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ANNUAL REPORT

KLAMATH RIVER FISHERIES ASSESSMENT PROGRAM

JUVENILE SALMONID TRAPPING ON THE MAINSTEM TRINITY RIVER AT WILLOW CREEK AND ON THE KLAMATH RIVER AT BIG BAR

1990

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ABSTRACT

This report details the third year of Klamath River basin juvenile salmonid fishery investigations and represents the second year of sampling with rotary screw traps. Two traps, positioned side to side, were used at both the Klamath and Trinity River sites. The traps on the Klamath River were located at Big Bar (rkm 81) and began operation in March. The traps operated until July 10 and 18 sampling 38 and 31 nights respectively. Combined catch included 333 chinook (Oncorhynchus tshawytscha), 178 steelhead (O. mykiss), and 30 coho (O. kisutch). No appreciable difference in mean catch or mean fork length of catch between the two traps was found. Peak weekly chinook catch effort, as an indicator of peak emigration, occurred the week of June 18 to 24. A total of five (1.5%) Ad-clip chinook were captured. A contribution of 134 (40%) hatchery chinook and 199 (60%) natural stock chinook was estimated for the total chinook captured. Mean migration rate for IGH Ad-clip chinook was 5.5 (rkm/day). Due to periods of high river flow with subsequent trap failures, population estimates and indexes were not generated. A single rotary trap resumed operation on October 17 and sampled 19 nights before ceasing operation on November 30. The trap captured four steelhead during this fall period. A single trap began operating on the Trinity River (rkm 37) on February 28 with the second trap commencing operation on March 15. The traps operated 96 and 83 nights respectively before ceasing operation on August 31. Combined catch included 1,023 chinook, 985 steelhead, and 272 coho. An initial weekly catch effort peak was observed for all salmonids in late April coinciding with a brief and minor increase in river flow. A substantial and prolonged flow increase began on May 16. Both rotary traps were damaged on May 21 and did not resume operation until June 11/12. Seining efforts were increased as an interim measure and recorded considerable increases in chinook abundance. Hatchery contribution to catches for the entire spring period was 10.3% for chinook and 40.7% for steelhead. Mean migration rate for TRH Ad-clip spring chinook was 16.3 (rkm/day). Mean migration rate for TRH Ad-clip fall chinook was 6.1 (rkm/day). The rotary trap operating near shore captured substantially more chinook (71% of combined catch) than the rotary trap operating nearer mid channel. Conversely, the rotary trap operating nearer mid channel captured a greater number of steelhead and coho than the near shore trap (80 and 72% of combined catch respectively). Trapping resumed with two rotary traps on October 4 and continued until November 30 with both traps operating 35 nights. Combined catch included 901 chinook (91% captured with the near shore trap) and 44 steelhead. No coho were captured. Hatchery chinook comprised 87% of all chinook captured during fall monitoring. All steelhead captured were natural stock. Mean migration rate for the TRH Ad-clip spring chinook yearlings was 16.9 (rkm/day) and 34.6 (rkm/day) for the TRH Ad-clip fall chinook yearlings. Limited trap efficiency test results precluded calculation of an population estimate. Abundance index value for spring emigration was 57,000 chinook, 58,000 steelhead, and 18,000 coho. However, the index does not account for fish migrating during the approximately four week period of trap non-operation when emigration may have been substantial. Abundance index value for the fall emigration was 35,000 chinook and 1,000 steelhead.

INTRODUCTION

The Klamath River watershed drains approximately 14,400 km^2 in Oregon and 26,000 km^2 in California. The most important anadromous salmonid spawning tributaries in the basin include the Trinity River, draining approximately 7,690 km^2, and the Shasta, Scott and Salmon rivers, each draining approximately 2,070 km^2. Iron Gate Dam on the Klamath River at river kilometer (rkm 306) and Lewiston Dam on the Trinity River (rkm 179) represent the upper limits of anadromous salmonid migration in these basins (Figure 1). Iron Gate and Trinity River hatcheries, located near the base of each dam, were constructed to mitigate for natural stock fish production losses resulting from each project.

Within the Klamath River basin, federal, tribal and state programs have monitored the in-river harvest levels, spawning escapement and upstream migration of adult fall chinook salmon. These programs have provided information concerning returning adults which is utilized to manage the harvest and estimate the return of fall chinook salmon to the Klamath and Trinity rivers. While this information is necessary to provide proper management of the resource, the ability to predict yearly variations in stock strength is diminished without knowledge of the factors affecting juvenile production.

Most information on chinook salmon juvenile life history within the Klamath River basin has come from natural stock assessment and production studies initiated by the California Department of Fish and Game (CDFG) in 1984 (Mills, T., personal communication). This work has been conducted within the tributaries of the upper Klamath River basin (Shasta, Scott, and Salmon rivers and Bogus Creek), the Trinity River mainstem and tributaries (South Fork, North Fork, Canyon Creek), and in the Klamath River estuary. In addition to these natural production studies there is a need to assess migrational characteristics and survival of salmon and steelhead released from Iron Gate Hatchery (IGH) and Trinity River Hatchery (TRH) as well as from hatchery supplementation programs. The U.S. Fish and Wildlife Service (Service) initiated a juvenile salmonid monitoring program on the mainstem Klamath and Trinity rivers during the spring of 1988. Work has continued through 1990. Primary goal through these monitoring efforts has been the development of juvenile salmonid population estimates and abundance indices. Additional intents of the program include determining the timing, composition, size, age and condition of hatchery and natural stocks salmonids as well as determine migration rates of hatchery fish and document the presence and abundance of other fish species. Sampling by the Service was also initiated in the Klamath River estuary in 1988 and on the lower mainstem Klamath River in 1989. These studies continued through 1990. The objective of these efforts were to gather further information on salmonid abundance and composition, emigration timing, size, age and condition of hatchery and natural stocks, residence time and timing of ocean entrance. In addition, these sample efforts allowed similar information to be collected on fish released from supplementation programs located downstream from the Klamath and Trinity traps

Toward these ends, the Service plans to continue monitoring juvenile production on an on-going basis and complement the restoration efforts of the Trinity River Basin Fish and Wildlife Management Program (P.L. 98-541) and the Klamath River Fish and Wildlife Restoration Act (P.L. 99-552)

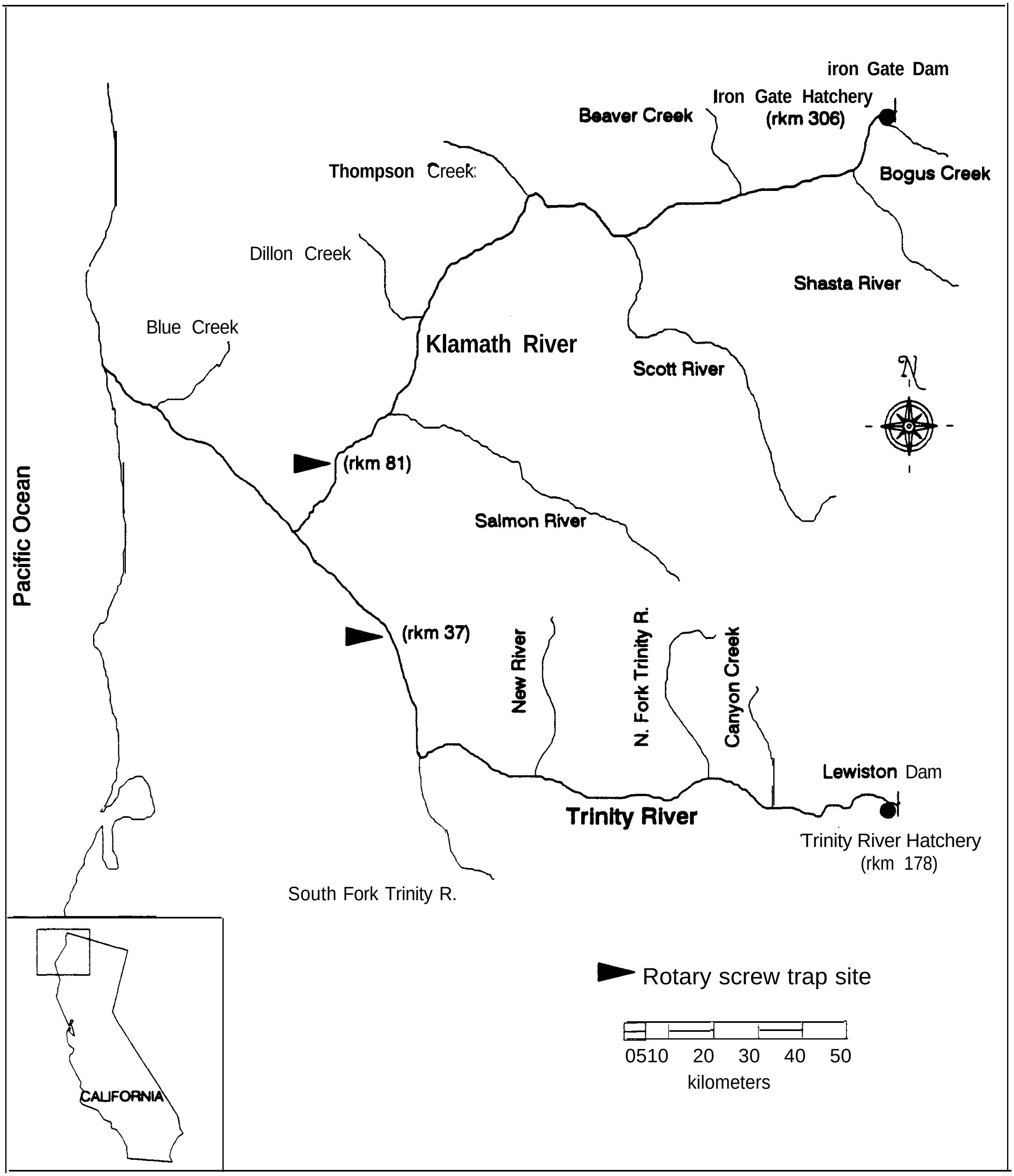

Figure 1. Rotary screw trap sites, Klamath and Trinity rivers, 1990.

METHODS

Klamath and Trinity River Trapping

Two locations were selected as suitable trapping sites (Figure 1). The trapping site on the Klamath River (river kilometer (rkm) 81) is basically unchanged from that of 1989 (USFWS 1991). However, the traps were moved to the opposite bank and slightly upstream in an effort to more efficiently sample the thalweg. The trapping site on the Trinity River (rkm 37) is approximately one kilometer downstream from the location used in 1989. The location change was necessary to appease landowner concerns. Rotary screw traps were again used at both the Klamath and Trinity River trapping locations. The rotary traps (2.44m diameter) were fished to a depth of 1.22m sampling a cross sectional area of $2.34m^2$ per trap. Two rotary traps were fished at each site essentially doubling the area sampled (only one trap was used per site in 1989). The traps were roped together and tires were used as fenders. The traps were secured into position with 2.5 cm. polypropylene rope tied to available trees upstream and adjacent to the river or tied to a series of fence post, anchored upstream along the bank. When necessary, an adjustable extension was used to maintain the traps away from the bank. The trap operating closest to the river bank was designated "inside trap". Accordingly, the trap operating adjacent to the inside trap was designated as the "outside trap".

Trapping on the Klamath and Trinity Rivers began in March, 1990. Due to structural problems, the inside trap on the Klamath River ceased operation on July 10. Due to a combination of decreased catches, high water temperatures, and increasing entrainment of filamentous algal mats, the outside trap ceased operation on July 18. Trapping resumed in October using one trap only. This trap, positioned near the bank, continued operation until November 30, 1990. Trapping on the Trinity River continued until August 31. The traps were operated for one week in September and then from October 04 to November 30, 1990. Trapping on the Klamath and Trinity rivers generally began on Monday and continued until Friday usually sampling at least four nights a week. On occasion the traps were fished throughout an entire seven day week. The traps were operated 24 hours a day and were checked daily. During periods of low catches, the traps were occasionally allowed to operate over a two to three day period before checking.

In addition to sampling with rotary traps, the mainstem Klamath River (rkm 5.0 to 54.4) and estuary (rkm 0 to 4.5) were seined during the spring and fall emigration periods. Seining was conducted to gather additional information on salmonid out-migration timing, size and abundance, hatchery and natural stock component, estuary residence time, timing of ocean entrance, and to develop a juvenile chinook population index. Seining results will be detailed in a separate report. Comparisons between rotary trap data and seining data will be incorporated in this report when appropriate.

Captured salmonids were anesthetized with Tricaine methanesulfonate (MS-222) and identified to species. Fork length (fl) measurements, in millimeters (mm), were taken from a randomly netted sample of up to 50 salmonids per species per day for each trap. A Student's t test ($p=0.05$) was used to determine if mean length differences existed between fish of each trap by week, or month (if catch numbers were low).

To appraise condition, displacements, in milliliters (ml), were taken on measured fish. Body volume, being proportional to weight, was used as a substitute measure (Anderson and Gutreuter 1983). The displacement-length relationship was described by the use of ordinary least-squares regression parameters (Cone 1989).

Resulting slope values for each species were compared to those calculated in 1989. Field crews also subjectively assess the health of captured salmonids based on the following qualities or symptoms: 1) presence/absence of fin rot, fungal infections, lesions, edema, protruding eye(s), scoliosis, petechia (minute rounded spots of hemorrhage on the skin); 2) excessive scale loss; 3) swimming ability or lack of; and 4) moribundity.

Measured coho salmon and steelhead were also identified to developmental stage (fry, parr, smolt). Fish that were silver in color, lacked visible parr marks, and had loose scales were classified as smolts regardless of size. Delineating between fry and parr was subjective and largely based on size. Generally, fish 65mm and less were termed young-of-year (YOY) or fry, and all larger, non-smolt fish, parr. Due to the fact that nearly all chinook captured displayed parr marks and silver coloration, the parr classification was not used. Chinook with lengths less than or equal to 65mm were therefore identified as fry and larger chinook as smolts. Parr and smolts of all species were identified as YOY, or yearlings, based on age analysis of scales in conjunction with length frequency data.

All salmonids were sampled for fin clips. Salmonids with an adipose fin clip (Ad-clip) were sacrificed and retained for subsequent recovery of the coded-wire-tag (CWT). Steelhead were identified to origin (hatchery or natural) based on either a ventral fin clip and/or on the condition of the dorsal fin (Peven and Hays 1986). All rainbow trout were assumed to be the anadromous form (steelhead). In this study, we define naturally-produced or wild fish as progeny of river or tributary spawning regardless of parent genetics (Bjornn 1977).

Scale samples were taken from a maximum of fifty measured salmonids per species per day. A subsample of the collected scales were analyzed in conjunction with length frequency data to partition age classes. Scales were placed on micro slides and viewed on a microfiche reader. Scales were analyzed independently by two biologists, with a third reading by an additional biologist when the initial two readings differed. Scales not aged with confidence after the final reading were excluded from the age analysis.

Emigration Monitoring

Emigration trends on the Trinity River were based on total weekly catch (TWC). TWC represents the sum of the estimated seven-day catch of both traps. When a trap operated less than seven days per week, weekly catch for that trap was estimated by dividing total catch by number of days sampled, expanded to estimate a seven-day catch. Because trapping on the Klamath River was conducted with both traps simultaneously during only five weeks, catch effort was modified and evaluated based on mean total weekly catch (MTWC). MTWC was obtained by dividing the TWC (calculated as above) by the number of traps operating that week.

Hatchery and Natural Stocks Estimate

Chinook and coho salmon:

The estimate of hatchery chinook and coho in catches were determined using CWT recoveries and expansion factors unique to each CWT group. The expansion factor was calculated as:

$$E_f = (t + t_p + nm)/(t)$$

where: t = number of fish tagged (CWT) in release group
t_p = number of fish in group with poor tag (shed tags)
nm = number of fish in group not tagged

Total hatchery contribution to catches was estimated by multiplying the number of recovered tags by the expansion factor for that tag group. Subtracting the estimated hatchery contribution from total catch yielded the estimated contribution of natural stocks to catches. The number of chinook from natural stock tagging programs contributing to the estimated natural stock component of catches was also calculated using expansion factors as above.

Lost tags, tags not collected (ie; Ad-clip fish released at time of capture), and an estimated fraction of non mark sampled fish were assigned a tag code based on the proportion of tags recovered for each unique tag code. The estimate was calculated for daily period and for all recovered tag codes as follows:

(A/T)*(LT+UA+((TA/TF)*NMS)) rounded to whole number and added to A = A_s

where: A = # of tags recovered in lab, per code
$T = \Sigma A$
LT = # of lost tags
UA = # Ad-clip fish captured and released
TA = # of Ad-clip fish captured and collected
TF = total # of fish captured and examined for mark
NMS = # fish captured not examined for mark
A_s = subtotal of tags recovered including assigned tags, per code

Lost tags were defined as Ad-clip fish having a registered tag (using magnetic field detector) which was subsequently lost during the tag removal process.

If no tag was initially detected, the head of the Ad-clip fish was dissolved in a potassium hydroxide solution. A magnet was then stirred through the resultant slurry to recover the tag. If the tag was not recovered, the fish was considered a no tag (accounted for in expansion factor calculations as poor tags).

The hatchery and natural stock estimate assumes no differential mortality between tagged and non-tagged hatchery fish and assumes equal vulnerability to capture. The estimate does not account for Ad-clips removed from the population at upstream sample locations by the Service office in Weaverville (rotary trap operating on the Trinity River at rkm 131), since the number of Ad-clip fish removed is small compared to the number released and effect on the estimate is negligible.

Steelhead:

The hatchery and natural stocks estimate for captured steelhead was based on presence or absence of fin clips and/or dorsal fin erosion. Steelhead from both hatcheries had discernable erosion of the dorsal fin. Steelhead released in 1990 from IGH were not marked (no fin clip). Steelhead released from TRH were marked with a left or right ventral fin clip (yearling and two year old respectively). Steelhead with no fin erosion were classified as of natural origin. The estimate assumes equal capture vulnerability of juvenile steelhead.

Migration Rate and Duration

Initial migration rates for hatchery chinook, coho, and steelhead were expressed as the number of days elapsed between release and initial capture for specific CWT, or otherwise marked, fish divided by distance (rkm) traveled . Initial rates are calculated to assist in determining sampling strategies. Mean migration rate of each tag group was calculated by first determining the rate of each tag recovered. The sum of these rates was then divided by the number of tags recovered. Obvious outliers (ie; spring released fish not recovered until the fall months) were excluded. The duration of migration was computed as the number of days between the 10% and 90% dates of capture (Fish Passage Center, 1985). The 10 and 90 percent capture dates are used to illustrate when the bulk of the specific CWT or mark groups migrated. When less than ten tags of any specific release group were recovered, all tags, with the exception of the outliers, were used to determine duration period. Ad-clip chinook not collected (ie; released at time of capture) were included in migration rate and duration calculations using tag allocation procedures described in the hatchery/natural stock estimation section of the report.

