Fishery Data Series No. 91-55

Migratory Patterns and Fishery Contributions of Chilkat River Chinook Salmon, 1990

by

Keith A. Pahlke

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Alaska Department of Fish and Game

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[1] This investigation was financed by the Federal Aid in Sport Fish Restoration Act (16 U.S.C. 777-777K) under Project F-10-6, Job No. S-1-5.

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ABSTRACT

A total of 13,851 wild juvenile chinook salmon *Oncorhynchus tshawytscha* was coded-wire tagged at three locations in the Chilkat River drainage during the fall of 1990. Subtracting estimates for tag loss, 1,367 fish with tag code 4-33-38 were tagged and released on the Tahini River between September 10 and October 8; 10,130 fish with tag codes 4-33-47 were tagged and released on the Kelsall River between September 18 and October 15; and 2,147 fish with tag code 4-33-39 were tagged and released on the mainstem Chilkat River between October 20 and October 27, 1990. An additional 2,192 chinook salmon pre-smolt from the 1988 brood year were tagged between April 14 and April 26, 1990. Recovery of the tags will occur in commercial and recreational fisheries sampling programs and on spawning grounds.

In 1985 and 1986 the Alaska Department of Fish and Game released hatchery-reared fry near spawning grounds on the Tahini River, a tributary to the Chilkat River. Tagged chinook salmon from these releases were recovered in commercial and recreational fisheries sampling programs, and on the Tahini River in 1989 and 1990. Tag recovery data show that some Chilkat River chinook salmon rear in the inside waters of northern southeast Alaska and are harvested as both mature and immature fish. Estimates of harvest rates and migratory patterns for a brood year will be available in 1992.

An estimated 16 (SE = 15) chinook salmon of Tahini River origin which were 6 years of age (1984 brood stock aged 1.4) were harvested in sport fisheries sampled in 1990, and another 9 (SE = 8) 1984 brood chinook salmon of Tahini River origin were delivered for sale in commercial fisheries sampled in 1990. Also, an estimated 45 (SE = 32) chinook salmon of Tahini River origin which were 5 years of age (1985 brood stock aged 1.3) were harvested in sport fisheries sampled in 1990, and another 40 (SE = 21) 1985 brood chinook salmon of Tahini River origin were delivered for sale in commercial fisheries sampled in 1990.

KEY WORDS: Chinook salmon, *Oncorhynchus tshawytscha*, Chilkat River, Tahini River, Kelsall River, coded-wire tagging, harvest, escapement, juvenile salmon, migration, Southeast Alaska.

INTRODUCTION

The Chilkat River originates in the Yukon Territories, Canada and flows into northern Lynn Canal near Haines, Alaska (Figure 1 and 2). This large, glacial river flows through a broad flood plain, forming numerous, braided stream channels, gravel bars and islands covered with dense stands of willow and cottonwood (Mills et al. 1983). The river supports large populations of sockeye, chum, and coho salmon, and a small population of chinook salmon that are very important to local recreational, subsistence and commercial drift gill net fisheries.

Chinook salmon returning to the Chilkat River are targeted by a marine recreational fishery and a salmon derby in Haines, Alaska. Because estimated escapements have been small (Table 1), fishing time, area restrictions, and bag limits have been imposed on the Haines marine recreational fishery since 1987. Since 1989, the Haines Chinook Salmon Derby has been voluntarily canceled to conserve Chilkat chinook salmon. From 1984 to 1988 an average of 23% of the total Haines area recreational harvest of chinook salmon was caught during the derby (Suchanek and Bingham 1989).

Progress in rebuilding Chilkat River chinook salmon stock(s) has been below expectations (Mecum 1990). It is possible that these stocks are harvested at immature life stages, in mixed-stock fisheries. In 1988 the Sport Fish and Commercial Fisheries divisions of the Alaska Department of Fish and Game (ADFG) began a coded-wire tagging (CWT) study to document harvest areas and estimate harvests of Chilkat River chinook salmon in commercial and recreational fisheries. Results from the third year of tagging juvenile chinook salmon in the Chilkat River drainage are reported in this document.

