ANNUAL PERFORMANCE REPORT

FEDERAL AID IN SPORT FISH RESTORATION ACT

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Project No. 17: Klamath River Basin Juvenile Salmonid Investigations

Job No. 1 & 2: Natural vs Hatchery Proportions of Juvenile Salmonids Migrating through the Klamath River Estuary *and* Monitor Natural and Hatchery Juvenile Salmonid Emigration From the Klamath River Basin

Period Covered: July 1, 2001, through June 30, 2002

I. Summary: During the past year the Natural Stocks Assessment Project (NSA) continued to monitor juvenile salmonid emigration through the Klamath River estuary to assess their relative abundance, emigration patterns and natural vs hatchery proportions. During 2001, natural origin fish accounted for 88% of the young-of-the-year Chinook (yoy) captured in the lower Klamath River estuary and 92% captured in the upper estuary. Median travel times of captured coded-wire tagged Chinook from hatchery to estuary were 32 days for Iron Gate Hatchery (IGH) fall Chinook, 12 days for Trinity River Hatchery (TRH) spring Chinook and 30 days for TRH fall Chinook. The travel time of IGH Chinook was intermediate to past years. Travel time was the fastest on record for TRH spring-run Chinook and the second fastest on record for TRH fall-run Chinook. We again noted that smaller fish took longer to emigrate from the basin than larger ones. June and July was the time when the greatest proportion of hatchery Chinook was present in the estuary. Natural Chinook abundance in the upper estuary and lower estuary was about average compared to past years. Mean fork-length of Chinook salmon was below average in both the upper and lower estuary compared to past years. The abundance of yearling coho in 2001 was above average in the upper estuary and below average in the lower estuary compared to past years. Of the 203 yearling coho salmon smolts NSA captured through June 30, 2002, 126 (62.1%) were released from TRH, 7 (3.4%) were released from IGH and 70 (34.5%) were natural fish. Natural origin coho comprised 34.5% of our yearling coho catch in 2002 compared to 26.8% in 2001 and 39.1% in 2000. The abundance of juvenile steelhead in 2001 was below average in the upper and lower estuary compared to past years. Of the 362 steelhead we captured through June 30, 2002, 48 (13.3%) were hatchery origin fish. All juvenile coastal cutthroat trout in our catches were natural origin fish. Their abundance in 2001 was above average in the upper estuary and below average in the lower estuary compared to past years. Their average length of estuary residence was 14 days and ranged from 7 - 28 days.

II. Background: Salmonid resources in the Klamath River have declined from historical levels (Klamath River Task Force 1991). Many factors such as dams, water diversion, logging, mining, over fishing, agriculture, grazing and hatcheries have been identified as contributing to this decline (Klamath River Task Force 1991; Nehlsen et al. 1991). In response to the State's shrinking salmonid population California enacted Senate Bill 221 to mandate that the California Department of Fish and Game (CDFG) maintain and enhance natural habitats to double the natural production of salmon and steelhead stocks by the year 2010. Also, coho salmon are presently listed as threatened under the Endangered Species Act and numerous other salmonid stocks in the Klamath-Trinity basin have been considered for threatened or endangered species status by the National Marine Fisheries Service (NMFS).

Information is needed to develop strategies to stop the declines in salmonid populations and gage the success of recovery plans implemented by the CDFG, NMFS and others. Presently, salmonid management in the Klamath-Trinity basin is largely based on adult escapement to the basin and its' hatcheries. The juvenile life history of anadromous salmonids in the basin has not been adequately described, especially for naturally produced fish. A thorough understanding of their juvenile life history is necessary for proper management to protect, restore, and enhance these stocks in order to meet SB 221's mandate and to avoid further Federal listings. Information on the relative abundance and survival of the juvenile stages of natural salmonid stocks would help improve management strategies by isolating the effects of in-river conditions from ocean conditions on salmonid survival. This would allow managers to identify in-river factors that reduce juvenile survival and take steps to remedy them thereby increasing natural salmonid production.

A basic need for the investigation of natural stocks is the ability to distinguish them from hatchery stocks. Recently, hatchery production has been cited as contributing to the decline of natural salmonid production (Klamath River Task Force 1991; Nehlsen et al. 1991). In the mid 1990's CDFG altered some of their hatchery practices in the Klamath basin to attempt to minimize competition between natural and hatchery salmonids. Some of these changes include universal marking of hatchery coho salmon and steelhead trout, setting and enforcing constraints on the number of eggs collected and juveniles released by hatcheries, and discontinuing the practice of releasing pre-smolt Chinook salmon. Also, CDFG and the Hoopa Valley Tribe have recently begun a constant fractional mark program for Chinook salmon at Trinity River Hatchery. Continued monitoring of juvenile salmonids is needed to assess their response to these recent changes.

One way to gage the success of these new management strategies is to see if the trend of relative abundance and/or proportion of natural juvenile salmonids increase after these strategies are implemented. However, little of this type of information exists for Klamath basin salmonids. Wallace (1993), reported that hatchery marked Chinook salmon were captured in the Klamath River estuary throughout much of the year and that peak catches of juvenile salmonids corresponded to peak catches of hatchery marked fish. The U.S. Fish and Wildlife Service (USFWS) reported that between 1992 and 1996, Iron Gate Hatchery (IGH) fingerlings comprised between 19 and 62% of young-of-the-year (YOY) Chinook migrating past their trap in the Klamath River at Big Bar and that Trinity River Hatchery (TRH) fingerlings comprised between 11 and 42% of the YOY Chinook migrating past their trap in the Trinity River at Willow Creek (USFWS 1998; USFWS 1999). USFWS also reported that TRH steelhead comprised between 15 and 76% of their steelhead catches and TRH coho salmon comprised between 26 and 90% of their coho catches at their Trinity River trap (USFWS 1998; USFWS 1999). However, their Big Bar and Willow Creek trapping sites are located roughly 50 and 60 miles, respectively, above the estuary and therefore miss the contribution of natural fish produced downstream of their sites. Beginning in 1993, (excluding 1995) the CDFG's Natural Stocks Assessment Project (NSA) established standard sampling sites and methodologies in the Klamath River estuary to monitor natural and hatchery juvenile Chinook emigration and to compare annual changes in the proportion, relative abundance and size of juvenile salmonids emigrating from the Klamath-Trinity basin. From 1993 to 1997, NSA estimated that natural origin Chinook salmon comprised 49 to 84% of their annual catches of YOY Chinook salmon in the Klamath estuary (CDFG unpublished data). They also found that in 1997 roughly 66% of their coho salmon catches were comprised of natural origin fish (CDFG unpublished data).

The purpose of this study is to continue monitoring the proportion of natural vs. hatchery salmonids emigrating from the basin to ascertain if rehabilitation efforts or new management strategies result in increased contributions of natural origin salmonids and to make CDFG's past data available to other researchers. We will also continue to monitor juvenile salmonid relative abundance, emigration timing, and average size to gage their response to changing management strategies. Gathering this baseline data will allow fishery managers to evaluate fish recovery plans by 1) gauging the relative change in proportion of at risk natural stocks; 2) evaluating possible impacts of hatchery fish on natural stocks; and 3) identifying the effects of adaptive management strategies (i.e. different flow schedules from basin dams and modifications in basin hatchery practices) on natural stocks.

III. Objectives:

1) To determine the annual proportion of natural vs. hatchery juvenile salmonids captured in the Klamath River estuary.
2) Compare trends in natural proportions over time.
3) Monitor annual emigration timing and patterns of juvenile salmonids leaving the Klamath River basin.
4) Determine sizes of juvenile salmonids annually leaving the Klamath River basin.
5) Try to determine if changes in juvenile salmonid emigration is due to specific natural or man-made events.

IV. Procedures: We defined the estuary as the lower four miles of the river normally subjected to tidal influence. The estuary is divided into an upper and lower section demarcated by Hunter Creek near river mile 1.5. Also, beginning in 1993, (excluding 1995) we established standard sampling sites and methodologies in the estuary to monitor natural and hatchery juvenile Chinook emigration and to compare annual changes in relative abundance and size of juvenile salmonids occurring there. We attempted to capture juvenile salmonids one day/week in each section from March through September to determine the relative abundance and average size of juvenile salmonids. We also performed a mark recapture study to determine the length of estuarine residence of juvenile sea-run coastal cutthroat trout.