Trap Efficiency

Only chinook salmon were used to determine trap efficiencies using mark-recapture methodologies, therefore estimates are specific to this species. Due to time and logistical constraints, efficiency tests were only conducted for the rotary traps on the Trinity River. In 1989, sufficient numbers of chinook were captured in the rotary trap for use in efficiency testing however, rotary trap catches of chinook in 1990 were insufficient. Seining was therefore conducted to secure the necessary numbers of chinook. The most productive seine sites were approximately one kilometer upstream of the rotary traps along a 300 meter stretch of river bank. The effect of seining on subsequent rotary trap catches is unknown. However, since seining for efficiency tests was conducted at most once a week, the probable effects on rotary trap catches were believed minimal.

All seining took place in the late afternoon. Seined chinook were held in large plastic containers containing approximately 95 liters of aerated water (using a tank of compressed air and air stones) until sufficient numbers had been captured (500-1000 chinook, no more than 500 chinook per container). Generally, the sample size could be attained in a few seine sets taking less than an half hour. Once sample size was met, 25 to 50 chinook were netted out of the holding container(s) and placed in a live box establishing a non-mark control group. All remaining chinook were then marked with a staining solution of Bismark Brown Y (Mundie and Traber 1983). Bismark Brown Y (48% concentration) powder was diluted to achieve an 1:102,000 solution by adding 2 grams of the stain to each holding container. Fish were held in the aerated staining solution for 15 minutes. After staining, 25 to 50 of the marked chinook were netted out of the staining container(s) and placed in the live box establishing a mark control group. All remaining stained fish were released immediately, usually in the early evening, approximately 500 meters above the rotary trap site.

Mark-recapture results from the previous two seasons indicate that nearly all recaptures were made within three days of release with the majority recovered in one day. Examination of rotary trap captured chinook for recaptures was therefore limited to three days post release date. Control group mortality was likewise assessed for three days post release date. If mark control group mortality was greater than non-mark group mortality, then that proportion of the differential mortality was applied against the number of released marked chinook. If non-mark control group mortality was greater than mark control fish, then the observed mortality rates are not believed representative, and differential mortality of released marked chinook was assumed to be zero.

Abundance Index

The abundance index was based on the proportion of river volume sampled to total river volume multiplied by the number of chinook, coho, and steelhead captured. The index was calculated by trap for each day sampled. The weekly index estimate was simply an expansion of calculated daily index values by the proportion of days each trap sampled during that week. The totals (daily and weekly) for each trap were summed to yield a single abundance index value. The index is used to describe relative abundance and is not intended as a population estimate. During the trapping season the rotary traps were occasionally repositioned to adjust for changing (normally decreasing) river flow conditions. These position modifications were necessary to maintain what was considered to be the optimal "fishing" location at the site. Most position changes were on the order of a few meters away from the bank and closer to, or within, the thalweg. The index, assuming similar trapping efficiency and effort will allow for comparisons of salmonid abundance between years.

Flow and Water Temperature

Water velocity measurements were recorded at three positions (0.61, 1.22, and 1.83m) across the front of the rotary trap opening using a General Oceanics digital flowmeter (Model 2030). Flow measurements were taken daily using instream flow criteria (.2 and .8 of trap operating depth at each of the three positions). River volume sampled by the rotary trap was then calculated in cubic feet per second (cfs). River flow information was provided by the U.S. Geological Survey Water Resource Division from gauge stations at rkm 94.7 for the Klamath River and at rkm 19.8 for the Trinity River.

In addition to daily water temperatures recorded with hand-held thermometers, Ryan Tempmentor thermographs were installed at both the Klamath River and Trinity River rotary trap sites. The thermographs were affixed to the base of the rotary trap live boxes in March, 1990, and recorded ambient water temperatures every two hours until removed in December, 1990.

RESULTS

KLAMATH RIVER TRAPPING

The rotary screw traps at Big Bar began operation in March and continued into July. The inside rotary trap (located closest to the left bank) began operation on March 20 and continued until July 10 sampling a total of 38 nights. During this period, the trap captured 236 chinook, 128 steelhead, and 18 coho. The outside trap began operation on March 27 and continued until July 18 sampling 31 nights. During this period, the trap captured 97 chinook, 50 steelhead, and 12 coho. A single rotary trap resumed operation on October 17 and sampled 19 nights before ceasing operation on November 30. The trap was positioned at an inside position. The trap captured only 4 steelhead during this fall sampling period. Due to the extremely limited data collected no assessment of fall trapping is presented.

Chinook Emigration Monitoring

Estimated chinook MTWC values were greatest during the three weeks from June 11 to July 01 (Figure 2). The single greatest MTWC occurred the week of June 18 -24 (98.0). A peak single-night catch (25) was made by the outside trap on June 27. Weekly catches declined rapidly after this time until mid-July when catches were similar to those in April. Trapping was discontinued July 18 due to low catches, high water temperatures, and an increasing entrainment of filamentous algal mats. Timing of peak chinook emigration in 1990 was similar to that observed in 1989 when a peak weekly catch occurred the week of June 26 -July 02.

However, timing and magnitude of chinook emigration occurring in 1989 and 1990 are not readily comparable. Both rotary traps used in 1990 were inoperative from April 26 to May 14 and, following 4 nights of operation, again inoperative from May 19 to June 11. Attempts were made on several occasions to resume trapping during these periods but high flows, in combination with high debris loads in the river, washed out the traps. Conversely, sampling in 1989 was conducted every week through the spring period. Recommendations were made following trapping in 1989 to modify subsequent sampling locations to more effectively sample the thalweg. Despite locating the outside trap within the thalweg in 1990, it is believed that trapping productivity decreased. Further, the positioning of the trap within the thalweg increased trap component wear and susceptibility to damage from high flows.

Despite the relatively low capture success in 1990 and periods of trap non-operation some trends were evident. During the period of greatest MTWC (June 11 to July 01), hatchery chinook contributed significantly. Of the 114 chinook captured during this period three were Ad-clipped. Subsequent CWT recovery indicated that these chinook were released from IGH May 21 and 22 (Appendix A). Based on the tagging rate it is estimated that approximately 80 of the 114 chinook captured were from this release group. These, and additional Ad-clips recovered in later weeks, are described in the Hatchery and Natural Stock Estimate section of this report.

To ascertain if hatchery chinook were present at the trap site following the hatchery release, and during the periods in which the rotary traps were non-operative, seining was conducted in the vicinity of the trap site. From May 28 to May 30, six seine hauls were made and 246 chinook were captured, none of which were Ad-

clipped. The following week seining was conducted on June 04 and 08. A total of 131 chinook were captured in eight seine hauls and again, no Ad-clips were observed. This data suggest that despite the high flows which occurred following the hatchery release (IGH coincided release with onset of increased river flow), hatchery chinooks had yet to arrive at the trapping location. This would also indicate that, despite the relatively low number of chinook captured
by the rotary traps after June 11, the timing of arrival of hatchery chinook, as indicated by the Ad-CWT recoveries, was representative.

In addition to increasing the river discharge sampled, the use of two rotary traps in 1990 also created the opportunity to examine whether possible quantitative and qualitative differences of catch occurred between the traps. From March 28 to June 27, the two traps operated simultaneously and with equal effort on thirteen occasions. There was no significant difference ($p<0.05$) in average catch or fork length of catch between the traps compared for all species.

Size and Condition

During the season, 327 chinook were measured. During March and April, a bimodal length frequency grouping was indicated (Figure 3). Chinook fry, or YOY (fl range 25-65mm) were predominant. Yearling chinook (fl range 155-196mm) were also captured during this period. Analysis of scale samples from these yearling chinook confirmed the age as 1 plus (1+). A similar bimodal length and age frequency was observed for this period in 1989. Monthly mean length of YOY chinook increased significantly ($p<0.05$) for all months during the sampling period.

As a measure of condition, displacements were taken on 209 of the chinook measured (Figure 4). Displacements were taken throughout the observed range of lengths and throughout the season and are believed to be representative. The calculated least-squares regression slope value (3.21) is not significantly different ($p>0.05$) then that calculated in 1989 (3.12). A slope value of 3.0 indicates that fish become heavier for a given length as they grow (Anderson and Gutreuter 1983). Field crews noted that the health of the juvenile chinook appeared better than observed in 1989 which may be related to the higher river flows and lower water temperatures in 1990. During June of 1990 just over 1 percent of the chinook examined showed signs of swelling or edema. In June of 1989, this condition was observed with nearly 25% of the chinook examined.

Hatchery and Natural Stock Estimate

During the spring trapping season a total of 321 YOY chinook were captured by the rotary traps. Of these, 162 were captured prior to the hatchery release and are thus presumed to be of native stock. A total of 154 non-marked, and five Ad-clipped, YOY chinook were captured after the May 21/22 hatchery release. All five Ad-clip chinook were identified as IGH fall chinook. Based on the tagging rate it is estimated that approximately 134 of the 159 chinook captured were IGH fall chinook. Since only twelve yearling chinook were captured (all non-marked), no attempt was made to estimate origin. Hatchery yearling chinook are released in the fall and presumably emigrate before spring trapping begins.

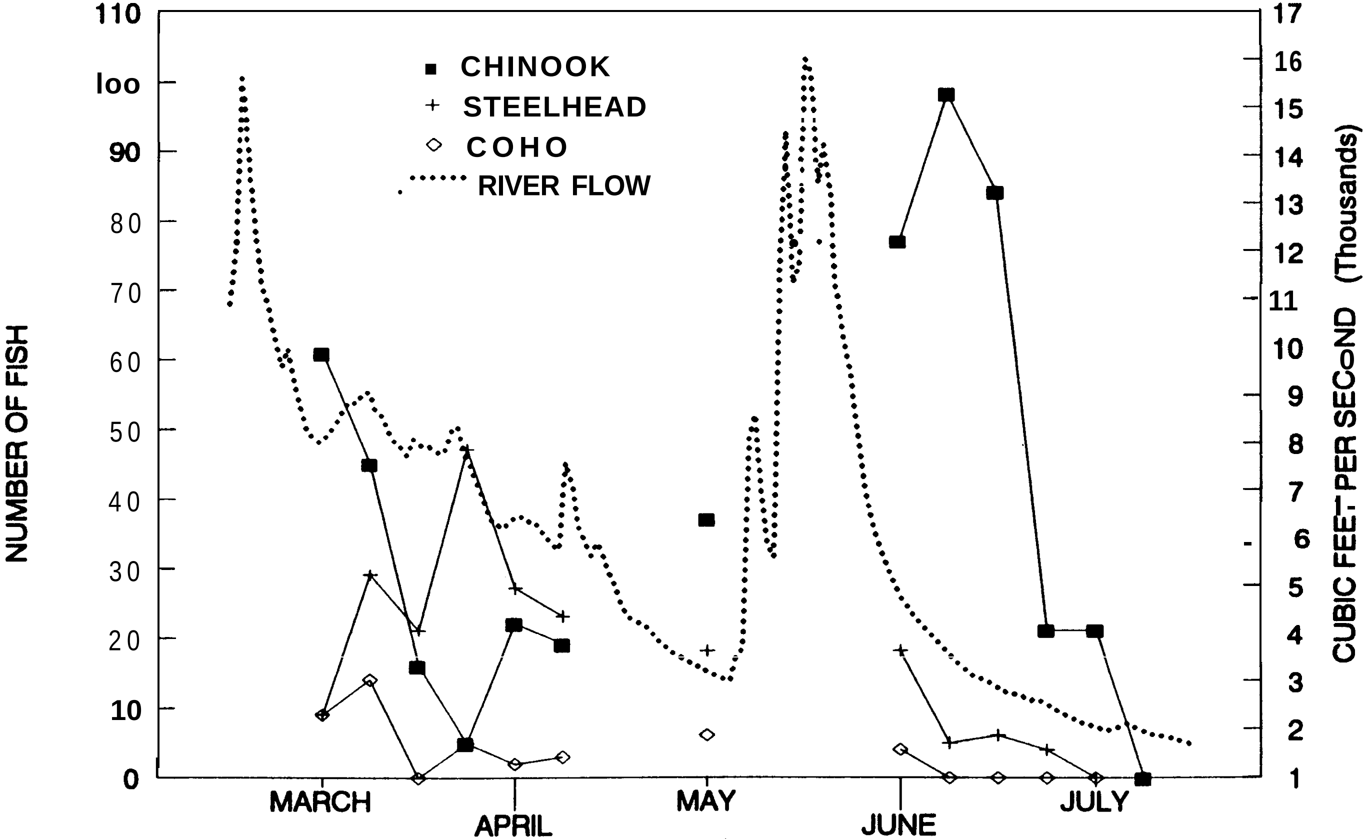

Figure 2. River flow and estimated mean total weekly catch (MTWC) of chinook, steelhead, and coho, Klamath River at Big Bar, 1990.

Migration Rate and Duration

The first capture of an IGH CWT fall chinook was made June 22 for an initial migration rate of 7.1 rkm/day. A mean migration rate of 5.5 rkm/day was calculated using all five IGH fall chinook CWT recoveries. The initial and mean migration rate are substantially lower than observed in 1989 for IGH chinook smolts (initial rate 45.0, mean 10.7 rkm/day) (Table 1). The decreased migration rate is surprising considering that the mean daily river flow calculated for the period between the respective release date and mean capture date, was greater in 1990 than observed in 1989 (7,330 and 5275 cfs, respectively).

It is possible that the 1990 rotary trap CWT recoveries were insufficient to accurately reflect the true migration rate of IGH CWT chinook. The migration rate was compared with that calculated for mainstem seining captured IGH CWT chinook. Based on 33 tag recoveries made during seining, a mean migration rate of 7.2 rkm/day was calculated which is significantly different ($p<0.05$) than the rate calculated using the five rotary trap captured CWT chinook. This suggest that the rotary trap did not secure a large enough CWT sample size, and therefore did not accurately represent the migration of IGH CWT chinook, or, that a change in migration rate occurred between the rotary trap site and seining sample sites downriver.

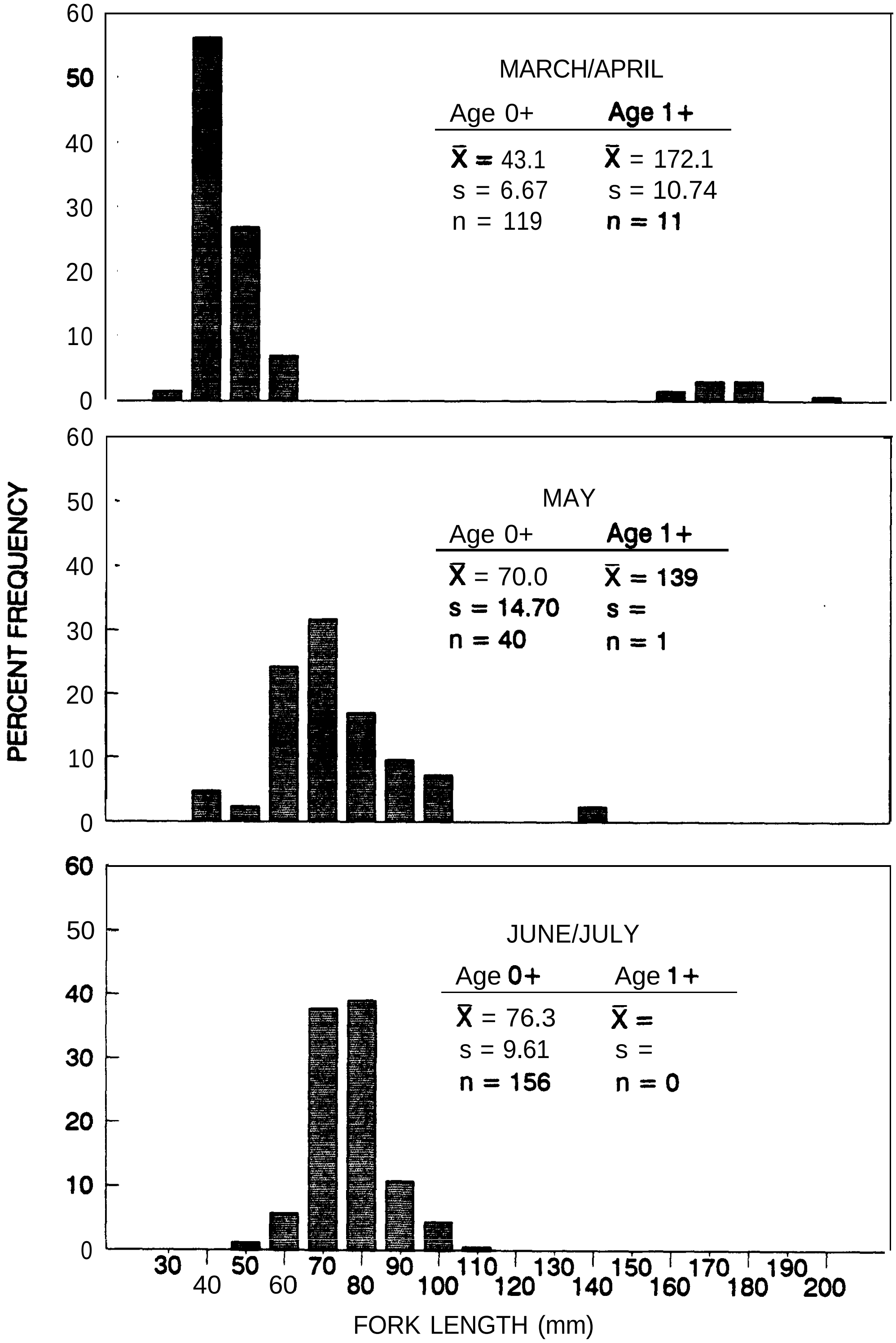

Figure 3. Percent length frequency of juvenile chinook captured from March to July at the rotary traps, Klamath River, 1990.