Field studies were also conducted in 1990 to estimate an escapement to an important tributary of the Chilkat River (the Tahini River), and estimate the harvest of chinook salmon aged 1.3[1] and 1.4 from the Tahini River to commercial and recreational fisheries sampled in 1990. Contribution estimates are the product of sampling for tagged, hatchery reared, chinook salmon from 1984 and 1985 brood years, which were released into the Tahini River in 1985 and 1986. These tagged fish were sampled in commercial and recreational fisheries, and in Tahini River escapements to estimate the proportion of tagged fish returning to the river. Escapement to the Tahini River was estimated with a Petersen marked-recapture study. In this study, fish were captured in a gill net, marked and released, and later counted during surveys on the Tahini River spawning grounds.

The objectives of the project in 1990 were to:

1. estimate the harvest of chinook salmon aged 1.3 and 1.4 from the Tahini River in ocean commercial and recreational fisheries in 1990;

2. estimate mean length of juvenile chinook salmon in the Chilkat River;

---

[1] Ages are reported in European notation. The first numeral refers to the number of years of freshwater residence after emergence. The second number refers to the number of years of marine residence. The total age is the sum of the two numbers plus one.

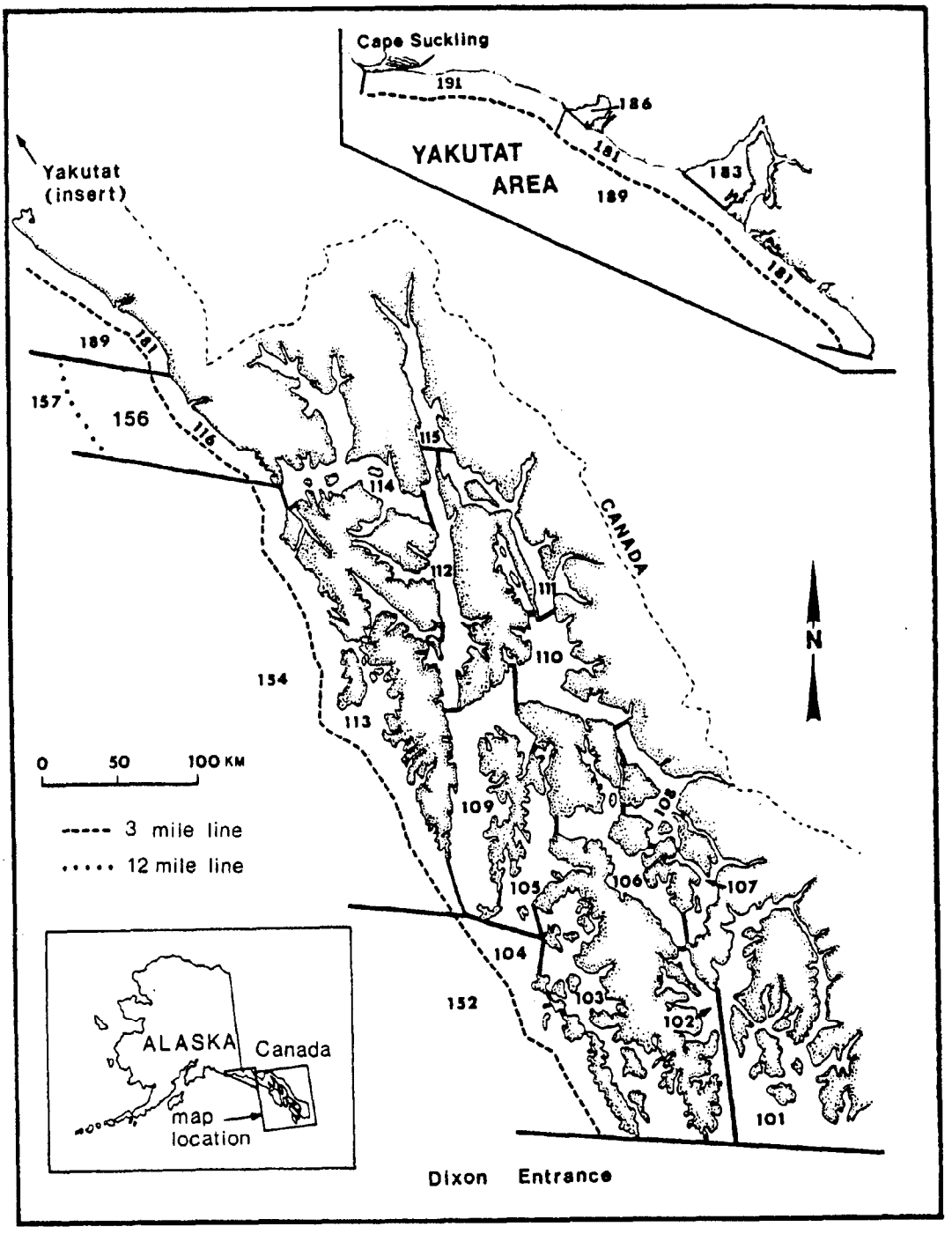

Figure 1. Southeast Alaska commercial fishing districts and statistical areas, including Lynn Canal (District 115).