We sampled the upper estuary at night with a Smith-Root SR-18 electrofishing boat. In the upper estuary we established and sampled the same four transects each year. We attempted to shock them once a week for up to 10 minutes each. We calculated catch-per-unit-effort (CPUE) as the number of fish captured per minute shocked. In the lower estuary we sampled five standard sites once a week with a 45.7 m X 3.1 m X 6.4 mm mesh beach seine deployed from the bow of a 4.9 m boat. We calculated the CPUE as the number of fish captured per 1000 ft^2 seined. These standard sampling sites allowed us to compare trends of natural Chinook proportions and juvenile salmonid abundance in the 2001 field season to those from previous years (CDFG 1994; CDFG 1996; CDFG 1997; CDFG 1998; CDFG 1999, CDFG 2000; CDFG 2001). During 2000 and 2001 we added 3 sites to our quantitative samples, in part, to investigate the importance of the cool water plume at the mouth of Hunter Creek to rearing juvenile salmonids. Unless otherwise stated I excluded catches from these new sites when we compared 2000 and 2001 salmonid abundance to past year's estimates. However, I did not exclude these sites when calculating and comparing the natural to hatchery fish ratio or average fish size. In 2002 we stopped two of these new sites adjacent to the mouth of Hunter Creek. I excluded the one remaining new site from our abundance estimate in 2002 but did include it when describing natural to hatchery fish ratio and average fish size.

Captured juvenile salmonids were narcotized with alka-seltzer prior to measurements. Field crews recorded fork lengths (FL) each week to the nearest millimeter (mm) for up to 30 fish per salmonid species per sampling location. We collected scales from the left side of the fish just above the lateral line and just posterior of the insertion of the dorsal fin from 10 fish per species per week in the upper and lower estuary. All fish were identified, counted and examined for fin clips and marks. All adipose fin clipped Chinook were retained to recover coded-wire tag information to evaluate the emigration patterns of known origin hatchery fish.

Field crews inserted visual implant (VI) tags into the anal fins of juvenile coastal cutthroat trout to determine their length of estuarine residence. Field crews also applied a secondary mark to assess VI tag retention by using a MadaJet needleless dental inoculator to inject alcian blue stain (65mg/mL aqueous solution) into the caudal fin of the fish. All recaptured project marked fish were counted, measured, its' VI tag code recorded, and released. Crews also collected scale samples from project marked fish at large for at least one week.

I made weekly estimates of the number of hatchery Chinook salmon in our sample by multiplying the number of fish captured in each tag code by its ratio of untagged to tagged fish reported by basin hatcheries (Table 1). However, to increase the sample size of CWT Chinook I pooled all tag codes into one of three groups, IGH, TRH fall and TRH spring to estimate their contribution. Any Chinook not accounted for by hatchery expansion were assumed to be of natural origin. In weeks when the estimated number of hatchery Chinook exceeded the actual number of fish captured, I used the actual number of fish captured as the number of hatchery fish present. Also, if there was more than one tag group represented during those weeks I "pro-rated" the number of each group by their percentage of expected occurrence. For example, the untagged to tagged ratio of each group in 2001 was roughly 25:1 for IGH fall-run, 3:1 for TRH fall-run and 3:1 for TRH spring-run (Table 1). Therefore, if we captured one CWT fish from each group I assumed a total of 31 hatchery fish were present in our catch. However, if we captured one fish from each tag group but only had 20 fish in our catch, I assumed

Table 1. Total number of Chinook salmon released and coded-wire tagged from Klamath basin hatcheries and expansion factors used to determine the hatchery component of emigrating Chinook in the Klamath River estuary, 2001.

HATCHERY	UNMARKED FISH	TAGGED FISH	EXPANSION FACTOR
Trinity River (spring-run)	743,174	228,842	3.25:1
Trinity River (fall-run)	1,622,641	522,316	3.11:1
Iron Gate	4,752,580	187,417	25.36:1
Trinity River Yearlings (fall-run)	655,495	216,593	3.03:1
Iron Gate Yearlings	865,310	91,220	9.49:1

all were hatchery fish but attributed 25/31 (80.6%) of the catch to IGH (.806*20=16.1) or 16 out of 20 fish to IGH. I then followed the same steps to allocate the number captured to the other groups of fish. I then summed the weekly estimates to determine the total portion of captured Chinook which were of hatchery origin by month and season. Estimates of natural origin coho salmon and steelhead in our catch were much easier since all hatchery origin fish were marked.

I also calculated the median days at liberty (DAL) for each salmon tag code by determining the number of days between their hatchery release date and their capture date in the estuary (Table 2). For hatchery marked fish released over multiple days I used the mid-point of release dates as the release date. I feel the mid-point release date must be within 7 days of the entire range of release dates in order for a meaningful travel time to be calculated.

V. Findings: River flows in the Klamath-Trinity basin in 2001 were extremely low which appeared to have the following detrimental effects on juvenile salmonids leaving the basin;1) juvenile salmonid abundance was below average compared to past years; 2) yoy Chinook were smaller than past years; 3) yoy Chinook emigration was earlier than past years, and; 4) there was a high incidence of disease (most notably *Ceratomyxa shasta* and a myxosporean parasite of the kidney) in yoy Chinook (Foott et al. 2002). Also, low winter river flows failed to completely scour the sill at the mouth of the Klamath River which, combined with low spring and summer river flows, allowed the sill to form at the river mouth earlier than past years. The sill and river mouth configuration prevented cool saltwater from entering the estuary for most of the summer and resulted in reduced areas of cool water refugia in the estuary in 2001. As a result NSA observed extremely large numbers of juvenile salmonids inhabiting the area adjacent to the mouth of Hunter Creek, the only area of cool water refugia in the estuary.

Chinook Emigration

Migration Rate - In 2001 the migration rate of IGH Chinook was intermediate to past years while TRH spring-run juvenile Chinook was the fastest on record and TRH fall-run Chinook the second fastest on record. The median DAL for Chinook from IGH was 32 days compared to 31, 30, 40, 43, 33, 26 and 52 days in 2000, 1999, 1998, 1997, 1996,

Table 2. Summary of young-of-the-year CWT juvenile Chinook salmon captured in the Klamath River estuary March-September 2001.

Release Site	CWT	Size at Release	No. Tagged	No. Released	No. Cap	Medi an DAL	Range DAL	AVG FL
	0601020305	90/lb	49,087	868,663	31	27	21-49	91.9
	0601020306	92/lb	48,954	869,863	15	34	16-58	92.6
IGH	0601020307	115/lb	44,238	1,742,500	5	30	23-37	90.6
	0601020308	164/lb	45,138	1,468,638	8	48	33-61	95.6
IGH TOTAL			187,417	4,949,664	59	32	16-61	92.5
	065260	33.3/lb	33,049	139,006	2	9	9- 9	106.1
	065262	33.3/lb	24,480	103,002	2	13	9-16	109.0
	065263	33.3/lb	34,385	139,236	2	13	9-16	101.0
TRH(s)	065264	42.0/lb	31,857	143,765	3	13	10-19	99.7
	065269	33.3/lb	52,491	212,540	4	11	9-16	104.8
	065270	42.0/lb	52,580	237,227	7	11	9-16	106.3
TRH SPRING TOTAL			228,842	974,776	20	12	9-19	104.7
	065265	56.5/lb	32,795	136,615	6	23	10-37	93.7
	065266	56.5/lb	33,806	137,340	6	19	9-37	95.5
	065267	56.5/lb	34,852	141,040	4	20	10-37	95.0
	065268	86.0/lb	33,240	136,834	10	33	16-79	89.3
	065271	56.5/lb	54,867	228,510	13	19	10-37	94.6
	065272	56.5/lb	36,035	150,105	10	24	9-44	95.3
TRH(f)	065273	56.5/lb	57,444	232,417	10	22	10-37	97.1
	065274	56.5/lb	32,096	129,893	8	31	9-44	97.9
	065275	56.5/lb	64,250	260,944	16	19	9-37	96.3
	065276	56.5/lb	27,159	110,356	9	25	16-39	96.4
	065277	86.0/lb	56,582	232,832	19	39	16-72	89.0
	065278	86.0/lb	34,183	140,711	14	52	16-79	91.9
	065643	65.6/lb	25,007	112,293	6	48	16-90	98.3
TRH FALL TOTAL			522,316	2,149,890	131	30	9-90	94.1
IGH	066351	10.0/lb	43,332	478,265	18	161	128-184	180.7
Yearling	066352	10.0/lb	47,888	478,265	22	156	128-184	181.6
IGH YEARLING TOTAL			91,220	956,530	40	158	128-184	181.2
TRH(f) Yearling	065259	11.5-12.7/lb	66,469	192,280	6	179	161-217	176.0

1994 and 1993, respectively. The median DAL of TRH spring-run Chinook was 12 days in 2001 compared to 17, 32, 35, 39, 19, 54, and 13 days in 2000, 1999, 1998, 1997, 1996, 1994 and 1993, respectively. The median DAL of TRH fall-run Chinook was 30 days in 2001 compared to 52, 75, 66, 59, 39, 71, and 28 days in 2000, 1999, 1998, 1997, 1996, 1994 and 1993, respectively. The larger size at release of TRH yoy Chinook probably contributed to their relatively fast emigration rates in 2001. Also, low river flows, that likely reduced mainstem rearing habitat, may also have contributed to their fast emigration rate (Wallace and Collins 1997).

