ANNUAL REPORT

KLAMATH RIVER FISHERIES ASSESSMENT PROGRAM

JUVENILE SALMONID PRODUCTION MONITORING

1988

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INTRODUCTION

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 (Oncorhynchus tshawytscha). These programs have provided information concerning the returning adults which is utilized to manage the harvest and estimate the return of fall chinook salmon to the Klamath River. 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.

To date, most of our knowledge of the chinook salmon juvenile life history within the Klamath River Basin has come from on-going natural production studies conducted by the California Department of Fish and Game (Department). This work has been conducted within the tributaries of the upper Klamath River Basin, the South Fork Trinity River and limited work in the Klamath River Estuary. To suppliment these investigations, the Fish and Wildlife Service (Service) initiated downstream migration monitoring of the mainstem Klamath and Trinity Rivers during the spring of 1988. In addition, an estuary sampling effort focusing on juvenile chinook salmon was initiated in July 1988. The objective of this monitoring effort was to gather additional information on out-migration timing, size and abundance of juvenile chinook. This work is being coordinated with the Department's natural production investigations to create an understanding of the basin-wide chinook production and factors which are possibly limiting the production of chinook salmon.

Added importance has been placed on monitoring the Klamath River chinook production by the recent decision to allow 35% of a given brood years natural production to spawn while 65% of the natural production may be harvested by the various ocean and in-river user groups (PFMC 1989). It has been determined that this level of escapement is necessary to achieve maximum sustainable yield for the natural stocks of the Klamath River basin. It is the intention of this program to document the current level of production and either validate the current assumptions or provide information to adjust spawning escapement levels to meet maximum sustainable yield from the natural and hatchery stocks of the Klamath River Basin.

Toward this end, the Service plans to continue monitoring juvenile production on an ongoing basis and develop a program to monitor 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).

METHODS

MIGRATION MONITORING

Trapping

Trapping began on March 7, 1988 and ended on June 30, 1988. The Klamath River site was at the Big Bar river access area (river kilometer 80) downstream from Orleans, California (Figure 1). This site afforded convenient

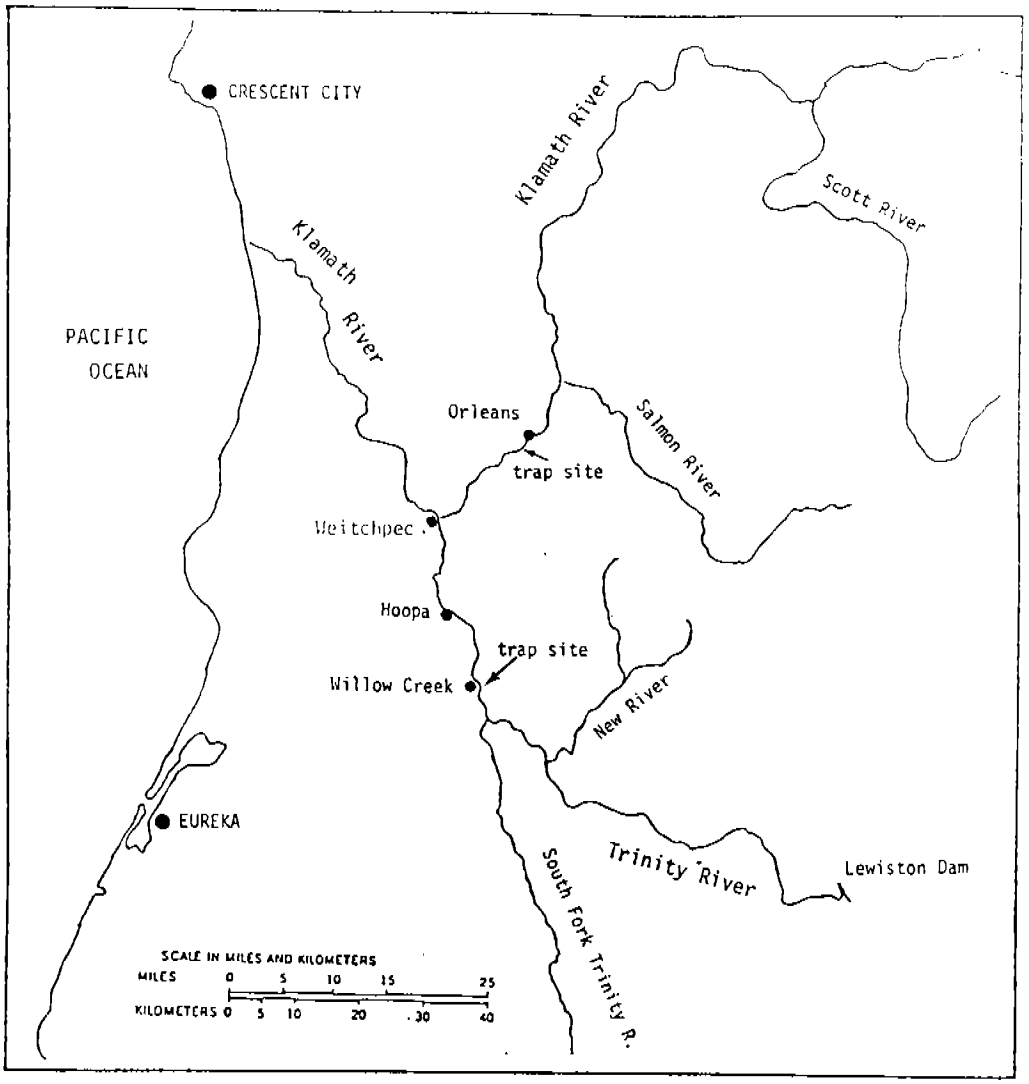

Figure 1. Map of Klamath-Trinity River Basin. Trapping locations indicated by arrows.

access and the channel morphology permitted efficient trapping throughout the anticipated range of river flows. The Trinity River trapping site (river kilometer 26) was originally chosen adjacent to the Tish-Tang-A-Tang campground. This site was abandoned after April 21, 1988 in anticipation of conflicts from increased recreational use of the area. The Trinity trapping effort was relocated to the MacIntosh gravel quarry site (river kilometer 38), downstream from Willow Creek, California (Figure 1).

