2% (n=874) and YOY accounted for 8.9% (n=3,442) during this peak period. The peak daily abundance value of 3,017 emigrants occurred on 26 May 1999. Coho were immediately captured after trap installation, indicating that coho were actively emigrating before trapping was initiated. The bulk of the hatchery coho emigrated during higher spring flows occurring during the trapping season (Figure 11). Total abundance values were noticeably smaller than abundance values calculated during the 1998 trapping season, but the capture timing and origin follow trends represented in the 1998 trapping season (Weskamp et al 1998).

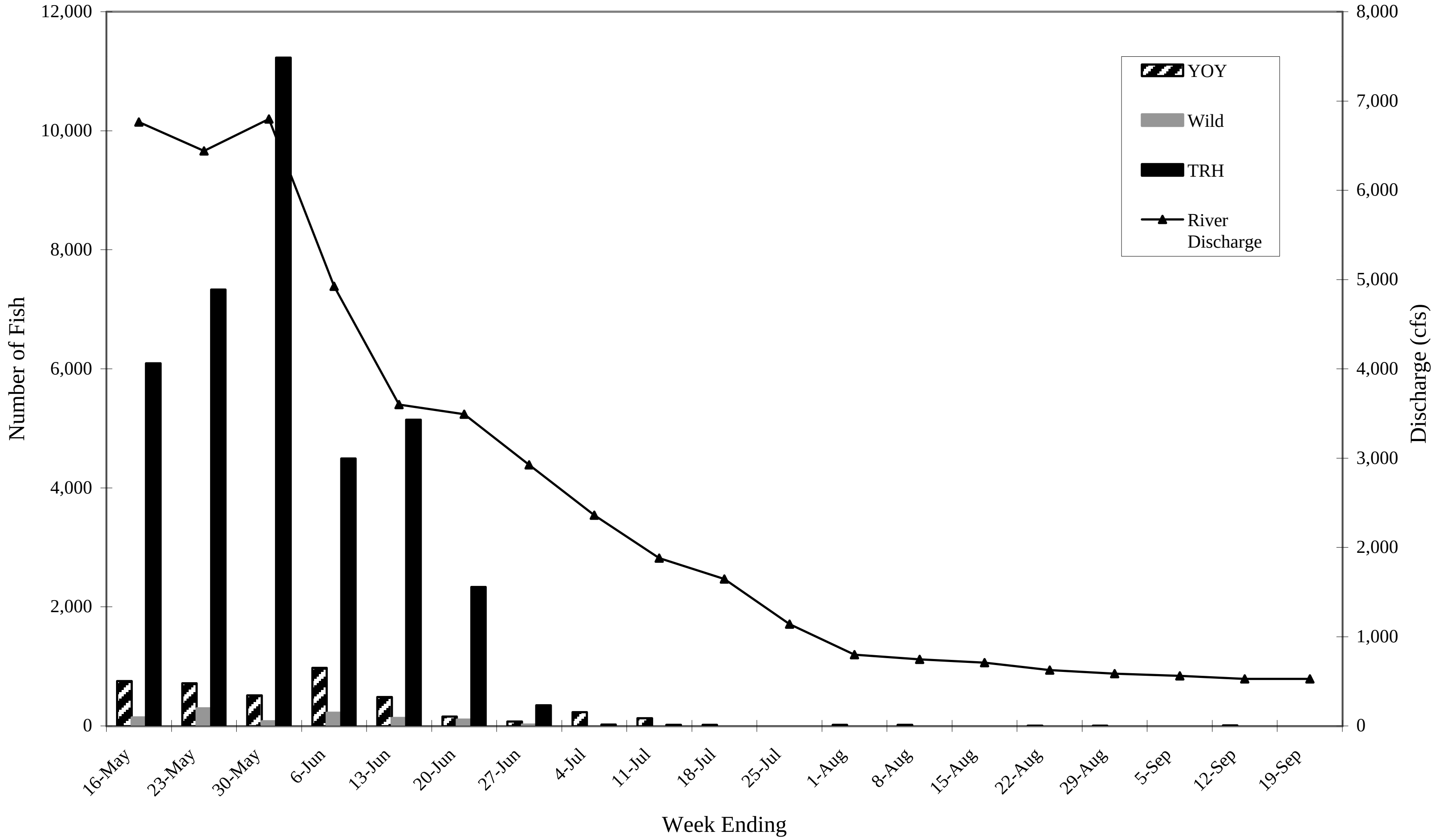

Figure 11. Estimated weekly coho by age/developmental class, lower Trinity River, California, 1999.

Size

Ninety percent of captured coho were measured to fork length (Figure 12). Coho captured during May ranged from 29-200 mm, with an average FL of 145 mm. TRH coho ranged from 124-197 mm, with an average FL of 153 mm. Wild coho yearlings ranged from 112-179 mm FL, with an average FL of 142 mm. This average size of wild coho is larger then compared to the average size of wild coho (FL-117 mm) captured during the 1998 trapping efforts (Weskamp et al. 1998).

Migrations Rates

TRH coho were released approximately two months prior to the trap installation, and as a result no migration rates could be calculated. More than likely a significant number of TRH coho emigrants passed the trap prior to the commencement of trapping efforts.

Steelhead

Capture

A total of 1,303 juvenile steelhead were captured during the trapping season (Tables 1-2). Of this total, wild stocks comprised 782 young of the year (YOY), 77 parr and 185 smolt. A total of 259 ad-clipped juvenile steelhead made up the remaining total capture and was comprised of 12 parr, and 247 smolt steelhead (Table 1-2).

Juvenile steelhead were captured immediately following trap installation, with ad-clipped fish comprising the largest portion of the capture. The largest contribution of parr and smolt steelhead (wild and ad-clipped fish combined) were captured from 16 May through 20 Jun (Tables 1-2). Ad-clipped steelhead were captured from 16 May through 27 Jun, with no other hatchery steelhead capture after this date. The largest weekly capture of parr and smolt steelhead occurred immediately following trap installation on week ending 16 May (n=120). TRH smolt comprised 58% (n=69) of this peak capture. TRH parr comprised 8% (n=9) of this capture. Wild steelhead smolts accounted for 27% (n=32), with wild parr accounting for the remaining 8% (n=10) of the peak capture. Parr and smolt steelhead numbers gradually tapered off after this date (Table 1). This suggests that YTFP's trapping efforts were capturing the tail end of juvenile parr and smolt steelhead emigration. YOY steelhead accounted for the largest capture of steehead for the season (n=782) and were captured consistently during the trapping season. The largest weekly capture of juvenile steelhead occurred during the week of 8 Aug with YOY steelhead accounting for 99% (n=224) with wild parr accounting for the remaining 1% (n=3) of the peak capture.

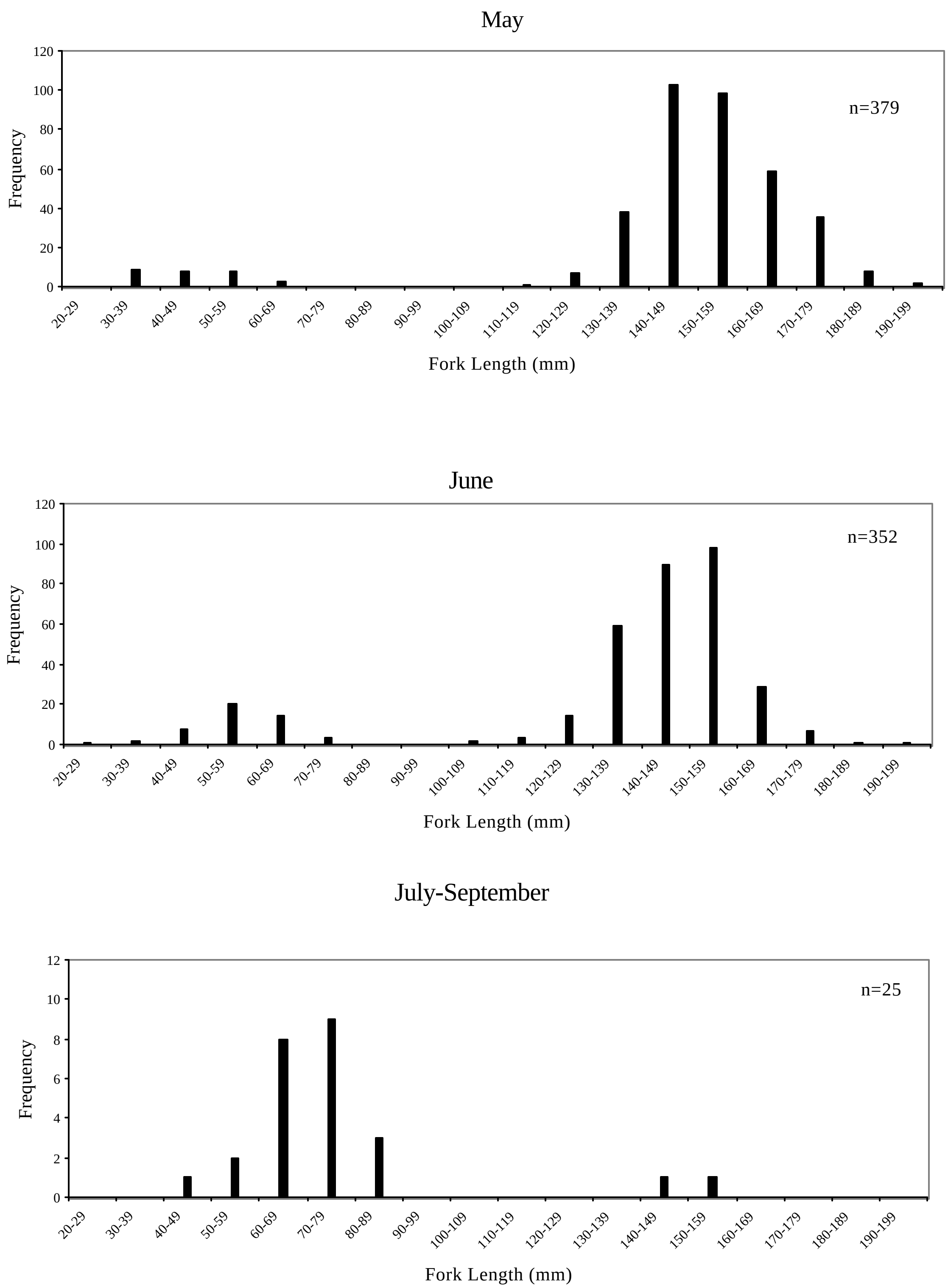

Figure 12. Length-frequency of juvenile coho sampled in the rotary screw trap lower Trinity River, California, 1999.

Hatchery and Natural Stock

Two groups of yearling steelhead totaling 611,443 were volitionally released from TRH between 15-22 Mar 1999. One hundred percent of TRH steelhead were marked with an adipose fin clip, readily allowing a hatchery/wild determination. A total of 259 TRH steelhead were captured during the trapping season. The bulk of the hatchery steelhead were captured from week ending 16 May through 30 May (n=183) (Table 1,2). Hatchery steelhead captures declined after this period with the last ad-clipped smolt captured during the week ending 27 Jun. Since TRH steelhead were released in mid March, most likely a large portion of these fish had already moved past the trap before installation (11 May). The large number of TRH steelhead captured immediately after trap installation reinforces this assumption (Figure 13). The bulk of the wild juvenile (smolt) steelhead were also captured during the same period as TRH steelhead (Figure 14).

Abundance Index

The total steelhead abundance index was estimated at 34,640 for the trapping season (Table 4). Ad-clipped steelhead smolt made up 43% of the abundance index (n=14,831), while ad-clipped parr comprised 2% (n=793). Wild steelhead smolt made up 27% (n=9,362), while parr comprised 10% (n=3,317), and YOY totaled 18% of the index (n=6,337). Trinity River Hatchery parr and smolt steelhead abundance values were highest during peak river flows (Figure 13). Wild parr and smolt steelhead abundance values were also highest during peak river flows, while YOY abundance values peaked later in the season when river flows had decreased substantially (Figure 14). The total steelhead abundance index was comparable to 1998's index, which was estimated at 35,503 steelhead. The most significant difference was the ad-clipped steelhead smolt index estimated at 5,135 for 1998 compared to 14,831 for 1999's trapping season (Weskamp et al. 1998).

Size

Seventy percent (n=913) of steelhead captured during the trapping season were measured to fork length (FL) (Figure 15). YOY steelhead ranged from 22-89 mm, with an average FL of 58 mm. YOY steelhead averaged 46mm FL from May through June, and increased to 59 mm from July through September, after which the trap was pulled for the season. Wild Steelhead parr ranged from 60-182 mm, averaging 122 mm, and wild smolt ranged from 110-252 mm. Ad-clipped parr steelhead ranged from 169-200 mm, averaging 180 mm, and ad-clipped smolts ranged from 128-298 mm, averaging 201 mm.

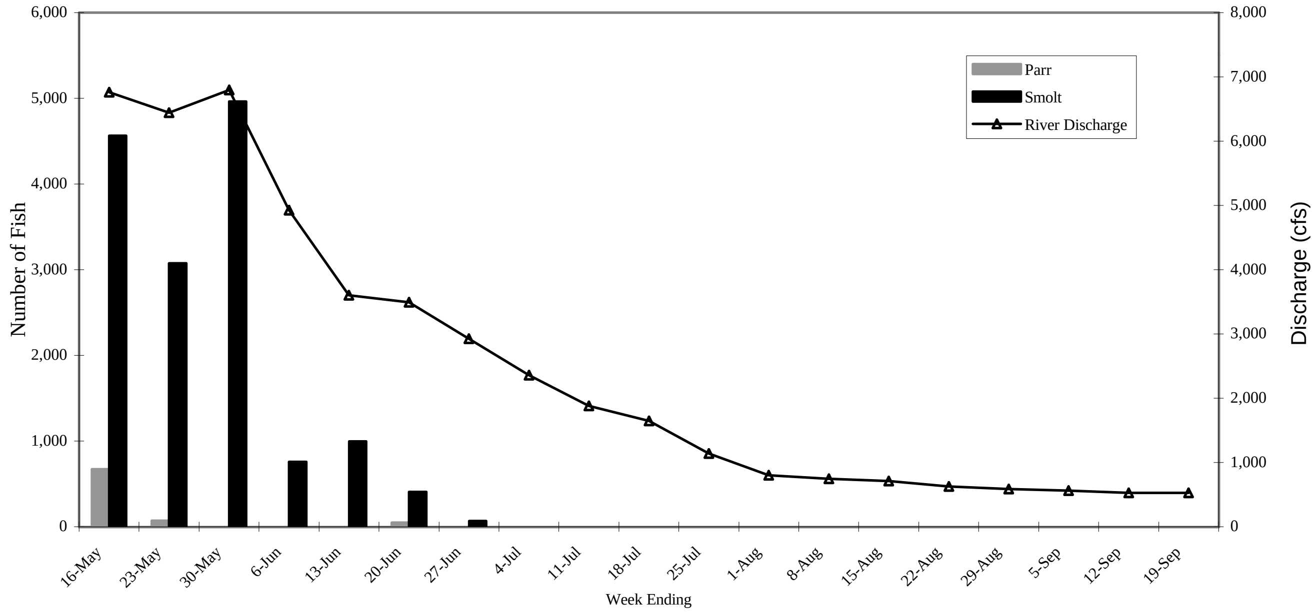

Figure 13. Estimated weekly Trinity River Hatchery steelhead abundance by age/developmental class, lower Trinity River, California, 1999.