Natural to Hatchery Ratio- The composition of natural to hatchery Chinook ratio in our catch was similar between the lower and upper estuary (Tables 3 and 4). During quantitative sampling from June through September, natural origin Chinook accounted for 87.1% of our catch in the lower estuary and 91.9% in the upper estuary. Overall estimates (upper and lower estuary catches combined) suggest that about 90% of the yoy Chinook captured by our project during 2001 were of natural origin (Table 4). The samples showed that hatchery origin Chinook comprised the greatest proportion of our catch during late June in the lower and upper estuary (Tables 3 and 4). This year the natural Chinook component was greater than last year and in fact was the highest composition for our surveys from 1993-2001 (Table 5). However, based on our yoy Chinook CPUE data the higher portion of natural origin Chinook was due primarily to the low abundance of hatchery Chinook in the upper and lower estuary (Table 6). Like past years, these estimates are tenuous because I based the expansions on a small number of CWT's (81 total). The 1997 through 1999 estimates should be the most reliable due to NSA's increased sampling effort and recovery of more CWT's compared to other years (Wallace 2000).

We sampled three additional sites in the lower estuary in 2001, two of which were adjacent to the mouth of Hunter Creek, a cool water tributary that enters the estuary at river mile 1.5. I did not include these three sites in our comparisons with past years because; 1) we did not sample these sites in past years; 2) they greatly inflated our annual CPUE estimates in 2001 (Table 7; Appendix 1 and 2); and 3) we were unable to sample the Hunter Creek sites after mid July due to high water covering our seining sites caused by sill formation at the river mouth. Also, hatchery origin Chinook composed a higher portion of our catch at these three sites compared to our historic five sites (Table 7). Most of the difference in percent composition was due to higher catches of IGH Chinook in the three new sites. IGH yoy Chinook composed 7.8% of our total Chinook catch in the five historic sites, but composed 18.4% of the total yoy Chinook catch in the three new sites. This suggests that for some reason IGH origin Chinook appeared to seek out the cool water of Hunter Creek relative to other stocks of Chinook salmon.

The natural to hatchery yearling Chinook ratio in our catches were higher in the lower estuary than the upper estuary, however, we captured most of the yearling Chinook in the upper estuary (Tables 8 and 9). Natural origin yearling Chinook accounted for 57.3% of our catch in the lower estuary and 37.1% in the upper estuary (Tables 8 and 9). Overall estimates (upper and lower estuary catches combined) suggest that about 40% of the yearling Chinook captured by our project during 2001 were of natural origin (Table 9). We probably only sampled the latter portion of the yearling Chinook emigration since they were present in large numbers when we first began sampling in March. Most of the yearling hatchery Chinook were from IGH (Tables 8 and 9). We

Table 3. Origin and portion of **young-of-the-year** Chinook salmon emigrating through the lower Klamath River estuary based on expansions of CWT's recovered at standard sampling sites, March-September 2001. Numbers in parenthesis are actual numbers of captured salmon containing CWT's.

WEEK OF	TOTAL CHINOOK	IGH	TRH fall	TRH spring	NO. NATURAL	NO. HATCHERY	PERCENT NATURAL
3/04	0	0	0	0	0	0	0
3/11	0	0	0	0	0	0	0
3/18	0	0	0	0	0	0	0
3/25	0	0	0	0	0	0	0
Total	**0**	**0**	**0**	**0**	**0**	**0**	**0**
4/01	2	0	0	0	2	0	100.0
4/08	6	0	0	0	6	0	100.0
4/15	24	0	0	0	24	0	100.0
4/22	3	0	0	0	3	0	100.0
4/29	48	0	0	0	48	0	100.0
Total	**83**	**0**	**0**	**0**	**83**	**0**	**100.0**
5/06	76	0	0	0	76	0	100.0
5/13	8	0	0	0	8	0	100.0
5/20	8	0	0	0	8	0	100.0
5/27	55	0	0	0	55	0	100.0
Total	**147**	**0**	**0**	**0**	**147**	**0**	**100.0**
6/03	12	0	0	0	12	0	100.0
6/10	119	25(1)	0	0	94	25	79.0
6/17	240	51(2)	0	0	189	51	78.8
6/24	225	25(1)	34(11)	3(1)	163	62	72.4
Total	**596**	**101(4)**	**34(11)**	**3(1)**	**458**	**138**	**76.8**
7/01	158	0	28(9)	0	130	28	82.3
7/08	83	0	16(5)	0	67	16	80.7
7/15	143	76(3)	19(6)	0	48	95	33.6
7/22	306	0	12(4)	0	294	12	96.1
7/29	121	0	0	0	121	0	100.0
Total	**811**	**76(3)**	**75(24)**	**0**	**660**	**151**	**81.4**
8/05	126	0	0	0	126	0	100.0
8/12	184	0	6(2)	0	178	6	96.7
8/19	229	0	0	0	229	0	100.0
8/26	186	0	0	0	186	0	100.0
Total	**725**	**0**	**6(2)**	**0**	**719**	**6**	**99.2**
9/02	48	0	0	0	48	0	100.0
9/09	18	0	0	0	18	0	100.0
9/16	44	0	0	0	44	0	100.0
9/23	41	0	0	0	41	0	100.0
Total	**151**	**0**	**0**	**0**	**190**	**3**	**100.0**
TOTAL	**2,513**	**177(7)**	**115(37)**	**3(1)**	**2,218**	**295**	**88.3**
JUNE-SEPT TOTAL	**2,283**	**177(7)**	**115(37)**	**3(1)**	**1,988**	**295**	**87.1**

		Untagged:Tagged
IGH	= Iron Gate Hatchery	25.36:1
TRH(sp)	= Trinity River Hatchery Spring Run	3.25:1
TRH(f)	= Trinity River Hatchery Fall Run	3.11:1

Table 4. Origin and portion of **young-of-the-year** Chinook salmon emigrating through the upper Klamath River estuary based on expansions of CWT's recovered during standard sampling, March-September 2001. Numbers in parenthesis are actual numbers of captured salmon containing CWT's.