Frame traps (1.52 m x 3.05 m) were used at both sites. Self-cleaning wooden holding boxes were secured to the cod end of the trap. The Klamath River trap was bridled to a cable that spanned the river. The trap was positioned in the channel at 90 cm to 100 cm water depth and about 10 m from the right bank. The Trinity River trap was secured by a system of fence-posts anchored into the river-bed. The posts were re-set as necessary to accomodate varying river stages and to allow trapping at depths from 87 cm to 112 cm.

The traps were operated overnight and checked the following morning. Captured fish were identified to species, salmonids were anesthesized with Tricaine methane sulfonate (MS-222), and measured to fork length (mm). Volumetric displacements (ml) were taken opportunistically from chinook and coho salmon (Oncorhynchus kisutch) with a graduated cylinder. Fork length measurements were taken on a maximum of 50 salmonids per species per day. Salmonids with adipose fin-clips (ad-clips) were sacrificed and retained for subsequent recovery of the coded wire tags (CWT). All rainbow trout (Oncorhynchus mykiss) captured were assumed to be the anadromous form (steelhead trout).

Seining

Salmonids were captured by seining to provide additional fish for determining trap efficiency using mark-recapture methodologies. A 30.5 m x 3.5m x 7.9 mm delta mesh (3.2 mm bag mesh) beach seine and a 15.3m x 1.8m x 4.8mm beach seine were set by a Valco jet boat or by hand to capture salmonids at sites near the trapping locations. Captured fish were identified to species, salmonids were anesthesized with MS-222, measured for fork length, examined for fin clips and held in aerated plastic garbage cans. Ad-clipped salmonids were sacrificed for later CWT recovery. Fish were marked by staining or fin-clipping.

Bismarck Brown Y (48% concentration) powder was used to stain the salmonids. To achieve an 1:102,000 solution, 2 grams of the stain was added to 94.6 liters of water. Fish were held in the aerated stain solution for 2 hours. Post-staining mortalities were removed and 50 stained salmonids were retained in live boxes to assess stain retention and delayed mortality. These groups were held up to 156 hrs. From these tests, the stained fish were distinguishable for one week. The remaining stained fish were released approximately 400 m upstream from the Klamath site and 500 m upstream from the Trinity River site. Non-stained controls were also set aside and evaluated opportunistically when circumstances and available sample sizes permitted.

Flow And Water Temperature

Water velocity measurements were recorded within the frame net opening using a General Oceanics Digital flowmeter (model 2030). Uniform velocity

throughout the frame opening was assumed in estimating volume of flow through the frame trap. Flow velocities were checked at least twice per week at each site.

Ryan Tempmentor thermographs were deployed at the Trinity River site on April 26 and at the Klamath River site on April 25, 1988. Thermographs were positioned on the stream bottom, within vented concrete casings in depths up to 1.0 m. The thermographs were programmed to record ambient water temperature every two hours.

ESTUARY MONITORING

Seining

The Klamath River estuary (River kilometer 0) was sampled once per week, beginning on July 25, and ending on September 19, 1988. Seining began about 0700 hrs and ended by 0830 hrs. Initial seining efforts identified suitable sites along the north spit, backwater areas adjacent to Dad's Camp and a island (remnant of the 1987 north spit) adjacent to the south spit (Figure 2). Because of time constraints, efforts were focused primarily on the island and on the south spit. Seining sites around the island were selected to avoid strong tidal currents.

A 76.2m x 3.1m x 10mm delta mesh (2.5mm delta mesh bag) beach seine was used to capture juvenile salmonids. The seine was set from a Valco jet boat. Captured fish were identified to species, enumerated and released. Salmonids were anesthesized with MS-222, measured to fork length (mm) and examined for fin clips prior to release. Salmonids with ad-clips were sacrificed for later recovery of CWT. Fork length measurements were taken on a maximum of 50 chinook per day. Volumetric displacements (ml) were taken opportunistically from chinook salmon.

RESULTS AND DISCUSSION

MIGRATION MONITORING

Catch Trends

During the trapping period (March 10, to June 28, 1988), 4,275 salmonids were captured. Chinook salmon were the most numerous species (3,027), followed by 825 coho salmon and 413 steelhead trout. The Trinity River site captured more salmonids (2,755) than the Klamath River site (1,520). The difference in catch is possibly explained by the higher trapping efficiency at the Trinity River site. The Trinity River channel width was 50.3 m at the trapping site and 94.6 m wide at the Klamath River site.

There was a difference in the overall catch timing between sites and among species between sites. At the Klamath River site, the catch timing of the three species generally coincided, while chinook in the Trinity appeared to have migration periods distinct from coho and steelhead. Chinook salmon migration past the Klamath site was greatest during May, whereas chinook catch peaked during April at the Trinity River site.