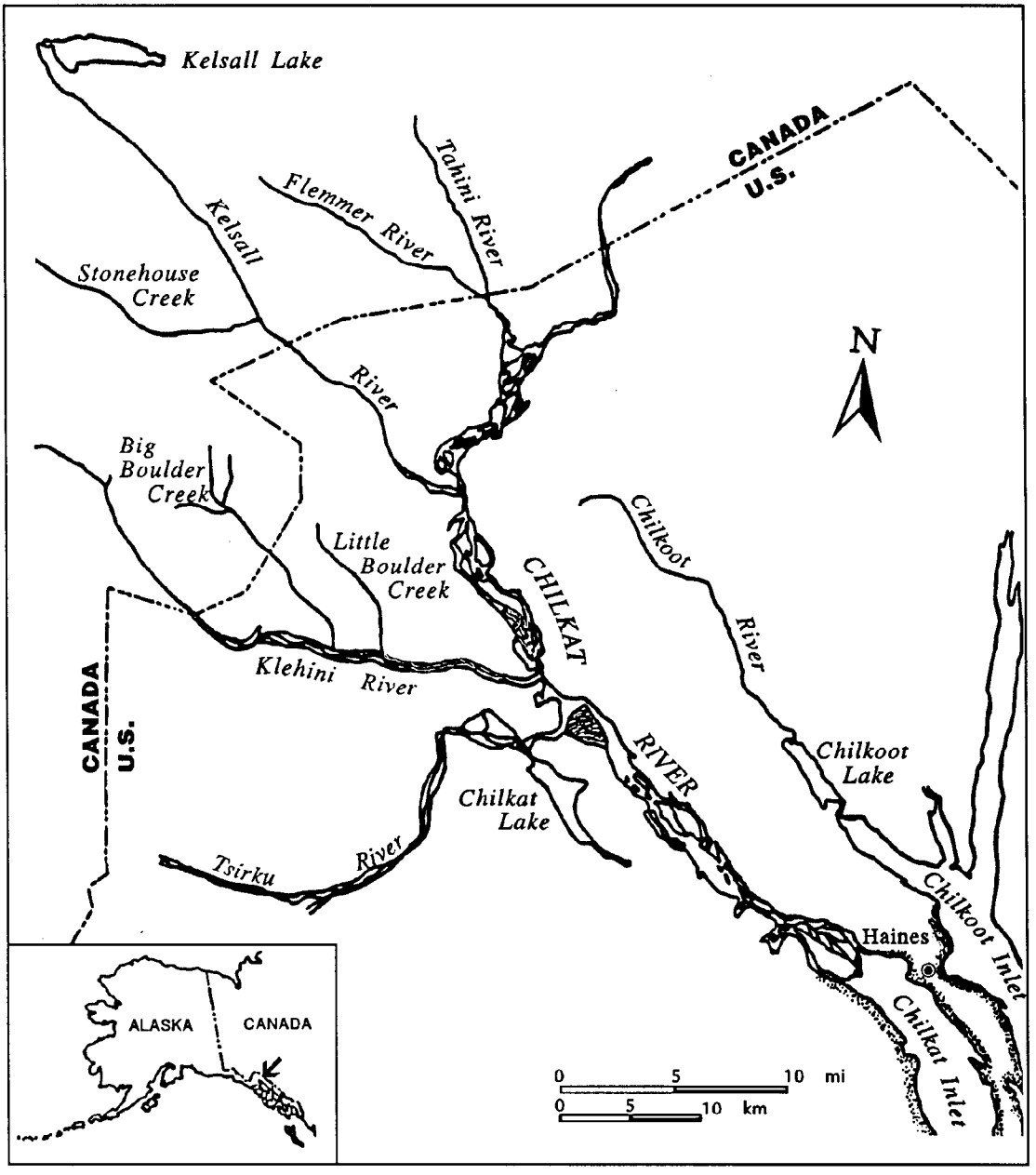

Figure 2. Chilkat River drainage, northwestern British Columbia and northern Southeast Alaska.

Table 1. Peak escapement counts of chinook salmon in the Chilkat River index areas, angler effort (angler-hours), and harvest of chinook salmon in the Chilkat Inlet marine recreational and District 115 drift gill net fisheries, 1960 to 1990.[a,b]

Year	Escapement						Angler effort	Harvest	
	Big Boulder		Stonehouse Creek		Total	Drainage expansion		Sport	115 Gill net
1960	316	(F)	-		316		-	-	1,453
1961	88	(F)	-		88		-	-	683
1962	-		-		-		-	-	806
1963	-		-		-		-	-	276
1964	-		-		-		-	-	771
1965	-		-		-		-	-	1,735
1966	330	(F)	-		330		-	-	868
1967	150	(F)	-		150		-	-	1,171
1968	259	(F)	-		259		-	-	1,489
1969	-		-		-		-	-	1,618
1970	176	(F)	-		176		-	-	1,771
1971	56	(F)	-		56		-	-	2,929
1972	-		-		-		-	-	986
1973	-		-		-		-	-	2,479
1974	0	(F)	-		0		-	-	1,672
1975	21	(F)	-		21	187	-	-	816
1976	25	(F)	-		25	223	-	-	2,142
1977	25	(F)	-		25	223	-	-	1,214
1978	-		-		-	214	-	-	536
1979	-		-		-	214	-	-	3,572
1980	-		-		-	214	-	-	440
1981	187	(H/F)	69	(H)	256	1,143	-	-	1,300
1982	56	(H/F)	123	(H)	179	799	-	-	5,945
1983	121	(H/F)	126	(H)	247	1,103	-	-	2,119
1984	229	(H/F)	104	(H)	333	1,487	10,250	1,070	6,207
1985	70	(H/F)	50	(H)	120	536	21,600	1,615	3,260
1986	20	(F)	9	(H)	29	129	31,540	1,620	2,772