WEEK OF	TOTAL CHINOOK	IGH	TRH fall	TRH spring	NO. NATURAL	NO. HATCHERY	PERCENT NATURAL
3/11	0	0	0	0	0	0	0
3/18	1	0	0	0	1	0	100.0
Total	**1**	**0**	**0**	**0**	**1**	**0**	**100.0**
4/08	0	0	0	0	0	0	0
4/15	7	0	0	0	7	0	100.0
4/22	4	0	0	0	4	0	100.0
4/29	0	0	0	0	0	0	0
Total	**11**	**0**	**0**	**0**	**11**	**0**	**100.0**
5/06	1	0	0	0	1	0	100.0
5/20	3	0	0	0	3	0	100.0
5/27	102	0	0	0	102	0	100.0
Total	**106**	**0**	**0**	**0**	**106**	**0**	**100.0**
6/03	20	0	0	0	20	0	100.0
6/10	266	51(2)	0	0	215	51	80.8
6/17	327	0	31(10)	19(6)	277	50	84.7
6/24	449	51(2)	28(9)	3(1)	367	82	81.7
Total	**1,062**	**102(4)**	**59(19)**	**22(7)**	**879**	**183**	**82.8**
7/01	159	0	0	0	159	0	100.0
7/08	398	0	9(3)	0	389	9	97.7
7/15	328	0	3(1)	0	325	3	99.1
7/22	108	25(1)	0	0	83	25	76.9
7/29	345	0	3(1)	0	342	3	99.1
Total	**1,338**	**25(1)**	**15(5)**	**0**	**1,298**	**40**	**97.0**
8/05	130	0	0	0	130	0	100.0
8/12	165	0	0	0	165	0	100.0
8/19	10	0	0	0	10	0	100.0
8/26	54	0	0	0	54	0	100.0
Total	**359**	**0**	**0**	**0**	**359**	**0**	**100.0**
GRAND TOTAL	**2,877**	**127(5)**	**74(24)**	**22(7)**	**2,654**	**223**	**92.2**
JUNE-SEPT TOTAL	**2,759**	**127(5)**	**74(24)**	**22(7)**	**2,536**	**223**	**91.9**
LOWER ESTUARY TOTAL	**2,283**	**177(7)**	**115(37)**	**3(1)**	**1,988**	**295**	**87.1**
ANNUAL TOTAL	**5,042**	**304(12)**	**189(61)**	**25(8)**	**4,524**	**518**	**89.7**

		Untagged:Tagged
IGH	= Iron Gate Hatchery	25.36:1
TRH(sp)	= Trinity River Hatchery Spring Run	3.11:1
TRH(f)	= Trinity River Hatchery Fall Run	3.25:1

Table 5. Proportions of natural and hatchery origin young-of-the-year Chinook salmon migrating through the Klamath River estuary, 1993-2001.

	Lower Estuary		Upper Estuary		Total	
Year	% Natural	% Hatchery	% Natural	% Hatchery	% Natural	%Hatchery
1993	83.5	16.5	85.7	14.3	85.5	14.5
1994	78.0	22.0	73.4	26.6	76.3	23.7
1996	76.3	23.7	66.0	34.0	69.8	30.2
1997	58.1	41.9	47.5	52.5	49.0	51.0
1998	37.2	62.8	68.3	31.7	56.7	43.3
1999	58.9	41.1	81.3	18.7	79.6	20.4
2000	58.0	42.0	60.1	39.9	59.0	41.0
2001	87.1	12.9	91.9	8.1	89.7	10.3

Table 6. Overall CPUE of natural, IGH, and spring and fall-run TRH Chinook salmon captured in the lower and upper Klamath River estuary, 1993-2000.

	LOWER (Fish/1000ft^2)					UPPER (Fish/minute)				
Year	Nat	IGH	TRHf	TRHs	Total	Nat	IGH	TRHf	TRHs	Total
1993	3.26	0.27	0.49	0.06	4.08	6.77	0.18	0.93	0.19	8.07
1994	6.17	1.28	0.03	0.43	7.91	2.42	0.66	0.004	0.04	3.13
1996	2.57	0.12	0.28	0.42	3.39	3.87	0.56	0.83	0.50	5.76
1997	1.82	1.08	0.19	0.04	3.13	5.25	5.14	0.53	0.14	11.06
1998	2.67	2.95	1.03	0.53	7.18	4.17	0.58	1.28	0.08	6.11
1999	0.59	0.24	0.12	0.05	1.00	8.80	1.32	0.54	0.16	10.82
2000	2.01	1.26	0.14	0.08	3.49	3.16	1.61	0.38	0.11	5.26
2001	2.88	0.23	0.15	0.004	3.26	4.14	0.20	0.12	0.03	4.49

Table 7. Origin and portion of **young-of-the-year** Chinook salmon emigrating through the lower Klamath River estuary based on expansions of CWT's recovered during standard sampling of sites 1-8, March-September 2001. Numbers in parenthesis are actual numbers of captured salmon containing CWT's.

WEEK OF	TOTAL CHINOOK	IGH	TRH fall	TRH spring	NO. NATURAL	NO. HATCHERY	PERCENT NATURAL
3/04	0	0	0	0	0	0	0
3/11	0	0	0	0	0	0	0
3/18	0	0	0	0	0	0	0
3/25	0	0	0	0	0	0	0
Total	**0**	**0**	**0**	**0**	**0**	**0**	**0**
4/01	2	0	0	0	2	0	100.0
4/08	6	0	0	0	6	0	100.0
4/15	24	0	0	0	24	0	100.0
4/22	27	0	0	0	27	0	100.0
4/29	48	0	0	0	48	0	100.0
Total	**107**	**0**	**0**	**0**	**107**	**0**	**100.0**
5/06	81	0	0	0	81	0	100.0
5/13	8	0	0	0	8	0	100.0
5/20	17	0	0	0	17	0	100.0
5/27	210	0	0	0	210	0	100.0
Total	**316**	**0**	**0**	**0**	**316**	**0**	**100.0**
6/03	97	0	0	0	97	0	100.0
6/10	1,845	456(18)	0	0	1,389	456	75.3
6/17	668	152(6)	16(5)	26(8)	474	194	71.0
6/24	1,048	355(14)	106(34)	16(5)	571	477	54.5
Total	**3,658**	**963(38)**	**122(39)**	**42(13)**	**2,531**	**1,127**	**69.2**
7/01	738	178(7)	50(16)	0	510	228	69.1
7/08	265	51(2)	3(1)	0	211	54	79.6
7/15	1,205	101(4)	81(26)	0	1,023	182	84.9
7/22	336	76(3)	25(8)	0	235	101	69.9
7/29	166	0	12(4)	0	154	12	92.8
Total	**2,710**	**406(16)**	**171(55)**	**0**	**2,133**	**577**	**78.7**
8/05	141	0	0	0	141	0	100.0
8/12	207	0	19(6)	0	188	19	90.8
8/19	276	0	12(4)	0	264	12	95.7
8/26	251	0	6(2)	0	245	6	97.6
Total	**875**	**0**	**37(12)**	**0**	**838**	**37**	**95.8**
9/02	61	0	3(1)	0	58	3	95.1
9/09	27	0	0	0	27	0	100.0
9/16	51	0	0	0	51	0	100.0
9/23	54	0	0	0	54	0	100.0
Total	**193**	**0**	**3(1)**	**0**	**190**	**3**	**98.4**
TOTAL	**7,859**	**1,369(54)**	**333(107)**	**42(13)**	**6,115**	**1,744**	**77.8**
JUNE-SEPT TOTAL	**7,436**	**1,369(54)**	**333(107)**	**42(13)**	**5,692**	**1,744**	**76.5**

		Untagged:Tagged
IGH	= Iron Gate Hatchery	25.36:1
TRH(sp)	= Trinity River Hatchery Spring Run	3.25:1
TRH(f)	= Trinity River Hatchery Fall Run	3.11:1

Table 8. Origin and portion of **yearling** Chinook salmon emigrating through the lower Klamath River estuary based on expansions of CWT recovered during standard sampling, March-September 2001. Numbers in parenthesis are actual numbers of captured salmon containing CWT's.

WEEK OF	TOTAL CHINOOK	IGH	TRH fall	TRH spring	NO. NATURAL	NO. HATCHERY	PERCENT NATURAL
3/04	4	0	0	0	4	0	100.0
3/11	3	0	0	0	3	0	100.0
3/18	1	0	0	0	1	0	100.0
3/25*	4	4(1)	0	0	0	4	0
Total	**12**	**4(1)**	**0**	**0**	**8**	**4**	**66.7**
4/01	0	0	0	0	0	0	0
4/08	0	0	0	0	0	0	0
4/15	0	0	0	0	0	0	0
4/22	1	0	0	0	1	0	100.0
4/29	0	0	0	0	0	0	0
Total	**1**	**0**	**0**	**0**	**1**	**0**	**100.0**
5/06	39	28(3)	0	0	11	28	28.2
5/13	0	0	0	0	0	0	0
5/20	16	0	0	0	16	0	100.0
5/27	7	0	0	0	7	0	100.0
Total	**62**	**28(3)**	**0**	**0**	**34**	**28**	**54.8**
6/03	0	0	0	0	0	0	0
6/10	0	0	0	0	0	0	0
6/17	0	0	0	0	0	0	0
6/24	0	0	0	0	0	0	0
Total	**0**	**0**	**0**	**0**	**0**	**0**	**0**
7/01	0	0	0	0	0	0	0
7/08	0	0	0	0	0	0	0
7/15	0	0	0	0	0	0	0
7/22	0	0	0	0	0	0	0
7/29	0	0	0	0	0	0	0
Total	**0**	**0**	**0**	**0**	**0**	**0**	**0**
8/05	0	0	0	0	0	0	0
8/12	0	0	0	0	0	0	0
8/19	0	0	0	0	0	0	0
8/26	0	0	0	0	0	0	0
Total	**0**	**0**	**0**	**0**	**0**	**0**	**0**
9/02	0	0	0	0	0	0	0
9/09	0	0	0	0	0	0	0
9/16	0	0	0	0	0	0	0
9/23	0	0	0	0	0	0	0
Total	**0**	**0**	**0**	**0**	**0**	**0**	**0**
TOTAL	**75**	**32(4)**	**0**	**0**	**43**	**32**	**57.3**