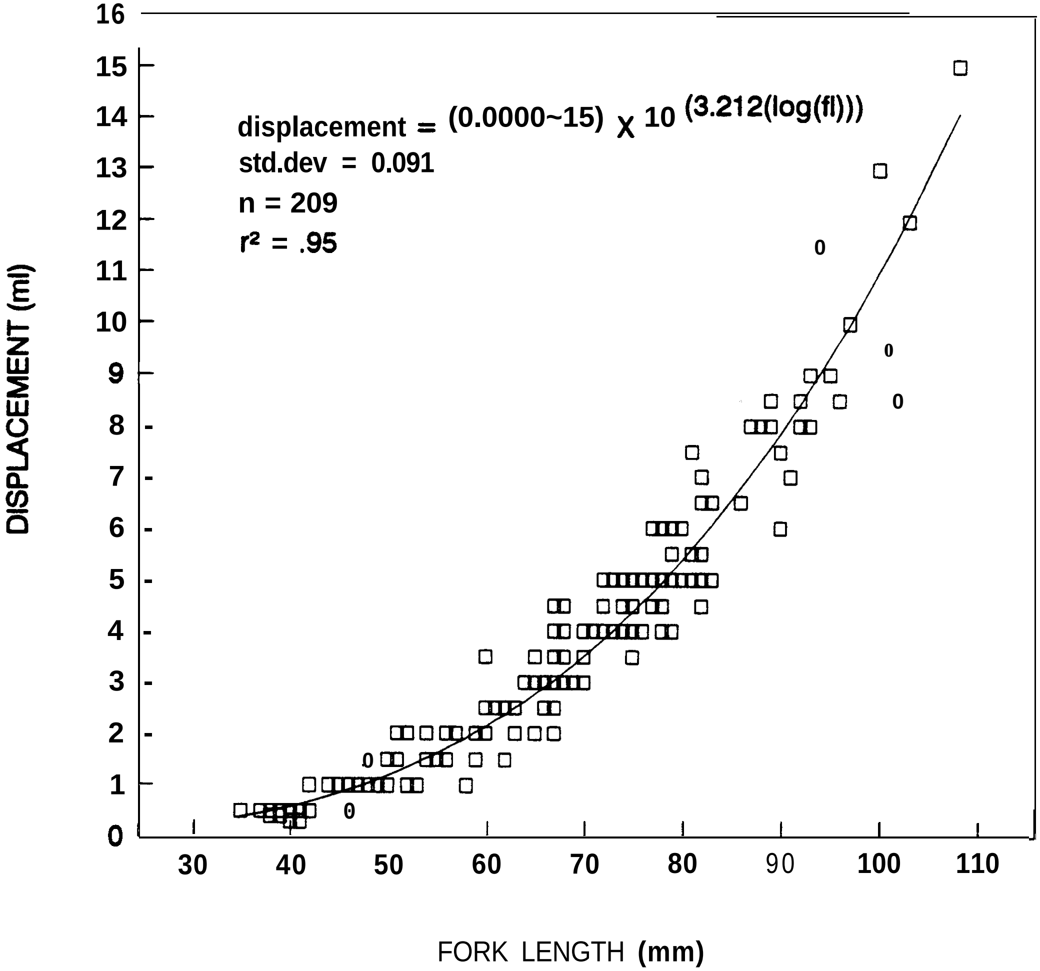

Figure 4. Chinook length-displacement relationship, Klamath River, 1990.

Table 1. Migration rates for IGH chinook released in 1989 and 1990 and captured by the rotary traps.

Tag code	Release Date	Size/lb	Initial Rate (rkm/day)	Mean Rate (rkm/day)	10-90% Duration (days)	1/Mean River Flow (cfs)	Number Sampled
B-Series (pre-smolts)	4/24/89	269	4.6	4.0	14	8950	9
6-Series (smolts)	6/02/89	122	45.0	10.7	19	5275	34
6-1-2-1-4 (smolts)	5/21/90	233	7.1	5.5	22	7330	5

1/ Mean river flow calculated from release date to mean capture date.

Another possible explanation for the decreased migration rate may be the relatively smaller size of CWT fish released in 1990. In 1989, IGH CWT smolts were released on June 02 at 122/lb and in 1990, smolts were released (May 21-22) at an average size of 233/lb (Appendix A). In 1989, IGH also released CWT pre-smolts (April 24) at 269/lb. Mean migration rate calculated for these pre-smolt CWT chinook, similar in size range to the CWT chinook released this year, was 4.6 rkm/day. There was no significant difference (p>0.05) of length between CWT chinook smolts recovered in 1989 (rotary trap) and 1990 (rotary trap and mainstem seine captured). This discrepancy would suggest that; 1) only the largest chinook of the 1990 release group were tagged, or 2) if a representative size range of fish were tagged, then only the largest of these survived, indicating higher differential mortality of smaller fish.

Trap Efficiencies

As in 1989, chinook catches by the Klamath rotary trap, and supplemental fyke netting and seining, were insufficient for use in determining trap efficiency.

Steelhead Emigration Monitoring

A total of 178 steelhead were captured during the sampling period (March 20 to July 18). Estimated steelhead MTWC values were greatest during five weeks of trapping from March 26 to April 23 (Figure 2). The single greatest MTWC occurred the week of April 9 to 15 (47.3). A peak one night catch (10) was made with the inside trap on April 13. Both rotary traps were damaged during increased river flows the week of April 23 to 29. Sampling did not resume until the week of May 14 to 20. Although weekly catches were decreasing the two weeks preceding trap failure, it is possible that substantial migration may have occurred before the traps resumed operation the week of May 14. The rotary traps were again damaged and inoperative from May 21 to June 11 due to a significant and extended period of increased river flow. Again, migration may have been substantial during this high flow period. In 1989, peak weekly steelhead catches occurred the first week of May.

Size and Condition

During the season, 177 steelhead were measured to length. Length frequency and scale analysis indicated that yearling (1+), and two year old (2+) steelhead predominated in catches from March through May (Figure 5). Young of year steelhead (fl range 37-67mm) were prevalent in catches in June and July. From April 10 to 17, four half-pounder steelhead were captured (fl range 300-358mm). Scale patterns indicated that an accelerated growing period, presumably estuarine or ocean growth, occurred with all four steelhead the summer of 1989. Half-pounder steelhead return to freshwater 3 to 4 months after initial entry into salt water (Hopelain 1987). Three of these half-pounders were aged as 3_2 (total age 3, two years freshwater), and one was 2_1. All four were identified as natural stock based on the condition of the dorsal fin.

Displacements were evaluated on 145 of the measured steelhead. A regression slope value of 2.85 was calculated (Figure 6). This value was not significantly different (p>0.05) than that calculated in 1989 (2.95). A comparison between hatchery and natural stock steelhead was not available due to the low number of hatchery steelhead captured. Field crews reported health of captured steelhead to be excellent without obvious signs of disease.

Hatchery and Natural Stock Estimate

Dorsal fin erosion was noted on only two of the 178 steelhead captured during the season. Both of these steelhead were captured in late March. Since their capture preceded the 1990 release, it was believed that they represented steelhead released in 1989 (1988 brood year). Subsequent scale analysis confirmed one of these fish as a two year old (2+), presumably a holdover from the 1989 release. The second steelhead was identified as a one year old (1+) which may indicate misidentification or that some escapement from the hatchery may have occurred. Iron Gate Hatchery released its yearling steelhead on May 15, 1990, and because the traps were inoperative from May 20 to June 11, it is probable that the majority of these fish migrated past the trap site during this period. Therefore, estimates of hatchery and natural stock contribution, and migration rates of hatchery steelhead, were not attempted.

Coho Salmon Emigration

A total of 30 juvenile coho salmon were captured during spring trapping. Estimated coho MTWC values were greatest the initial two weeks of trapping (14.0 on March 19-25, and 9.3 on March 26-April 01) (Figure 2). All of the coho captured during the first weeks of trapping were classified as fry. Catches of coho peaked approximately mid May in 1988 and 1989 at this location and consisted primarily of smolts (USFWS 1989). In 1990, IGH released coho smolts on March 6. The initial smolt capture in 1990 was on April 13. The third greatest MTWC of coho occurred the week of May 14-20 (6.1) and consisted exclusively of smolts. Of 7 smolts captured the week of May 14-20, three were Ad-clipped. Because the traps were non operative from April 30 to May 13 and again from May 21 to June 11, it is impossible to clearly ascertain when peak coho smolt emigration may have occurred.

Coho Size and Condition

During the season, 29 of the 30 coho captured were measured. A bimodal length frequency grouping was observed (Figure 7). Coho fry (YOY) (fl range 34-77mm) were captured primarily in March and April. Yearling coho smolts (fl range 128-166mm) were captured predominantly in May. Similar bimodal length and age frequency was apparent for the same period in 1989.

Displacements were taken on 19 of the coho measured (Figure 8). The calculated least-squares regression slope value (3.15) is not significantly different ($p>0.05$) then calculated with coho captured in 1989 (3.08).

Hatchery and Natural Stock Estimate

Since hatchery coho were released as yearlings it is evident that the majority of coho captured in 1990 were natural stock (22 of thirty coho captured were identified as fry). Of the eight coho smolts captured three were Ad-clipped with subsequent tag identification confirming release from IGH (Appendix A).

Approximately 37% of the 122,962 coho smolts released in 1990 from IGH were Ad-clipped suggesting that the five unmarked smolts captured were of hatchery origin.

Migration Rate and Duration

On March 6, 1990 IGH released 80,962 coho smolts of which 46,030 were Ad-clipped (Appendix A). A subsequent release of 42,000 unmarked smolts was made on March 23. The three marked coho smolts were recovered 70,70, and 72 days post release (May 15 and 17). River flows generally decreased between release and capture dates (Figure 2). A mean migration rate was calculated at 3.2 rkm/day (225rkm between IGH and sample site). Because the rotary traps were operative only one week between April 26 to June 11 it is highly likely that peak migration was not represented by trap catches and therefore the migration rate must be considered tentative.

Salmonid Abundance Index

An abundance index is designed to provide comparative analysis of yearly population abundance trends based on catches and the proportion of flow sampled during each sample year. Because the traps were inoperative over such an extended period of time in 1990 the key assumption of similar effort between years cannot be made and therefore no index was calculated for 1990.

Temperature

A Tempmentor was affixed to a rotary trap live box on March 27 and began recording ambient water temperature every two hours (Figure 9). The trap was damaged during high river flows on April 23 and was removed for repair. The Tempmentor was removed from the trap at this time and data downloaded. The trap and Tempmentor resumed operation for one week in May before high flows again necessitated trap repair and Tempmentor removal. Trapping and temperature recording resumed by mid June and continued through the remainder of spring trapping. Temperature recording with the thermograph resumed during the fall trapping period. Lowest mean daily temperature during the trapping year was recorded on December 5 (6.3°C). Highest mean daily temperature for the trapping year was recorded on July 18 **(24.5°C).**

Other Species

During the sampling period a variety of non-Salmonid species were trapped. Listed in order of frequency: Klamath smallscale sucker (Catastomous rimiculus), Pacific lamprey (Lampetra tridentata) (ammocete to adult), Speckled dace (Rhinichthvs osculus), Prickly sculpin (Cottus asper), Threespine stickleback (Gasterosteus aculeatus), and catfish (Ictalurus sp.). Additional species caught infrequently included Yellow perch (Perca flavescens), American shad (Alosa senidissima), Green sunfish (Lepomis cvanellus), Golden shiner (Notemiqonus chrvsoleucas), and Red-legged frog (Rana aurora).

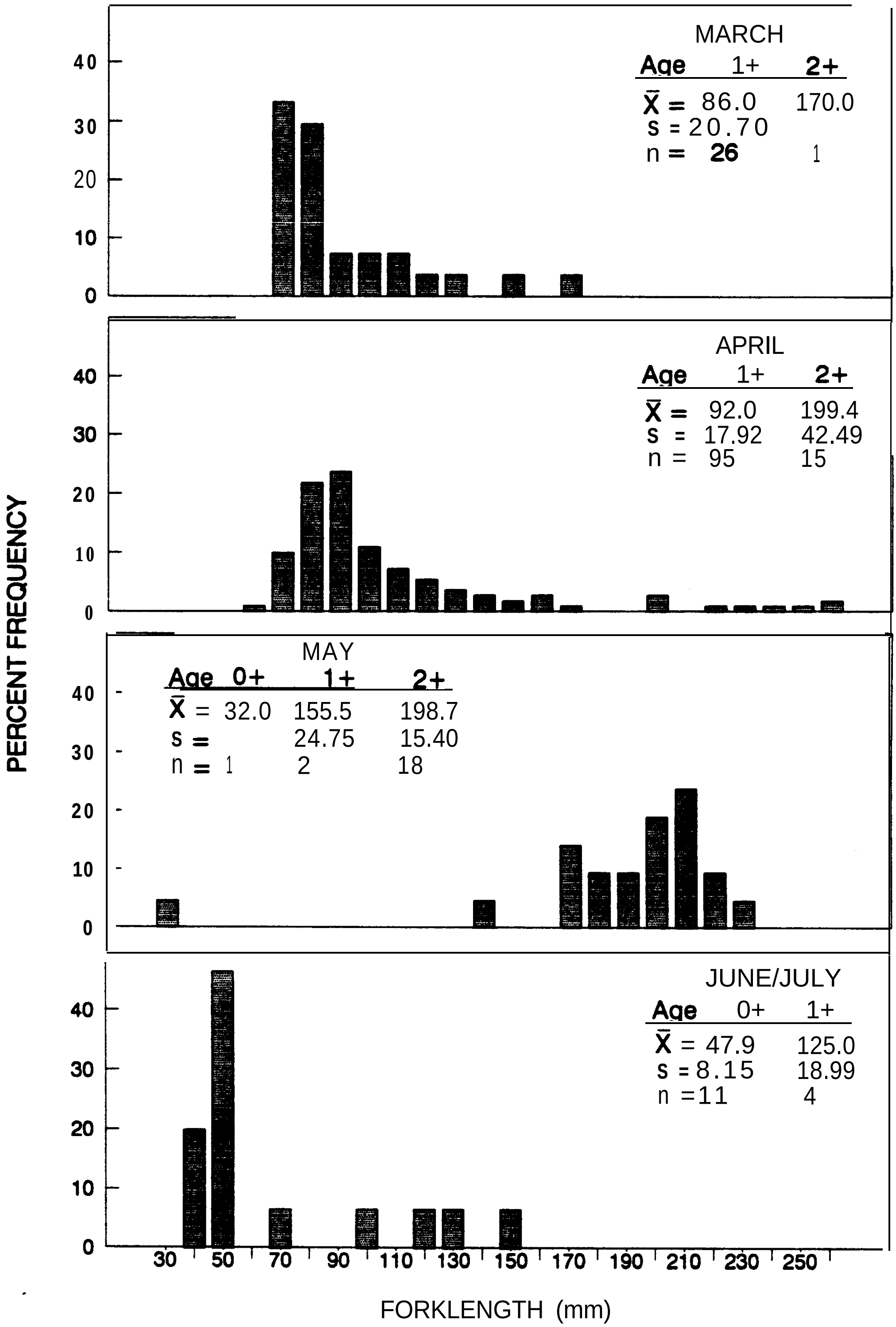

Figure 5. Percent length frequency of juvenile steelhead captured from March to July at the rotary traps, Klamath River, 1990.

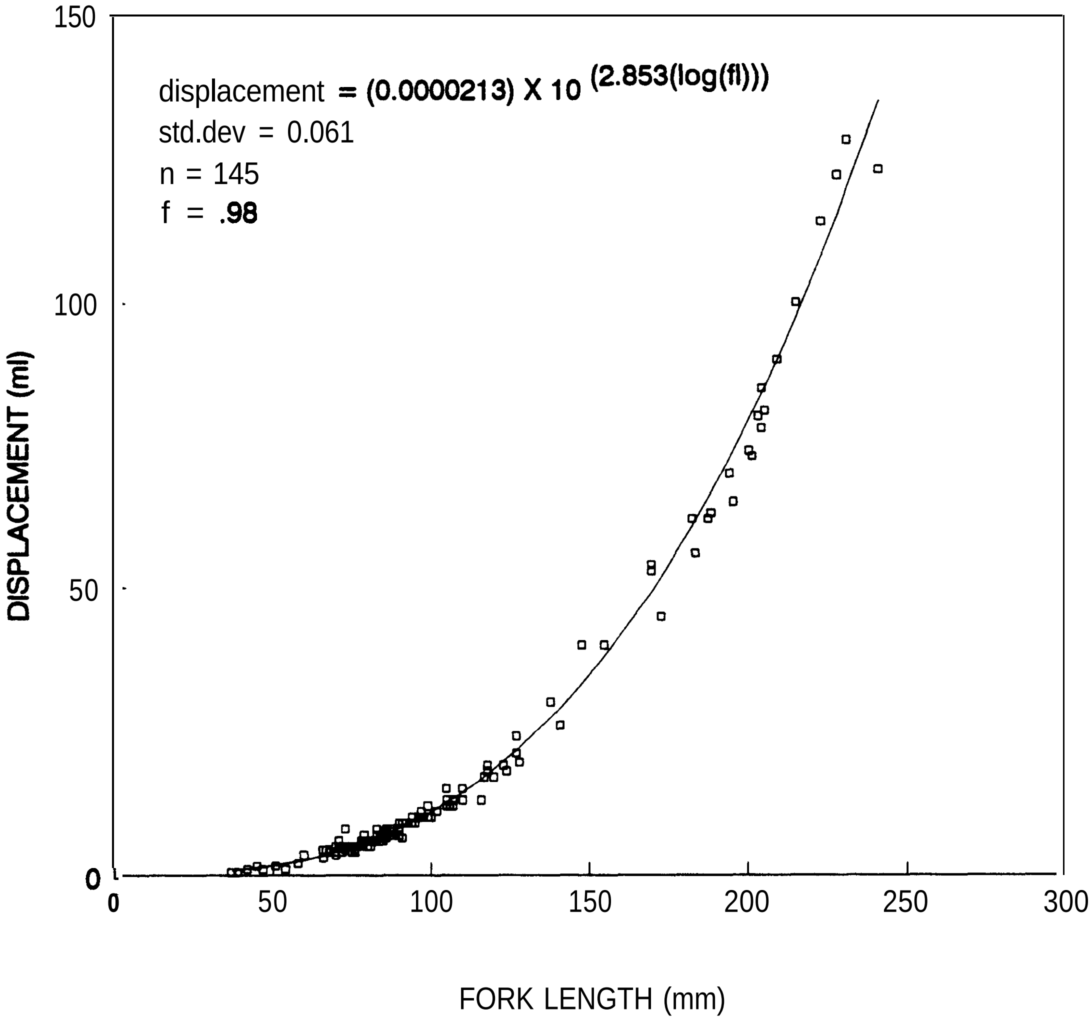

Figure 6. Steelhead length-displacement relationship, Klamath River, 1990.

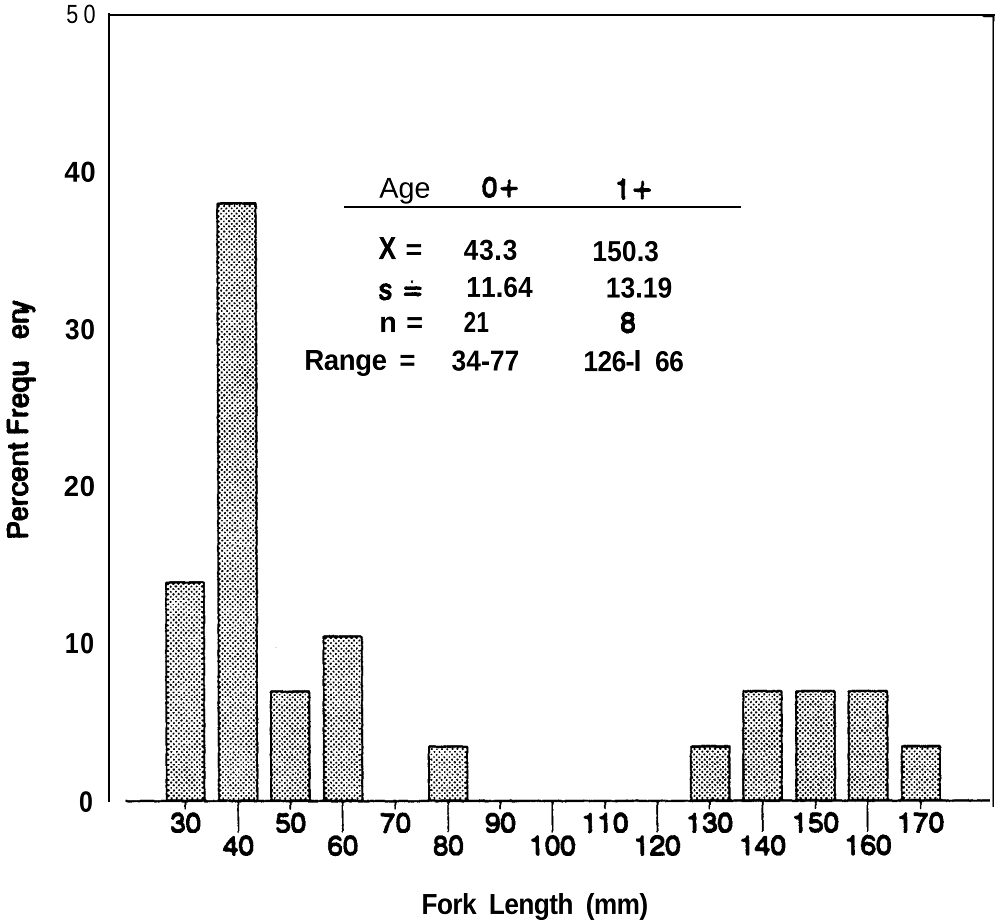

Figure 7. Percent length frequency of juvenile coho captured from March to June at the rotary traps, Klamath River, 1990.