1987	98	(F)	190	(H)	288	1,286	26,590	1,094	3,223
1988	86	(F)	89	(H)	175	781	36,222	481	1,257
1989	74	(F)	231	(H)	305	1,362	10,526	252	1,995
1990	19	(F)	42	(H)	61	272	8,784	210	670

[a] (F) = Escapement survey conducted by walking.
(A) = Escapement survey conducted by fixed-wing aircraft.
(H) = Escapement survey conducted by helicopter.
(H/F) = Escapement survey conducted by helicopter and by walking.
- = No survey conducted or data not comparable.

[b] Escapement counts prior to 1975 may not be comparable because of differences in survey dates and counting methods.

3. estimate the tagged to untagged ratio (for CWT's) in the 1990 escapement of chinook salmon aged 1.3 and 1.4 to the Chilkat River; and

4. estimate the age composition of chinook salmon harvested by commercial and sport fisheries in the Haines area, and of chinook salmon returning to the Tahini River.

Estimation of tagging ratios is required to estimate harvests of Tahini River chinook salmon aged 1.3 and 1.4 in commercial and recreational fisheries. The sampling data will also be combined with sampling data from 1989, for fish then aged 1.2 and 1.3 years. Additional data documenting the tagging ratios will be collected in 1991. Estimated contributions of the Tahini River stocks by brood years will be available in 1992.