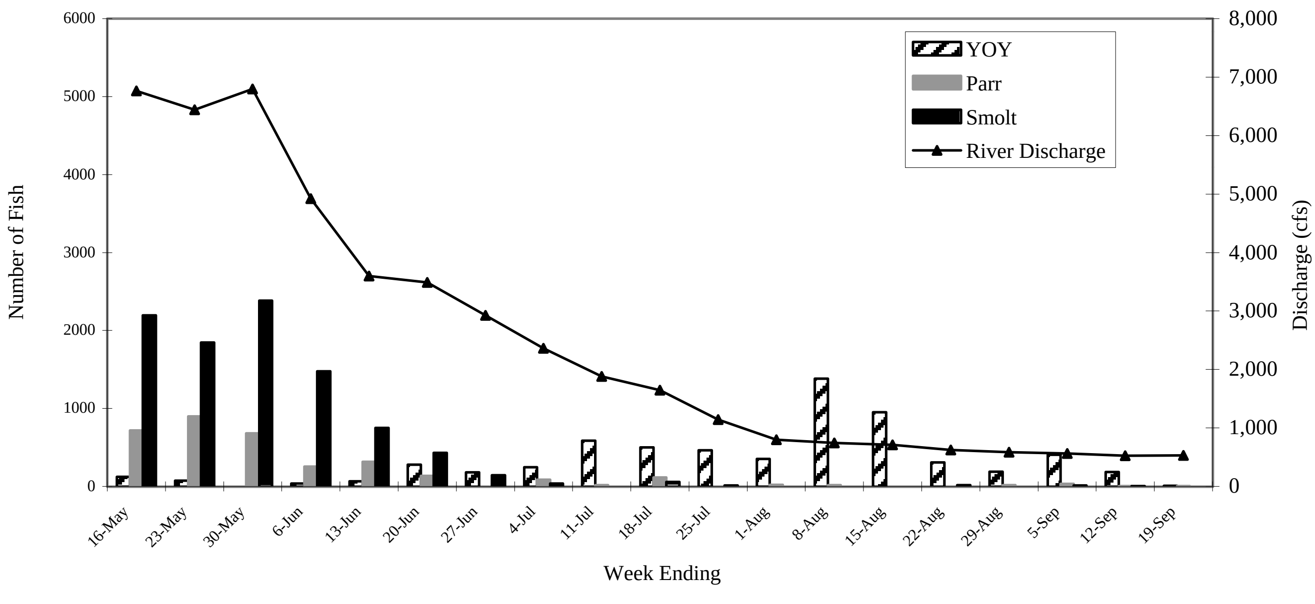

Figure 14. Estimated weekly wild steelhead abundance by age/developmental class, lower Trinity River, California, 1999.

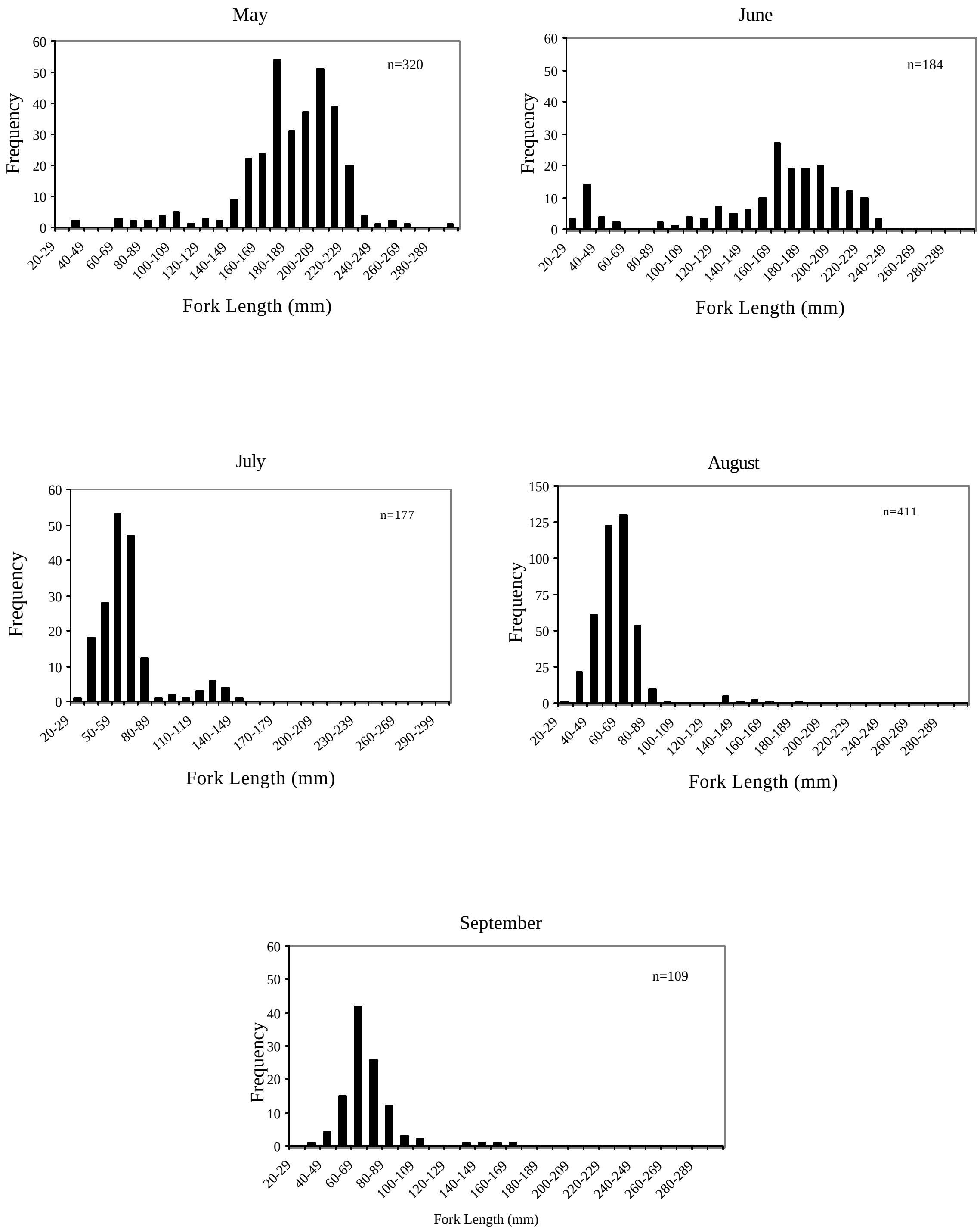

Figure 15. Length-frequency of juvenile steelhead sampled in the rotary screw trap, lower Trinity River, California, 1999

Migration Rates

TRH steelhead were released approximately two months prior to the trap installation, and as a result no migration rates could be calculated. More than likely a significant number of TRH steelhead emigrants passed the trap prior to the commencement of trapping efforts.

Coastal Cutthroat Trout

No cutthroat trout were captured during the 1999 lower Trinity River rotary screw trap effort. The upstream-most distribution of cutthroat trout in the Klamath River Basin is currently understood as Mettah Creek. Mettah Creek has a confluence with the Klamath River at rm 28.5, and is approximately 15 miles downstream of the Trinity River confluence.

Other species captured

Various fish and amphibian species were captured during the trapping season. A total of 6 juvenile green sturgeon were captured between 27-Jun and 22-Aug (Table 1). Pacific lamprey ammocoetes were consistently captured throughout the trapping season for a total of 269. The bulk of ammocoetes were captured between 16 May and 13 Jun. A total of 21 adult Pacific lamprey were captured during the trapping season (Table 1). One brown trout (*Salmo trutta*) measuring 117 mm was captured on 12 May. Non-salmonids are listed in Table 6 in descending order of numbers captured.

Table 6. Non-salmonid fish species sampled in the rotary screw trap, listed in descending order of capture, lower Trinity River, California, 1999.

Common Name	Species
Klamath smallscale sucker	*Catostomus rimiculus*
Speckled dace	*Rhinichthys osculus*
Threespine stickleback	*Gassterosdeus aculateus*
Prickly sculpin	*Cottus asper*
Pacfic lamprey	*Lampetra tridentata*
American shad	*Alosa sapidissima*
Green Sturgeon	*Acipenser medirostris*

Lower Trinity River Rotary Screw Trap 2000

Results and Discussion

The 2000 outmigrant trapping effort began on 21 Apr and continued through 12 Sep for a total of 144 sampling nights. The trap was pulled for the season because of a significant reduction in captured salmonids (Table 7). A total of 4,076 juvenile chinook emigrants were sampled throughout the trapping season (Table 7). Juvenile steelhead (n=862), coho (n=595) were also enumerated during the 2000 trapping effort. The overall capture for all salmonids was considerably lower then the 1999 trapping efforts (Table 7).

Water Temperature Monitoring

At the lower Trinity River rotary trap site, daily average water temperatures ranged from 51°F-76°F during the 2000 trapping period (Figure 16). A season maximum water temperature of 78º F occurred on 1 Aug 2000. Daily average water temperatures approached upper lethal limits for a short period of time (29 Jun-6 Aug) for all salmonids (76-78°F) as identified by Bell (1991). Daily average temperatures did exceed the preferred temperature range for migrating chinook salmon (67°F) from 15 Jun through the remaining trapping season as well as reaching the upper lethal limit (78° F) on 1 Aug of (Figure 16).

River Flow

Daily average river flow during the trapping season ranged from 5,342 cfs on the first day of operation (21 Apr) to a low of 493 cfs on 1 Sep 2000 (Figure 17). The peak flow of 5,342 cfs occurred on the first day of trap installation, and the river flow was 508 cfs on 12 Sep when the trap was pulled from the season.

River discharge sampled by the screw trap cone averaged 103 cfs throughout the season. Percent of total river flow sampled ranged from 2.93% to 16.16% with a season average of 8.71%. As total river discharge progressively decreased throughout the season, percent discharge sampled progressively increased (Figure 17).

Fish Health

An increase in captured moribund chinook occurred beginning the week of 23 Jul 2000. Small numbers (1-10) of moribund chinook were captured daily for approximately 5 weeks. No apparent symptoms were recognized during this period, and no samples were collected for further investigation. Compared to 1998 and 1999 trapping efforts in the Trinity River, clinical health signs did not seem as apparent.

Table 7. Total number of juvenile salmonids, green sturgeon, and Pacific Lamprey captured by week in the rotary screw trap, lower Trinity River, California, 2000.

Week	# Days	Week Avg.	% Flow	Chinook			Steelhead						Coho				Green	Pacific Lamprey	
								Wild		TRH				Yearling					
Ending	Sampled	Flow (cfs)	Trapped	No Clip	Ad-Clip	Total	YOY	Parr	Smolt	Parr	Smolt	Total	YOY	Wild	TRH	Total	Sturgeon	Adult	Ammocoete
23-Apr-00	3	5,023	3.10	111	0	111	4	24	86	0	57	171	0	75	56	131	0	1	6
30-Apr-00	7	3,811	3.71	137	0	137	2	25	37	0	40	104	0	20	32	52	0	1	20
7-May-00	7	3,065	3.93	24	0	24	1	46	84	0	66	197	0	17	102	119	0	3	14
14-May-00	7	3,601	3.51	19	0	19	0	25	48	0	42	115	2	33	91	126	0	9	11
21-May-00	7	4,399	3.13	76	0	76	2	13	31	0	22	68	1	34	70	105	0	4	8
28-May-00	7	3,889	3.32	58	0	58	4	6	5	0	0	15	0	11	8	19	0	3	16
4-Jun-00	7	2,587	4.31	78	0	78	8	6	17	0	7	38	4	7	13	24	0	0	20
11-Jun-00	7	2,329	4.46	144	1	145	2	3	7	0	10	22	1	4	8	13	0	1	5
18-Jun-00	7	2,149	5.12	334	45	379	1	3	2	0	0	6	0	1	0	1	0	1	3
25-Jun-00	7	1,661	6.59	799	98	897	1	1	1	0	0	3	1	0	0	1	0	0	2
2-Jul-00	7	1,429	7.29	324	22	346	3	2	1	0	0	6	0	0	0	0	0	0	3
9-Jul-00	7	1,186	8.14	143	4	147	5	1	2	0	0	8	0	0	0	0	0	0	0
16-Jul-00	7	977	9.21	149	12	161	0	0	0	0	0	0	0	0	0	0	0	0	0
23-Jul-00	7	802	10.86	332	22	354	3	1	0	0	0	4	0	0	0	0	0	0	5
30-Jul-00	6	658	12.98	363	19	382	9	2	1	1	0	13	0	0	0	0	0	0	6
6-Aug-00	7	603	13.88	205	12	217	2	14	11	0	0	27	1	0	0	1	0	0	2
13-Aug-00	7	555	14.94	129	9	138	2	11	5	0	0	18	1	0	0	1	0	0	2
20-Aug-00	7	530	15.16	104	5	109	2	5	0	0	0	7	1	0	0	1	0	0	4
27-Aug-00	7	515	16.04	95	8	103	0	0	5	0	0	5	1	0	0	1	0	0	9
3-Sep-00	7	508	16.33	81	2	83	10	2	2	0	0	14	0	0	0	0	0	0	6
10-Sep-00	6	542	15.04	74	0	74	18	1	1	0	0	20	0	0	0	0	0	0	3
12-Sep-00	2	513	16.01	37	1	38	0	0	1	0	0	1	0	0	0	0	0	0	1
Total:	143			3,816	260	4,076	79	191	347	1	244	862	13	202	380	595	0	23	146