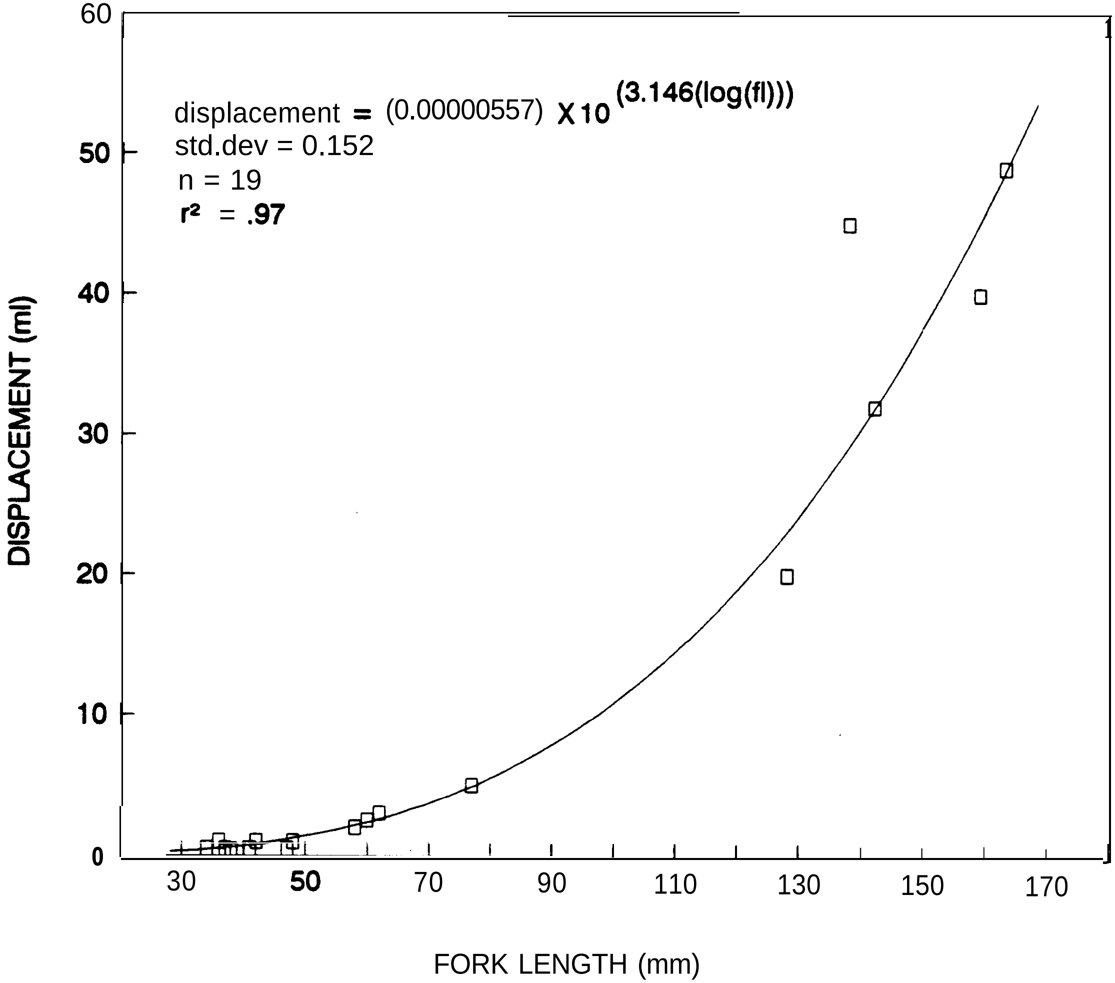

Figure 8. Coho length-displacement relationship, Klamath River, 1990.

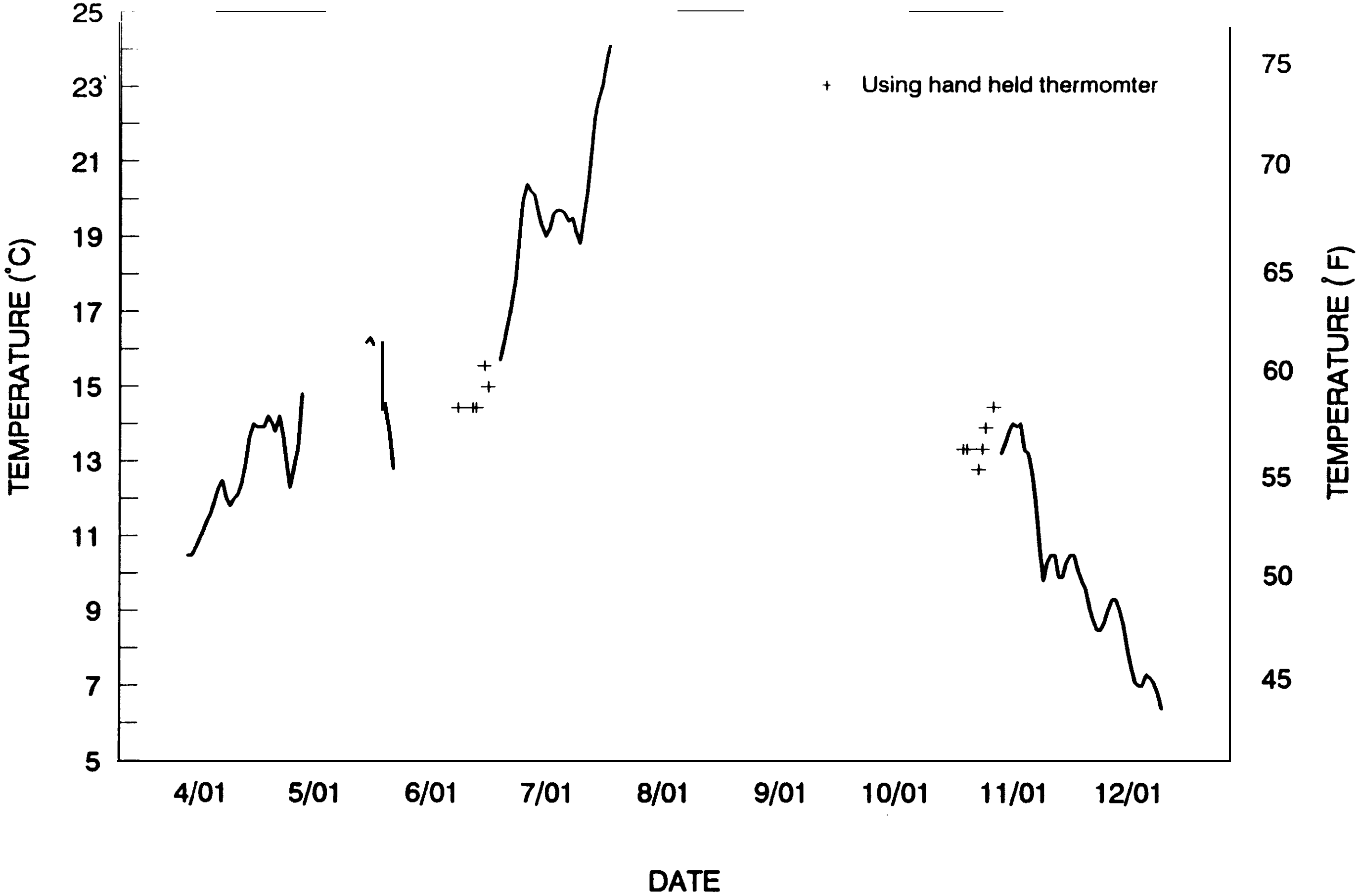

Figure 9. Mean daily water temperature, Klamath River (rkm 81), 1990.

TRINITY RIVER TRAPPING

The inside rotary screw trap (located closest to the right bank) began operation on February 28. The outside rotary trap began operation on March 15. Both traps were damaged during high river flows and ceased operation by May 24. Sampling with both traps resumed on June 11 and 12 respectively. Trapping continued until August 31 at which time, due to consistently low catches, the traps were pulled. From the onset of trapping until August 31 the traps operated 96 and 83 nights respectively. The inside rotary trap captured 724 chinook, 201 steelhead, and 78 coho. The outside trap captured 299 chinook, 784 steelhead, and 194 coho. Both traps operated 4 nights in September (0 fish captured). Trapping resumed on October 4 and continued until November 30 with both traps operating 35 nights. During this Fall period, the inside trap captured 819 chinook and 23 steelhead. The outside trap captured 82 chinook and 21 steelhead. No coho were captured.

Chinook Emigration Monitoring

Following the installation of the second rotary trap on March 15, both traps operated at least one day a week each throughout the described time period. Chinook TWC (representing the sum of the estimated seven-day catch for both traps) values increased through March and, coinciding with a brief increase in flow, increased appreciably in late April (Figure 10). Chinook TWC and river flow decreased during the following two week period. Chinook TWC and river flows increased the week of May 14 to 18.

Trinity River Hatchery, due in part to the increased river flows with a forecast for continued precipitation, released its entire production of spring and fall run chinook May 18 to 21. Based on chinook migration rates calculated for the 1989 TRH CWT chinook, it was anticipated that the hatchery chinook could arrive at the sample area within a few days following release. Both rotary traps were set on Monday, May 21, at a river flow of 1850 cfs. By the following day (May 22) flow had increased to 3630 cfs and both rotary traps had been rendered inoperative due to debris. Repairs were made and both traps were reset the same day. By May 23, river flow increased to 6550 and again, both traps were fouled by debris and damaged. The outside rotary trap was pulled indefinitely for repair. The inside trap was repaired on site and resumed fishing the same day. By May 24, river flow had decreased to 4180 cfs but again, the trap was found inoperative and damaged due to debris. The trap had to be pulled for repair.

Trapping, as previously indicated, resumed with both traps on June 11 and 12. Subsequent chinook TWC values were lower than observed before the May flow increases and declined through the remainder of spring trapping.

For several reasons it was apparent that the majority of spring time chinook emigration occurred during the period the rotary traps were not operating: 1) seining, conducted approximately weekly from April 10 to May 21 (to secure fish for trap efficiency tests) did not recover any Ad-clipped CWT chinook until May 21 (in addition, although the May 21-23 rotary trap catches could not be used for catch effort purposes, several Ad-clip CWT chinook were captured) and, 2) following the rotary trap failures, seining efforts were increased to document chinook abundance and composition (Ad-clipped and non clipped) (Table 2). During this period, seining catch effort values increased substantially. Seine catch effort data are believed comparable as area and sampling method were consistent.

Fall emigration monitoring began with two rotary traps on October 4. TRH released yearling spring run chinook on October 1 and yearling fall run chinook on October 15 and 16 (Appendix A). The first capture of an Ad-clip yearling spring run chinook was made on October 5. The first capture of an Ad-clip yearling fall run chinook was made on October 18. TWC values increased slowly the first two weeks of trapping (October 4 to 12) (Figure 10). TWC peaked the following week (n=692) in response to the arrival of the more numerous yearling fall run chinook. TWC decreased significantly through the remainder of the sampling period ending November 30. During the fall months, three TRH spring released Ad-clip chinook (two spring run and one fall run) and one natural stock Ad-clip chinook were also recovered.

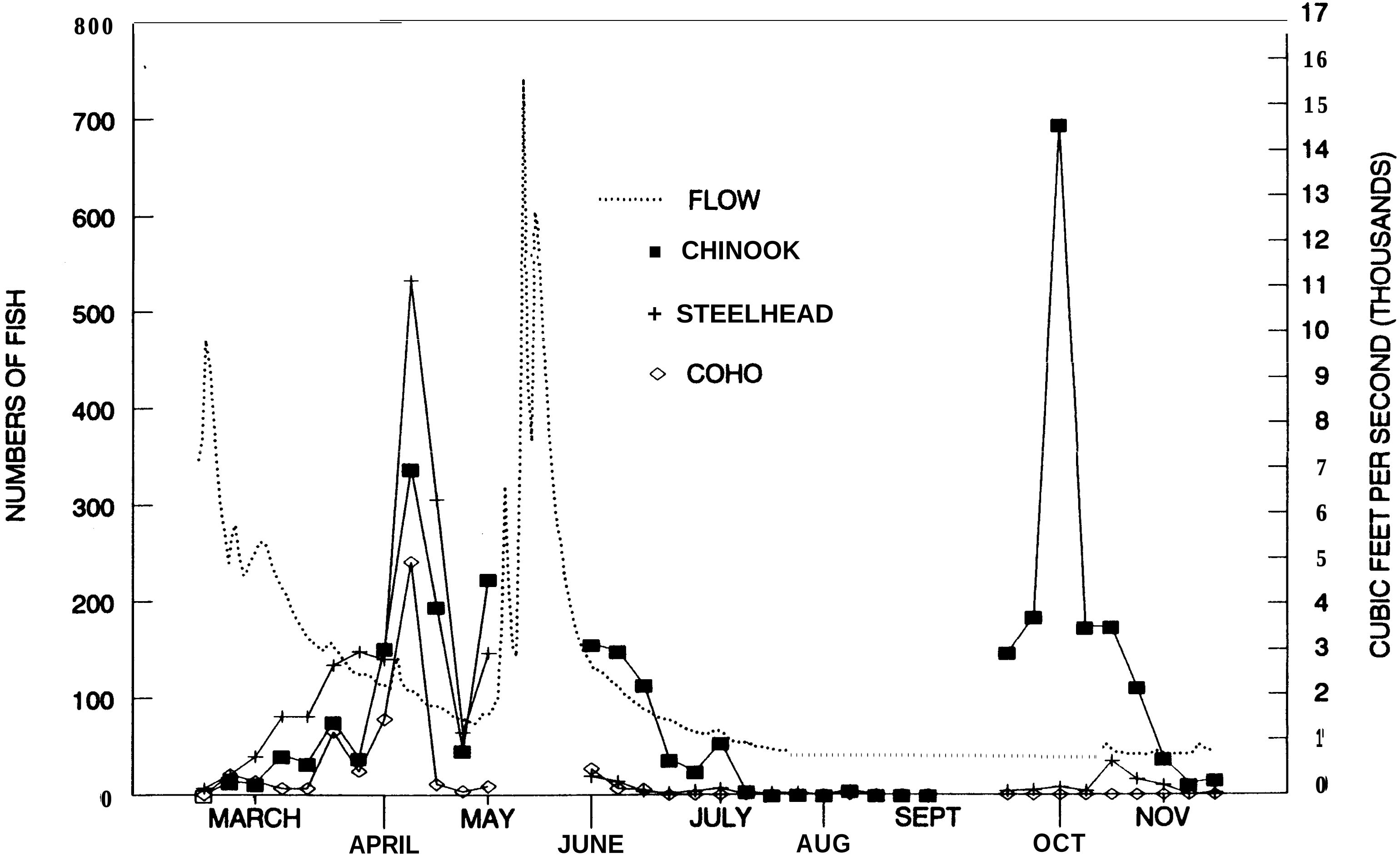

Figure 10. River flow and estimated total weekly catch (TWC) of chinook, steelhead, and coho, Trinity River rotary traps, 1990

Table 2. Seining catch data, Trinity River, 1990.

Date	Sets	# Chinook	# Ad-clip (% Ad-clip)	[1/]C/E
4/10	4	97	0 (0.0)	24.3
4/17		450	0 (0.0)	
4/18	4	251	0 (0.0)	62.8
4/30	2	100	0 (0.0)	50.0
5/01		803	0 (0.0)	
5/07	10	475	0 (0.0)	47.5
5/08		400	0 (0.0)	
5/21	3	360	2 (0.6)	120.0
5/24	4	658	20 (3.0)	164.5
5/25	5	803	15 (1.9)	160.6
5/27	4	407	11 (2.7)	101.8
5/30	2	597	18 (3.0)	298.5
6/04	3	477	16 (3.4)	159.0
6/08	5	228	2 (0.9)	45.6

1/ C/E calculated as total catch divided by number of sets. Number of sets was not always recorded so no C/E was calculated.

Given equal effort (daily catches expanded to estimate seven day total and standardized for flow sampled), there were substantial differences of chinook catch between the traps. The "inside" trap, located adjacent to the river bank, captured a greater percent of chinook than the trap located outside-or riverside (Table 3). The opposite occurred with steelhead and coho (ie; a greater percent of fish were captured by the outside trap than the inside trap). The disparity in catch between the two traps were most pronounced during the weeks of greatest catches and were consistent during both spring and fall emigration periods.

These data indicate species specific differences in distribution occur during emigration that need to be considered when designing sampling methodology. It is anticipated that future trapping will be conducted with a single rotary trap (to ensure greater sampling coverage the second trap will be used as a spare). It is recommended that the single rotary trap be located in an median position relative to the positioning of the dual rotary traps. Such trap placement should allow for representative sampling of juvenile salmonids through all development stages (fry, parr, smolt).

Table 3. Catch comparison for chinook, steelhead, and coho, between the inside and outside trap given standardized (for flow and days sampled) effort. Values are percent of total catch for sample week.