METHODS

Coded-Wire Tagging of Juvenile Chinook Salmon

Trapping areas on the lower Tahini River, the Kelsall River, and the mainstem Chilkat River below the Klehini River (Figure 2) were selected on the basis of our accessibility to preferred juvenile chinook salmon habitat (Kissner 1986). Trapping was concentrated on the lower Tahini River first, then moved downstream as catch rates dropped, to the Kelsall River, and then to mainstem areas. This progression was employed to maximize the number of juveniles tagged.

Juvenile chinook were captured with standard minnow traps (Gee brand) during spring and fall 1990. Between 40 and 100 minnow traps baited with clusters of salmon roe were available to fish each day. Salmon roe was disinfected before use by immersion in a dilute solution of betadyne at a ratio of 1 part betadyne per 90 parts water, for 15 minutes. Traps were checked and re-baited daily.

Juvenile fish were transported from capture sites to a field camp and held in live pens until tagged in a nearby semipermanent shed. Juvenile chinook salmon were anesthetized with tricaine methanesulfonate (MS 222), marked by removal of the adipose fin, and injected with a CWT using a Northwest Marine Technology (NMT) tag injector. The 120 fish/pound head mold was used to tag young-of-year (YOY) salmon. A different tag code was used for each area trapped.

The CWT's used in this study were 1.0 mm in length, 0.25 mm in diameter, and made of Type 302 stainless steel. The tags were implanted in the cartilaginous wedge of the fish snout. Tag placement was observed on several chinook salmon each day by making a vertical incision through the dorsal median plane to the oral cavity. Head mold depth was adjusted if improper placement of tags was observed. Bisection and adjustment continued until tags were properly placed. Implanted CWT's were magnetized by dropping tagged fish, head first, through a ring magnet into a bucket of water, and then passing the fish through a NMT field sampling detector to check for the presence of a magnetized tag. Tagged juvenile chinook salmon were released in mainstem areas above or below the areas being trapped at the time of their release to minimize recaptures.

All juvenile chinook salmon with missing adipose fins that were recaptured during the tagging operation were checked with a NMT magnetic tag detector for the presence of a CWT to estimate the percentage of fish that had lost their tags. The total number of fish released with tags was then estimated from this in-river

tag loss percentage. Once every week during the tagging process about 40 tagged YOY chinook salmon were selected by random grab of a dip net through the days catch and measured for length (tip of snout to the fork of tail, to nearest millimeter). Mean lengths and associated standard errors are calculated with normal procedures (Zar 1974).

Tagging of Juveniles in 1985 and 1986:

In 1984 and 1985, chinook salmon eggs were taken from Tahini River fish, incubated and reared in Crystal Lake hatchery, coded-wire tagged, and released back into the Tahini River. Approximately 42,360 fry from brood year 1984 were returned to the Tahini River in May 1985, and 44,120 fry from brood year 1985 were returned in May 1986 (Table 2). Adult chinook salmon from the 1984 brood which are 6 years of age (age-1.4) and fish from the 1985 brood which are 5 years of age (age-1.3) may return to the Tahini River or be harvested in 1990. Sampling for fish with these tags was conducted in 1989 and 1990.

Estimation of Θ, the Fraction of Juvenile Chinook Salmon Tagged

The total number of juveniles in the population at the time of tagging (or enhancement with tagged fish) was unknown. However, estimation of the harvest of a tagged stock or release to a mixed-stock fishery requires that the proportion of the population of interest which is tagged is known or estimable. In this study, the tagging ratio for a brood year is estimated from sampling adults that have returned to spawn, for age and CWTs. Since fish of several ages and brood years will be present in a typical sample of spawning adults, tagging ratios for a given brood are estimated as

$$\hat{\theta}_{b,i} = \frac{y_{b,i}}{t_{b,i}} \qquad (1)$$

where

$\hat{\theta}_{b,i}$ = estimate from year i of the proportion of juveniles from brood year b that were tagged with a coded wire tag;
$y_{b,i}$ = number of fish in the sample from year i that are successfully aged, determined to be from brood year b, and are missing their adipose fin; and
$t_{b,i}$ = number of fish in the sample from year i that are successfully aged and determined to be from brood year b.

The standard errors of the estimates were calculated with normal procedures (Cochran 1972).