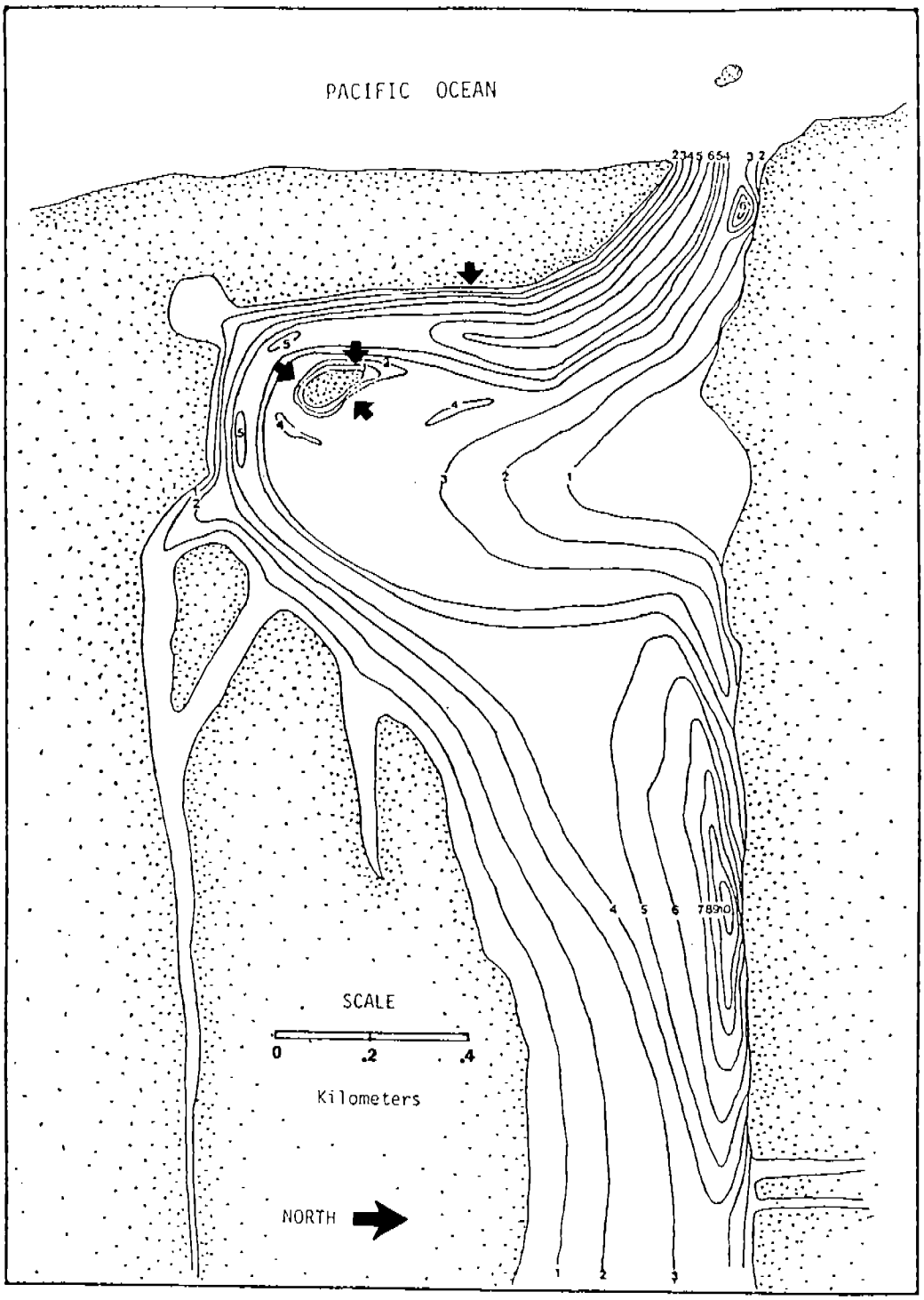

Figure 2. Depth contours (expressed in meters below mean high tide) of the Klamath River estuary in 1988. Seining locations indicated by arrows.

Chinook Salmon

Chinook salmon (n=1,037) was the dominant salmonid species in the Klamath River catch throughout the trapping period (Table 1). There were two distinct migration pulses or peaks, the initial peak occurred during mid-April and the second peak in mid-May which corresponded to the peak weekly catch (n=284) (Figure 3). During latter May through early June, a series of storms produced high flows which washed out the trap on May 31 and sampling did not resume until the week of June 7. During this period of high flows, a third migration peak of chinook may have occurred.

Mean fork length of chinook increased from 36.5 mm in early March to 53.8 mm by the end of April. The largest increases in mean length occurred during May. In June, weekly mean length of chinook was relatively constant: 76.4, 76.1, 74.6, and 75.0 mm.

The successive decline in catch per unit of effort in late June was interpreted as the end of the chinook spring migration time period. This conclusion was also supported by the seining which showed that chinook were common in the river, despite low catches of chinook in the traps.

The Trinity River chinook catch was 1,786 with 907 captures in April and 599 during May. The season's weekly peak catch (363) occurred during April 19-22. The second largest weekly catch (250) was on May 3-6, 1988 (Table 2).

The mean size of sampled chinook increased weekly, although a wide range of lengths were noted throughout the season. Chinook in the 40-50 mm range were also trapped during early June, indicating late emergence. Two large increases in mean fork length were noted, from the weeks of April 12 to 19, and from June 7 to 14. This may represent the influence of distinct groups of migrating larger chinook. After June 14, the mean size decreased along with the catch rate. The reduction in the mean size of chinook may reflect the absence or reduction in abundance of larger juveniles that had smolted and migrated downstream. Also, although not quantified, the fyke traps are believed to be less selective for larger salmonids. The degree of bias to which this may affect the mean size is unknown.

In comparison, the growth of Klamath chinook was relatively more constant, without distinct sudden increases in mean size. The mean size of Klamath chinook did not increase during June. After mid-April the size range of Klamath chinook was much greater than observed at the Trinity site. During June, at both sites, the appearance of chinook in the 40 mm to 60 mm size interval was not uncommon. These small chinook suggest a wide time range of spawning, which may be related to variable life history strategies or distinct stocks that spawn later.

Yearling sized chinook (> 120 mm) were rarely captured in the traps and may reflect their absence in the Klamath and Trinity Rivers during the trapping period or the inability of the frame nets to capture larger individuals. Yearling chinook were released from Trinity River Hatchery and Iron Gate Hatchery during the fall months and probably reached the estuary prior to the trapping period.