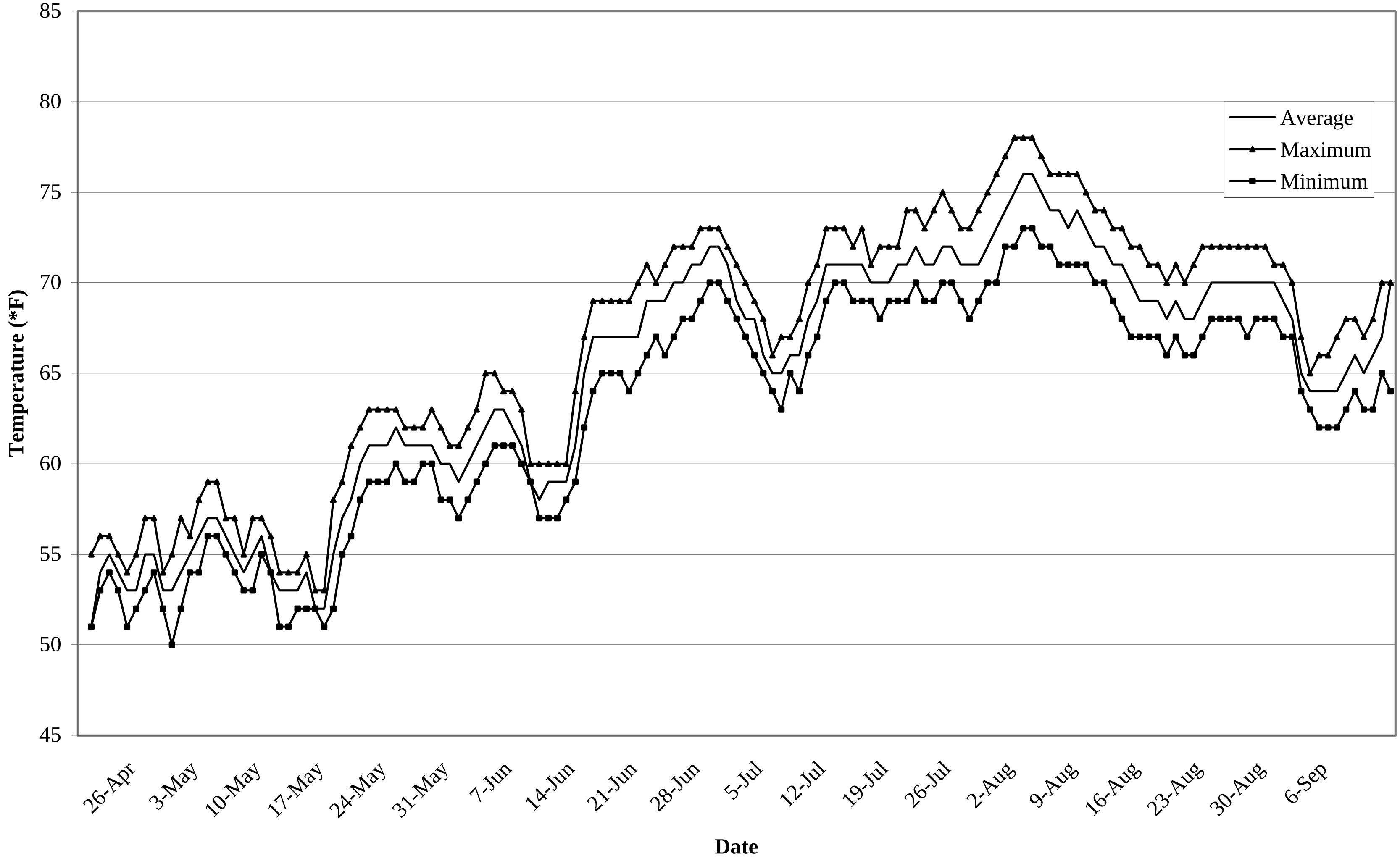

Figure 16. Average daily, maximum & minimum water temperature, lower Trinity River near Weitchpec, California, April-September, 2000.

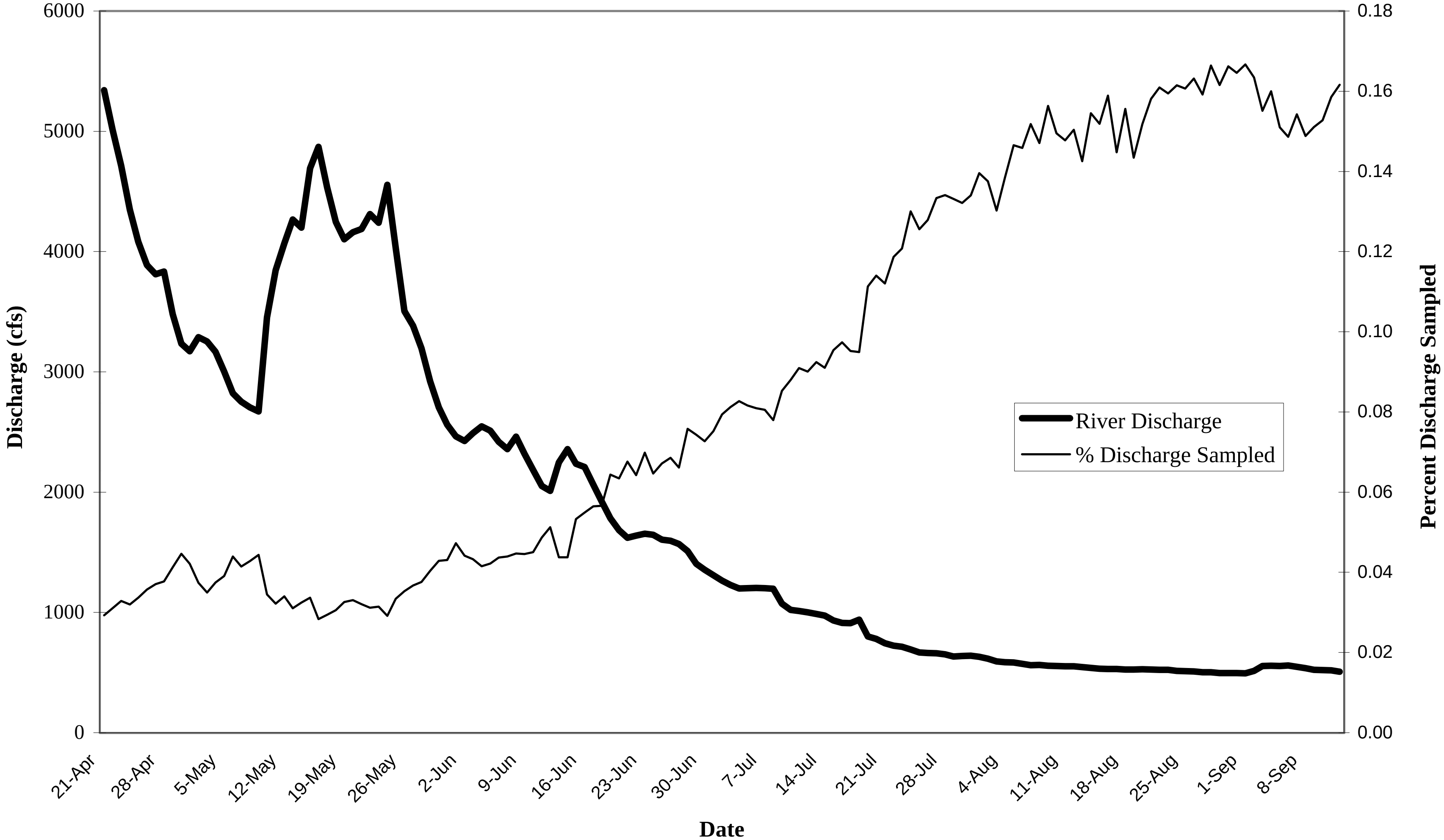

Figure 17. Average daily discharge at USGS "Hoopa" gage (13.04rm) and percent river discharge sampled at rotary screw trap, lower Trinity River, California, 2000

Chinook salmon

Capture Summary

Chinook were captured immediately after trap installation and were consistently captured throughout the trapping season. A larger portion of chinook were captured early compared to previous trapping years, while typically very few chinook are captured prior to the onset of hatchery chinook releases (Weskamp et al. 1997,1998) (Table 1,7). Chinook numbers decreased after the second week of trapping with small numbers of chinook observed through week ending 7 May and 4 Jun (Table 7). After this date numbers of captured chinook steadily increased with variable fluctuations for a period of twelve weeks. The weekly peak capture of 919 chinook occurred during the week ending 25 Jun (Table 7), with the largest single night capture (n=177) taking place on 21 Jun. Following this peak period there was a decrease in chinook capture with numbers stabilizing until week ending 3 Sep. The last week of sampling concluded with a total of 38 chinook captured. Chinook captures were considerably lower then 1999 trapping efforts as well as peak captures occurring approximately one month earlier then in 1999.

The first adipose-clipped chinook was captured on 8 Jun, with all chinook captured prior to this date assumed to be of natural origin. The increase in captured chinook emigrants corresponded with hatchery releases from TRH, which occurred between 1 June and 7 Jun (Table 8).

Peak capture of hatchery chinook occurred between the weeks ending 18 Jun-2 Jul, with TRH spring and TRH fall-run representing 45% and 26% of total fish captured, respectively (Table 9). USFWS operated a rotary screw trap in the Trinity River near Willow Creek (rm 21) during 2000. The peak chinook capture at the Willow Creek trap occurred during the weeks ending 9 Jul- 30 Jul (USFWS 2001). Their peak hatchery chinook capture occurred between 16 Jul-23 Jul. USFWS peak hatchery chinook capture occurred approximately two weeks later than YTFP's peak hatchery capture. Since the USFWS trap is located upstream of this trap, this difference in peak timing is attributed to trapping efficiency differences between the two traps under decreasing flow conditions

Hatchery/Natural Estimation

During 2000 four groups of fall-run chinook and three groups of spring-run chinook were volitionally released from TRH between Jun 1-7, 2000 (Table 8). A total of 572 chinook were captured prior to the arrival of the first ad-clipped chinook on 8 Jun. No determination of origin was possible for these fish, and hence they were assumed to be wild fish.

From the total of 4,076 chinook sampled during the trapping season, 260 fish (6.4%) possessed ad-clips. A total of 239 chinook were collected for coded wire tag (CWT) retrieval, with 228 CWT's ultimately recovered for determination of the origin and release group. Based on these tag recoveries, the weekly expansion factor (E) was utilized together with the production multiplier (PM) for each tag group to determine the origin of the unmarked portion of the capture (Appendix B).

Table 8. Coded wire tag information for Trinity River Hatchery juvenile chinook salmon release groups, Klamath River Basin, California, 2000

Trinity River Hatchery: Spring Chinook (06-52-51)

Total # Tagged	# Poor Tags	# Unmarked Fish	Production Multiplier	Brood Year	Release Date
49,421	2,601	277,522	6.3	1999	June 1-7, 2000

Trinity River Hatchery: Spring Chinook (06-52-52)

Total # Tagged	# Poor Tags	# Unmarked Fish	Production Multiplier	Brood Year	Release Date
51,993	1,974	278,609	6.20	1999	June 1-7, 2000

Trinity River Hatchery: Spring Chinook (06-52-53)

Total # Tagged	# Poor Tags	# Unmarked Fish	Production Multiplier	Brood Year	Release Date
49,966	385	243,244	6.1	1999	June 1-7, 2000

Trinity River Hatchery: Fall Chinook (06-52-54)

Total # Tagged	# Poor Tags	# Unmarked Fish	Production Multiplier	Brood Year	Release Date
44,654	545	438,212	10.7	1999	June 1-7, 2000

Trinity River Hatchery: Fall Chinook (06-52-55)

Total # Tagged	# Poor Tags	# Unmarked Fish	Production Multiplier	Brood Year	Release Date
42,549	0	416,836	10.8	1999	June 1-7, 2000

Trinity River Hatchery: Fall Chinook (06-52-56)

Total # Tagged	# Poor Tags	# Unmarked Fish	Production Multiplier	Brood Year	Release Date
43,565	533	427,326	10.7	1999	June 1-7, 2000

Trinity River Hatchery: Fall Chinook (06-52-57)

Total # Tagged	# Poor Tags	# Unmarked Fish	Production Multiplier	Brood Year	Release Date
50,533	208	502,893	10.9	1999	June 1-7, 2000

Chinook captures prior to the arrival of TRH fish were slightly higher compared to previous trapping years, although the trap was installed approximately three weeks earlier then 1999. TRH chinook were captured during a period of fifteen weeks from the week of 18 Jun through 3 Sep, peaking during the week of 25 Jun (Table 9).

TRH spring-run chinook were the first ad-clipped chinook captured for the trapping season. The initial capture of TRH spring run chinook took place on 8 Jun, with the first peak occurring on the week of 25 Jun (n=426), according to CWT expansions. TRH spring run chinook were captured for seven weeks followed by no spring run fish captured for two weeks, with the remaining fish captured during 13 Aug (Table 9). No spring run fish were captured after this date.

TRH fall-run chinook were initially captured for twelve weeks from 18 Jun through 3 Sep, with the peak capture occurring on the week of 25 Jun (n=283) according to CWT expansions. TRH Fall-run chinook numbers fluctuated during the trapping season with a second peak capture occurring during the weeks of 23 Jul-30 Jul (Table 9). From CWT expansions it was estimated that TRH spring-run chinook accounted for 20% (n=826) and TRH fall chinook accounted for 28% (n=1,126) of total fish (n=4,123) captured during the trapping season, with the remainder assumed to be wild fish. (Tables 9).

Wild chinook emigrated throughout the trapping season with a weekly peak capture occurring during the week ending 30 Jul (Table 7,9). Wild fish accounted for a total of 52% (n=2,123) of the total fish captured (n=4,123) during the trapping season (Table 9). The first peak capture (n=209) coincided with the peak capture of both TRH fall-run and TRH spring-run. A second peak capture (n=210) occurred five weeks later coinciding with the second peak capture of TRH fall-run chinook. Although two peak captures occurred for wild chinook, these fish were captured consistently with no dramatic fluctuations occurring during these two peaks, except during the week of 16 Jul (n=75).