The estimate $\hat{\theta}_{b,i}$ is an unbiased estimate of the true tagging ratio θ_b, assuming that tagging does not affect survival and recapture rates. The estimate of θ_b can be updated from year to year as additional age classes from a given brood year are sampled on the spawning grounds (e.g., Pahlke et al. 1990). Fish age was estimated from scale pattern analysis, which we assume is an unbiased estimator.

In the current study, sampling to estimate θ_{1984} and θ_{1985} was conducted with a gill net set in the lower Tahini River (see below), and by surveys of carcasses on the spawning grounds. All chinook salmon caught in the gill net were sampled

Table 2. Summary of coded-wire tag releases in the Chilkat River, 1985 to 1989.[a]

Tag code	Number of tagged chinook released	Number of untagged chinook released	Estimated tag loss
B41114[b]	42,360	601	1.4%
Total (1985)	42,360		
B30610[c,d]	10,419	556	3.2%
B30611[c,d]	10,539	563	3.2%
B30612[c,d]	11,383	608	3.2%
B30613[c,d]	11,779	631	3.2%
Total (1986)	44,120		
42717[e]	4,553	0	0%
Total (1988)	4,553		
42837[f]	5,293	0	0%
42843[g]	5,467	27	0.5%
42714[g]	10,447	52	0.5%
42715[g]	4,184	21	0.5%
42710[h]	9,897	119	1.2%
Total (1989)	20,098		

[a] Johnson and Longwill (1991).
[b] 1984 Tahini River brood stock released in 1985.
[c] 1985 Tahini River brood stock released in 1986.
[d] Replicate tag codes.
[e] Chilkat River wild juveniles tagged in 1988.
[f] Tahini River wild juveniles tagged in 1989.
[g] Kelsall River wild juveniles tagged in 1989.
[h] Mainstem Chilkat River juveniles tagged in 1989.

for scales (age) and a missing adipose fin. Some sampled fish were retained for brood stock, and all remaining fish were returned to the river with a marked dorsal fin. Later, carcasses on the spawning grounds were sampled for missing adipose fins and marks on dorsal fins. Scales and adipose fin clip data from all carcasses *without dorsal marks* were added to the pool of samples (from the gill net) to be aged and used to estimate tagging ratios, and all CWTs were collected.

In 1991 when returns of (age-1.2) jack chinook salmon from the multiple tagging conducted in this study occurs, carcass surveys in many spawning areas of the Chilkat River drainage will be conducted to estimate tagging ratios. The ratios most surely will vary by spawning area. Definitions of $y_{b,i}$ and $t_{b,i}$ may then be redefined to be specific for a tag code, instead of a missing adipose fin.

Sampling Tahini River Escapement for Age, Length, and Abundance

The escapement of chinook salmon measuring ≥660 mm mid-eye to fork of tail (MEF) and aged 1.3 years and older to the Tahini River in 1990 was estimated using the Chapman modified Petersen estimators (Seber 1982):

$$\hat{N} = \frac{(n_1+1)(n_2+1)}{(m_2+1)} - 1 \qquad (2)$$

$$V[\hat{N}] = \frac{(n_1+1)(n_2+1)(n_1-m_2)(n_2-m_2)}{(m_2+1)^2(m_2+2)} \qquad (3)$$

where

$\hat{N}$ = abundance;
n_1 = number of marked chinook salmon ≥660 MEF released in the lower river;
n_2 = number of carcasses ≥660 MEF examined on the spawning grounds; and,
m_2 = number of carcasses ≥660 MEF examined that had a dorsal fin mark.

A set gill net was used to catch salmon as they moved up the Tahini River between July 21 and August 1 to spawn. The net was also used to collect chinook salmon for brood stock. Netted fish were either retained for brood stock or returned to the river with a dorsal fin clip. The number of fish returned to the river was tallied by releases greater than and less than 660 mm MEF.

Dead or nearly dead chinook salmon in post-spawning condition were enumerated in carcass surveys (the recapture event). Spawning grounds were sampled six times between August 7 and August 17, the period of peak spawning activity (Mecum 1990) and again on August 28. Spawning grounds on the Tahini River were defined as the area between the set gill net site and the junction with the Flemmer River.