	CHINOOK		STEELHEAD		COHO	
Date	**Inside**	**Outside**	**Inside**	**Outside**	**Inside**	**Outside**
3/19-3/23	38.0	62.0	49.3	50.7	0.0	100.0
3/26-3/30	80.4	19.6	40.1	59.9	0.0	100.0
4/02-4/06	85.7	14.3	18.9	81.1	7.7	92.3
4/09-4/13	84.1	15.9	22.7	77.3	8.0	92.0
4/16-4/20	77.2	22.8	13.5	86.5	25.2	74.8
4/23-4/27	84.3	15.7	15.7	84.3	15.4	84.6
4/30-5/04	75.5	24.5	22.7	77.3	86.0	14.0
5/07-5/11	80.9	19.1	23.1	76.9	59.2	40.8
5/14-5/18	63.2	36.8	25.4	74.6	80.4	19.6
6/11-6/15	98.1	1.9			100.0	0.0
6/18-6/22	64.3	35.7	73.1	26.9	100.0	0.0
6/25-6/29	60.9	39.1	100.0	0.0	100.0	0.0
7/02-7/06	79.8	20.2	0.0	100.0		
7/09-7/13	93.2	6.8	54.4	45.6		
7/16-7/20	88.9	11.1	0.0	100.0		
7/23-7/28	100.0	0.0				
7/30-8/03			100.0	0.0		
8/07-8/10	100.0	0.0	100.0	0.0		
8/20-8/24	100.0	0.0	100.0	0.0		
10/04-10/06	94.7	5.3	100.0			
10/07-10/12	93.9	6.1	100.0	0.0		
10/15-10/19	90.6	9.4	47.7	52.3		
10/22-10/26	86.8	13.2	47.6	52.4		
10/29-11/02	89.3	10.7	44.8	55.2		
11/05-11/09	95.8	4.2	27.8	72.2		
11/13-11/16	85.6	14.4	47.5	52.5		
11/19-11/23	78.9	21.1	0.0	0.0		
11/26-11/30	87.0	13.0	0.0	100.0		

Size and Condition

Weekly mean chinook length were compared between traps over the entire spring and fall season for weeks when both traps operated and sample size per trap was greater than 1. Despite chinook catch differences between the two traps there was no single week in which mean length were significantly different ($p>0.05$). Qualitative data from both traps were therefore combined. During the spring trapping season, 969 chinook were measured. A bimodal length frequency grouping was observed for chinook captured in March and April (Figure 11). Similar bimodal groupings were observed for the same period in 1989 and 1988. During March, fry and 1+ chinook were captured with nearly equal frequency. One Ad-clip chinook was captured in March (TRH fall yearling release). By April, fry predominated in catches with relatively few 1+ chinook captured. Monthly mean length of captured YOY chinook increased significantly ($p<0.05$) through the spring trapping period. No 1+ chinook were captured after April.

During the fall trapping period, 613 of the 901 chinook captured were measured. Mean length of 464 chinook measured in October was 122mm (sd = 22.76). Mean length of 149 chinook measured in November decreased to 107mm (sd = 16.69). The decrease in mean length may be attributed to the fact that catches in November, as indicated by recoveries of Ad-clip CWT chinook, consisted entirely of TRH yearling fall run chinook. Fall run chinook were released on October 15 and 16 with 86% of the chinook at a size of 12 - 19/lb (Appendix A). Conversely, TRH yearling spring run chinook were released on October 1 at a size of 11 - 12/lb. Spring run Ad-clip CWT chinook were only recovered in October

Displacements were taken on 1340 of the 1582 chinook measured in 1990 and resulted in a regression slope value of 3.00 (Figure 12). Compared for similar trapping periods (March to August), there was no significant difference ($p>0.05$) in condition, or slope value, between chinook captured in 1989 and 1990 (2.86 and 3.05 respectively). Trapping was not conducted during the fall months of 1989.

As observed in 1989, chinook captured during spring trapping appeared to be in good health with no external sign of disease or fungal infection.

Yearling chinook captured in October and November were judged to be in poor health. The most common symptoms observed were fin rot and/or fungal infection. The amount of fin rot varied from minor to total loss of fin(s) and was observed most often on the caudal fin and peduncle area. Fungal infection likewise varied from slight to complete infection of gills, head, fins, and extensive areas of the body. Nearly every fish captured during this period exhibited some degree of fin rot and/or fungus. During October, moderate to severe fungal infection was observed on approximately 30% of chinook captured. Approximately 8% of all chinook captured were moribund. The rate of moribundity decreased in late October perhaps in response to decreasing water temperatures and/or death of unhealthy fish.

Hatchery and Natural Stock Estimate

All chinook captured by rotary traps and seining were used to estimate stock composition for spring time emigration (includes chinook not used for C/E data). Yearling plus (1+) chinook captured in March and April (n = 27) were omitted from calculations. From the onset of trapping to May 15 (last sample date prior to hatchery releases), 3305 chinook were captured and mark sampled. All chinook were non-marked and assumed to be natural stocks. For the entire spring trapping period, an estimated 752 (10.3%) of the 7297 total chinook captured were believed to be of TRH origin and of these, 602 (80.0%) were spring-run chinook. Estimated hatchery contribution was greatest for catches in July and August (87.7%), although total chinook catches were low for this time period (n = 73) (Table 4).

The estimate of hatchery contribution for the spring of 1990 (10.3%) is less than observed in 1989 (53.2%). Several factors could have contributed to the low hatchery estimate and at least partially explain the disproportionate number of spring run chinook making up the hatchery component. Much of the change in contribution rate in 1990 may be attributed to unequal, and/or biased, sampling effort in combination with the size at release of the TRH spring and fall run Ad-clip chinook.

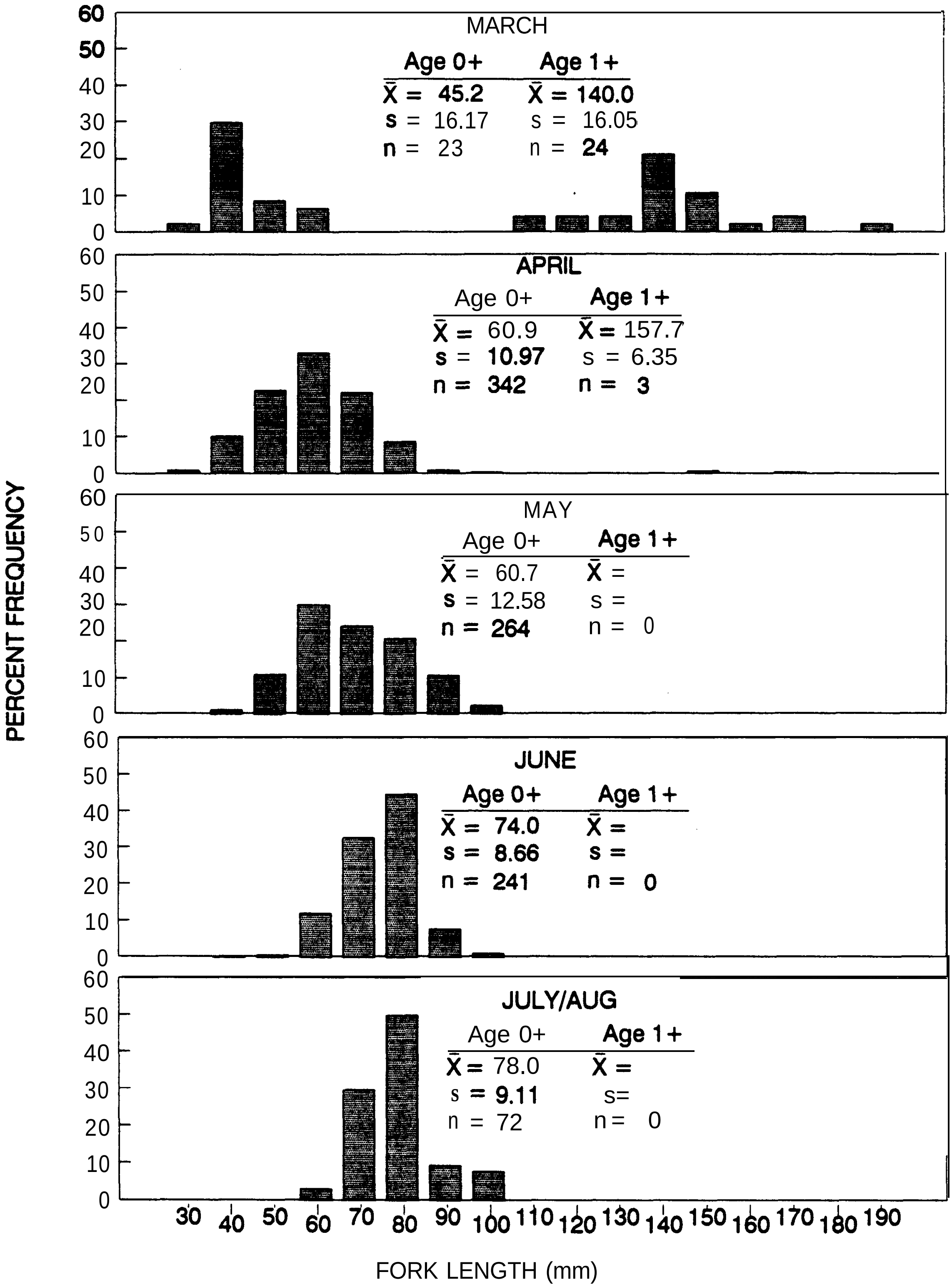

Figure 11. Percent length frequency of juvenile chinook captured from March to August at the rotary traps, Trinity River, 1990.

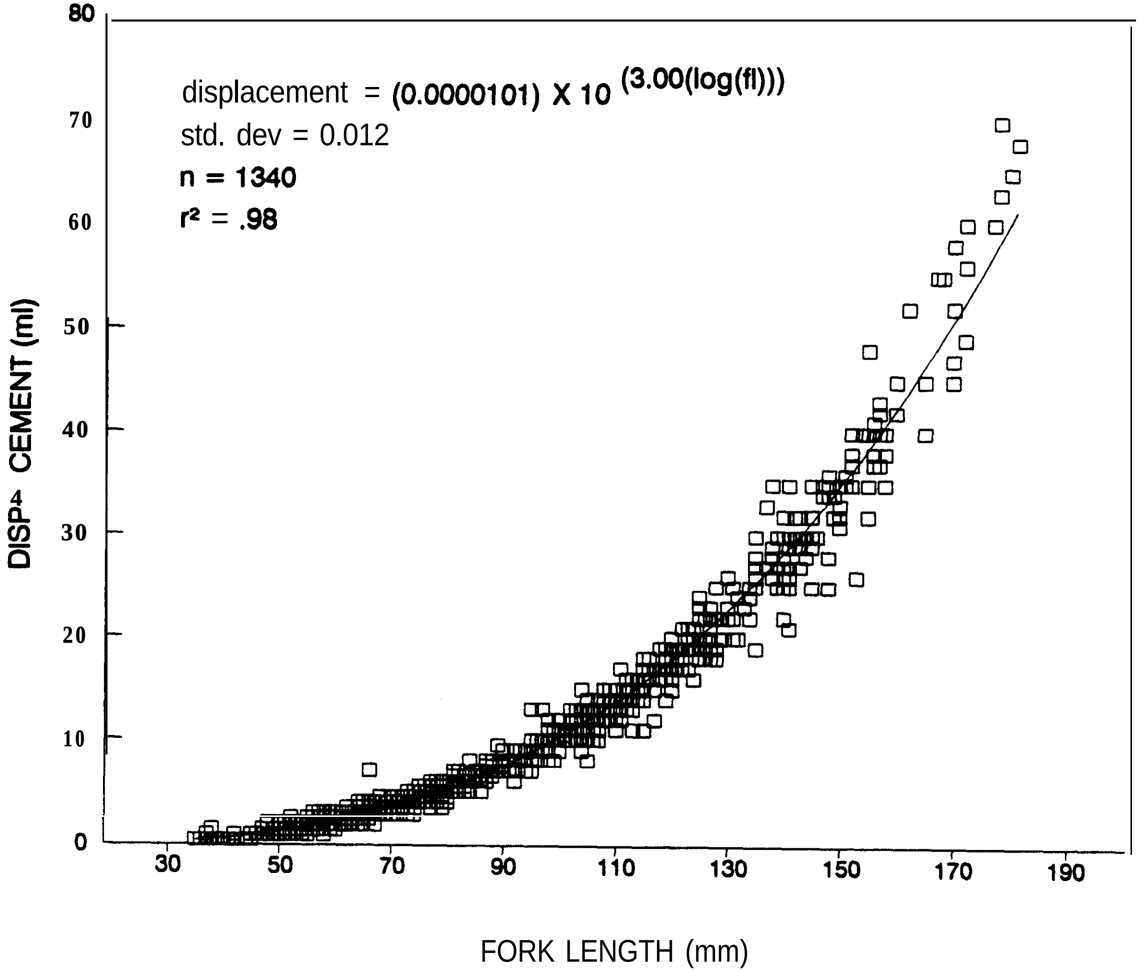

Figure 12. Chinook length-displacement relationship, Trinity River, 1990.

Table 4. Hatchery and natural stock estimate by tag code and period for chinook smolts captured by the rotary traps and seining, Trinity River, 1990.

	Period	March & April	May	June	July & August	March to Aug 31	Oct to Nov 30
	Total chinook sampled	1 460	4 820	9 44	73	7 297	901
Contribution & (Ad-clips recovered)-TRH spring releases	1/spring run	0	435 (47)	157 (17)	9 (1)	602 (65)	19 (2)
	2/fall run	0	41 (3)	55 (4)	55 (4)	150 (11)	41 (3)
Contribution & (Ad-clips recovered)	3/natural stocks	(0)	(5)	(3)	(1)	(10)	(2)
Contribution & (Ad-clips recovered)-TRH fall releases	4/spring run	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	21 5 (62)
	5/fall run	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	51 0 (58)
Estimated # and % of hatchery / natural stock	Hatchery	0 (0%)	476 (9.9%)	212 (22.5%)	64 (87.7%)	752 (10.3%)	780 (86.5%)
	Natural	1460 (100%)	4344 (90.1%)	732 (77.5%)	9 (12.3%)	6545 (89.7%)	121 (13.4%)

Tagcodes: 1/ 6-1-4-1-2, 2/ 6-1-4-1-1, 3/ 6-1-8-1-8,9,10,11, 4/ 6-56-39, 5/ 6-56-34,37,41

Rotary traps, as mentioned earlier, were inoperative during the apparent peak period of hatchery chinook migration, and seining, conducted as an interim measure, offers a relatively narrow duration sample. While the traps were inoperative (May 21 to June 11), 3530 chinook, representing 89% of all chinook captured after the hatchery release on May 18, were captured seining. During this period, 56 of the 60 TRH Ad-clip chinook captured were identified as spring run. The preponderance of TRH Ad-clip CWT spring chinook during seining is believed related to their larger size (86/lb), and subsequent faster migration rate (arriving at the sample area concurrent with the seining) than Ad-clip CWT fall chinook released at 156/lb and migrating at a slower rate (see Migration Rate and Duration section). Further, TRH Ad-clip fall chinook came from only one lot of five lots released. The Ad-clip CWT lot represent fish smaller in average size than the other lots (105,108,112,127,156/lb)(Appendix A). Assuming size is related to migration rate then it is possible that TRH unmarked fall chinook were present during the seining period in greater proportion than indicated based on CWT recoveries. Additionally, assuming survival is positively related to size at release, and assuming that differential mortality of Ad-clip CWT fish is equal to or greater than non clips, it is probable that the expansion factors are low for both spring and fall chinook (Ad-clip spring chinook were also from the lot of smallest fish of four lots (66,73,79,86/lb)(Appendix A)).

Ad-clip recoveries, because of the unequal effort and methods used during the spring trapping season at the Trinity River site, were compared with those made during Klamath River seining. Klamath River seining was conducted on a consistent basis even during the periods of high flows. Ad-clipped TRH spring run chinook recoveries (n = 86) were again greater than the TRH fall run Ad-clips (n = 42) although the percent disproportionality decreased (from 86% spring run Ad-clip CWT captured by the Trinity River rotary traps and seining to 67% captured during Klamath River seining). Of the 388,035 TRH Ad-clip CWT chinook released during the spring of 1990, 186,413 (48%) were spring run and 201,622 (52%) were fall run. The disparity between Ad-clip CWT chinook recoveries and Ad-clip CWT chinook released, observed at both sampling areas, suggest that the smaller size at release of Ad-clip fall run chinook may have precipitated lower survival.

In 1989, TRH released Ad-clip spring run chinook at 83/lb and Ad-clip fall run at 73/lb. These Ad-clip fish were recovered in nearly exact proportion to numbers released indicating similar survival. Since capture methods differed between the two years, direct comparisons are tentative. However, the disproportionate number of Ad-clip spring run chinook recovered in 1990 suggests that the deliberate release of hatchery chinook at a period of high flows probably increases survival if the fish are of the appropriate size and development. If fish size and/or development are deficient the benefit of release at a period of high flows may be lessened.

The CDFG tagged and released 112,000 natural stock chinook in the spring of 1990. Approximately 60% of the chinook were captured, tagged (three tag codes), and released between March 16 and April 18 at Lewiston (rkm 176) (Appendix A). The remaining 40% were captured, tagged (two codes), and released from April 18 to May 3 at Indian Creek (rkm 153). The chinook released at Indian Creek were larger than those released at Lewiston (Table 5). All releases occurred during daylight hours and at river flows of 300 cfs (M. Zuspan, CDFG, pers. comm.).

Nine of the tagged natural stock chinook were recovered during spring trapping at the Trinity River trap site (rotary traps and seining), seven were from the Indian Creek releases suggesting that survival may have been better for the later tag groups (Table 5). The one Ad-clip natural chinook recovered in fall sampling was also an Indian Creek release. Better survival of the Indian Creek releases is also supported by similar recovery proportions observed with Ad-clip CWT natural stock chinook sampled during Klamath River mainstem seining (22 of 28 Trinity River natural stock Ad-clip CWT recoveries were from the Indian Creek releases).

During fall sampling (October 4 to November 30) it is estimated that hatchery chinook made up 780 (86.5%) of the 901 chinook captured (Table 4). Four tag codes were used to mark the TRH yearling release with two of the codes accounting for 85% of all tagged chinook released (two tag groups were feed experiment lots) (Appendix A). Of the two large Ad-clip groups, spring run yearlings comprised 52% of the Ad-clip chinook released and fall run contributed the remaining 48%. During the fall trapping, seventy four Ad-clip chinook from these two groups were captured. Recoveries were similar in proportion to releases (55% spring run and 45% fall run) indicating similar survival of the two tag groups. Trapping was not conducted during the fall of 1989 and it is unknown whether hatchery chinook usually contribute such a high percentage of the yearling run component. One Ad-clipped natural chinook was recovered on October 18.

Migration Rate and Duration

The first capture of an TRH Ad-clip spring chinook was made on May 21 (seining) for an initial migration rate of 47.0 rkm/day (Table 6). Although unlikely, the initial rate may have actually been faster as trapping was not conducted May 19 or 20. The initial rate is three times as fast as observed with Ad-clip spring chinook in 1989 (15.6 rkm/day). Mean migration rate of Ad-clip spring chinook in 1990 (16.3 rkm/day) was also nearly three times that calculated for Ad-clip spring chinook in 1989 (5.8 rkm/day). Given the rate increases observed with the 1990 Ad-clip spring chinook, it is not unexpected that the period of duration was much reduced from that observed in 1989 (12 and 30 days respectively). Size at release for the 1990 and 1989 Ad-clip spring chinook was similar (86/lb and 83/lb respectively). Mean river flow, for the period between release date and mean capture date, was greater in 1990 (3394 cfs) than in 1989 (2637 cfs) and is believed to have led to the increased migration rates in 1990 (Table 6).

Table 5. Trinity River natural stocks CWT releases and recoveries, Trinity River, 1990.