Abundance Index

Before the first ad-clipped fish was captured, cumulative chinook abundance was estimated at 16,370 fish, all of which were assumed to be of wild origin (Table 10). This pre-hatchery release abundance value is considerably higher compared to the 1999-trapping season, which was estimated at 3,129 chinook. The abundance index increase in late June was a direct response to hatchery-released chinook from TRH (Table 10, Figure 18). The peak weekly abundance value occurred during the week ending 25 Jun (n=22,908) (Table 10), with the peak daily abundance occurring on 22 Jul (n=5,194). Peak chinook abundance occurred when river flows ranged from 1,500-2300 cfs (Figure 19). The total chinook abundance index for the entire trapping season was estimated at 99,505 emigrants.

Wild chinook comprised the largest proportion of the total season abundance value. Out of the estimated 99,505 emigrants, 21,407 chinook (21%) were TRH spring-run and 26,470 (27%) were TRH fall-run fish (Table 10). The remaining 51,628 (52%) of the estimated emigrants were assumed to be wild fish.

Cumulative chinook abundance before any ad-clip chinook influence was considerably higher compared to the 1999 trapping efforts (n=3,129), although the total chinook abundance index for the 2000 trapping season was lower by 196,972 fish compared to 1999 trapping efforts (Table 4).

Table 9. Total number of juvenile salmonids with CST expansions, green sturgeon, and Pacific lamprey captured by week in the rotary screw trap, lower Trinity, California, 2000.

Week	# Days	Week Avg.	% Flow	Chinook				Steelhead						Coho				Green	Pacific Lamprey	
									Wild		TRH				Yearling					
Ending	Sampled	Flow (cfs)	Trapped	Spring	Fall	Wild	Total	YOY	Parr	Smolt	Parr	Smolt	Total	YOY	Wild	TRH	Total	Sturgeon	Adult	Ammocoete
23-Apr-00	3	5,023	3.10	0	0	111	111	4	24	86	0	57	171	0	75	56	131	0	1	6
30-Apr-00	7	3,811	3.71	0	0	131	131	2	25	37	0	40	104	0	20	32	52	0	1	20
7-May-00	7	3,065	3.93	0	0	24	24	1	46	84	0	66	197	0	17	102	119	0	3	14
14-May-00	7	3,601	3.51	0	0	19	19	0	25	48	0	42	115	2	33	91	126	0	9	11
21-May-00	7	4,399	3.13	0	0	76	76	2	13	31	0	22	68	1	34	70	105	0	4	8
28-May-00	7	3,889	3.32	0	0	58	58	4	6	5	0	0	15	0	11	8	19	0	3	16
4-Jun-00	7	2,587	4.31	0	0	78	78	8	6	17	0	7	38	4	7	13	24	0	0	20
11-Jun-00	7	2,329	4.46	8	0	139	147	2	3	7	0	10	22	1	4	8	13	0	1	5
18-Jun-00	7	2,149	5.12	256	22	102	379	1	3	2	0	0	6	0	1	0	1	0	1	3
25-Jun-00	7	1,661	6.59	426	283	209	919	1	1	1	0	0	3	1	0	0	1	0	0	2
2-Jul-00	7	1,429	7.29	68	118	160	346	3	2	1	0	0	6	0	0	0	0	0	0	3
9-Jul-00	7	1,186	8.14	12	21	115	149	5	1	2	0	0	8	0	0	0	0	0	0	0
16-Jul-00	7	977	9.21	31	65	75	171	0	0	0	0	0	0	0	0	0	0	0	0	0
23-Jul-00	7	802	10.86	19	184	152	354	3	1	0	0	0	4	0	0	0	0	0	0	5
30-Jul-00	6	658	12.98	0	172	210	382	9	2	1	1	0	13	0	0	0	0	0	0	6
6-Aug-00	7	603	13.88	0	86	131	217	2	14	11	0	0	27	1	0	0	1	0	0	2
13-Aug-00	7	555	14.94	6	86	66	158	2	11	5	0	0	18	1	0	0	1	0	0	2
20-Aug-00	7	530	15.16	0	32	78	111	2	5	0	0	0	7	1	0	0	1	0	0	4
27-Aug-00	7	515	16.04	0	76	45	121	0	0	5	0	0	5	1	0	0	1	0	0	9
3-Sep-00	7	508	16.33	0	22	61	83	10	2	2	0	0	14	0	0	0	0	0	0	6
10-Sep-00	6	542	15.04	0	0	74	74	18	1	1	0	0	20	0	0	0	0	0	0	3
12-Sep-00	2	513	16.01	0	0	16	16	0	0	1	0	0	1	0	0	0	0	0	0	1
Total:	143			826	1,166	2,131	4,123	79	191	347	1	244	862	13	202	380	595	0	23	146

* Chinook number were estimated from CWT expansions

Table 10. Weekly abundance index estimates for juvenile salmonids captured in the rotary screw trap, lower Trinity River, California, 2000

Week Ending	# Days Sampled	Week Avg. Flow (cfs)	% Flow Trapped	Wild	Chinook			Steelhead						Coho			
								Wild			TRH				Yearling		
				Wild	Spring	Fall	Total	YOY	Parr	Smolt	Parr	Smolt	Total	YOY	Wild	TRH	Total
23-Apr-00	3	5,023	3.10	3,533	0	0	3,533	126	762	2,866	0	1,875	5,629	0	2,499	1,887	4,386
30-Apr-00	7	3,811	3.71	3,866	0	0	3,866	52	669	887	0	1,020	2,628	0	528	743	1,271
7-May-00	7	3,065	3.93	609	0	0	609	29	1,206	2,129	0	1,633	4,997	0	428	2,612	3,040
14-May-00	7	3,601	3.51	560	0	0	560	0	661	1,310	0	1,187	3,158	52	974	2,523	3,549
21-May-00	7	4,399	3.13	2,524	0	0	2,524	63	423	1,016	0	731	2,233	34	1,111	2,286	3,431
28-May-00	7	3,889	3.32	1,725	0	0	1,725	109	184	152	0	0	445	0	355	245	600
4-Jun-00	7	2,587	4.31	1,818	0	0	1,818	185	141	385	0	164	875	96	158	299	553
11-Jun-00	7	2,329	4.46	3,295	215	0	3,510	45	68	159	0	222	494	23	91	184	298
18-Jun-00	7	2,149	5.12	3,117	6,308	526	9,951	20	60	46	0	0	126	0	20	0	20
25-Jun-00	7	1,661	6.59	4,648	11,099	7,161	22,908	16	15	14	0	0	45	16	0	0	16
2-Jul-00	7	1,429	7.29	4,850	1,888	3,369	10,107	43	27	13	0	0	83	0	0	0	0
9-Jul-00	7	1,186	8.14	3,616	412	728	4,756	61	12	25	0	0	98	0	0	0	0
16-Jul-00	7	977	9.21	2,447	959	2,034	5,440	0	0	0	0	0	0	0	0	0	0
23-Jul-00	7	802	10.86	2,956	439	4,263	7,658	27	8	0	0	0	35	0	0	0	0
30-Jul-00	6	658	12.98	5,150	0	3,704	8,854	69	15	7	7	0	98	0	0	0	0
6-Aug-00	7	603	13.88	2,659	0	1,785	4,444	14	101	79	0	0	194	8	0	0	8
13-Aug-00	7	555	14.94	1,093	87	1,322	2,502	13	73	34	0	0	120	7	0	0	7
20-Aug-00	7	530	15.16	1,033	0	419	1,452	13	34	0	0	0	47	7	0	0	7
27-Aug-00	7	515	16.04	550	0	919	1,469	0	0	31	0	0	31	6	0	0	6
3-Sep-00	7	508	16.33	695	0	240	935	62	12	13	0	0	87	0	0	0	0
10-Sep-00	6	542	15.04	564	0	0	564	119	7	7	0	0	133	0	0	0	0
12-Sep-00	2	513	16.01	320	0	0	320	0	0	6	0	0	6	0	0	0	0
Total:	143			51,628	21,407	26,470	99,505	1,066	4,478	9,179	7	6,832	21,562	249	6,164	10,779	17,192

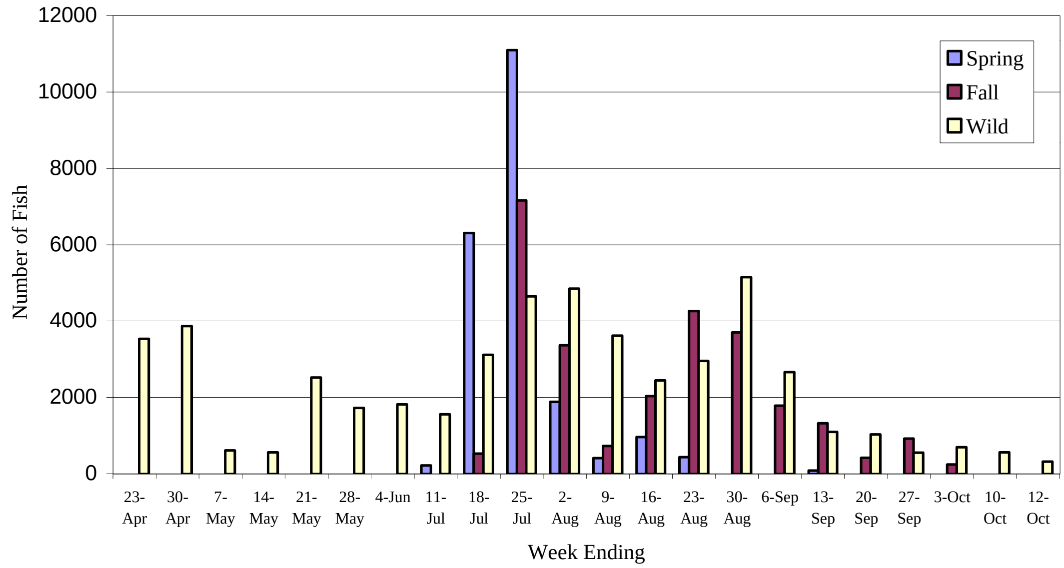

Figure 18. Estimated weekly chinook abundance by origin, lower Trinity River, California, 2000.

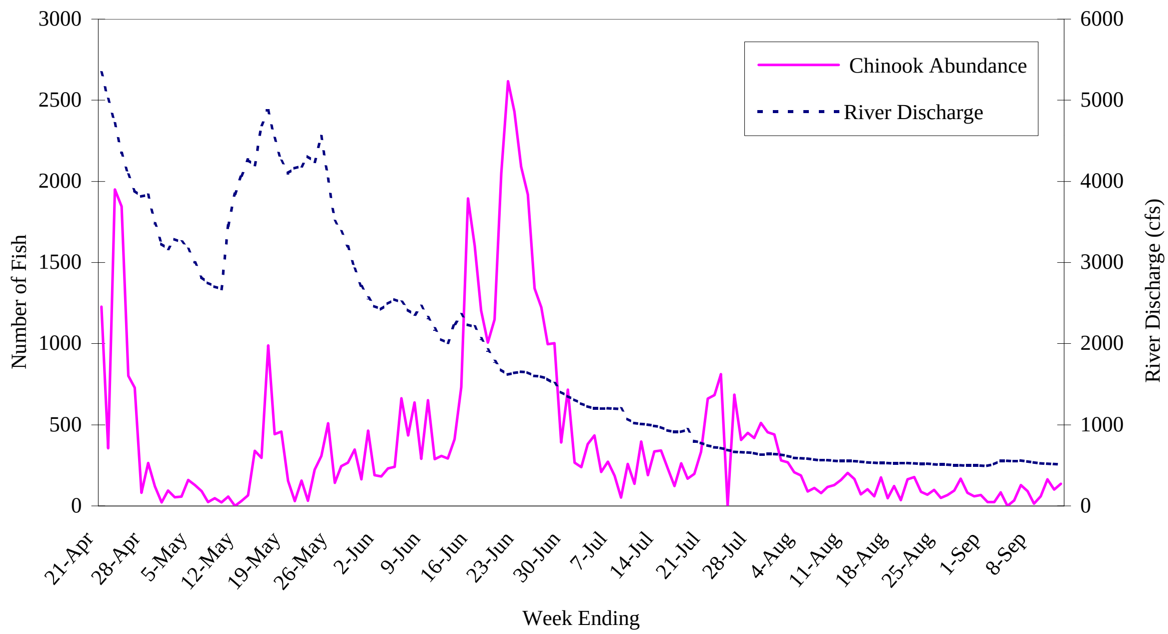

Figure 19. Estimated total chinook abundance and river discharge by week, lower Trinity River, California, 2000.

Size

A total of 2,517 chinook out of the 4,076 fish captured during the trapping season were measured to fork length (FL) (Figure 20). Juvenile chinook size throughout the trapping season ranged from 34-125 mm, with a season mean length of 88 mm. Initial captures of young-of-the-year (YOY) chinook occurred in Apr, immediately after trap deployment, with a mean fork length 58 mm, and increased to a mean fork length of (72 mm) in May (Figure 21). The following month chinook mean fork length increased to 92 mm. The first ad-clipped chinook was captured 8 Jun and the increase in chinook fork length is due to the presence of Trinity River Hatchery chinook. Mean fork lengths for the month of Jul and Aug were 91 mm, and 92 mm respectively. An increase in mean length (99mm) occurred during the month of Sep (Figure 21).

One juvenile chinook measuring 119 was captured on 22 Apr 2000 and assumed to be a yearling chinook. Yearling chinook have been captured in previous years by both YTFP and USFWS in the Klamath River during this time.

Migration Rate and Duration

Trinity River: Spring Chinook

TRH spring chinook were volitionally released between Jun 1-7, 2000. Jun 4 was used as the release date in estimating the mean migration rate, while 1 Jun was used for calculating the initial rate. Although a mean migration rate was calculated, these rates should be viewed with caution due to the extended period of the volitional release. Three separate tag codes were released during this period. Tag code (06-52-51) was captured after 7 days and the other two tag codes were captured 14 days after initial release, based on the first day of hatchery release. The initial migration rate for tag code (06-52-51) was estimated to be 15.83 rm/day and the other two tag codes were estimated at a migration rate of 7.92 rm/day. Two groups of TRH spring-run chinook weighed an average of 5.04 grams more than TRH fall-run chinook, while one group was 3.25 gms larger then TRH fall-run chinook. TRH spring-run chinook also exhibited an overall faster mean migration rate compared to TRH fall-run chinook.