		Untagged:Tagged
IGH	= Iron Gate Hatchery	9.49:1
TRH(f)	= Trinity River Hatchery Fall Run	1.88:1

Table 9. Origin and portion of **yearling** Chinook salmon emigrating through the upper Klamath River estuary based on expansions of CWT's recovered during standard sampling, March-September 2001. Numbers in parenthesis are actual numbers of captured salmon containing CWT's.

WEEK OF	TOTAL CHINOOK	IGH	TRH fall	TRH spring	NO. NATURAL	NO. HATCHERY	PERCENT NATURAL
3/11	81	76(8)	3(1)	0	2	79	2.5
3/18	77	9(1)	6(2)	0	62	15	80.5
Total	**158**	**85(9)**	**9(3)**	**0**	**64**	**94**	**40.5**
4/08	79	47(5)	3(1)	0	29	50	36.7
4/15	94	85(9)	0	0	9	85	9.6
4/22	30	28(3)	0	0	2	28	6.7
4/29	128	38(4)	0	0	90	38	70.3
Total	**331**	**198(21)**	**3(1)**	**0**	**130**	**201**	**39.3**
5/06*	37	34(4)	3(1)	0	0	37	0
5/20	2	0	0	0	2	0	100.0
5/27	0	0	0	0	0	0	0
Total	**39**	**34(4)**	**3(1)**	**0**	**2**	**37**	**5.1**
6/03	0	0	0	0	0	0	0
6/10	0	0	0	0	0	0	0
6/17	0	0	0	0	0	0	0
6/24	0	0	0	0	0	0	0
Total	**0**	**0**	**0**	**0**	**0**	**0**	**0**
7/01	0	0	0	0	0	0	0
7/08	0	0	0	0	0	0	0
7/15	0	0	0	0	0	0	0
7/22	0	0	0	0	0	0	0
7/29	0	0	0	0	0	0	0
Total	**0**	**0**	**0**	**0**	**0**	**0**	**0**
8/05	0	0	0	0	0	0	0
8/12	0	0	0	0	0	0	0
8/19	0	0	0	0	0	0	0
8/26	0	0	0	0	0	0	0
Total	**0**	**0**	**0**	**0**	**0**	**0**	**0**
TOTAL	**528**	**317(34)**	**15(5)**	**0**	**196**	**332**	**37.1**
Low Est Total	**75**	**32(4)**	**0**	**0**	**43**	**32**	**57.3**
GRAND TOTAL	**603**	**349(38)**	**15(5)**	**0**	**239**	**364**	**39.6**

		Untagged:Tagged
IGH	= Iron Gate Hatchery	9.49:1
TRH(f)	= Trinity River Hatchery Fall Run	3.03:1

captured many more yearling Chinook, especially CWT hatchery Chinook, this year compared to past years. This is, in part, due to NSA's earlier sampling season compared to past years. However, the few years when NSA successfully sampled in February and March we've never encountered this many CWT yearling Chinook. In past years we've captured only one or two CWT yearling Chinook from IGH and this is the first time we've captured CWT yearling Chinook from TRH. The higher abundance of yearling Chinook may have been due to the very low winter river flows in the Klamath and Trinity Rivers that may have prompted yearling Chinook to linger in the mainstem rivers rather than migrate to the ocean. These natural to hatchery composition estimates for yearling Chinook are tenuous because I based the expansions on a small number of CWT's (43 total).

Relative Abundance- The abundance of naturally produced yoy Chinook was about average compared to past years (Table 6). CPUE and percent composition of natural origin Chinook were higher than during 2000 in both the upper and lower estuary. Natural Chinook arrived in the estuary in low numbers beginning in late March and early April (Appendix 1 and 3). NSA observed a bimodal peak in natural Chinook CPUE during mid June and mid August in the lower estuary and a single peak in mid July in the upper estuary (Appendix 2 and 3).

Spawner escapement estimates for natural Chinook in 2000 were about 4 times greater than 1999 and likely contributed to the higher catch of yoy Chinook in 2001 compared to 2000. However, NSA noted nothing close to a four fold increase in the catch of natural origin Chinook this year compared to last. Very low river flows in 2001 likely created poor rearing conditions in the mainstem river that may have reduced the survival of natural Chinook this year. Foott et al. (2002), painted a bleak picture of overall fish health in the mainstem Klamath River and estuary this year. Also, the average size of yoy Chinook in 2001 was among the smallest on record (Tables 10 and 11). For example, in the lower estuary the mean FL was 87 mm in 2001 compared to 96 mm in 2000 and in the upper estuary their average FL was 87 mm in 2001 compared to 100 mm in 2000. The smaller average size of yoy Chinook also suggests that rearing conditions in the basin were poorer than last year.

TRH spring Chinook CPUE was the lowest ever measured by NSA in the upper and lower estuary (Table 6). They arrived in the upper and lower estuary in mid June and their emigration peaked the week of their arrival in the upper and lower estuary (Appendix 1 and 3). In past years, TRH spring Chinook were typically the first hatchery Chinook to reach the estuary and had a shorter average travel time from hatchery to the estuary than IGH and TRH fingerling fall Chinook. This year they again had the shortest travel time, but IGH fish were the first hatchery Chinook to arrive in the estuary, probably because IGH released a portion of their fish earlier than TRH released their fish. TRH spring Chinook are considerably larger at hatchery release than the other fingerling Chinook stocks released from IGH and TRH. Their larger size is probably one of the factors that causes them to migrate faster than the other stocks of smaller hatchery Chinook. This year their size at release was even larger than past years (Table 2). It has been well established that larger yoy Chinook migrate faster than smaller sized fish in the Klamath-Trinity basin (USFWS 1998; Wallace 1995; memo dated 12/15/98 from Michael Wallace to Gary Stacey).

Table 10. Monthly mean fork length (FL), standard deviation (SD) and number (n) of young-of-the-year Chinook salmon measured in the lower Klamath River estuary 1993-2001

Year	May			June			July			August			September			Total		
	n	FL	SD	n	FL	SD	n	FL	SD	n	FL	SD	n	FL	SD	n	FL	SD
2001	80	69.0	16.6	313	87.3	7.9	444	86.1	7.1	407	89.0	6.9	151	96.4	7.9	1395	87.4	9.8
2000	40	67.6	9.3	205	91.0	10.1	237	91.6	8.7	177	97.3	8.5	177	113.7	8.4	836	96.2	14.1
1999	-	-	-	15	94.3	2.6	184	92.2	7.2	115	97.9	7.5	48	113.8	10.9	362	96.9	10.5
1998	-	-	-	110	88.7	4.9	234	89.7	5.8	195	92.8	6.9	153	106.3	7.0	692	94.1	9.2
1997	50	55.1	13.1	278	94.3	7.1	184	92.4	5.5	74	97.9	7.3	-	-	-	586	90.8	13.3
1996	79	75.9	14.2	254	87.3	10.4	174	88.8	7.4	134	89.0	6.3	-	-	-	641	86.7	10.4
1994	42	51.4	11.3	195	88.6	9.4	304	84.1	5.8	526	89.1	6.5	5	99.8	7.5	1072	86.2	10.3
1993	56	49.5	11.5	137	83.7	15.7	344	86.3	7.3	45	98.9	11.3	12	111.5	6.7	594	83.7	16.1