Tag Code	# Released	Release Date	Release Location	Mean length (mm)		Trinity R. Recoveries
				Release	Recovery	
61817	19,247	3/16 - 3/27	Lewiston	35.7		0
61818	26,148	3/27 - 4/06	Lewiston	35.9	84	1
61819	21,388	4/04 - 4/18	Lewiston	40.2	68	1
618110	20,767	4/18 - 4/25	Indian Ck.	53.3	77.0	3
618111	24,582	4/25 - 5/03	Indian Ck.	55.7	84.8	4
Total	112,132					9

The first capture of a TRH Ad-clip fall chinook was made on May 30 (seining) for an initial migration rate of 11.8 rkm/day (Table 6). The initial rate may have been faster as seining was not conducted May 28 or 29. The initial rate is nearly four times slower than observed for Ad-clip fall run chinook released in 1989 (Table 6). Mean migration rate of 1990 Ad-clip fall chinook (6.1 rkm/day) was also slower than observed for Ad-clip fall chinook in 1989 (14.0rkm/day). Given the decreased migration rate it is no surprise that the duration of migration for the 1990 fall chinook was greater than observed for fall chinook released in 1989 (52 and 18 days, respectively). The decrease in migration rate of 1990 Ad-clip fall chinook and extended period of duration are contrary to what might be anticipated given that mean river flows were greater in 1990 than 1989 (5587 and 1781 cfs, respectively).

Based on the disproportionately high number of Ad-clip spring chinook recovered and increased migration rates and shortened duration, the release of hatchery spring run chinook during high river flows probably facilitated survival. Conversely, the release of the Ad-clip fall chinook during the same high river flows did not result in an increase in migration rate or decrease the duration of migration. It is suggested that at release on May 18, insufficient size and/or physiological development of the Ad-clip fall chinook may have led to the observed decrease in migration rates and prolonged duration, and probably impacted survival. During the preceding six years (1984 to 1989) all TRH fingerling fall chinook have been released in June with most releases occurring approximately mid month (Johnson and Longwill 1991).

On October 1, TRH released Ad-clip yearling spring run chinook on site. Initial recoveries were made four days later (10/5) for an initial rate of 35.3 rkm/day (Table 6). It is possible that the actual rate may have been faster as sampling did not start until the afternoon of 10/4. Despite substantially lower flows, mean migration rate for the Ad-clip yearling spring chinook was similar to the Ad-clip spring chinook released in May (16.9 and 16.3 respectively). This may be due to the large size of the yearling fish released.

Table 6. Migration rates for TRH chinook released in the spring of 1989 and the spring and fall of 1990.

Tag code Race	Release Date	Size/lb	Initial Rate (rkm/day)	Mean Rate (rkm/day)	[1/]10-90% Duration (days)	Mean[2/] River Flow (cfs)	Mean[3/] Fork Length (mm)	[4/]Number Tags Used for Rate Calculation
6-1-4-1-2 Spring run	5/18/90	86	47.0	16.3	12	3394	82.0	65
6-61-49 Spring run	5/26/89	83	15.6	5.8	30	2637	81.2	685
6-1-4-1-1 Fall run	5/18/90	156	11.8	6.1	52	5587	75.8	11
6-56-35 Fall run	6/12/89	73	35.0	14.0	18	1781	81.3	712
6-56-34 Fall run	10/15/90	12-14	47.0	34.6	7	582	116.5	66
6-56-37* Fall run	10/16/90	8	15.7	15.7	1	587	163.0	2
6-56-39 Spring run	10/01/90	11-12	35.3	16.9	17	548	138.7	44
6-56-41* Fall run	10/16/90	8	47.0	42.8	5	582	172.0	7

[1/] For sample size greater than 10. Uses all recoveries for sample size <= 10 excluding obvious outliers.
[2/] Mean river flow calculated from release date to mean capture date.
[3/] Mean length calculated using all recoveries for sample size less than ten and uses recoveries within 10 - 90% duration dates when sample size is greater than ten.
[4/] Includes all tags recovered except obvious outliers.
* Experimental feed lots.

The principal release of yearling fall chinook occurred on October 15. Initial recoveries of the Ad-clip yearling chinook were made three days later for an initial rate of 47.0 rkm/day. The Ad-clip yearling fall chinook, and presumably non-marked yearling fall chinook as well, migrated at a relatively fast mean rate of 34.6 rkm/day. The yearling fall chinook also migrated en masse resulting in a short duration period of seven days with 54 of 66 tags being recovered three to four days after release.

Mean migration rates of 1989 and 1990 TRH Ad-clip fingerling and 1990 yearling chinook (spring and fall run) captured at or near the rotary trap(s) (rkm 37) were approximately 2 to 8 times greater than migration rates calculated using data from fish captured at rotary trap(s) operating upstream (rkm 131) (USFWS 1991b). This may be a function of increasing river flow as the fish migrate downriver and/or may suggest that some holding behavior may occur as fish acclimate following release at the hatchery (rkm 179).

Trap Efficiencies

Trap efficiencies were conducted on April 18, May 1, and May 8. Trap efficiency values (0.57, 0.71, 0.37% respectively) were an order of magnitude less than determined for the single rotary trap used in 1989 conducted during similar flows. This indicates deficiencies with respect to the 1990 trapping location. Upon resumption of trapping operations in June, catches were too low for conducting further efficiency tests. Because efficiency test data were severely limited, no population estimate for the spring migration period was attempted in 1990. The low trap efficiency is believed related to water column depth at the trap site and not necessarily a lack of sufficient flow into the trap. Sonar tracings indicated depths of 3.7 to 4.3 meters at the downstream end of the traps. Depths may have been greater under the trap openings. It is possible that fish may have avoided the trap by swimming under the mouth opening. Preceding the fall trapping period the traps were adjusted to more effectively sample river flow. However, we considered the health of yearling chinook too poor for use of these fish in mark/recapture test.

Steelhead Emigration Monitoring

Steelhead TWC values increased through March and peaked the week of April 23 to 27, (TWC = 532) (Figure 10). Steelhead TWC values dropped sharply for the next two weeks before increasing again the week of May 14 - 20. Whether catches would have continued to increase is unknown as the traps were rendered inoperative on May 21 due to high flows and debris. Hatchery steelhead were captured as early as the week of March 5 - 11 although the single fish captured was unmarked (except for dorsal fin erosion) and may have been a holdover from the 1989 TRH release. Scale analysis confirmed the age as 2+. During the week of March 19 - 25, three additional unmarked steelhead (age 1+) with eroded dorsal fins were captured. These steelhead may have been inadvertently released/escaped before fin marking occurred (yearling steelhead were not released from TRH until at least April 6) (Appendix A). The same week, a single right ventral (RV) fin clipped steelhead was captured (TRH released 2+ steelhead, RV marked on March 15). This was the only RV steelhead captured at the trap(s). Left ventral (LV) fin clipped steelhead, representing 98.7% of hatchery steelhead released in 1990, were first captured on April 10, four days after release at the hatchery. However, a single LV steelhead was captured on March 27 suggesting some escapement may have occurred before release.

Hatchery yearling steelhead first significantly contributed to the TWC the week of April 9 - 15 (Table 7). Hatchery yearling steelhead comprised 36.5 percent of the season peak week catch (April 23-29). It is believed that most of the hatchery steelhead caught during the peak catch week were from the April 6 release. As TWC values decreased the following two weeks the percent of hatchery steelhead in catches increased to 74.7 percent and probably consisted of steelhead from both the April 6 and April 23 release. During the week of May 14 - 20, TWC value increased as did the percent hatchery component (77.3).

During fall sampling, a relatively minor TWC peak (35) occurred the week of October 29 to November 5 (Figure 10). All 84 of the steelhead caught in the fall period were natural stocks.

As observed with chinook catches, there were substantial differences of steelhead catch between the two rotary traps. Unlike chinook, which were captured with greater frequency by the "inside" trap, steelhead parr and smolts were captured predominantly by the "outside" trap (Table 3). Steelhead fry were captured primarily by the inside trap. Mean length of yearling hatchery smolts captured by the inside trap (188mm) were not significantly different ($p>0.05$) than those captured in the outside trap (190mm). There was also no significant difference in length between natural parr captured by the inside trap (108mm) and captured by the outside trap (105mm). There was a significant difference ($p<0.05$) in length between natural smolts captured by the inside trap (166mm, n=67, s=27.73) and those captured by the outside trap (180mm, n= 255, s=28.46). This may indicate that larger natural stock smolts preferentially migrate in areas of greater water velocity.

Table 7. Total weekly catch (TWC) and hatchery/natural steelhead stocks estimate by week, April 02 to May 20, and for week of June 11 to 17, Trinity River rotary trap(s), 1990.

Dates	TWC	# Sampled	# Natural	%	# Hatchery	%
4/02 - 4/08	134	76	76	100.0	0	0.0
4/09 - 4/15	154	72	28	38.9	44	61.1
4/16 - 4/22	140	80	51	63.8	29	36.3
4/23 - 4/29	532	296	188	63.5	108	36.5
4/30 - 5/06	306	180	82	45.6	98	54.4
5/07 - 5/13	64	37	12	32.4	25	67.6
5/14 - 5/20	147	83	21	25.3	62	74.7
6/11 - 6/17	19	11	10	90.9	1	9.1

Size and Condition

During the spring trapping period, 818 of the 985 steelhead captured were measured. During March, steelhead from 90 to 200mm predominated in catches (Figure 13). Perfunctory scale analysis indicated both age 1+ and 2+ steelhead were present in March with 1+ steelhead prevalent. Additional steelhead captured in March included three half pounders (fl 340, 370, 410mm) and one spawned adult (559mm). The three half pounders were all age 3_2 (total age 3, 2 years freshwater, one year salt). The adult was age 4_2. An additional adult was captured in April (605mm). Scale analysis indicated this adult to be age 5_2 and had what may be interpreted as a spawn check for the previous season. Based on condition of the dorsal fin and lack of mark, the half pounders and adults were believed to be natural stocks.

During April, a bimodal length frequency grouping was evident. However, much of the percent frequency increase observed in the upper size ranges can be attributed to the presence of 1+ hatchery steelhead. During May, hatchery steelhead comprised the majority of catches and a unimodal length distribution was evident. Only one hatchery steelhead was captured after May. From June to August, natural YOY fry (mean length 54mm), parr (110mm) and natural smolt steelhead (164mm) were captured. Upon resumption of trapping in the fall, steelhead parr (mean length 104mm) predominated in catches (77% of total catch).

The condition of steelhead was assessed by length-displacement relationship. Length-displacement analysis was confined to steelhead captured and measured during the spring months. Displacements were taken on 554 of the 818 steelhead measured. Displacements were taken on a representative sample of all steelhead measured. Trinity River natural steelhead fry, parr, and smolts had a slope value of 2.84 (Figure 14), similar to Klamath River natural stocks (slope = 2.85). The slope value of 2.84 for Trinity River natural steelhead is lower, though not significantly different ($p>0.05$), than observed in 1989 (3.07).

Slope value of hatchery smolts (2.84) was greater, though not significantly different ($p>0.05$), than calculated for natural smolts (2.77) (Figure 15). In both 1989 and 1990, hatchery smolts have had a greater slope value than natural smolts. However, the differences have not been significant. Field crews note that natural smolts appeared to be in better shape than the hatchery smolts. Hatchery smolts consistently show more scale loss and exhibit eroded and fungal infections of fins. At times, eye infections and/or loss of an eye were also noted with hatchery smolts. Entrainment in the rotary trap does not appear to precipitate these conditions as natural stocks do not, with few exceptions, suffer these symptoms. In 1990, hatchery smolts had a lower slope value (2.84) than hatchery smolts in 1989 (3.29), though the differences were not significant ($p>0.05$).

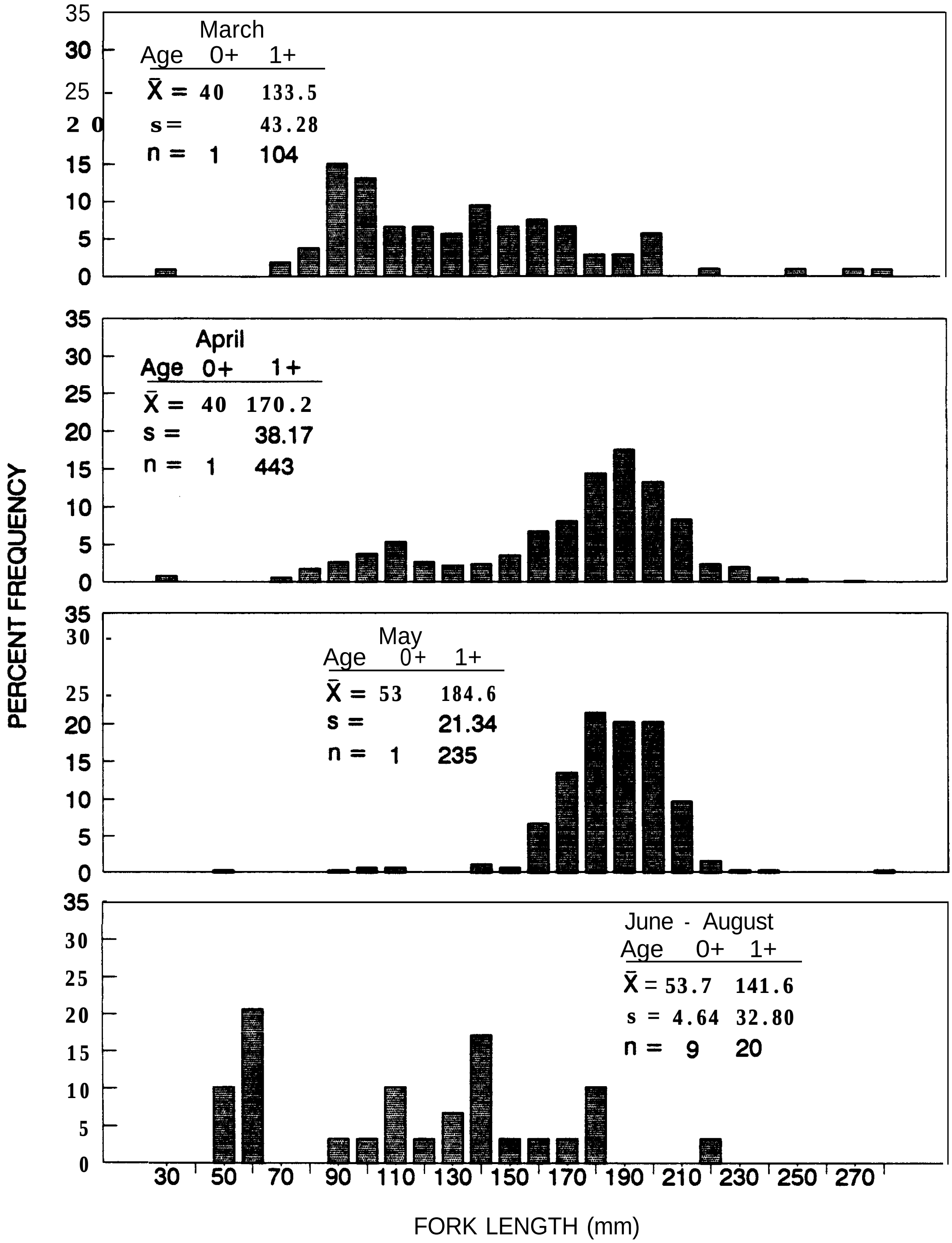

Figure 13. Percent length frequency of juvenile steelhead captured from March to August at the rotary traps, Trinity River, 1990.

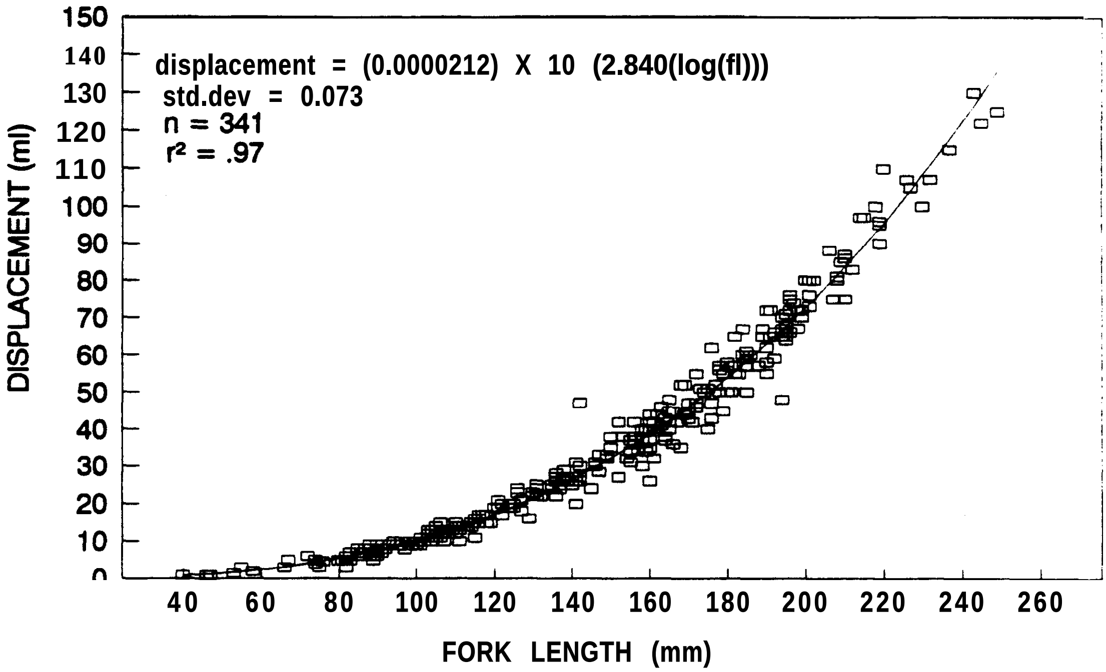

Figure 14. Natural stock steelhead length-displacement relationship, Trinity River, 1990

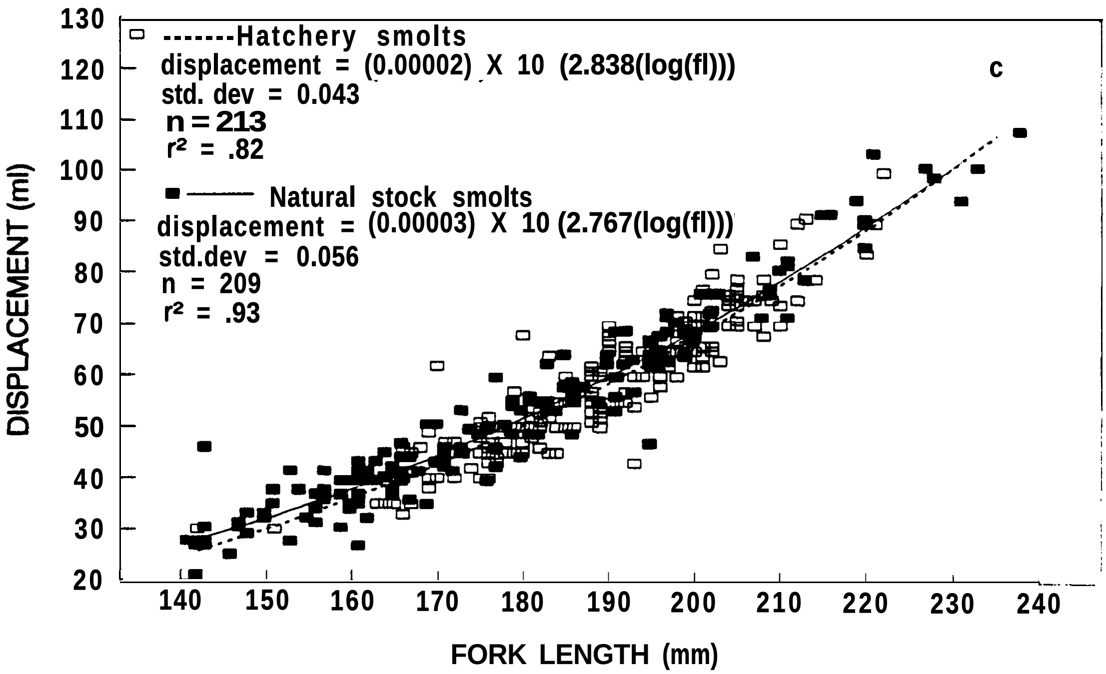

Figure Length-displacement relationship, natural and hatchery stock steelhead smolts, Trinity River, 1990.