- Trinity River: Fall Chinook

TRH fall-chinook were released during the same period as TRH spring-run chinook (Jun 1-7). Four separate tag groups were released during this period and three tag groups were all captured later then the TRH spring-run chinook. Initial migration rates ranged from 5.83-7.92 rm/day for the four separate tag groups (Table 11). The size of chinook released ranged from 5.01-5.71 grams, and the mean migration rates ranged from 2.17-3.84 rm/day (Table 11).

The initial migration rates for the 2000 spring-run chinook were faster then both the spring and fall run chinook during the 1999 trapping season, while the 2000 fall-run were comparable to 1999 spring and fall chinook mean migration rates.

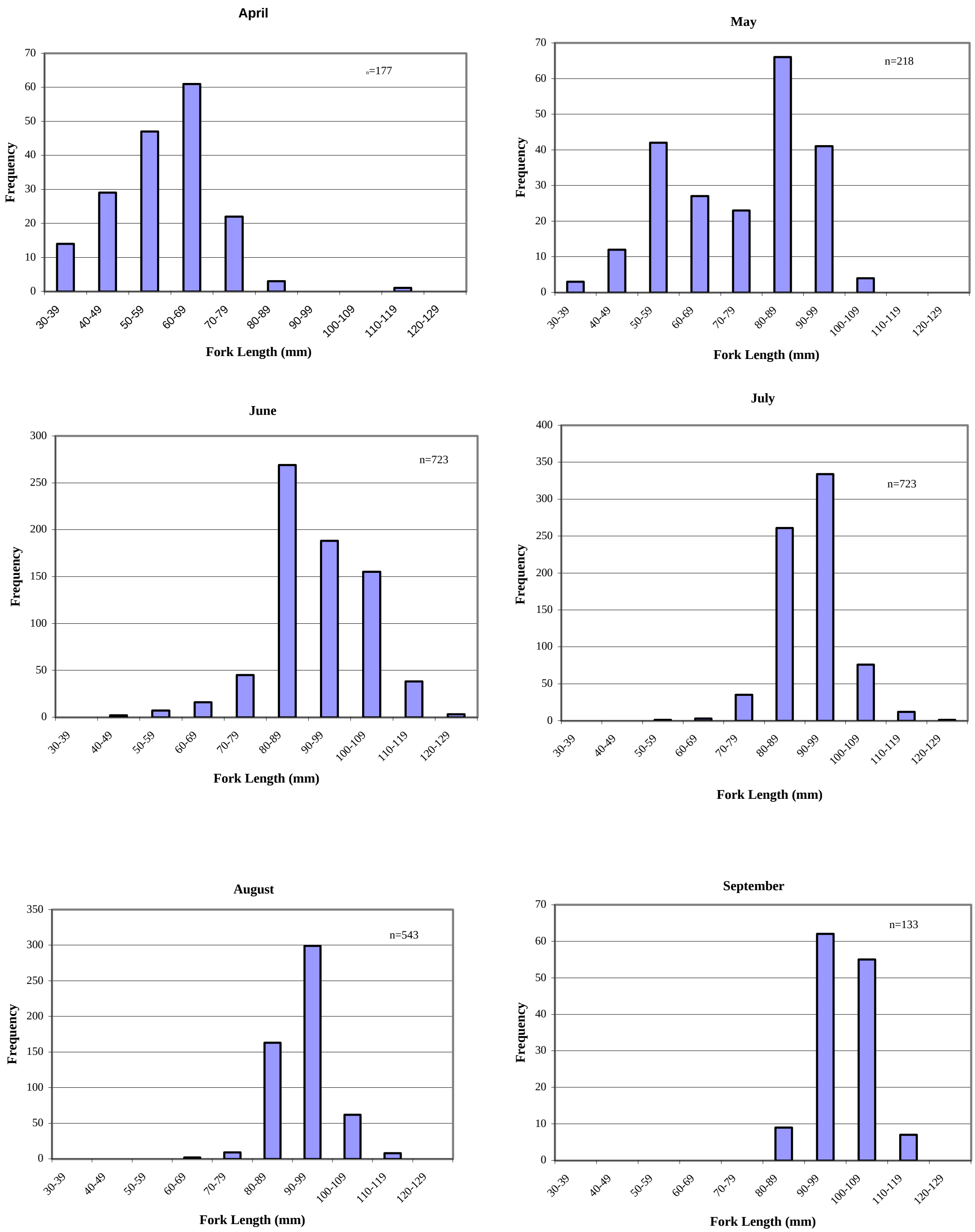

Figure 20. Length-frequency of juvenile chinook sampled in the rotary screw trap lower Trinity River, California, 2000

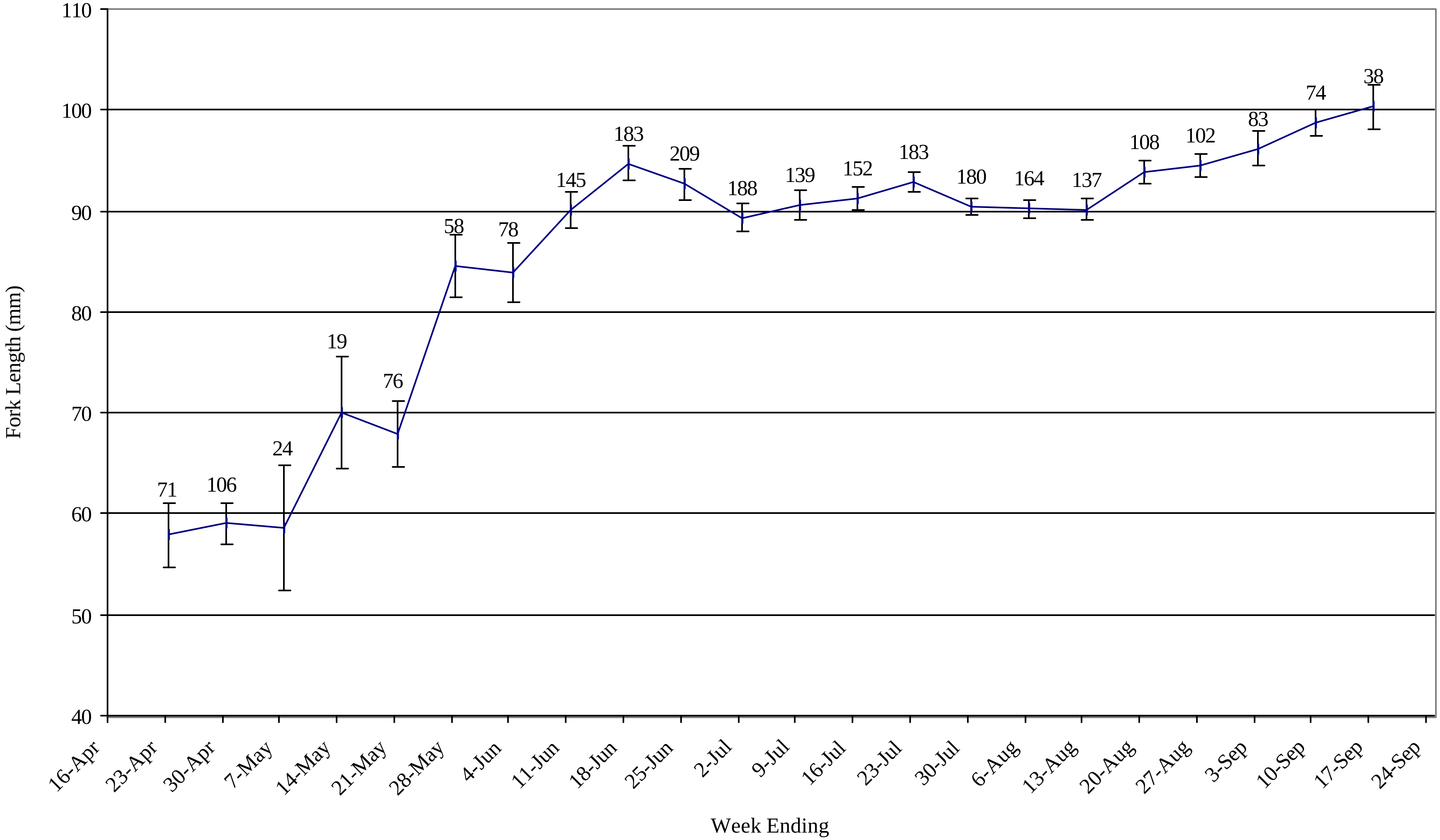

Figure 21. Mean weekly fork length (+/- 95% CI) and sample size of juvenile chinook sampled in the rotary screw trap, lower Trinity River, California, 2000.

Table 11. Estimated migration rates for TRH chinook captured in the rotary screw trap, lower Trinity River, California, 2000.

Tag Code	Release Location and Group	Release Date	Weight (gms) (rm/day	Initial Rate (rm/day)	Mean Rate	10-90% Duration	Mean River Flow (cfs)	Number Sampled
06-52-51	TRH:Spring	June 1-7, 2000	11.12	15.83	6.24	33	2,459	53
06-52-52	TRH:Spring	June 1-7, 2000	11.12	7.92	6.42	10	2,339	34
06-52-53	TRH:Spring	June 1-7, 2000	8.96	7.92	5.16	16	2,339	35
06-52-54	TRH:Fall	June 1-7, 2000	5.71	5.83	2.30	10	2,237	28
06-52-55	TRH:Fall	June 1-7, 2000	5.71	6.93	3.84	13	2,315	18
06-52-56	TRH:Fall	June 1-7, 2000	5.01	7.92	2.46	14	2,339	34
06-52-57	TRH:Fall	June 1-7, 2000	5.01	6.16	2.17	24	2,266	24

Steelhead

Capture

A total of 862 juvenile steelhead were captured during the trapping season (Table 8). The wild stocks component of this total was comprised of 79 young of the year (YOY), 191 parr, and 347 smolt. A total of 245 ad-clipped juvenile steelhead made up the remaining total capture and were comprised of 1 parr, and 244 smolt steelhead (Table 8).

Juvenile steelhead were captured immediately following trap installation, with wild fish comprising the largest of the capture. The largest contribution of wild and ad-clipped age 1+ and older steehead were captured form 23 Apr through 11 Jun. Ad-clipped steelhead were captured from 23 Apr through 11 Jun, with no other hatchery steelhead captured after this date. The largest weekly capture of age 1+ steelhead occurred three weeks after trap installation on week ending 7 May (n=197). TRH smolt comprised 33.5% (n=66) of this peak capture. Wild steelhead smolts accounted for 43% (n=84), with wild parr accounting for the remaining 23% (n=46) of the peak capture. One YOY steelhead was also captured during this period. Parr and smolt steelhead numbers gradually tapered off after this date, although small numbers of wild juvenile steelhead were consistently captured throughout the season. This suggests that YTFP’s trapping efforts were capturing the tail end of juvenile parr and smolt steelhead emigration

Hatchery and Natural Stock

Four groups of yearling steelhead totaling 382,903 were volitionally released from TRH between 15-21 Mar 2000. 100% of TRH steelhead were marked with an adipose fin clip allowing a hatchery/wild determination. A total of 245 TRH steelhead were captured during the trapping season. The bulk of the hatchery steelhead were captured from week ending 23 Apr through 14 May (n=205). Hatchery smolt steelhead captures declined after this period with the last ad-clipped smolt captured during the week ending 11 Jun. One TRH parr steelhead was captured on 30 Jul. Since TRH steelhead were released in mid March, most likely a large portion of these fish had already moved past the trap before installation

(21 April. This is also reinforced by the large number of TRH steelhead captured immediately after trap installation. The bulk of the wild juvenile (smolt) steelhead were also captured during the same period as TRH steelhead, indicating that our trapping efforts also missed the early portion the wild emigration as well.

Abundance Index

The total steelhead abundance index was estimated at 21,562 for the trapping season (Table 10). Ad-clipped steelhead smolt made up 32% of the abundance index (n=6,832), while only seven ad-clipped parr steelhead accounted for the index. Wild steelhead smolt made up 43% (n=9,179), while parr comprised 21% (n=4,478), and YOY totaled 4.9% of the index (n=1,066). Wild age 1+ and older steelhead abundance values were highest during peak river flows (Figure 22). Trinity River Hatchery steelhead abundance values were also highest during peak river flows (Figure 23). YOY steelhead were captured consistently throughout the trapping season.

Size

85% (n=729) of steelhead captured during the trapping season were measured to fork length (Figure 24). YOY steelhead ranged from 28-90 mm, with and average FL of 51 mm. YOY steelhead averaged 50 mm in FL from April through May, and increased slightly to 52 mm from June through September, when the trap was pulled for the season. Wild steelhead parr ranged from 71-170 mm, averaging 111 mm, and wild smolts ranged from 110-257 mm, averaging 160mm. TRH steelhead ranged from 115-286 mm, averaging 212 mm.

Coho Salmon

Capture Summary

A total of 582 yearling coho and 13 YOY were captured during the trapping season (Table 8). Coho yearlings were captured immediately after trap installation (Apr 21). Peak yearling captures occurred between 23 Apr and 21 May 2000 with TRH fish accounting for 66% (n=351) of the total catch (533) during this period. A total of 179 wild coho (34%) were captured during this peak period. Three YOY were captured during this peak period. No wild or hatchery yearlings were captured after week ending 18 Jun. A total of 13 YOY coho were captured during the season with no apparent capture trend.

Hatchery and Natural Stock

TRH continued to mark 100% of all coho released during 2000. A total of 493,727 coho were volitionally released from TRH from 15 Mar through 20 Mar. Of the season total capture (n=595 fish), 64% (n=380) were from TRH, wild fish accounted for 34% (n=202) and YOY coho accounted for 2.2% (n=13). TRH coho were captured for a total of 8 weeks and wild coho were captured for 9 weeks, with no wild and TRH yearling coho captured after this period. YOY coho were captured throughout the trapping season, with a peak capture of only 4 fish during the week ending of 4 Jun (Table 8). This timing suggests that yearling coho were actively emigrating through May and June during the trapping season, while YOY coho may just be displaced downstream.