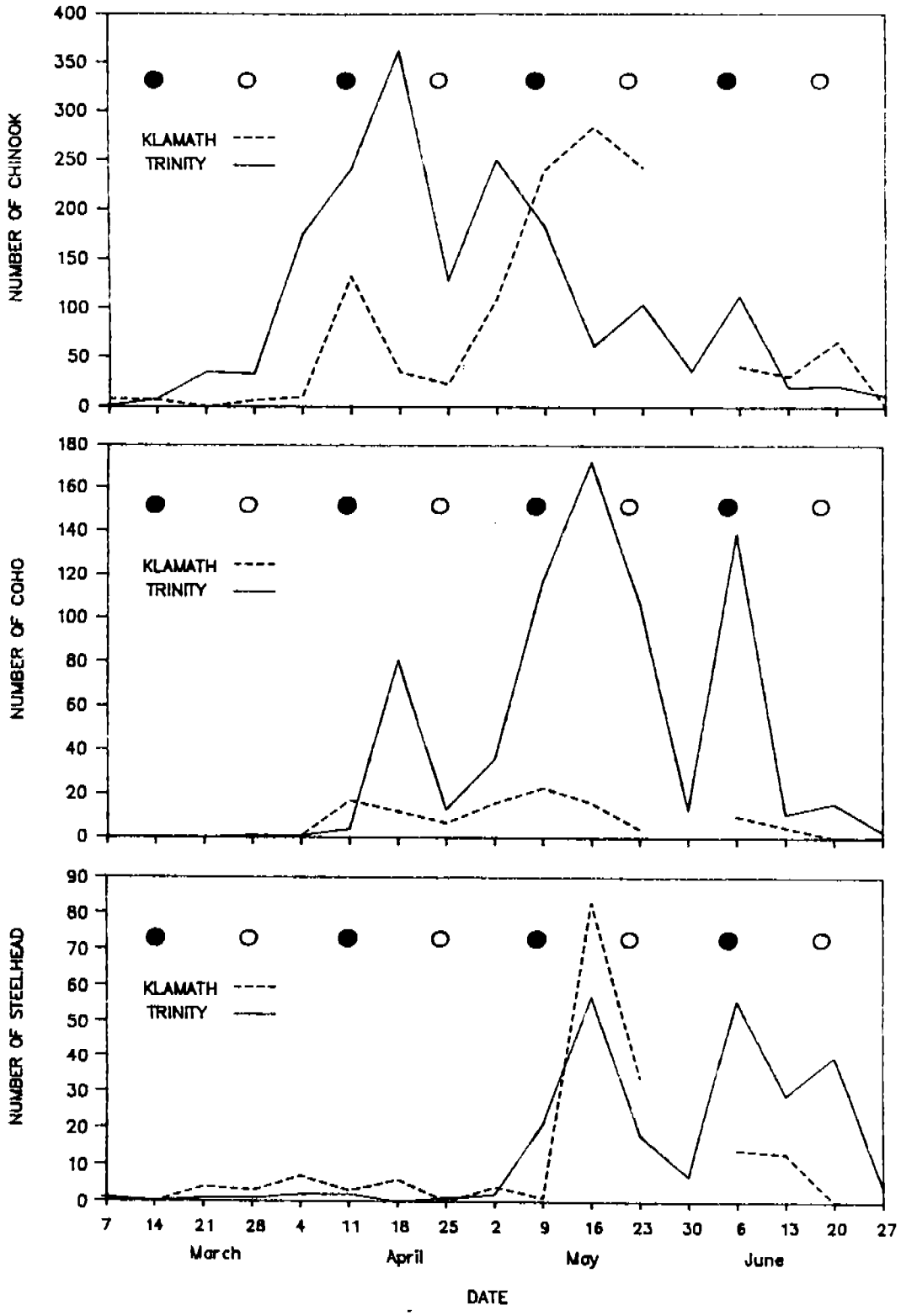

Figure 3. Weekly catch per effort of chinook, coho and steelhead captured in the frame net at the Klamath and Trinity River sites in relation to the Lunar phase (○ full ● new).

Table 1. Weekly catch number (n), mean fork length (x FL (mm)) standard deviation (s) and mean volume (x vol (ml)) of salmonids captured in the frame net at the Big Bar site, Klamath River.

	Chinook Salmon				Coho Salmon			Steelhead Trout		
Week 1/	n	$\bar{x}$ Fl	s	$\bar{x}$ Vol	n	$\bar{x}$ Fl	s	n	$\bar{x}$ Fl	s
10	8	36.5	1.41		0	---	---	0	---	---
11	7	36.1	2.27		0	---	---	0	---	---
12	0	---	---		0	---	---	4	84.3	11.33
13	7	39.0	3.79		0	---	---	3	77.0	10.44
14	10	42.2	5.59		1	---	---	7	71.6	2.99
15	133	41.3	3.63		17	36.4	1.91	3	78.7	6.43
16	35	47.1	10.11	2	12	37.9	4.52	6	78.5	10.75
17	23	53.9	7.73	---	7	38.0	14.20	0	---	---
18	110	54.7	11.94	3	16	47.7	4.09	4	35.3	11.33
19	240	62.7	13.68	3	23	45.8	7.48	1	29.0	---
20	284	63.2	15.57	4	16	51.6	8.90	83	29.7	1.56
21	242	69.2	14.00	4	4	56.3	6.70	34	31.7	5.28
22										
23	41	76.4	11.16	6	10	62.4	8.69	14	35.2	6.52
24	31	76.1	14.58	5	5	59.6	6.77	13	45.1	32.13
25	66	74.6	9.22	6	0	---	---	0	---	---
26	1	---	---	---	0	---	---	0	---	---

1/ Statistical week 10 began on March 6, and ended on March 12, 1988.

Table 2. Weekly catch number (n), mean fork length (x FL (mm)) standard deviation (s) and mean volume (x vol (ml)) of salmonids captured in the frame net at the McIntosh Quarry site, Trinity River.