Gaffs and gill nets were used to collect fish for examination. All fish were checked for a missing adipose fin, measured for length, sexed using external characteristics, and tallied separately if ≥660 mm MEF. Also, fish marked with a dorsal fin clip were counted for the Petersen estimator. Once sampled or counted, carcasses were slashed to prevent repeated sampling. The heads of all carcasses with missing adipose fins were removed, tagged with a numbered strap inserted through the mouth, and sent to the ADFG Fisheries Rehabilitation, Enhancement, and Development (FRED) Division Tag Lab in Juneau for dissection and decoding of CWT's.

The Petersen estimate was compared to an index of escapement of large fish obtained from a helicopter survey (Mecum 1990). A normal approximation is used to estimate 95% confidence intervals for $\hat{N}$.

Harvest Sampling

A port sampling program conducted by the Alaska Department of Fish and Game (ADFG) Division of Commercial Fisheries exists to recover chinook salmon with CWT's from commercial fisheries in southeast Alaska (Van Alen 1988). Port sampling is stratified by statistical area (Figure 1) and statistical weeks (1-52). For example, in 1988 ≈100% of the troll harvest of chinook salmon landed in southeast Alaska, 99% of the Lynn Canal (district 115) gill net harvest of chinook salmon, and 91% of district 109, 112, and 114 seine harvests of chinook salmon occurred in strata sampled for CWT fish (John E. Clark, ADFG Commercial Fisheries Division, Douglas, personal communication). With similar sampling rates in 1990, minimal bias was expected in estimates of total commercial harvests of Chilkat River chinook salmon to commercial fisheries due to incomplete sampling of strata. About 46% of the total commercial catch of chinook salmon was inspected for CWT's in 1988; in the northern inside districts about 64% of the catch was inspected (Oliver 1989). Thus, sampling fractions were also expected to be high in 1990.

Creel surveys of major marine boat and selected roadside fisheries exist to recover chinook salmon with CWT's from sport fisheries in southeast Alaska. The marine surveys are conducted in Haines, Juneau, and Ketchikan at times of peak sport fishing activity (Suchanek and Bingham *In press*). About 72% of sport harvests in 1988 in the Haines/Skagway and Juneau areas occurred in strata that were sampled (Suchanek and Bingham 1989, Mills 1989). Since sport harvests are a small (≤10%) component of total (sport plus commercial) southeast Alaska or northern southeast Alaska chinook harvests, minimal bias in estimates of harvests of Chilkat River chinook salmon to all sampled fisheries were likely to result from incomplete sampling in 1990.

Fishery Contributions

Contributions to sport and commercial fisheries in 1990 of two ages (1.3 and 1.4) of chinook salmon from the Tahini River could be estimated from random recoveries of CWT's obtained during the port and creel sampling programs described above.

The contribution for each age (brood) to each sampled stratum h was estimated:

$$\hat{n}_1 = \left(\frac{a_1}{a_2}\right)\left(\frac{m_1}{m_2}\right)\left(\frac{\hat{N}_h}{n_2}\right)\left(\frac{m_c}{\theta}\right) \qquad (4)$$

where

$\hat{N}_h$ = estimated number of chinook salmon (fish) harvested in stratum h;
n_2 = number of fish in stratum h inspected for a missing adipose fin;
m_c = number of CWT's from stratum h removed from fish heads and found to contain the unique code for the Tahini River;
θ = proportion of the escapement (for each age) which contains a CWT;
a_1 = number of fish in stratum h missing an adipose fin which are counted and marked with a head strap;

a_2 = number of fish from stratum h and marked with a head strap which arrive at the tag lab;
m_1 = number of CWT's from stratum h which are detected in fish heads at the tag lab;
m_2 = number of CWT's from stratum h which are removed from fish heads and decoded.

Variance of a contribution to a commercial fisheries strata was estimated according to the formula in Clark and Bernard (1987). Variance of a contribution to sport fishery strata was estimated using the formula in Carlon and Vincent-Lang (1989) which considers that total catch is estimated. Total contributions to sport and commercial fisheries for chinook salmon of the 1984 and 1985 brood years (aged 1.2 through 1.5 years) released into the Tahini River will be made in 1992, when all age classes have been sampled.