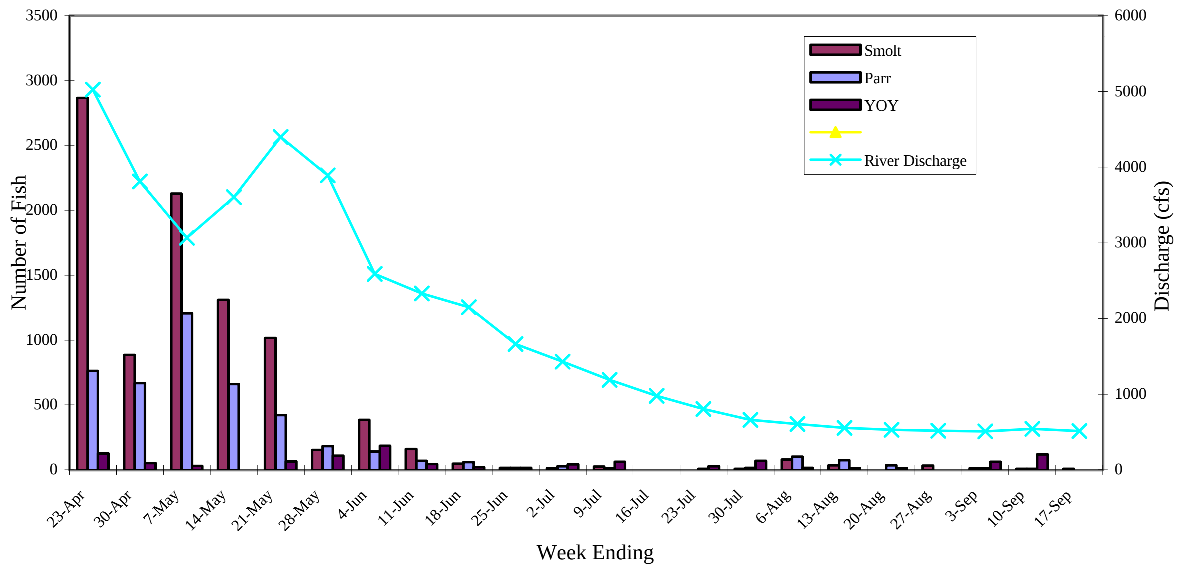

Figure 22. Estimated weekly wild steelhead abundance by age/developmental class, lower Trinity River, California, 2000.

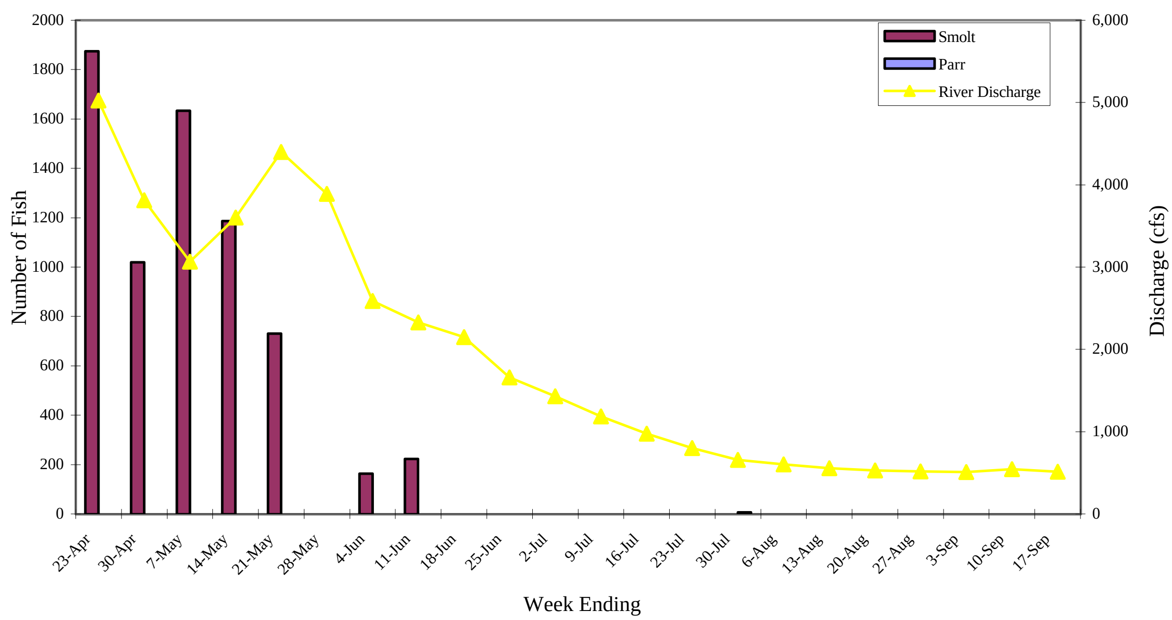

Figure 23. Estimated weekly Trinity River Hatchery steelhead abundance by age/developmental class, lower Trinity River, California, 2000.

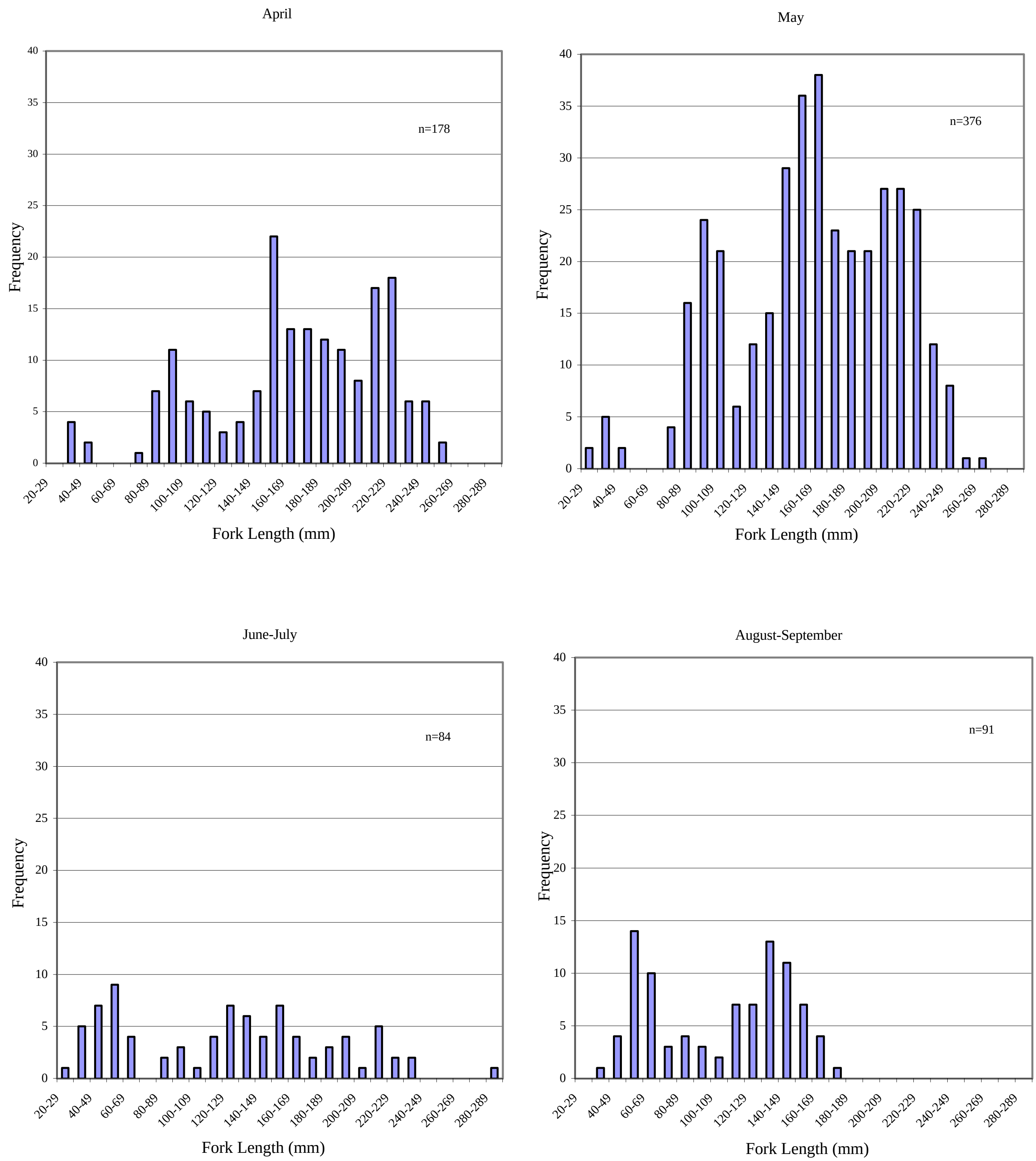

Figure 24. Length-frequency or juvenile steelhead sampled in the rotary screw trap , lower Trinity River, California, 2000.

Abundance Index

Total coho abundance was estimated at 17,192 fish for the 2000-trapping season (Table 10). TRH coho abundance values comprised 63% (n=10,779) of the total season abundance index. Wild coho abundance values comprised 36% (n=6,164). YOY coho comprised 1.4% for an abundance value of 249 fish.

The first peak abundance values occurred during the first week of trapping (23-Apr). The second peak abundance took place for three weeks during week ending 7 May –21 May, totaling 10,020 fish (Table 10, Figure 25). TRH accounted for 74% (n=7,421). Wild fish accounted for 25% (n=2,513) and YOY accounted for 0.9% (n=86) during this peak period. The peak daily abundance value of 3,447 emigrants occurred on 21 April, 2000, which was comprised of 1,877 Wild coho and 1, 570 TRH coho. YOY coho were captured during this daily peak abundance.

Coho were immediately captured after trap installation, indicating that coho were actively emigrating before trapping occurred. The bulk of the hatchery coho emigrated during higher spring flows occurring during the trapping season (Figure 25). Total abundance values were quite smaller than abundance values calculated during the 1998 and 1999 trapping season, but the timing and origin of capture follow similar trends represented in past years of trapping.

Size

88% of the total coho captured were measured to fork length (Figure 26). Coho captured during the trapping season ranged from 49-218 mm, with an average FL of 141 mm. TRH coho ranged from 119-190 mm, with an average FL of 156 mm. Wild coho captured (including YOY) ranged from 49-168 mm FL, with an average FL of 115 mm.

Migrations Rates

TRH coho were released approximately two months prior to the trap installation, due to this no migration rates were calculated. More than likely TRH coho emigrants passed the trap prior to the commencement of trapping efforts.

Coastal Cutthroat Trout

No cutthroat trout were captured during the 2000 lower Trinity River rotary screw trap effort. The upstream-most distribution of cutthroat trout in the Klamath River Basin is currently understood as Mettah Creek. Mettah Creek has a confluence with the Klamath River at rm 28.5, and is approximately 15 miles downstream of the Trinity River confluence.

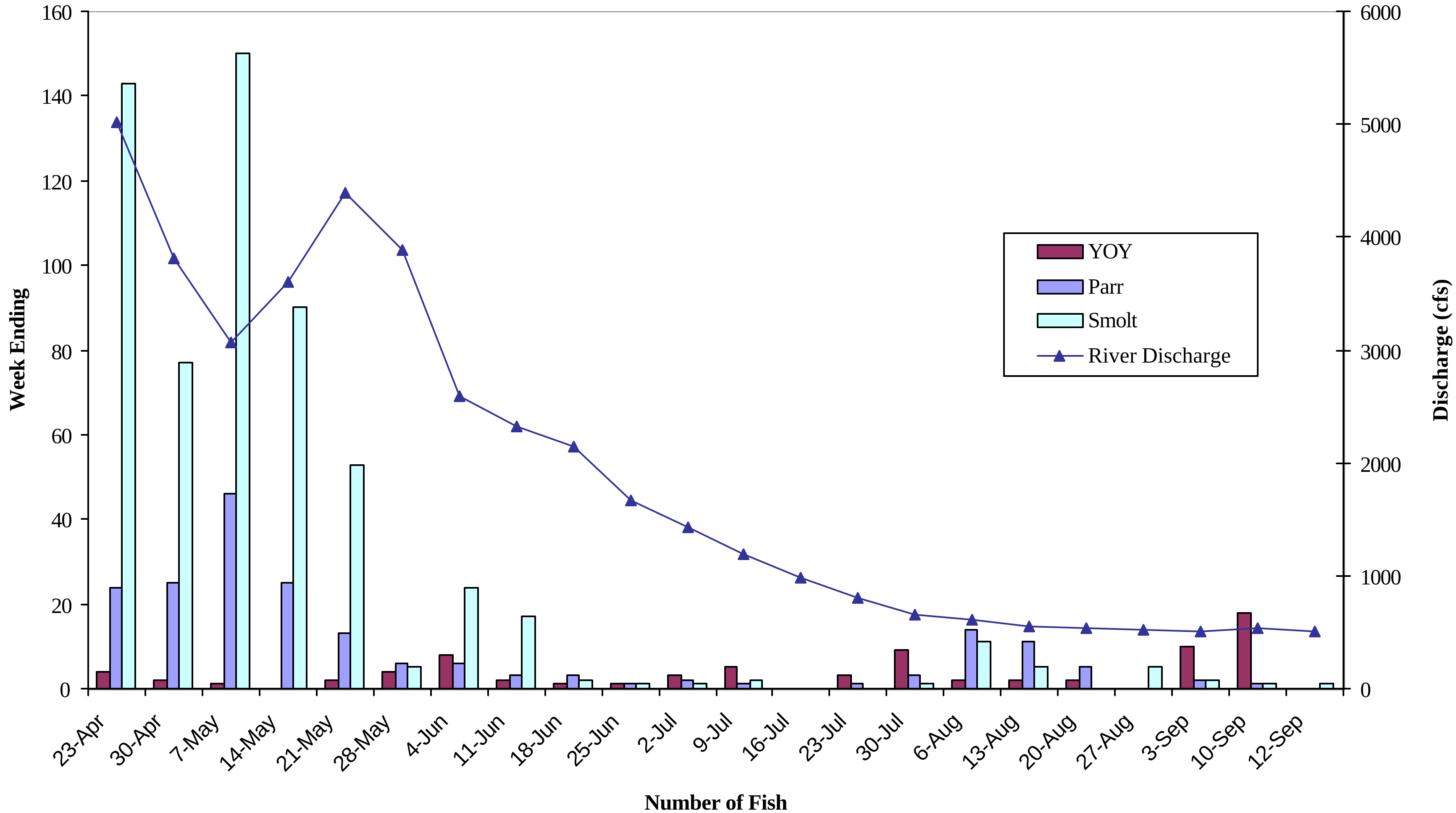

Figure 25. Total weekly steelhead abundance by age/developmental class, lower Trinity River, California, 2000.