Table 11. Monthly mean fork length (FL), standard deviation (SD) and number (n) of young-of-the-year Chinook salmon measured in the upper Klamath River estuary 1993-2001

Year	May			June			July			August			September			Total		
	n	FL	SD	n	FL	SD	n	FL	SD	n	FL	SD	n	FL	SD	n	FL	SD
2001	83	86.9	10.5	322	88.7	9.2	387	84.6	6.4	206	87.7	7.1	-	-	-	998	86.8	8.1
2000	29	91.9	13.7	171	100.7	11.8	431	93.8	7.2	222	97.4	6.8	251	112.6	9.5	1104	99.8	11.4
1999	-	-	-	62	93.7	6.8	426	91.0	7.2	380	98.8	8.6	468	116.6	10.8	1336	102.3	14.1
1998	-	-	-	-	-	-	328	89.1	8.1	519	92.3	6.7	237	103.3	6.6	1084	93.7	8.8
1997	14	96.3	11.6	154	95.4	10.0	512	93.6	6.6	298	95.1	6.4	-	-	-	978	94.4	7.3
1996	-	-	-	359	89.4	9.6	304	87.5	7.8	200	88.5	6.2	-	-	-	863	88.5	8.3
1994	17	89.8	20.9	281	89.8	8.7	247	82.8	6.6	149	87.4	7.2	-	-	-	696	86.8	8.8
1993	6	67.3	11.8	280	89.0	13.5	297	86.8	7.3	422	96.2	7.5	490	112.0	9.0	1495	98.0	14.0

TRH fall Chinook CPUE was below average in the upper and lower estuary this year (Table 6). They arrived in the upper estuary in mid June and their emigration peaked the week of their arrival (Appendix 3). This peak was about a month earlier than 2000. In the lower estuary they arrived in mid June, peaked in abundance in late June and mid July, and were present into September (Appendix 1). In past years TRH fall Chinook abundance typically peaked in July and August (CDFG 2001; CDFG 2000). Their 30 day median travel time to the estuary this year was the second fastest on record. They were markedly larger at release this year compared to past years and that likely contributed to their fast migration rate in 2001. As stated above smaller sized Chinook migrate at a slower rate than larger fish. Whether this is due to slower swimming speed of small fish or because smaller fish need to rear more to attain ocean entry size, or both, is not known. This shows that if the Department wants to minimize potential competition between natural and hatchery yoy Chinook, then hatchery yoy Chinook must be raised to as large a size as possible before release.

The CPUE of IGH Chinook in 2001 was below average in the upper and lower estuary (Table 6). IGH fish arrived in the estuary in mid June and persisted throughout most of July (Appendix 1 and 3). Their emigration peaked the week of their arrival in both the upper and lower estuary. Large numbers of IGH fish were captured in the lower estuary primarily adjacent to the mouth of Hunter Creek (Appendix 1). We again noted that the CWT group containing the smallest sized fish (tag code 0601020308) was the last to arrive in the estuary and had a longer DAL than the other CWT groups (Table 2). Also, NSA captured three times more fish from the two tag groups (0601020305 and 0601020306) containing the largest fish than the two tag groups containing the smallest fish (0601020307 and 0601020308). This suggests that the larger fish survived at a higher rate than the smaller fish. So in addition to reducing potential competition with wild fish, releasing hatchery yoy Chinook at a large size also appears to increase their in-river survival.

Coho Emigration

During 2001, CPUE of yearling coho salmon peaked during late May and early June in the lower estuary and in late May in the upper estuary (Tables 12&13). Most (98.5%) of the coho salmon NSA captured in the lower estuary were from the sites adjacent to the mouth of Hunter Creek. In fact our annual coho CPUE of 0.01 fish/1000ft^2 rose to 0.27 fish/1000ft^2 if the Hunter Creek sites were included. NSA captured most of the coho in the lower estuary between May 30 and June 11 after estuary water temperatures reached greater than 18^o C. The high catch of coho adjacent to Hunter Creek is probably due to the coho seeking cold water supplied by Hunter Creek. The annual CPUE of yearling coho in the upper estuary was one of the highest recorded by our project, but it is also one of the few years we were able to electrofish extensively during May when yearling coho are most abundant in the estuary (Wallace 1995).

As of June 30, 2002, CPUE of yearling coho salmon peaked during late May in the lower estuary and in early to mid May in the upper estuary. Yearling coho CPUE in the upper estuary was about half as much as their CPUE in 2001. Low flows during 2001 may have limited the survival of yoy coho last summer thereby reducing the abundance of yearling coho emigrating this spring.

Table 12. Monthly beach seine catch-per-unit-effort (fish/1000ft^2) of juvenile coho salmon, steelhead trout and coastal cutthroat trout captured in the lower Klamath River estuary 1993-2001. Three sites were excluded from the 2000 and 2001 catches so that we could compare these year's CPUE to past years.

Year	May				June				July				August				September				Total			
	Effort	Coho	SH	CUT	Effort	Coho	SH	CUT	Effort	Coho	SH	CUT	Effort	Coho	SH	CUT	Effort	Coho	SH	CUT	Effort	Coho	SH	CUT
2001	95.0	0.04	0.12	0.18	105.5	0.00	0.04	0.04	135.8	0.00	0.10	0.01	108.4	0.00	0.04	0.08	105.2	0.00	0.00	0.05	549.9	0.01	0.06	0.07
2000	58.1	0.15	0.33	0.12	94.4	0.01	0.01	0.24	76.1	0.00	0.28	0.28	107.8	0.00	0.03	0.07	99.1	0.00	0.03	0.07	435.5	0.02	0.11	0.15
1999	19.9	0.90	0.00	0.05	102.6	0.99	0.14	0.12	81.2	0.00	0.43	0.16	104.8	0.00	0.25	0.14	78.8	0.00	0.43	0.17	387.4	0.31	0.28	0.14
1998	-	-	-	-	29.9	0.00	0.30	1.04	56.3	0.02	0.28	0.57	67.3	0.00	0.15	0.18	45.4	0.00	0.04	0.46	198.8	0.01	0.19	0.48
1997	47.9	1.40	1.42	1.92	89.5	0.03	0.19	0.52	70.7	0.00	0.00	0.14	63.7	0.00	0.00	0.02	-	-	-	-	276.2	0.25	0.31	0.54
1996	27.2	0.07	0.47	0.33	62.8	0.02	1.21	0.80	84.8	0.00	0.00	0.01	96.7	0.00	0.02	0.01	-	-	-	-	271.4	0.01	0.34	0.22
1994	96.5	0.00	0.03	0.01	101.5	0.00	0.13	0.05	87.5	0.00	0.00	0.00	116.3	0.00	0.01	0.01	-	-	-	-	424.9	0.00	0.04	0.02
1993	27.8	0.18	0.07	0.54	51.4	0.00	0.08	0.12	97.2	0.00	0.11	0.12	118.2	0.00	0.00	0.02	83.6	0.00	0.00	0.00	378.3	0.01	0.04	0.09

Table 13. Monthly electrofishing catch-per-unit-effort (fish/minute) of juvenile coho salmon, steelhead trout and coastal cutthroat trout captured in the upper Klamath River estuary 1993-2001.