	Chinook Salmon				Coho Salmon			Steelhead Trout		
Week 1/	n	$\bar{x}$ Fl	s	$\bar{x}$ Vol	n	$\bar{x}$ Fl	s	n	$\bar{x}$ Fl	s
10	1	---	---		0	---	---	1	---	---
11	8	37.5	3.12		0	---	---	0	---	---
12	35	38.3	2.18		0	---	---	1	---	---
13	33	42.0	3.78		1	---	---	1	---	---
14	168	41.5	4.47		1	---	---	2	97.5	81.32
15	241	42.4	4.69		4	42.5	4.80	2	130.0	70.71
16	363	52.9	11.19	3	81	41.7	4.74	0	---	---
17	128	56.0	7.59	5	13	50.2	7.47	1	---	---
18	250	57.3	8.95	3	36	50.6	5.97	2	68.5	57.27
19	183	56.1	9.16	3	117	50.6	4.82	21	51.4	36.43
20	62	54.6	8.53	3	172	53.0	4.77	57	31.4	6.29
21	104	57.4	8.93	4	107	54.0	4.11	18	49.0	24.95
22	36	58.1	11.28	5	13	53.6	3.86	7	45.6	10.11
23	113	59.0	10.17	4	139	57.9	5.65	56	51.3	6.04
24	20	74.3	13.33	5	11	59.4	6.99	29	49.6	6.23
25	22	69.6	10.12	5	16	62.3	4.84	40	51.9	4.95
26	12	65.6	10.16	4	3	63.7	6.51	4	50.0	5.77

1/ Statistical week 10 began on March 6, and ended on March 12, 1988.

Coho Salmon

Coho salmon were the least abundant (n=111) salmonid in the Klamath River trap (Table 1). The first coho was trapped on April 8 and the peak weekly catch (23) of coho occurred the week of May 9. The catch trend shows three peak pulses, and although the catch numbers were small, the first two peaks (week of April 11 and May 16) coincided with the first two chinook and steelhead catch peaks (Figure 3). The high catch period was similar to coho from the Trinity site, although fewer numbers were caught at the Klamath site.

Mean fork length of coho increased from 36.4 mm (week of April 11) to 59.6 mm (week of June 13). However, mean weekly fork length did not increase during April (range 36.4 - 39.0 mm); the majority of coho captured were recently "buttoned up" (absorbed their yolk sacs) fry. The size of these coho suggests they were of natural origin, since Iron Gate Hatchery releases of coho are yearlings. Small (<50 mm) coho were also trapped in May and June.

At the Trinity River site, coho salmon were the second most abundant (714) salmonid captured in the trap (Table 2). There were three distinct weekly peak catch periods, April 19, May 17 and June 7. The largest weekly catch (172) occurred during the week of May 17. The first peak coincided with the highest chinook weekly catch of April 12; however the two largest coho peaks came after the largest chinook peak. Coho and steelhead peak catches occurred on the same weeks (May 17 and June 7).

The mean size of Trinity coho were larger than Klamath coho during March, April and early May (Table 1 and 2). Statistical comparison of weekly mean fork lengths indicated that Trinity coho were larger ($p>0.05$) during the weeks of April, early May. After mid-May, Klamath coho were slightly larger. These differences may not be unusual since emergence times and environmental conditions may differ between basins. However, due to small sample sizes, length comparisons between sites after mid-May necessitates caution since Klamath captures of coho decreased while Trinity coho catches remained relatively higher.

Despite these complicating factors, the trapping results indicate that natural coho recruitment is occurring in both rivers. The majority of coho captured were young-of-year and it is uncertain whether the appearance of coho in the traps represents active migration or passive drift with the current. Typically, coho salmon in California spend about a year in freshwater residence prior to ocean entry.

Steelhead Trout

The first Klamath River steelhead was trapped on March 23. The season total catch was 171. Most steelhead (122) were captured during May, with the peak weekly catch (83) occurring during May 17-20. For March and April, only 7 and 16 steelhead were caught, respectively. These fish were all believed to be age 1+; the forklengths ranged between 65 mm and 99 mm. In May, most of the steelhead were age 0. The size range of the 122 steelhead captured in May was 25 mm to 49 mm.

The steelhead catch pattern at the Trinity site was similar to the Klamath (Figure 3). Of 241 steelhead captures, 3 were trapped during March, 5 in April, 97 in May and 136 in June. Many of the steelhead were yearling-size. The average size of steelhead during the two major peak weeks (May 17, and June 7) was 31.4 mm and 51.3 mm, respectively (Table 2).

At both sites, age 1+ steelhead were captured during March and early April. Thereafter, the mean size of steelhead decreased, reflecting the appearance of recently emerged steelhead fry. The scarcity of larger steelhead (>100 mm) in May and June may suggest that migratory age 1+ trout have outmigrated or were avoiding the traps. Seining efforts during these months captured large juveniles. Although the traps captured larger steelhead in March and April, river flows were less in May and June, which may have affected capture of this species. However, mean water velocity through the frame nets were higher during May and June than in March and April.

Freshwater residence of juvenile steelhead is variable and seaward migration may occur throughout the year. For the 1988 trapping period, May and June were the major catch months for both river basins. Most of these steelhead were fry size and it is unknown whether they are drifting actively or passively with the current.

Other Species

Non-salmonid species were also trapped at both sites, and were common throughout the season. Juvenile lamprey (*Lampetra* sp.), three-spine stickleback (*Gasterosteus aculeatus*) and sucker (*Catostomus* sp.) were the most common non-salmonids caught in the traps. Other species trapped included speckled dace (*Rhinichthys osculus*) and sculpins (*Cottus* sp.). Species trapped only at the Klamath River site included green sturgeon (*Acipenser medirostris*), golden shiner (*Notemigonus chrysoleucas*), bullhead (*Ictalurus* sp.) and bluegill (*Lepomis macrochirus*).