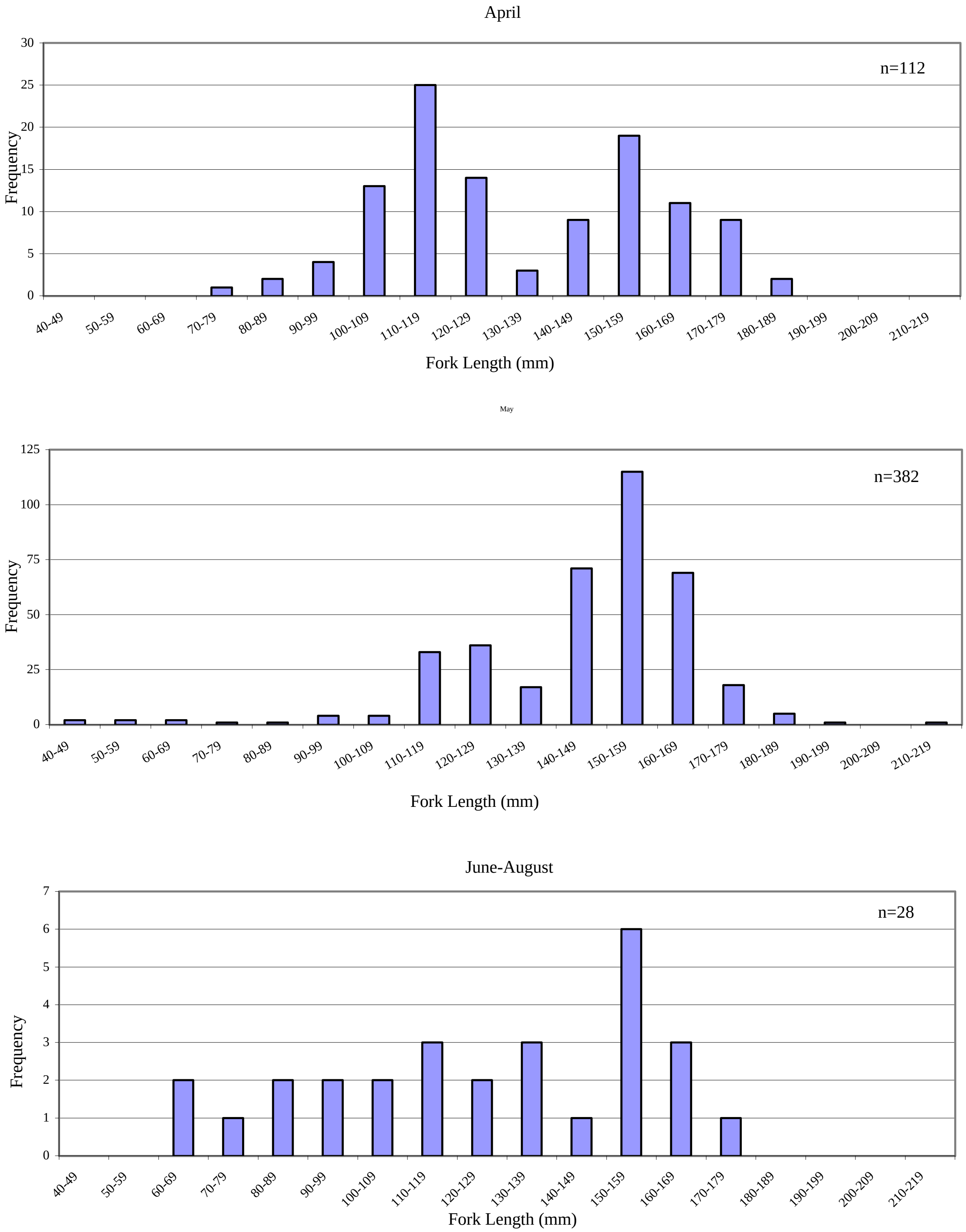

Figure 26. Length-frequency of juvenile coho sampled in the rotary screw trap, lower Trinity River, California, 2000.

Other species captured

Various fish species as well as amphibians were captured during the trapping season. Pacific lamprey ammocoetes were consistently captured throughout the trapping season (n=146). The bulk of ammocoetes were captured between 23 April and 4 Jun (n=95). A total of 23 adult Pacific lamprey were captured during the trapping season (Table 8). Non-salmonids are listed in Table 12 in descending order of numbers captured.

Table 12. Non-salmonid fish species sampled in the rotary screw trap, listed in descending order of capture, lower Trinity River, California, 2000.

Common Name	**Species**
Klamath smallscale sucker	*Catostomus rimiculus*
Speckled dace	*Rhinichthys osculus*
Threespine stickleback	*Gassterosdeus aculateus*
Prickly sculpin	*Cottus asper*
Pacific lamprey	*Lampetra tridentata*
American shad	*Alosa sapidissima*

Recommendations

1999 and 2000 trapping season concludes three years of outmigrant trapping efforts on the lower Trinity River near Weitchpec, CA. Multiple rotary screw traps were operated in the Klamath River Basin during this same time period. USFWS operated screw traps at Big Bar (Klamath River), Junction City (Trinity River), and Willow Creek (Trinity River). CDFG also continued juvenile salmonid monitoring in the Klamath Estuary. YTFP also operated a rotary screw trap on Blue Creek, the largest and most important chinook stream downstream of the Trinity River confluence.

In order to continue the long term efforts in monitoring the Klamath Basin, the following recommendation are suggested to manage the quality and scientific utility of future efforts. Continuing trap operations and data collection protocols from year to year is the most important factor. Multi agency efforts has improved dramatically over the years and should continue, providing qualitative databases for future management decisions.

Continuing multiple trap locations in the Klamath Basin offers managers the ability to track migration patterns through the geographic area. Migration timing of both hatchery and wild fish provide crucial information regarding the impacts hatchery fish have on wild fish populations. YTFP recommends the continued use of multiple trap locations.

Consistent Year-to-Year Monitoring

YTFP has formulated several recommendations to maximize the quality and scientific utility of future long-term monitoring efforts. The most important (and obvious) recommendation is for all involved parties to maintain consistent trapping operations and data collection protocols from season to season. This will allow comparison of abundance indices between years and facilitate the identification of long-term emigration trends. Maintaining consistent quantitative databases will facilitate informed management decisions.

In addition, the spatial array of outmigrant trap sites throughout much of the Klamath River offers managers the opportunity to track fish movement (migration rates) over a large geographic area. The determination of more accurate migration rates helps to better assess how long hatchery fish are present in the river system, and could enhance our knowledge of how hatchery releases impact wild fish populations. Therefore, we also recommend that the 1999 and 2000 spatial array of trap locations become an annual protocol.

Mark and Recapture Efforts

While initial efforts to determine trap efficiency at the lower Trinity River rotary trap showed some potential for M/R estimates of emigrating salmonids, it is clear that a larger/more efficient trap would be required to consistently produce such estimates. Also, it is likely that such estimates would only be producible during peak emigration periods, as sample sizes would likely be too low outside of this peak period (overall low trapping efficiencies necessitate a large sample size of marked fish to produce adequate recaptures). Using "peak period" efficiency-based estimates as a trend monitoring tool could prove difficult. Factors including varying river flow and water quality conditions and variation in the interaction between wild and hatchery fish would likely result in an annual variation in the length and magnitude of these peak periods.

The difference between trap efficiencies for steelhead and chinook is notable. Steelhead typically produce a trapping efficiency that is as much as one order of magnitude less then that of chinook (Gale et al. 1998), so the fact that the SH efficiencies were 3-4 times that of the chinook efficiencies would show how dramatically the trap efficiency decreased as flow levels dropped. Such radically changing efficiencies will greatly impact the analysis of such data, especially when low recapture numbers necessitated the pooling of most of the data. This indicates the need to ensure even higher numbers of marked fish to minimize pooling of individual strata. As river flows are ramped down, it is likely that efficiencies change significantly within one given strata (one week); thus to pool strata is to compound the problem.

Another potential problem with mark/recapture-derived trap efficiencies at either the lower Trinity or lower Klamath rotary screw traps is that both wild and hatchery chinook were marked. If both hatchery and wild fish are marked in order to derive trap efficiency, then one assumes that their emigration behavior is the same (i.e.: that they both utilize the same part of the water column, they both only emigrate at night when the trap is less visible, and that they generally respond to the trap in a similar fashion). These assumptions are likely tenuous at best, yet without the means to reliably identify hatchery chinook in the wild, are required in order to generate mark/recapture-derived trap efficiencies.

Marking of Hatchery Stocks

Large numbers of hatchery chinook continue to be released annually from both IGH and TRH, and only a small proportion of these fish are marked with a CWT and an adipose fin clip. We recommend utilizing constant fractional marking. This is a method where a consistent percentage of hatchery fish are marked regardless of the overall number released. For example, if 20% of released fish are always marked, then anytime an ad-clipped fish is captured we will know that there are four more out there that are unmarked. Thus, we gain the ability to perform instantaneous expansions of capture data. In addition, simply increasing the sample size of tagged hatchery fish would also enhance the reliability of ad-clip expansions and allow a more accurate accounting of hatchery versus wild fish emigration.

A method of representative marking should also be adopted. This method selects a representational sub-sample from the group of fish to be released for marking. Current practices do not necessarily incorporate this idea as fish tend to be marked out of a raceway until tag quotas are reached. Marking a sub-sample of fish that are representational of the entire group with regards to their size and health will incorporate a degree of quality control that is, currently, variable at best.

All hatchery coho released from both IGH and TRH in 1999 and 2000 were given identifying maxillary clips and we recommend that this become a permanent policy. All hatchery-reared steelhead released in 1999 and 2000 were ad-clipped and we recommend that this be implemented as a permanent policy as well. Although all hatchery steelhead possessed ad-clips, there was no reliable means to determine between IGH and TRH steelhead. Therefore, YTFP recommends that an additional identifying feature such as a permanent colored mark applied to all hatchery-reared steelhead from at least one of the facilities so biologists and managers would be able to determine point of origin.

Marking of Wild Stocks

To aid in the understanding of wild stock composition and abundance, fisheries managers should consider marking wild chinook from specific drainages. Marking wild fish from areas such as the Shasta, Scott, and Salmon Rivers that enter the Klamath, as well as the North and South Fork Trinity Rivers would allow agencies to visually identify specific wild chinook stocks. This information could possibly be used to understand the differences (if any) in migratory behavior of hatchery and various wild fish stocks. This would also improve resource managers' ability to manage individual stocks. With the potential of recapturing marked fish from upstream monitoring projects it is possible that coordinated efforts could provide migration rates and the duration of residency between trap sites and the estuary.

Fish Disease Studies

In 1999 and 2000, moribund chinook with disease symptoms were captured in both the Lower Klamath and Lower Trinity River screw traps. Moribund chinook have been collected since the inception of YTFP's rotary screw trap operations and as seen in the past, peak moribund chinook captures corresponded with the arrival of IGH and TRH fish and the onset of degraded water conditions in both the Klamath and Trinity Rivers. The USFWS and CNFHC conducted an evaluation of moribund juvenile salmonids throughout the Lower Klamath River Basin. CNFHC has been monitoring the health and physiology of chinook emigrants since 1991, and results have shown that several diseases play a major role in the survival of chinook emigrants including *C. shasta*, *Nanophyetus salmincola* and *Renibacterium salmoninarum* (Willamson and Foott 1998). We recommend that studies addressing the casual factors of the disease(s) and the accompanying effects on fish populations be continued and/or expanded. We support the CNFHC recommendation that controlled experiments investigating the relationship between Klamath Basin pathogens, water quality and the development of fish disease(s) should be conducted (Williamson and Foott 1998).

Future Direction

Numerous juvenile salmonid monitoring projects are regularly implemented throughout the Klamath River Basin. YTFP recommends that all involved entities cooperate towards achieving a unified annual basinwide effort. A technical meeting sponsored by the Fish, Farms, and Forest Communities Forum (FFFC) in January 2000 brought together state and federal agencies, Tribes, and local watershed organizations to develop a common methodology for operating outmigrant traps, and to discuss methods of data analysis that are both meaningful and statistically valid. This far-reaching, cooperative meeting serves as a model for all future biological monitoring efforts in the Klamath River Basin. Semi-annual meetings should be arranged for all involved entities to formulate and implement a cohesive basinwide monitoring strategy.

Literature Cited

Bell , M. C. 1991. Temperature- Effects on Fish. Pages 11.1-11.10 *in* M. C. Bell, editor. Fisheries Handbook of Engineering Requirements and Biological Criteria, third edition. Fish Passage Development and Evaluation Program, United States Army Corps of Engineers, North Pacific Division, Portland, Oregon.

Berggren, T.J., and M. J. Filardo. 1993. An analysis of variables influencing the migration of juvenile salmonids in the Columbia River basin. North American Journal of Fisheries Management 13:48-63.

Bjorkstedt, E. P. 2000. DARR (Darroch analysis with rank-reduction): A method for analysis of stratified mark-recapture data from small populations, with application to estimating abundance of smolts from outmigrant trap data. U.S. Dept. of Commerce, NOAA, NMFS, SWFSC, Administrative Report SC-00-02, Santa Cruz, California.

Craig, J.L. 1997. Weekly outmigrant trapping summaries from Big Bar and Willow Creek screw traps, May-September, 1997. United States Fish and Wildlife Service, Coastal California Fishery Resource Office. Arcata, California.

Craig, J.L. 1998. Preliminary 1997 outmigrant trapping data from Big Bar and Willow Creek screw traps. United States Fish and Wildlife Service, Coastal California Fishery Resource Office. Arcata, California.

Foott, J.S., R.L. Walker, J.D. Williamson, and K.C. True. 1994. Health and physiology monitoring of chinook and steelhead smolts in the Trinity and Klamath Rivers. Pages 110-121 *in* T.J. Hassler, editor. Proceedings of the Klamath Basin Fisheries Symposium. California Cooperative Fishery Research Unit, Arcata, California.

Gale, D.B., T.R. Hayden, L.S. Harris, and H.N. Voight. 1998. Assessment of anadromous fish stocks in Blue Creek, lower Klamath River, California, 1994-1996. Yurok Tribal Fisheries Program, Habitat Assessment and Biological Monitoring Division Technical Report No. 4, Klamath, California.

Goldsmith, G.H. 1994. Juvenile salmonid monitoring on the Trinity and Klamath Rivers. United States Fish and Wildlife Service, Coastal California Fishery Resource Office. Arcata, California.

Hassler, T.J. 1987. Species profiles: life histories and environmental requirements of coastal fishes and invertebrates (Pacific Southwest)– coho salmon. United States Fish and Wildlife Service Biological Report 82(11.70). United States Army Corps of Engineers, TR-EL-82-4.