Hatchery and Natural Stock Estimate

Of the 985 steelhead captured in 1990, 901 were captured during spring trapping. For this spring period, 326 (39.8%) of the 901 steelhead captured were of hatchery origin. Only one of the steelhead was from the release group of two year olds (1988 brood, RV marked). As previously mentioned in the emigration section of the report, the proportion of hatchery steelhead in catches increased after mid April (Table 7). The week before the traps were rendered inoperative on May 21, steelhead catches reversed a two week trend and began increasing. Whether trap catches, and the proportion of hatchery steelhead in those catches, would have continued to increase after May 21 is unknown. Upon resumption of trapping on June 11, and until spring trapping concluded August 31, steelhead catches were low and only one hatchery steelhead was observed. During fall sampling, all steelhead captured were natural.

Migration Rate and Duration

Trinity River Hatchery released the bulk of the yearling steelhead production on April 6. The LV marked steelhead were first captured on April 10 for an initial migration rate of 35.3 rkm/day. The initial rate may have been faster as trapping was not conducted April 7 - 9. The second group of steelhead were released on April 23. As these steelhead were similar in size and also LV marked they could not be differentiated from the first release group and therefore migration rates for this group were not possible. The inability to differentiate between the two releases also precludes attempts to calculate a mean migration rate or duration period for either group.

Coho Emigration Monitoring

Coho TWC substantially increased the first week of April (TWC = 65) (Figure 10). Coho emigration peaked the week of April 23 - 29 (TWC = 241) coinciding with the week of peak chinook and steelhead emigration. A minor storm event raised river flows from 2080 cfs on April 22 to 2770 cfs on April 24 and may have stimulated downstream movement of fish. Coho emigration in following weeks, perhaps in response to dropping river flows, apparently decreased as catches fell sharply. Because of subsequent trap failures, it is unknown whether emigration was substantial between May 21 and June 10 . No coho were captured after June 28. In 1989, coho catches were greatest from May 1 to June 5 (peaked mid May).

There were substantial catch differences between the two rotary traps. As observed with steelhead, the majority of coho were captured by the outside rotary trap (Table 3). After standardizing trap catches for flow and days sampled, the outside trap accounted for nearly 85% of coho captured during the peak catch week and 72% of all coho for the season. Differences in age and development of catch between the traps occurred as well. During the season, 237 of the coho captured were identified as 1+ smolts. Of these, 210 (87.9%) were captured in the outside trap. Conversely, sixty coho captured during sampling were identified as YOY fry and parr. Of these, 52 (86.7%) were captured by the inside trap. There were however no significant differences ($p>0.05$) in mean length observed between coho of like development between traps.

Size and Condition

During spring trapping, 262 coho were measured (90% of total catch). During March, age 1+ smolts dominated catches with no YOY coho observed (Figure 16). Bimodal length frequency grouping, consisting of YOY fry and 1+ smolts, was evident in April and May. By June, catches were nearly exclusively YOY with only a single 1+ coho captured. In 1989, bimodal grouping was also evident in April and May with 1+ smolts dominating catches in June. The lack of 1+ smolts in June of 1990 is believed due to earlier hatchery release and higher river flows. In 1989, TRH released coho smolts on March 20. In 1990, the coho smolt release occurred on March 2. In addition, river flows at release location (both on site releases) were greater in 1990 than 1989 (300 and 150 cfs, respectively) and may have contributed to earlier emigration timing and decreased travel time.

Displacements were obtained on 120 of the 262 coho measured during spring sampling. Resultant slope value of 2.80 was indicated (Figure 17). The slope value was significantly lower ($p<0.05$) than calculated for coho captured in 1989 (2.90). The lower slope values observed for coho, natural steelhead smolts, and hatchery steelhead smolts in 1990, compared to 1989, may indicate poorer rearing conditions in 1990.

Hatchery and Natural Stock Estimate

Hatchery coho were not Ad-clipped or otherwise marked in 1990. Attempts were made to differentiate hatchery from natural stocks coho smolts based on the presence of a slight distortion of the anterior dorsal ray. Coho YOY and yearling parr are readily identifiable to natural origin based on superior fin quality, body shape and coloration. Of the 290 coho captured, fifty (17%) were identified as YOY natural stock fry, parr or yearling parr. The remaining 255 coho were identified as smolts. Of the 255 smolts, 212 were classified to hatchery or natural origin. Based on dorsal fin condition, eighty four (40%) were believed to be of hatchery origin. However, this estimate of hatchery contribution is probably low. Considering the overall appearance of smolts captured (ie; long thin body with comparatively large head, some fin erosion) as well as timing of capture, it is probable that most smolts were of hatchery origin. Differentiation based solely on the condition of the anterior dorsal ray is probably too inconsistent and subjective an indicator. Consequently, a clearly defined hatchery and natural stock estimate could not be presented.

Migration Rate and Duration

Due to the inability to precisely identify hatchery coho smolts, no attempt was made to calculate and describe migration rates.

Salmonid Abundance Index

Salmonid abundance index values, based on catches, nights trapped, and proportion of river discharge sampled, estimated 56,500 chinook emigrated from March 20 to August 31 with an additional 35,100 chinook emigrating during the fall period (Figure 18). The abundance index for steelhead was 58,335 for the spring emigration and an additional 1,016 for the fall period (Figure 19). The index for coho, captured during spring months only, was 17,925 (Figure 20). The purpose of the index is to describe relative abundance comparable between years assuming similar effort and similar trapping efficiency. It is obvious however that these assumptions were not met in 1990 as; 1) 1990 trap efficiency values were an order of magnitude less than trap efficiencies in 1989, and 2) the traps were inoperative for three weeks in which emigration of all species may have been significant, and 3) hatchery releases alone far exceed the index numbers. In 1989 trapping was conducted on a consistent basis through the spring and summer months and the index value for chinook was 927,000. Trapping was not conducted during the fall of 1989.

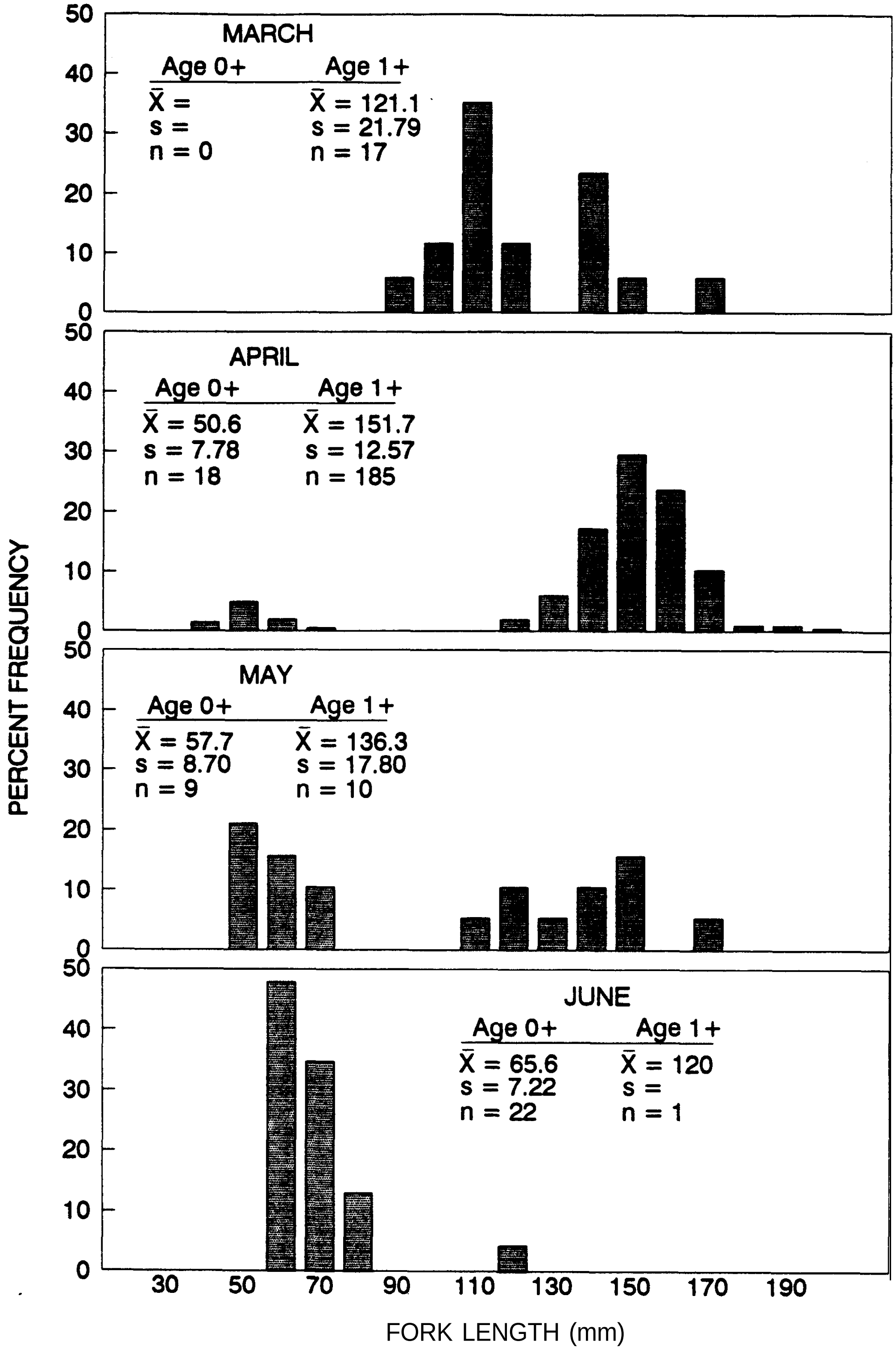

Figure 16. Percent length frequency of juvenile coho captured from March to June at the rotary traps, Trinity River, 1990.

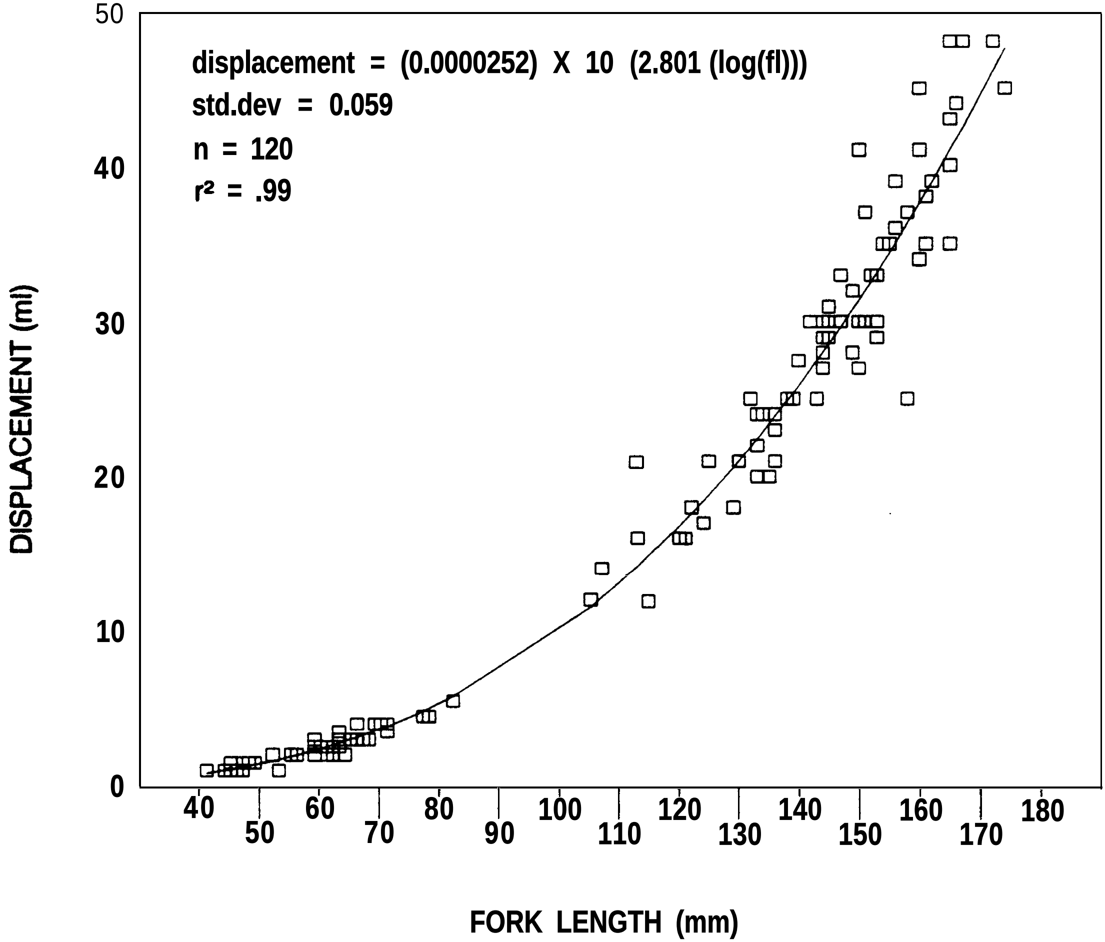

Figure 17. Coho length-displacement relationship, Trinity River, 1990.

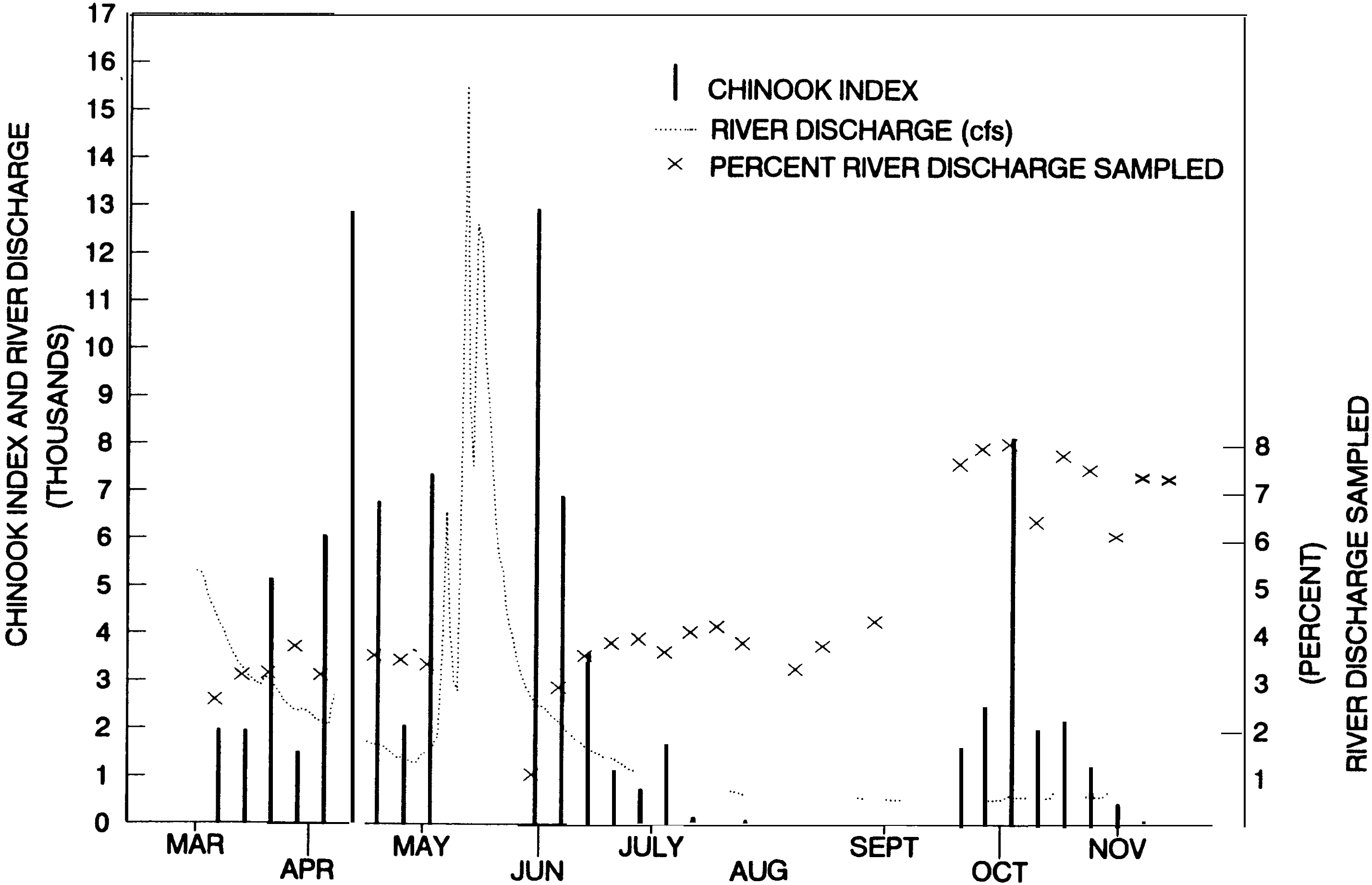

Figure 18. Weekly chinook index, river discharge, and percent river dischargesampled, Trinity River 1990.