Effect of Flow on Catch

Chinook catch versus river discharge are shown in Figure 4 for the Klamath and Trinity Rivers. It appears that river discharge did not influence the chinook catch although, in early June, high flows probably accelerated downstream migration of salmonids. River discharge increased from 106.1 cms (3,750 cfs) on May 27 to 254.7 cms (9,000 cfs) and receded to 185.4 cms (6,550 cfs) by June 7. Trapping at both sites was curtailed during this time period. When trapping was resumed, a decline in catch at both sites was observed.

Effect of Water Temperature on Catch

The Klamath and Trinity River temperature profiles were virtually identical (Figure 4). The diurnal temperature ranges were wider on the Trinity River which may be related to the greater volume and rate of flow in the Klamath River which acted to stabilize water temperatures. At both sites, the maximum daily water temperatures were less than 19 C during the peak chinook migration periods. From early May through the latter part of the month, the water temperatures were increasing gradually. During the last week of May, seasonal storms raised river discharge and lowered water temperatures to about 11 to 13 C. After June 10, the temperatures increased quickly.

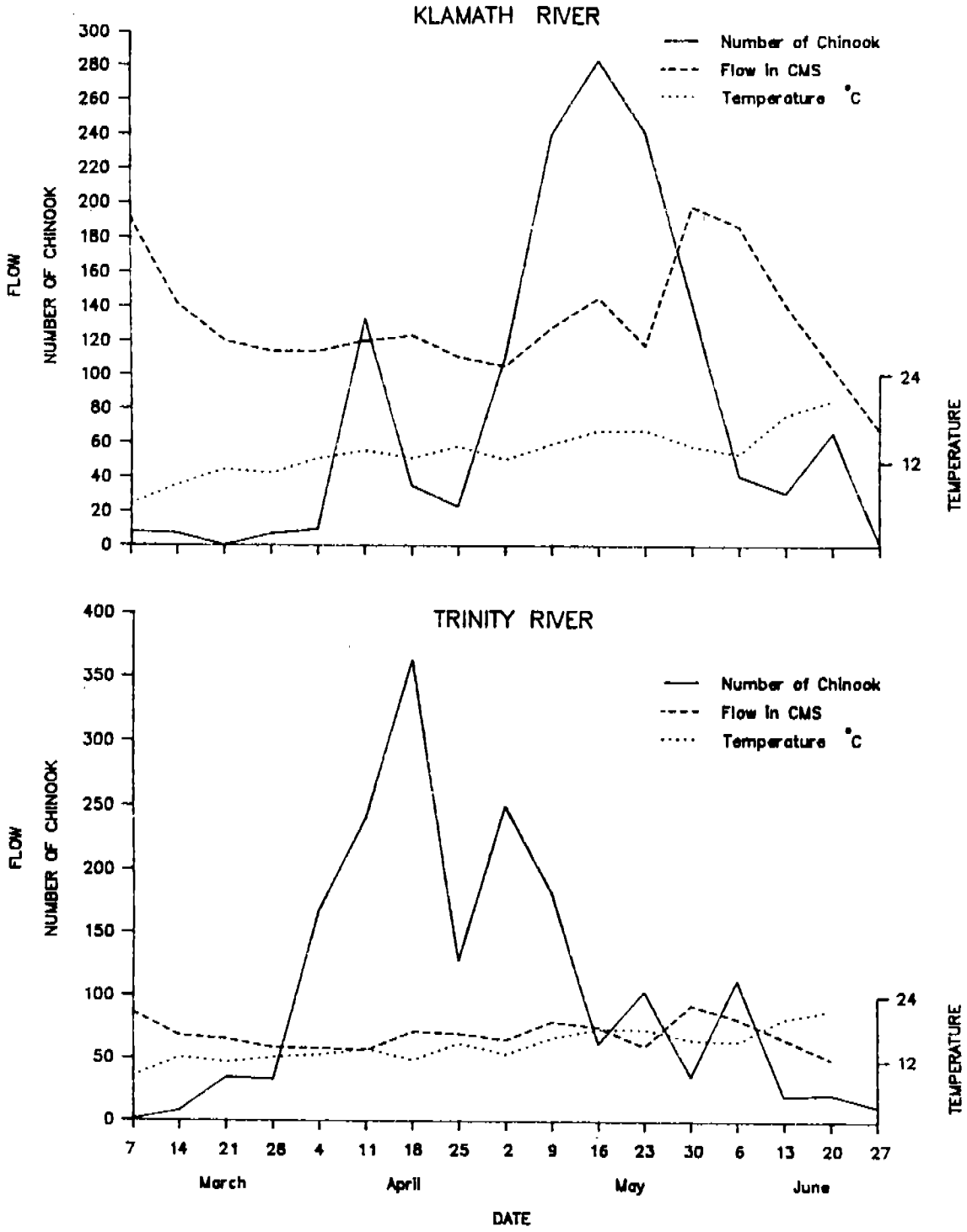

Figure 4. Water temperature, river discharge and number of chinook captured in the frame net at the Klamath and Trinity River sites.

Between April 25 and June 10, the chinook catch success appeared to be independent of water temperature. After June 10, the chinook catch dropped considerably; the higher river temperatures may be defining an migratory "window" for chinook. Seining efforts in June indicated that juvenile chinook were still common adjacent to both trapping sites, but not appearing in any sizeable numbers in the traps at either site. Also, rising water temperatures may have forced chinook to seek deeper, cooler habitats not sampled by the trap or seine which would partially explain the overall decline in salmonid abundance.

Effect of Lunar Cycle on Catch

The full and new moon phases are diagrammed in Figure 3. The full moon occurred on April 2, May 1, May 31 and June 29; while the new moon occurred on March 17, April 16, May 15, and June 14, 1988.

The relationship between lunar phase and salmonid migration was not apparent during March, possibly due to low catch numbers. From April through early June, the higher weekly C/E periods coincided with the new moon phases. The lowest C/E periods coincided with the full moon phases. This relationship was observed for the three salmonid species at both trapping sites.