Healey, M.C. 1991. Life history of chinook salmon (*Oncorhynchus tshawytscha*). Pages 311-393 *in* C. Groot and L. Margolis, editors. Pacific salmon life histories. UBC Press, Vancouver, British Columbia.

Hoar, W.S. 1976. Smolt transformation: evolution, behavior, and physiology. Journal of the Fisheries Research Board of Canada 33:1234-1252.

Holt, R.A., J.E. Sanders, J.L. Zinn, J.L. Fryer, and K.S. Pilcher. 1975. Relationship of water temperature to *Flexibacter columnaris* infection in steelhead trout (*Salmo gairdneri*), coho (*Oncorhynchus kisutch*), and chinook (*O. tshawytcha*). Journal of the Fisheries Research Board of Canada. 32:1553-1559.

Inglis, V., R.J. Roberts, and N.R. Bromage. 1993. Bacterial diseases of fish. Institute of Aquaculture, Halsted Press, New York.

Jearld, A. 1983. Age determination. Pages 301-324 *in* L.A. Nielsen and D.L. Johnson, editors. Fisheries techniques. American Fisheries Society, Bethesda, Maryland.

Kier, W.M. and Associates. 1991. Long range plan for the Klamath River Basin conservation area fishery restoration program. Report prepared for the Klamath River Basin Fisheries Task Force. United States Fish and Wildlife Service, Klamath River Fishery Resource Office, Yreka, California.

Lasee, B. A., editor. 1995. Introduction to Fish Health Management, 2nd edition. United States Fish and Wildlife Service, La Crosse Fish Health Center, Onalaska, Wisconsin.

Leider, S. A., M. W. Chilcote, and J. J. Loch. 1986. Movement and survival of presmolt steelhead in a tributary and the main stem of a Washington river. North American Journal of Fisheries Management 6:526-531.

Noga, E.J. 1996. Fish Disease Diagnosis and Treatment. Mosby-Year Book, Inc. St. Louis, Missouri. 367 pp.

PFMC (Pacific Fishery Management Council). 1994. Klamath River fall chinook review team report: An assessment of the status of the Klamath River fall chinook stock as required under the salmon fishery management plan. United States Department of Commerce, National Oceanic and Atmospheric Administration, Portland, Oregon.

Piper, R.G., and five coauthors. 1982. Fish Hatchery Management. United States Department of the Interior, Fish and Wildlife Service, Washington, D.C. 517 pp.

Post, G. 1987. Textbook of Fish Health. T.F.H. Publications, Neptune City, New Jersey. 218 pp.

Roper, B., and D.L. Scarnecchia. 1996. A comparison of trap efficiencies for wild and hatchery age-0 chinook salmon. North American Journal of Fisheries Management 16:214-217.

True, K.C. 1997. Memorandum to D.B. Gale, Yurok Tribal Fisheries Program, concerning laboratory analysis of juvenile chinook collected at the lower Klamath screw trap. United States Fish and Wildlife Service, California-Nevada Fish Health Center, Anderson, CA.

USDOI (U.S. Department of the Interior). 1980. Environmental impact statement on the management of river flows to mitigate the loss of the anadromous fishery of the Trinity River, California. United States Fish and Wildlife Service, Sacramento, California.

Wallace, M. 1994. The emigration and timing of juvenile salmonids through the Klamath River estuary. Pages 54-72 in T.J. Hassler, editor. Proceedings of the Klamath Basin Fisheries Symposium. California Cooperative Fishery Research Unit, Arcata, California.

Williamson, J. and J.S. Foott. 1997. Health and physiological evaluation of natural and hatchery chinook smolts in the Klamath estuary, May-August 1997. United States Fish and Wildlife Service, California-Nevada Fish Health Center, Anderson, California.

Williamson, J.D. and J.S. Foott. 1998. FY98 Investigational Report: Diagnostic evaluation of moribund juvenile salmonids in the Trinity and Klamath Rivers (June – September 1998). United States Fish and Wildlife Service, California-Nevada Fish Health Center, Anderson, CA.

Zedonis, P.A., and T.J. Newcomb. 1997. An evaluation of flow and water temperatures during the spring for protection of salmon and steelhead smolts in the Trinity River, California. United States Fish and Wildlife Service, Coastal California Fish and Wildlife Office, Arcata, California.

Appendix A1. Coded wire tag expansions for TRH origin chinook captured in the rotary trap, lower Trinity River, California, 1999

Trinity River Hatchery: Fall Chinook (06-52-42)

Week ending	Number Captured	Expansion Factor	Production Multipler	Expanded capture
6/20/99	0	1.00	11.23	0
6/27/99	1	1.48	11.23	17
7/4/99	0	1.00	11.23	0
7/11/99	4	1.20	11.23	54
7/18/99	4	1.06	11.23	47
7/25/99	36	3.39	11.23	1370
8/1/99	24	3.74	11.23	1007
8/8/99	27	1.45	11.23	439
8/15/99	10	1.13	11.23	127
8/22/99	8	1.38	11.23	124
8/29/99	3	1.28	11.23	43
9/5/99	5	1.17	11.23	66
9/12/99	0	1.18	11.23	0
9/19/99	0	0	11.23	0

Trinity River Hatchery: Fall Chinook (06-52-43)

Week ending	Number Captured	Expansion Factor	Production Multipler	Expanded Capture
6/20/99	0	1.00	11.23	0
6/27/99	0	1.48	11.23	0
7/4/99	0	1.00	11.23	0
7/11/99	5	1.20	11.23	67
7/18/99	19	1.06	11.23	225
7/25/99	29	3.39	11.23	1104
8/1/99	30	3.74	11.23	1259
8/8/99	29	1.45	11.23	471
8/15/99	16	1.13	11.23	203
8/22/99	6	1.38	11.23	93
8/29/99	4	1.28	11.23	57
9/5/99	2	1.17	11.23	26
9/12/99	0	1.18	11.23	0
9/19/99	0	0	11.23	0

Trinity River Hatchery: Fall Chinook (06-52-44)

Week ending	Number Captured	Expansion Factor	Production Multipler	Expanded capture
6/20/99	0	1.00	10.71	0
6/27/99	0	1.48	10.71	0
7/4/99	0	1.00	10.71	0
7/11/99	0	1.20	10.71	0
7/18/99	2	1.06	10.71	23
7/25/99	21	3.39	10.71	762
8/1/99	33	3.74	10.71	1320
8/8/99	21	1.45	10.71	326
8/15/99	13	1.13	10.71	157
8/22/99	12	1.38	10.71	177
8/29/99	11	1.28	10.71	150
9/5/99	0	1.17	10.71	0
9/12/99	0	1.18	10.71	0
9/19/99	0	0	10.71	0

Trinity River Hatchery: Fall Chinook (06-52-45)

Week ending	Number Captured	Expansion Factor	Production Multipler	Expanded Capture
6/20/99	0	1.00	11.32	0
6/27/99	0	1.48	11.32	0
7/4/99	1	1.00	11.32	11
7/11/99	0	1.20	11.32	0
7/18/99	1	1.06	11.32	12
7/25/99	27	3.39	11.32	1036
8/1/99	32	3.74	11.32	1353
8/8/99	18	1.45	11.32	295
8/15/99	7	1.13	11.32	90
8/22/99	6	1.38	11.32	94
8/29/99	5	1.28	11.32	72
9/5/99	4	1.17	11.32	53
9/12/99	0	1.18	11.32	0
9/19/99	0	0	11.32	0

Appendix A2. Coded wire tag expansions for TRH origin chinook captured in the rotary trap, lower Trinity River, California, 1999.

Trinity River Hatchery: Spring Chinook (06-52-47)

Week ending	Number Captured	Expansion Factor	Production Multipler	Expanded capture
6/20/99	16	1.00	7.08	113
6/27/99	44	1.48	7.08	460
7/4/99	7	1.00	7.08	50
7/11/99	5	1.20	7.08	42
7/18/99	1	1.06	7.08	7
7/25/99	12	3.39	7.08	288
8/1/99	8	3.74	7.08	212
8/8/99	1	1.45	7.08	10
8/15/99	4	1.13	7.08	32
8/22/99	3	1.38	7.08	29
8/29/99	0	1.28	7.08	0
9/5/99	0	1.17	7.08	0
9/12/99	0	1.18	7.08	0
9/19/99	0	0	7.08	0

Trinity River Hatchery: Spring Chinook (06-52-48)

Week ending	Number Captured	Expansion Factor	Production Multipler	Expanded Capture
6/20/99	9	1.00	6.32	57
6/27/99	32	1.48	6.32	299
7/4/99	22	1.00	6.32	139
7/11/99	15	1.20	6.32	113
7/18/99	1	1.06	6.32	7
7/25/99	26	3.39	6.32	557
8/1/99	26	3.74	6.32	614
8/8/99	15	1.45	6.32	137
8/15/99	3	1.13	6.32	21
8/22/99	1	1.38	6.32	9
8/29/99	0	1.28	6.32	0
9/5/99	0	1.17	6.32	0
9/12/99	0	1.18	6.32	0
9/19/99	0	0	6.32	0

Trinity River Hatchery: Spring Chinook (06-52-49)

Week ending	Number Captured	Expansion Factor	Production Multipler	Expanded capture
6/20/99	7	1.00	6.35	44
6/27/99	28	1.48	6.35	263
7/4/99	20	1.00	6.35	127
7/11/99	11	1.20	6.35	84
7/18/99	5	1.06	6.35	34
7/25/99	21	3.39	6.35	452
8/1/99	14	3.74	6.35	332
8/8/99	8	1.45	6.35	74
8/15/99	8	1.13	6.35	57
8/22/99	4	1.38	6.35	35
8/29/99	2	1.28	6.35	16
9/5/99	0	1.17	6.35	0
9/12/99	0	1.18	6.35	0
9/19/99	0	0	6.35	0

Appendix B1. Coded wire tag expansions for TRH origin chinook captured in the rotary trap lower lower Trinity River, California, 2000.

Trinity River Hatchery: Spring Chinook (06-52-51)

Week ending	Number Captured	Expansion Factor	Production Multiplier	Expanded capture
6/11/00	1	1	6.3	6
6/18/00	21	1	6.3	132
6/25/00	23	1	6.3	145
7/2/00	4	1	6.3	25
7/9/00	1	1	6.3	6
7/16/00	2	1	6.3	13
7/23/00	1	1	6.3	6
7/30/00	0	1	6.3	0
8/6/00	0	1	6.3	0
8/13/00	0	1	6.3	0
8/20/00	0	1	6.3	0

Trinity River Hatchery: Spring Chinook (06-52-52)

Week ending	Number Captured	Expansion Factor	Production Multiplier	Expanded capture
6/11/00	0	1	6.2	0
6/18/00	13	1	6.2	81
6/25/00	17	1	6.2	105
7/2/00	2	1	6.2	12
7/9/00	0	1	6.2	0
7/16/00	2	1	6.2	12
7/23/00	0	1	6.2	0
7/30/00	0	1	6.2	0
8/6/00	0	1	6.2	0
8/13/00	0	1	6.2	0
8/20/00	0	1	6.2	0

Trinity River Hatchery: Spring Chinook (06-52-53)

Week ending	Number Captured	Expansion Factor	Production Multiplier	Expanded capture
6/11/00	0	1	6.1	0
6/18/00	7	1	6.1	43
6/25/00	18	1	6.1	110
7/2/00	5	1	6.1	31
7/9/00	1	1	6.1	6
7/16/00	1	1	6.1	6
7/23/00	2	1	6.1	12
7/30/00	0	1	6.1	0
8/6/00	0	1	6.1	0
8/13/00	1	1	6.1	6
8/20/00	0	1	6.1	0

Appendix B2. Coded wire tag expansions for TRH origin chinook captured in the rotary trap lower Trinity River, California, 2000.

Trinity River Hatchery: Fall Chinook (06-52-54)

Week ending	Number Captured	Expansion Factor	Production Multiplier	Expanded capture
6/11/00	0	1	10.7	0
6/18/00	0	1	10.7	0
6/25/00	7	1	10.7	75
7/2/00	4	1	10.7	43
7/9/00	0	1	10.7	0
7/16/00	0	1	10.7	0
7/23/00	4	1	10.7	43
7/30/00	6	1	10.7	64
8/6/00	1	1	10.7	11
8/13/00	2	1	10.7	21
8/20/00	2	1	10.7	21
8/27/00	2	1	10.7	21
9/3/00	0	1	10.7	0

Trinity River Hatchery: Fall Chinook (06-52-55)

Week ending	Number Captured	Expansion Factor	Production Multiplier	Expanded capture
6/11/00	0	1	10.8	0
6/18/00	1	1	10.8	11
6/25/00	3	1	10.8	32
7/2/00	4	1	10.8	43
7/9/00	0	1	10.8	0
7/16/00	2	1	10.8	22
7/23/00	1	1	10.8	11
7/30/00	5	1	10.8	54
8/6/00	1	1	10.8	11
8/13/00	1	1	10.8	11
8/20/00	0	1	10.8	0
8/27/00	0	1	10.8	0
9/3/00	0	1	10.8	0

Trinity River Hatchery: Fall Chinook (06-52-56)

Week ending	Number Captured	Expansion Factor	Production Multiplier	Expanded capture
6/11/00	0	1	10.8	0
6/18/00	1	1	10.8	11
6/25/00	7	1	10.8	76
7/2/00	3	1	10.8	32
7/9/00	2	1	10.8	22
7/16/00	3	1	10.8	32
7/23/00	4	1	10.8	43
7/30/00	4	1	10.8	43
8/6/00	4	1	10.8	43
8/13/00	3	1	10.8	32
8/20/00	0	1	10.8	0
8/27/00	2	1	10.8	22
9/3/00	0	1	10.8	0

Trinity River Hatchery: Fall Chinook (06-52-57)

Week ending	Number Captured	Expansion Factor	Production Multiplier	Expanded capture
6/11/00	0	1	10.9	0
6/18/00	0	1	10.9	0
6/25/00	4	1	10.9	43.6
7/2/00	0	1	10.9	0
7/9/00	0	1	10.9	0
7/16/00	1	1	10.9	10.9
7/23/00	8	1	10.9	87.2
7/30/00	3	1	10.9	32.7
8/6/00	1	1	10.9	10.9
8/13/00	1	1	10.9	10.9
8/20/00	1	1	10.9	10.9
8/27/00	3	1	10.9	32.7
9/3/00	2	1	10.9	21.8