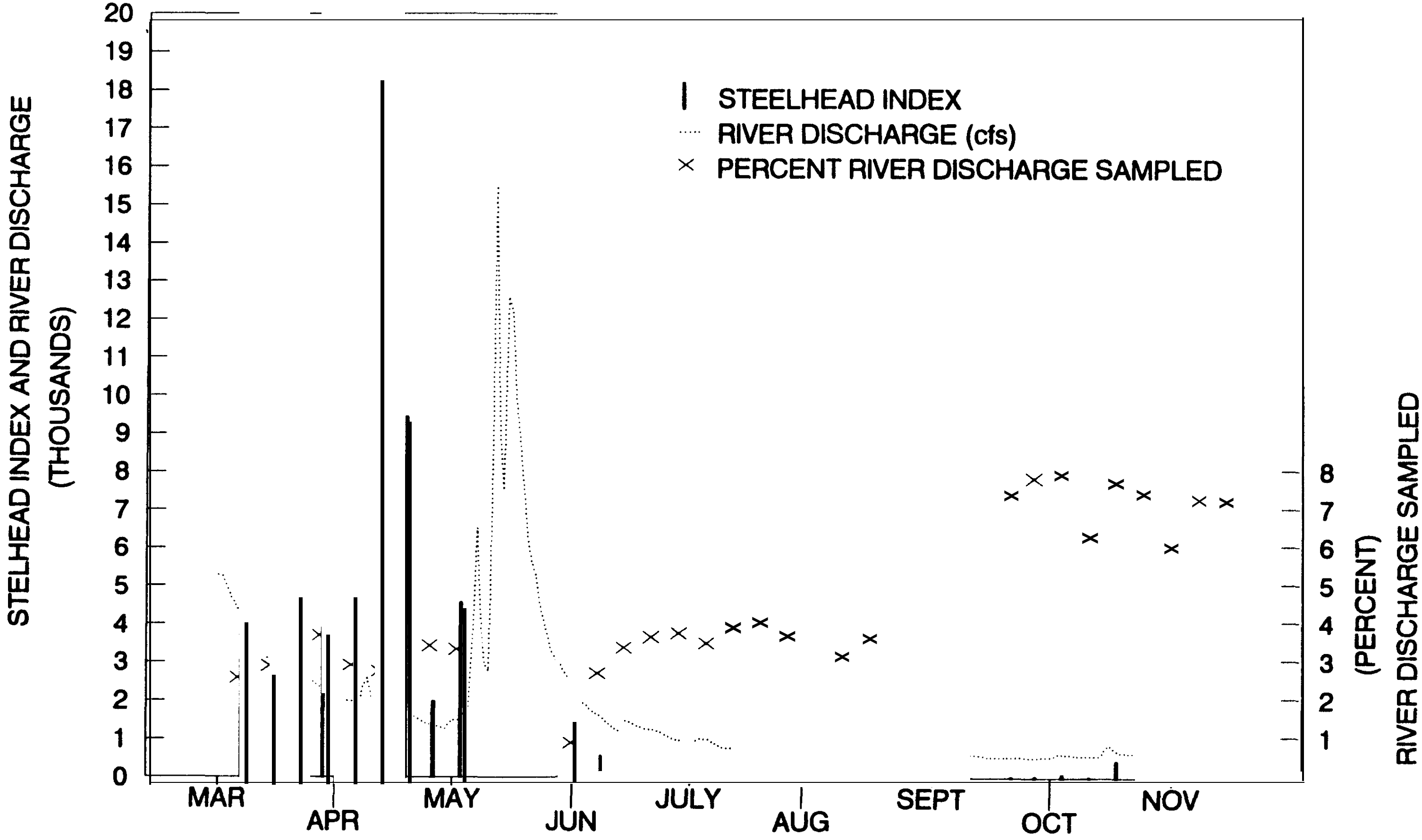

Figure 19. Weekly steelhead index, river discharge, and percent river dischargesampled, Trinity River, 1990.

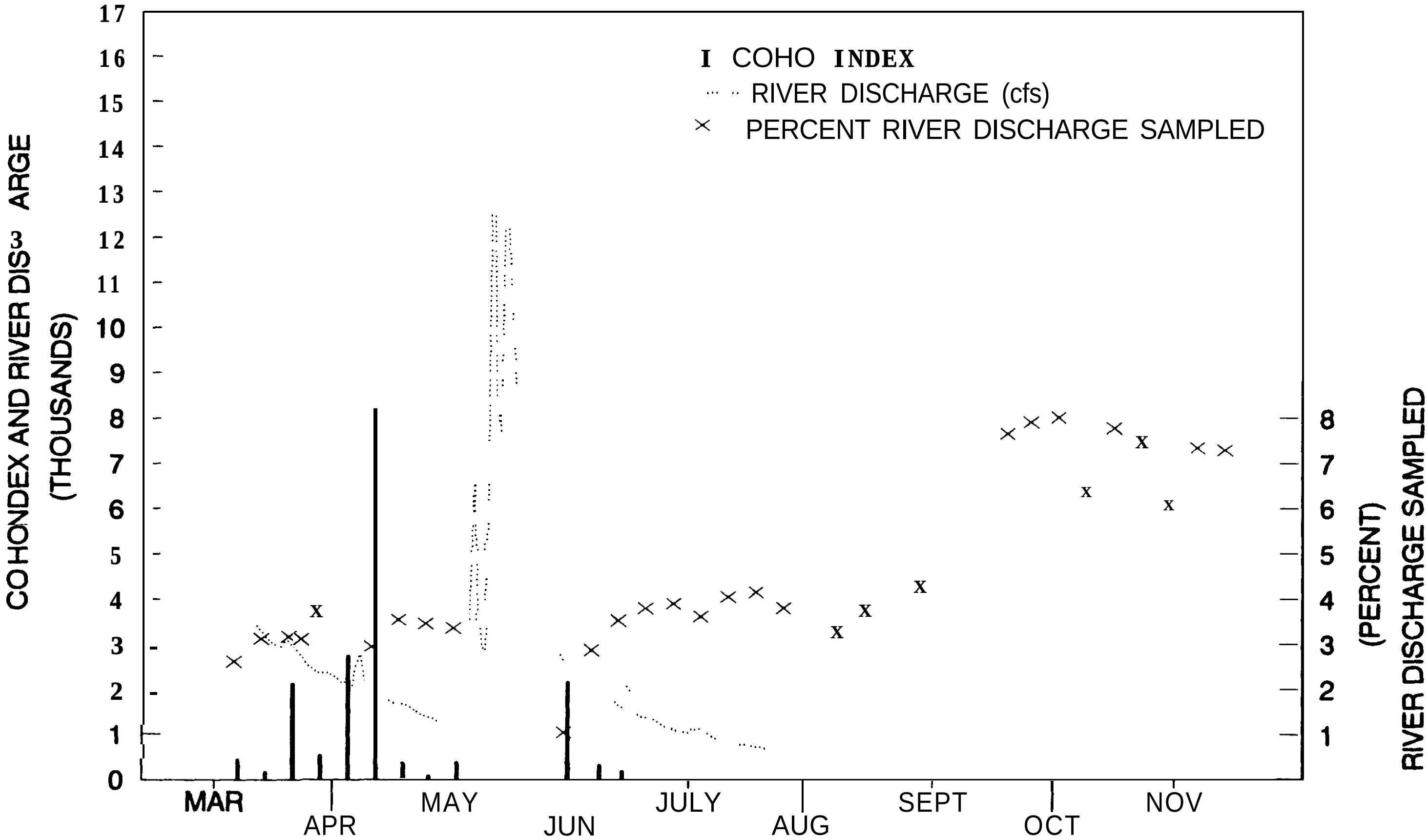

Figure 20. Weekly coho index, river discharge, and percent river dischargesampled, Trinity River, 1990.

Temperature

A Tempmentor was affixed to a rotary trap live box on March 01 and began recording ambient water temperature every two hours (Figure 21). Temperature recording continued throughout the year and ended December 10. Lowest mean daily temperature during the trapping year was recorded on December 9 (5.6 $^{\circ}$C). Highest mean daily temperature for the trapping year was recorded on July 16 (25.6 $^{\circ}$C). The most substantial water temperature change (decrease) occurred between May 16 and June 02 in response to the increased river flow. Water temperature substantially increased during the following weeks as river flow decreased to summer low flow conditions.

Other Species

Other salmonids captured include two juvenile chum salmon (O. keta) and one brown trout (Salmo trutta). A variety of non-salmonid species were also trapped. Listed in order of frequency: Klamath smallscale sucker , Pacific lamprey (ammocete to adult), Speckled dace, Threespine stickleback, American shad (juvenile), and prickly sculpin.

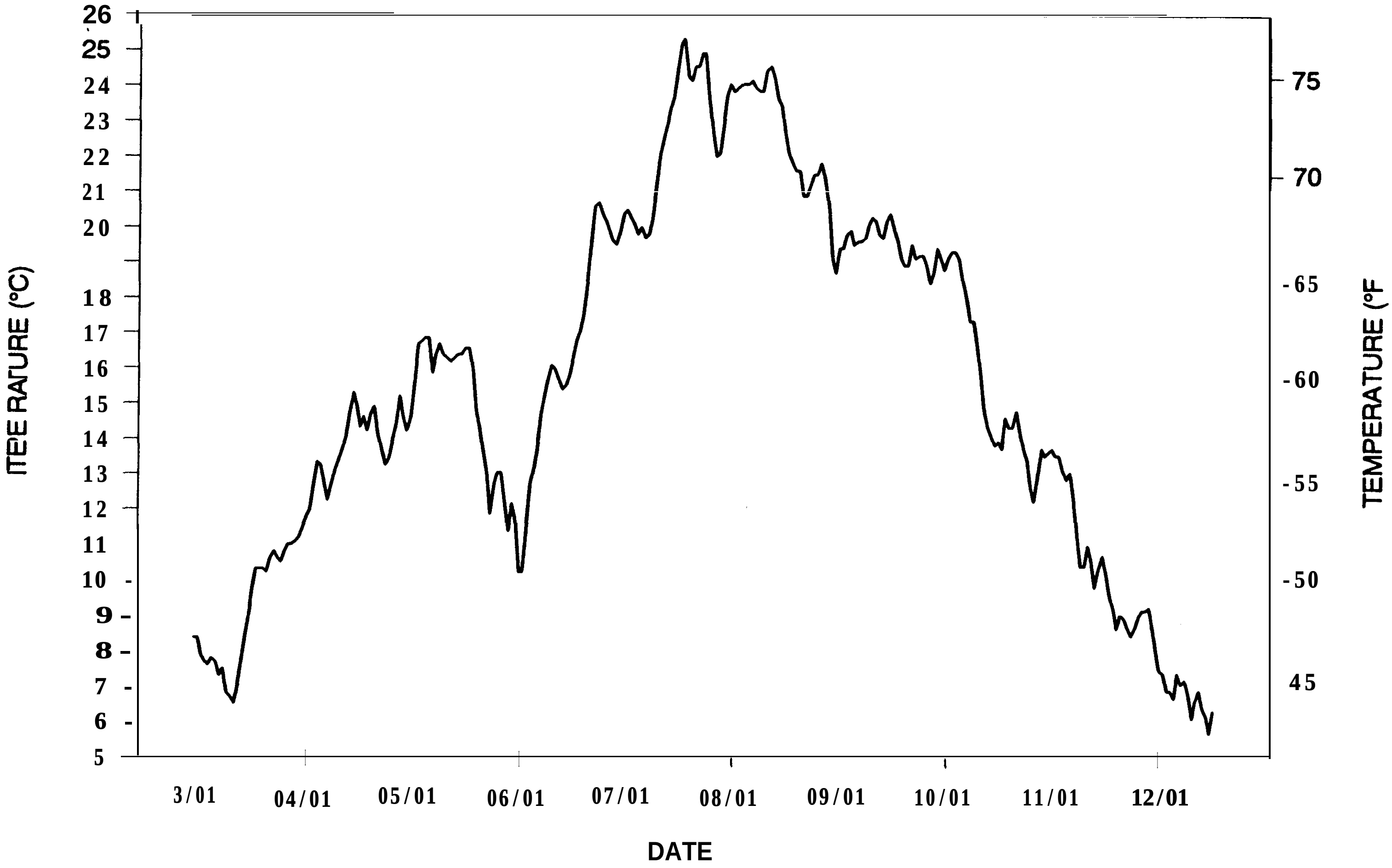

Figure 21. Mean daily water temperature, Trinity River (rkm 37), 1990.

RECOMMENDATIONS

This season (1990) marks the third year of juvenile salmonid investigations in the Klamath River basin and represents the second year of sampling with the rotary screw trap. The rotary trap remains a superior trapping gear compared to the frame nets used in 1988 and its continued employment is recommended. Last year we recommended that the Klamath trap be repositioned to a more aggressive location. The result was excessive downtime for trap repair. It is therefore suggested that the trap be repositioned at a somewhat less aggressive location.

During the late fall of 1990, a new trapping site was also identified for the Trinity River. Channel morphology at the new site is similar to the 1989 trapping location which will allow for more comparative catch analysis. In addition, the use of dual traps in 1990 at both the Klamath and Trinity River sites left no reserve trap(s) to replace those damaged during high flows. To avoid unacceptable monitoring data gaps we recommended that a single trap be used during subsequent monitoring. As mentioned earlier, we recommended that the rotary trap be located in an median position relative to the positioning of the dual rotary traps. Such trap placement should allow for representative sampling of juvenile salmonids through all development stages (fry, parr, smolt).

Following recommendations outlined in the 1989 report, sampling was conducted earlier in the spring of 1990. While not voluminous, data collected during this early spring period does yield information on natural stocks and yearling salmonid emigration and should be continued.

Data collected in 1989 and 1990 indicate that size of fingerling chinook at release may play an important role regarding emigration rates and survival. The data indicate that larger fish, presumably more physiologically fit, migrate at a faster rate and possibly survive the migration better than fish released at smaller sizes. Healthy fish that migrate fast will probably have less impact on natural stocks - the primary management bottleneck in this system. It may be beneficial to hatcheries to evaluate the size of fish released in that survival of emigrating smolts might be increased. This could be accomplished with more representational marking of fish releases. Primarily, this would require that a sample of fish from distinct size lots be marked with unique CWT codes. Total number of tags applied need not necessarily differ than currently used to identify release groups (ie; instead of tagging 200,000 chinook from one size lot with a unique code, apply a unique tag code to 40,000 chinook from each lot (assuming 5 lots). Our trap data could then provide near immediate feedback on migration timing, health, and, based on proportions of recoveries, estimate relative survival of release groups to the trap site. More representative marking would also facilitate all aspects of data analysis used in harvest management.

Flexible timing of release, demonstrated in 1990 with the release of sufficiently developed spring chinook from TRH during a period of increased flow, may be considered a beneficial release practice. Additional benefit may have been realized by natural stocks in that the rapid emigration of the hatchery spring chinook probably lessened competition spatially and temporally. Conversely, the release of insufficiently developed fall run chinook during the same high flow period led to a prolonged emigration and possibly increased competition with natural stocks.

Despite the periods of trap failures in 1990 important data on juvenile salmonid emigration were collected. The trap locations anticipated for 1991 will be an improvement over locations used this year and should provide for more comparative data analysis. Extreme fluctuations in river flow will always present sampling problems. However, it is believed that the experience gained through the past two seasons of trapping will result in consistent data collection throughout the majority of anticipated flow levels.

In afterword, the recommended changes in trapping locations have resulted in much improved results in 1991 and 1992. Consistent and efficient trapping effort has resulted in chinook catches of approximately 25,000 and 40,000 juveniles, respectively. These results are currently being analyzed and will be presented in future reports.

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PERSONAL COMMUNICATION

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Zuspan, M., California Department of Fish and Game, Weaverville, CA.

Appendix A: Klamath River basin CWT and non-mark Salmonid release information, 1990.

Iron Gate Hatchery

Race	Brood Yr	Avg. Size I / l b	CWT-code	# Tagged	#Poor Tag	#Non-CWT Released	Expansion Factor	1990 Release Information
Fall Chinook	1989	233	0601020104	190499	11686	4909501	26.833	5/21-22 on site (IGH)
	1989	12	066311	19874	1987	39218	3.073	10/24 at Bluff Creek
	1989	12	066312	16019	1601		1.100	10/24 at Bluff Creek
	1989	10	066313	15162	1691	29931	3.086	10/22-23 at Indian Creek
	1989	10	066314	11771	1312		1.111	10/22-23 at Indian Creek
	1989	11	066315	11828	1241		1.105	10/23 at Elk Creek
	1989	11	066316	15821	1660		1.105	10/23 at Elk Creek
Coho	1988	14	066322	46030	4720	30100	1.756	3/06 on site (IGH)
	1988	20				42000		3/23 on site (IGH)
Steelhead	1989	10	Not marked			310000		5/15 on site (IGH)

Natural Stock Assessment Project

Race	Brood Yr	Avg.Size # / l b	CWT-code	# Tagged	#Poor Tag	#Non-CWT Released	Expansion Factor	Release Information
Fall Chinook	1989	942	0601080103	33385	1859		1.056	3/26-4/13 at Bogus Creek
	1989	1261	0601080107	19248	7407		1.385	3/16-3/27 at Lewiston site
	1989	1195	0601080108	26148	3273		1.125	3/27-4/06 at Lewiston site

Appendix A: Klamath River basin CWT and non-mark salmonid release information, 1990 (continued).

Natural Stock Assessment Project (cont)

Race	Brood Yr	Avg.Size # / l b	CWT-code	# Tagged	#Poor Tag	#Non-CWT Released	Expansion Factor	Release Information
Fall Chinook	1989	na	0601080109	21388	1900		1.089	4/4-4/18 at Lewiston site
	1989	272	0601080110	20768	2413		1.116	4/18-4/25 at Indian Creek
	1989	239	0601080111	24581	2806		1.114	4/25-503 at Indian Creek

Trinity River Hatchery

Race	Brood Yr	Avg.Size # / l b	CWT-code	# Tauaed	#Poor Tag	#Non-CWT Released	Expansion Factor	Release Information
Spring Chinook	1989	66,73,79,86	0601040102	186413	21035	1517789	9.255	5/18-5/21 on site (TRH)
Fall Chinook	1989	105,108,112, 127,156	0601040101	201622	17073	2531079	13.638	5/18-5/21 on site (TRH)
Spring Chinook	1989	11,12	065639	102555	6792	239567	3.402	10/01 on site (TRH)
Fall Chinook	1989	12,14	065634	97810	3811	376899	4.892	10/15-10/16 on site (TRH)
	1989	8	065637	23625	1451	378258	17.072	q10/16 on site (TRH)
	1989	8	065641	22540	1092	379618	17.890	10/16 on site (TRH)
Coho	1988	13	Not marked			519134		3/02 on site (TRH)

Appendix A: Klamath River basin CWT and non-mark Salmonid release information, 1990 (continued).

Trinity River Hatchery (cont)

Race	Brood Yr	Avg.Size # / l b	CWT-code	# Tagged	#Poor Tag	#Non-CWT Released	Expansion Factor	Release Information
Steelhead	1988	1.6	RV marked	5490				3/15 on site (TRH)
Steelhead	1989	9	LV marked	257997				4/06 on site (TRH)
Steelhead	1989	10	LV marked	148000				4/23 on site (TRH)

Horse Linto Creek

Race	Brood Yr	Avg.Size # / l b	CWT-code	# Tagged	#Poor Tag	#Non-CWT Released	Expansion Factor	Release Information
Fall Chinook	1989	na	0601080305	17927	2610	913	1.197	June at Horse Linto Creek
	1989	na	0601080302	17850	2750		1.154	Nov. at Horse Linto Creek
Late Fall Chinook	1989	12.5	065302	11919	8282		1.695	10/22-11/05 at Cappel Creek
	1989	56	065303	3954		5980	2.512	8/05 at Omagar Creek
	1989	30	065304	15860	490		1.031	10/21 at Hunter Creek
	1989	43	065305	15185	633		1.042	6/26-6/30 at Salt Creek
Fall Chinook	1989	na	0501010105	2915	235		1.081	5/02-7/19 at Blue Creek