Population Estimates

In addition to collecting information on migration timing and general bioloigal data, the juvenile sampling was designed to estimate the number of juvenile outmigrants or if the numbers cannot be estimated, develop an indice of fish abundance. However, the first years data would serve more as pilot to guide development of future techniques and to test the feasibility of such an endeavor. Questions to be answered the first year included whether the sample sites were appropriate, the nets would adequately sample the fish populations and the best method to determine trap efficiency.

The criteria used to select a sampling site included: 1) whether the majority of the adult spawning occurred upstream, 2) the location was accessable yet secure such that the equipment wasn't vandalized and 3) the flow conditions were appropriate for the equipment. The sites described in the methods fulfill the above requirements and should serve as long term sampling areas.

For the first year, a frame net was used to sample the fish populations. This sampling gear had several negative aspects. First the net was difficult to set in higher water velocities (above 3.5 ft per sec). Not being able to sample in higher velocities may have allowed larger fish to avoid the net. Also, the nets tended to fill with debris which reduced their trapping efficiency. The nets were at the mercy of fluctuating flows particularly during storm events. The increased water force against the nets would pull the anchors from the substrate and the nets would drift downstream. To reliably sample these rivers, a floating trap would be required.

To estimate trapping and trap efficiency, three methods were used; proportion of river trapped (by volume), mark/recapture and the catch of ad-clipped chinook. The proportion of river trapped was calculated by measuring the mouth area of the trap in water then multipling that measurement by the water velocity in the trap. This gave the volume of water trapped. The amount of

water trapped was then divided by the river discharge to estimate the proportion of river trapped. Generally the volume of water trapped ranged between 1 to 3 percent (Tables 3 and 4). To estimate the number of fish migrating past the sampling station, the number of fish trapped was divided by the proportion of river trapped. This data resulted in estimates of 114,000 and 58,000 hatchery and naturally produced chinook migrating past the Klamath and Trinity trap sites, respectively.

A simple Petersen mark-recapture estimate was also used to estimate trap efficiency. Three estimates were completed at each trap site (Tables 3 and 4). Because of the low number of recaptures (Table 5), the results were combined to yield one efficiency for each site. The efficiency was 0.9% for the Klamath site and 0.4% for the Trinity site. The efficiency was then used to estimate the number juvenile chinook migrating past the trapping site. This data resulted in estimates of 265,000 and 774,000 chinook migrating past the Klamath and Trinity trap sites, respectively.

Chinook numbers based on the proportion of river trapped and mark-recapture appeared to substantially under estimate the true population. In 1988, Iron Gate Hatchery released over 11 million fingerling chinook and Trinity River Hatchery released over 5 million fingerling chinook. It is unlikely that all of these died prior to reaching the trap sites. We suspect that the fish are able to avoid the frame net which would explain the under estimate produced using the proportion of river trapped. The mark-recapture estimate should not have been influenced by trap avoidance if the marked and unmarked fish were equally vulnerable to capture. The marking stress may have rendered these fish less able to avoid the trap and violated the assumption of equal vulnerability to capture which would cause the population to be underestimated.

The third method to estimate the number of fish migrating past each trap site to was use the change in ratio of ad-clipped released at the hatchery and at the trap site. The information would yield an estimate of the naturally produced juvenile chinook which could be added to number fish released from the hatchery to estimate the total number of fish passing the trap site. Of 2,823 chinook fyke-trapped, 9 fish (0.32%) of the catch was ad-clipped. Three ad-clipped chinook were trapped at the Klamath River site, one chinook on May 10, and two on June 9, 1988 (Table 6). The CWT recovered from the first chinook was a full length tag that had been cut in half and was illegible. The latter two chinook had no tags. Six ad-clipped chinook were trapped at the Trinity River site; two on June 8 and four on June 21. The two chinook captured on June 6 were 70 mm and 82 mm in length and were from the 6-61-47 release group from the Saw Mill Pond site (2,183,000 unmarked and 186,000 CWT released May 23, 1988). The four ad-clipped chinook trapped on June 21 were lost during transport. Because of the low number of cwt fish recovered in the frame net at either site, no estimate could be generated.

ESTUARY MONITORING

Chinook Salmon

From July 25, to September 19, 1988, 2,569 juvenile chinook salmon were captured in the seine (Table 7). Lengths were recorded from 630 chinook, and volumetric displacements taken from 135 chinook. The mean fork length of

Table 3. The estimated number of juvenile chinook migrating past the Klamath River trapping site based on two methods: the volume of water trapped and mark-recapture.

Week of	Klamath Flow	Volume Trapped	Number Of Chinook	Estimated Chinook	
				Volume	Mark Recapture
3/21	4236		0		0
3/28	4016	81.7	7	602	1361
4/4	4024	72.7	10	969	1944
4/11	4244	95.3	133	10365	25861
4/18	4358	87.0	35	3068	6806
4/25	3904	121.0	23	1299	4472
5/2	3708	90.1	110	7922	21389
5/9	4512	111.2	240	17049	46667
5/16	5128	100.0	284	25486	55222
5/23	4160	91.0	242	19360	47056
5/30	7005	122.3	142	14183	27514
6/6	6584	70.6	41	6691	7972
6/13	4972	111.7	31	2415	6028
6/20	3670	85.2	66	4978	12833
6/27	2366	70.2	1	59	194
Total			1365	114447	265319

Table 4. The estimated number of juvenile chinook migrating past the Trinity River trapping site based on two methods: the volume of water trapped and mark-recapture.