Year	May				June				July				August				September				Total			
	Effort	Coho	SH	CUT	Effort	Coho	SH	CUT	Effort	Coho	SH	CUT	Effort	Coho	SH	CUT	Effort	Coho	SH	CUT	Effort	Coho	SH	CUT
2001	125.4	1.69	0.57	0.33	107.0	0.04	0.64	0.55	151.1	0.00	0.08	0.07	123.5	0.00	0.27	0.19	-	-	-	-	507.0	0.43	0.36	0.28
2000	57.8	2.23	3.20	0.45	91.6	0.07	1.88	0.34	130.3	0.01	0.97	0.17	97.8	0.00	0.86	0.08	109.8	0.00	0.77	0.11	487.3	0.28	1.34	0.20
1999	-	-	-	-	25.6	0.04	0.74	0.74	108.6	0.00	1.33	0.09	130.6	0.00	0.28	0.01	136.6	0.01	0.54	0.07	434.8	0.01	0.65	0.09
1998	-	-	-	-	-	-	-	-	128.4	0.01	0.97	0.33	180.0	0.00	0.40	0.02	84.7	0.01	0.20	0.00	393.0	<0.01	0.54	0.11
1997	24.8	0.57	1.62	0.36	99.2	0.01	1.36	0.29	154.0	0.00	0.84	0.12	128.6	0.00	0.31	0.02	-	-	-	-	406.6	0.04	0.85	0.15
1996	-	-	-	-	84.7	0.04	2.01	0.58	99.2	0.00	1.02	0.26	93.6	0.00	0.88	0.17	-	-	-	-	277.4	0.01	1.27	0.33
1994	109.4	2.39	0.52	0.48	154.2	0.01	0.10	0.16	158.5	0.01	0.01	0.01	200.8	0.00	0.00	0.03	-	-	-	-	623.0	0.43	0.12	0.14
1993	10.1	0.50	0.60	0.60	77.1	0.00	0.51	0.36	77.8	0.00	0.06	0.04	152.3	0.00	0.07	0.03	199.0	0.00	0.18	0.06	516.2	0.01	0.19	0.10

Of the 203 yearling coho salmon smolts NSA captured through June 30, 2002, 126 (62.1%) were released from TRH, 7 (3.4%) were released from IGH and 70 (34.5%) were natural fish. There was no apparent difference in emigration timing between natural and hatchery coho. Natural origin coho comprised 34.5% of our yearling coho catch in 2002 compared to 26.8% in 2001 and 39.1% in 2000 (CDFG 2001). Hatchery origin coho smolts were considerably larger than natural coho smolts. In the upper estuary the mean FL of coho smolts was 200 +/- 32 mm (n=89) for TRH fish, 216 +/- 19 mm (n=2) for IGH fish and 135 +/- 30 mm (n=12) for natural origin coho. In the lower estuary the mean FL of coho smolts was 186 +/- 23 mm (n=23) for TRH fish, 156 mm (n=1) for IGH fish and 132 +/- 13 mm (n=34) for natural origin coho. The composition of our lower estuary catch contained about five times the percentage of natural coho smolts (53 of 88, 60.2%) than the upper estuary catch (12 of 103 smolts, 11.7%).

Steelhead Emigration

During 2001 CPUE of juvenile steelhead in the lower estuary peaked during late April and mid May (Appendix 2). This is about the time of peak catches in past years (Wallace 1995). However, if I include the sites adjacent to the mouth of Hunter Creek the peak occurred in mid June (Appendix 1). Hunter Creek provides an area of cool water refugia during the summer and we observed much higher salmonid catches at these sites compared to our other estuary sampling sites. Our annual steelhead CPUE of 0.06 fish/1000ft^2 (Table 12), rose to 0.26 fish/1000ft^2 if I included the Hunter Creek sites. It is apparent that high numbers of juvenile salmonids congregated in this area during the summer to escape high water temperatures found throughout much of the rest of the estuary. In the upper estuary steelhead peak abundance occurred during mid April but we consistently captured steelhead throughout the entire summer (Appendix 3).

Juvenile steelhead CPUE in the lower estuary was below average compared to past years (Table 12). Juvenile steelhead CPUE in the upper estuary from May through September was the lowest recorded by our project since 1994 (Table 13). However, their abundance peaked in April this year, so low river flows may have prompted juvenile steelhead to emigrate earlier than in past years of the study. Juvenile steelhead CPUE in the upper and lower estuary from 1996-2000 is higher than levels observed in 1993 and 1994 (Tables 12 and 13) and during the late 1980's (CDFG unpublished data) during the prolonged drought of the late 1980's and early 1990's. The increased steelhead CPUE observed by NSA suggests that steelhead production in the Klamath-Trinity basin has increased during the last 5 to 6 years of relatively good water years.

Of the 362 steelhead we captured through June 30, 2002, 48 (13.3%) were hatchery origin fish. All hatchery steelhead were from TRH. This is similar to the hatchery steelhead composition in 2001. The last two years are the highest hatchery contribution observed by NSA. I think this is due to NSA initiating sampling at an earlier date than past years resulting in intercepting hatchery marked steelhead at a greater rate than past years. Most of the emigrating hatchery origin steelhead passed through the estuary in April prior to the start of sampling in past years. It appears that hatchery origin steelhead leave the Klamath basin rather quickly, about 1 month after their release from basin hatcheries.

Sea-run Coastal Cutthroat Trout Emigration and Estuary Rearing

During 2001 all juvenile coastal cutthroat trout in our catches were natural origin fish and their abundance was below average in the lower estuary and above average in the upper estuary (Tables 12 and 13). The CPUE of sea-run cutthroat trout peaked in May in the lower estuary and in June in the upper estuary during 2001 (Tables 12 and 13).

In 2001 we marked and released 132 cutthroat trout with visual implant (VI) tags and a secondary mark of alcian blue dye. We recaptured only three marked fish and two additional fish which had lost their VI tag (one fish we captured twice). Their average length of residence was 14 days (range 7-28 days). In 2000 we marked 245 cutthroat trout with only dye marks. We recaptured 34 fish (which likely included individual fish captured multiple times). Their mean length of estuary residence was 27 days and ranged from 5-89 days. The recaptured cutthroat trout in 2001 had a high growth rate. The one fish at large for 28 days grew more than 30 mm while the two fish at large for seven days grew 4 and 5 mm respectively. The Klamath River estuary appears to be extremely important rearing habitat for Klamath River sea-run coastal cutthroat trout.

In 2002 NSA attempted to continue marking coastal cutthroat trout, but due to the poor VI tag retention and increased difficulty of tagging fish due to the deterioration of the unused VI tags we discontinued marking cutthroat in May. Therefore we only marked and released 28 cutthroat trout and have not recaptured any of them.

Conclusions

It appears that yoy Chinook salmon abundance in the Klamath-Trinity basin was lower in 2001 than 2000 and poor overall. This conclusion is based on the lower CPUE of natural origin and especially hatchery Chinook in the upper and lower estuary, the lower abundance of Chinook emigrating in the late summer and early fall, and their smaller size in 2001 compared to past years. CPUE of coho salmon, steelhead and sea-run coastal cutthroat trout were also generally below average providing more evidence that salmonid rearing conditions in the Klamath-Trinity basin were poor in 2001. Earlier NSA studies (Wallace and Collins 1997) hypothesized that increased mainstem river flows created more favorable in-river rearing conditions and increased the survival of late summer emigrating juvenile Chinook (summer flows were lower in 2001 than 2000). Other studies from Oregon coastal rivers have shown that these later emigrating Chinook are larger upon ocean entry and have higher marine survival rates than earlier emigrating Chinook and therefore survive to adults at a higher rate (Nicholas and Hankin 1989). Perhaps the low river flows in the mainstem Klamath and Trinity Rivers reduced acceptable habitat in the basin, increased the incidence of disease or increased inter or intraspecific competition for food and space resources in the basin and reduced the survival of juvenile salmonids. The predicted low flow and poor rearing conditions in the mainstem rivers for 2001 were accurate and as a result juvenile salmonids apparently suffered in 2001.

VII. <u>Estimated FY 00-01 Job Cost</u>: (Allotment= $112,999)

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Appendix 1. Weekly and total catch-per-unit-effort (fish/1000ft^2) of young-of-the-year Chinook salmon at sites 1-8 in the lower Klamath River estuary, 2001.