Week of	Trinity Flow	Volume Trapped	Number Of Chinook	Estimated Chinook	
				Volume	Mark Recapture
3/21	2310	68.8	35	1176	15313
3/28	2064	70.2	33	971	14438
4/4	2044	66.4	168	5172	73500
4/11	2002	70.2	241	6873	105438
4/18	2532	76.2	363	12070	158813
4/25	2456	67.7	128	4646	56000
5/2	2300	68.4	250	8406	109375
5/9	2816	85.0	183	6066	80063
5/16	2660	67.9	62	2431	27125
5/23	2128	75.4	104	2937	45500
5/30	3290	65.1	36	1819	15750
6/6	2914	75.3	113	4371	49438
6/13	2342	77.1	20	608	8750
6/20	1762	78.9	22	492	9625
6/27	1678	59.3	12	340	5250
Total			1770	58377	774375

Table 5. Recovery rate of marked fish used to estimate trap efficiency.

Date	Location	Marking Method	Number Released	Number Recovered	Recovery Rate
May 3	Klamath	Stain	404	2	0.005
May 16	Klamath	Stain	681	9	0.013
June 13	Klamath	Finclip	63	0	0.000
May 9	Trinity	Stain	710	2	0.003
June 7	Trinity	Stain	706	3	0.004
June 20	Trinity	Finclip	817	0	0.000

TABLE 6. Coded wire tag (CWT) recoveries during the 1988 juvenile production monitoring program.

Tag Code	Brood Year	Race	Hatchery[1/] of Origin	Release[2/] Type	Number CWT Released	CAPTURE NUMBER AND LOCATION				
						Estuary	Klamath River Frame	Klamath River Seine	Trinity River Frame	Trinity River Seine
B6-02-01	1987	Fall	IGH	F	185,000	1	---	---	---	---
06-56-33	1987	Fall	AP	F	189,000	20	---	---	---	4
06-59-37	1987	Fall	IGH	Y	100,000	1	---	---	---	---
06-61-47	1987	Spring	SMP	F	186,000	5	---	---	2	7
06-63-31	1987	Fall	KCSC	Y	10,943	---	---	1	---	---
TOTAL TAGS						27	1[3/]	1	2	11
AD-CLIPPED FISH WITH NO TAGS						0	2	4	0	3
TOTAL						27	3	5	2	14

1/ AP - Ambrose Pond - Trinity River
IGH - Iron Gate Hatchery - Klamath River
KCSC - Kelsey Creek Spawning Channel - Klamath River
SMP - Saw Mill Pond - Trinity River

2/ F (Fingerling) - May or June release
Y (Yearling) - Late September to December release

3/ Illegible tag

Table 7. Weekly catch of chinook salmon, number of hauls, catch per effort (C/E), tidal stage, mean fork length (x mm), standard deviation (s) and range of fork lengths (mm).

Week[1/]	n	Total	Hauls	C/E	Tide[2/]	$\bar{x}$	s	range
30	63	301	6	50.2	I	92.8	8.23	74/115
31	58	322	4	80.5	0	94.4	8.08	81/120
32	65	508	3	169.3	I	99.9	11.25	76/138
33	74	517	5	103.4	0/LS	98.2	8.50	77/120
34	65	224	4	56.0	I	103.4	9.20	87/131
35	53	79	3	26.3	0	106.3	8.07	91/126
36	62	134	4	33.5	I	111.6	11.92	89/171
37	123	334	4	83.5	0	114.2	12.28	89/171
38	67	150	3	50.0	HS/0	119.7	11.38	91/143

1/ HS - High Slack I - Incoming Tide
LS - Low Slack 0 - Outgoing Tide

2/ Statistical week 30 began on July 17 and ended on July 23

chinook measured during the first week was 92.8 mm and increased to 119.8 mm by the last week of sampling and ranged from 74.0 to 171 mm. The highest catch per effort was on August 8. The tidal stage did not appear to influence catch success (except on August 29, 1988, noted below). Sampling sites within the study area were seined routinely throughout the nine-week period. Catch success of these specific sites were highly variable. The largest single haul ranged from 39.5% to 88.4% of the total daily catch. For the entire season, 57.1% of the catch was attributed to the sum of the largest single hauls. The presence of chinook at specific sites was not predictable, but the general locale yielded fairly uniform catches throughout the monitoring. The low number (79) of chinook captured on August 29 was due to sampling difficulties resulting from an extreme outgoing tide. The frequency of sampling did not allow reliable inferences about potential distribution and movement patterns of juvenile chinook.

Other Species

One juvenile coho salmon, four juvenile steelhead trout, and one adult cutthroat trout (*Oncorhynchus clarki*) were the only other salmonids captured. Anchovies (*Engraulis sp.*) were common in the estuary during July and August. On August 8, an estimated 3,000 anchovies were captured in the seine. Anchovies were absent in the catch in September. Juvenile starry flounders (*Platichthyes stellatus*) were also captured frequently.

Coded-Wire-Tag Recoveries

Of 2,269 chinook examined for ad-clips, 35 were ad-clipped, for a rate of 1.5%. From these 35 fish, 27 CWT's were recovered; seven of the ad-clip chinook had shed their CWT tags and one CWT was lost. The 06-56-33 code was the most common (n=21), followed by four chinook with 06-61-47, one 06-59-37, and one B6-02-01 (Table 7). The 06-61-47 code group chinook were caught on July 25, August 1, 8, and 16, 1988. The Department's estuary sampling recovered two chinook from this group in August and one in September (M. Pisano, Personal Communication, March 1989). One chinook 06-59-37 originated from Iron Gate Hatchery and was tagged during May 1988. This fish was caught in the estuary on 8/16/88 and appearantly escape early as it was not scheduled for release until October 19-26, 1988.

CONCLUSION

One season of monitoring was insufficient to draw inferences on basin productivity, migration behavior and growth. This season served to define the needed refinements in the juvenile sampling. The trapping method was the area that need the most modification as the frame nets were difficult to fish and did not produce adequate sample sizes. In 1989 rotary screw traps will be used instead of the frame nets. Preliminary information from the spring 1989 sampling suggest the floating rotary traps will catch sufficient numbers of fish such that the long term goals of the project can be obtained.