JW	Date	Effort	Total # Chin	Total CPUE	No. IGH	CPUE IGH	# TRH fall	CPUE TRH f	# TRH spring	CPUE TRH s	No. Hatch	CPUE Hatch	No. Nat	CPUE Nat
10	3/05	27275	0	0	0	0	0	0	0	0	0	0	0	0
11	3/15	40175	0	0	0	0	0	0	0	0	0	0	0	0
12	3/19	35600	0	0	0	0	0	0	0	0	0	0	0	0
13	3/27	32725	0	0	0	0	0	0	0	0	0	0	0	0
14	4/04	28775	2	0.07	0	0	0	0	0	0	0	0	2	0.07
15	4/09	39300	6	0.15	0	0	0	0	0	0	0	0	6	0.15
16	4/16	34100	24	0.70	0	0	0	0	0	0	0	0	24	0.70
17	4/23	38275	27	0.71	0	0	0	0	0	0	0	0	27	0.71
18	4/30	24525	48	1.96	0	0	0	0	0	0	0	0	48	1.96
19	5/07	42100	81	1.92	0	0	0	0	0	0	0	0	81	1.92
20	5/17	28750	8	0.28	0	0	0	0	0	0	0	0	8	0.28
21	5/23	33050	17	0.51	0	0	0	0	0	0	0	0	17	0.51
22	5/30	31950	210	6.57	0	0	0	0	0	0	0	0	210	6.57
23	6/04	38150	97	2.54	0	0	0	0	0	0	0	0	97	2.54
24	6/11	44450	1,845	41.51	456	10.26	0	0	0	0	456	10.26	1,389	31.25
25	6/18	41025	668	16.28	152	3.71	16	0.39	26	0.63	194	4.73	474	11.55
26	6/25	42150	1,048	24.86	355	8.42	106	2.51	16	0.38	477	11.32	571	13.55
27	7/02	36825	738	20.04	178	4.83	50	1.36	0	0	228	6.19	510	13.85
28	7/09	36700	265	7.22	51	1.39	3	0.08	0	0	54	1.47	211	5.75
29	7/16	38300	1,205	31.46	101	2.64	81	2.11	0	0	182	4.75	1,023	26.71
30	7/23	40625	336	8.27	76	1.87	25	0.61	0	0	101	2.49	235	5.78
31	7/30	32225	166	5.15	0	0	12	0.37	0	0	12	0.37	154	4.78
32	8/06	33525	141	4.21	0	0	0	0	0	0	0	0	141	4.21
33	8/13	29800	207	6.95	0	0	19	0.64	0	0	19	0.64	188	6.31
34	8/20	34800	276	7.93	0	0	12	0.34	0	0	12	0.34	264	7.59
35	8/27	29750	251	8.44	0	0	6	0.20	0	0	6	0.20	245	8.24
36	9/07	32200	61	1.89	0	0	3	0.09	0	0	3	0.09	58	1.80
37	9/10	33925	27	0.80	0	0	0	0	0	0	0	0	27	0.80
38	9/17	32150	51	1.59	0	0	0	0	0	0	0	0	51	1.59
39	9/24	30175	54	1.79	0	0	0	0	0	0	0	0	54	1.79
Total		**1,043,375**	**7,859**	**7.53**	**1,369**	**1.31**	**333**	**0.32**	**42**	**0.04**	**1,744**	**1.67**	**6,115**	**5.86**

Appendix 2. Weekly and total catch-per-unit-effort (fish/1000ft^2) of young-of-the-year Chinook salmon at sites 1-5in the lower Klamath River estuary, 2001.

JW	Date	Effort	Total # Chin	Total CPUE	No. IGH	CPUE IGH	# TRH fall	CPUE TRH f	# TRH spring	CPUE TRH s	No. Hatch	CPUE Hatch	No. Nat	CPUE Nat
10	3/05	23275	0	0	0	0	0	0	0	0	0	0	0	0
11	3/15	25775	0	0	0	0	0	0	0	0	0	0	0	0
12	3/19	28800	0	0	0	0	0	0	0	0	0	0	0	0
13	3/27	20625	0	0	0	0	0	0	0	0	0	0	0	0
14	4/04	23175	2	0.09	0	0	0	0	0	0	0	0	2	0.09
15	4/09	24300	6	0.25	0	0	0	0	0	0	0	0	6	0.25
16	4/16	28400	24	0.85	0	0	0	0	0	0	0	0	24	0.85
17	4/23	25275	3	0.12	0	0	0	0	0	0	0	0	3	0.12
18	4/30	20525	48	2.34	0	0	0	0	0	0	0	0	48	2.34
19	5/07	26000	76	2.92	0	0	0	0	0	0	0	0	76	2.92
20	5/17	23850	8	0.34	0	0	0	0	0	0	0	0	8	0.34
21	5/23	23950	8	0.33	0	0	0	0	0	0	0	0	8	0.33
22	5/30	21200	55	2.59	0	0	0	0	0	0	0	0	55	2.59
23	6/04	25550	12	0.47	0	0	0	0	0	0	0	0	12	0.47
24	6/11	24650	119	4.83	25	1.01	0	0	0	0	25	1.01	94	3.81
25	6/18	27525	240	8.72	51	1.85	0	0	0	0	51	1.85	189	6.87
26	6/25	27800	225	8.09	25	0.90	34	1.22	3	0.11	62	2.23	163	5.86
27	7/02	24200	158	6.53	0	0	28	1.16	0	0	28	1.16	130	5.37
28	7/09	26150	83	3.17	0	0	16	0.61	0	0	16	0.61	67	2.56
29	7/16	25000	143	5.72	76	3.04	19	0.76	0	0	95	3.80	48	1.92
30	7/23	35225	306	8.69	0	0	12	0.34	0	0	12	0.34	294	0.68
31	7/30	25225	121	4.80	0	0	0	0	0	0	0	0	121	4.80
32	8/06	28425	126	4.43	0	0	0	0	0	0	0	0	126	4.43
33	8/13	24700	184	7.45	0	0	6	0.24	0	0	6	0.24	178	7.21
34	8/20	30000	229	7.63	0	0	0	0	0	0	0	0	229	7.63
35	8/27	25250	186	7.37	0	0	0	0	0	0	0	0	186	7.37
36	9/07	26200	48	1.83	0	0	0	0	0	0	0	0	48	1.83
37	9/10	27925	18	0.64	0	0	0	0	0	0	0	0	18	0.64
38	9/17	27250	44	1.61	0	0	0	0	0	0	0	0	44	1.61
39	9/24	23775	41	1.72	0	0	0	0	0	0	0	0	41	1.72
Total		**770,000**	**2,513**	**3.26**	**177**	**0.23**	**115**	**0.15**	**3**	**0.004**	**295**	**0.38**	**2,218**	**2.88**

Appendix 3. Weekly and total catch-per-unit-effort (fish/minute) of young-of-the-year Chinook salmon in the upper Klamath River estuary, 2001.

JW	Date	Effort (sec)	Total # Chin	Total CPUE	No. IGH	CPUE IGH	# TRH fall	CPUE TRH f	# TRH spring	CPUE TRH s	No. Hatch	CPUE Hatch	No. Nat	CPUE Nat
11	3/13	1822	0	0	0	0	0	0	0	0	0	0	0	0
12	3/20-21	1828	1	0.03	0	0	0	0	0	0	0	0	1	0.03
15	4/12	1626	0	0	0	0	0	0	0	0	0	0	0	0
16	4/17	1602	7	0.26	0	0	0	0	0	0	0	0	7	0.26
17	4/24&27	1174	4	0.20	0	0	0	0	0	0	0	0	4	0.20
18	5/02	1826	0	0	0	0	0	0	0	0	0	0	0	0
19	5/08	2192	1	0.03	0	0	0	0	0	0	0	0	1	0.03
21	5/21	1681	3	0.11	0	0	0	0	0	0	0	0	3	0.11
22	5/28	1827	102	3.35	0	0	0	0	0	0	0	0	102	3.35
23	6/05	1041	20	1.15	0	0	0	0	0	0	0	0	20	1.15
24	6/12	1728	266	9.24	51	1.77	0	0	0	0	51	1.77	215	7.47
25	6/19	1876	327	10.46	0	0	31	0.99	19	0.61	50	1.60	277	8.86
26	6/28	1773	449	15.16	51	1.73	28	0.95	3	0.10	82	2.77	367	12.42
27	7/05	1741	159	5.48	0	0	0	0	0	0	0	0	159	5.48
28	7/10	1788	398	13.36	0	0	9	0.30	0	0	9	0.30	389	13.05
29	7/18	1742	328	11.30	0	0	3	0.10	0	0	3	0.10	325	11.19
30	7/26	1632	108	3.97	25	0.92	0	0	0	0	25	0.92	83	3.05
31	7/31	2165	345	9.56	0	0	3	0.08	0	0	3	0.08	342	9.48
32	8/07	1833	130	4.26	0	0	0	0	0	0	0	0	130	4.26
33	8/14	1796	165	5.51	0	0	0	0	0	0	0	0	165	5.51
34	8/23	1810	10	0.33	0	0	0	0	0	0	0	0	10	0.33
35	8/28	1971	54	1.64	0	0	0	0	0	0	0	0	54	1.64
Total		**38474**	**2877**	**4.49**	**127**	**0.20**	**74**	**0.12**	**22**	**0.03**	**223**	**0.35**	**2654**	**4.14**