Variances to all (summed) sport and/or commercial fishery strata were obtained by summing variance estimates across sampled strata. Standard errors of the estimates are the square roots of the estimated variances.

Age Measurement and Age Compositions

Age of sampled chinook salmon was estimated from scale pattern analyses. Four scales were removed from the left side of each sampled fish (right side if scales were missing or regenerated) at the posterior edge of the dorsal fin, two scale rows above the lateral line. Scales were mounted on gummed cards, and impressions made in cellulose acetate (Clutter and Whitesel 1956). Age was estimated during visual examination of scale impressions magnified ≈70x on a microfiche reader.

Age composition, average lengths, and standard errors of these estimates for sampled harvests and escapements were estimated using standard normal estimators (Van Alen et al. 1987).

RESULTS

Coded-Wire Tagging of Juvenile Chinook Salmon

Trapping was conducted between April 14 and April 27 to capture over-wintering pre-smolt chinook salmon. Catches in April were good; early sets in the mainstem Chilkat River averaged about 7 fish per set, dropping to 2 or 3 fish per set after a week (Table 3). Average length of pre-smolt chinook was 67.4 mm (SE=1.09). A total of 2,192 valid tags were released.

Trapping occurred on the Tahini River from the confluence of the Flemmer River downstream to the confluence of the Tahini and mainstem of the Chilkat River, between August 6 and October 6. Approximately 30 minnow traps were fished in an exploratory manner on the Tahini River in early August (Table 4); catch rates were low and no fish were tagged. Trapping began in earnest on September 10 and continued through October 6. An estimate of the average length of wild juveniles trapped is 73.4 mm (SE=0.48), and sizes ranged from 55 to 91 mm. A total 1,379 YOY chinook salmon were tagged between September 10 and October 8, with an estimated tag retention (derived from the tagged to untagged ratio of recaptured, adipose-clipped fish) of 99.1% yielding an total of 1,367 valid tags released.

Table 3. Summary of trapping and coded-wire tagging of pre-smolt chinook salmon on the Chilkat River from April 14 to April 26, 1990.

Date	Traps checked	Estimated catch			Chinook tagged	Number recap.	Tags retained	Tag code	Mean length (mm)	Sample size
		Chin	Coho	DV						
14-Apr	34	207								
15-Apr	40	320								
16-Apr	48	335			797	79	77	04-33-37		
17-Apr										
18-Apr	43	120			494	36	36	04-33-37		
19-Apr	52	91								
20-Apr	60	202								
21-Apr	56	74								
22-Apr	47	98								
23-Apr	18	158			326	40	39	04-33-37		
24-Apr	73	328			127	32	32	04-33-37		
25-Apr	27	131								
26-Apr	27	63			476	47	47	04-33-37	67.4	50
27-Apr	12	14								
	537	2,141	0	0	2,220	234	231		67.4	50

Overall statistics (lengths in mm)

Valid tags released: (4-33-37) 2,192
Catch/trap 4.1
Tag retent. 98.7
Mean length 67.4
95% CI 65.2 to 69.5
Range 53 to 88
SD 7.7
SE 1.09

Table 4. Summary of trapping and coded-wire tagging of YOY chinook salmon on the Tahini River from August 5 to October 7, 1990, and comparison of lengths of wild and hatchery release fish.

Date	Traps checked	Estimated catch			Chinook tagged	Number recap.	Tags retained	Tag code	Mean length (mm)	Sample size
		Chin	Coho	DV						
06-Aug	20	124	17	111		13	11		65.6[a]	49
07-Aug	27	113	24	107		20	20			
08-Aug	29	40	23	59	no	5	5			
09-Aug	30	27	22	63	fish	2	2			
10-Aug	30	9	18	75	tagged	2	2			
11-Aug	20	53	40	212		5	5		73.7[b]	34
10-Sep	70	562	460	439	fish	78	77		82.5[c]	58
11-Sep	74	344	230	248	tagged	42	41		74.8[d]	58
12-Sep	80	89	150	135		9	9			
13-Sep	79	32	65	85		2	2			
14-Sep	67	77	26	46	1,008	7	7	4-33-38		
15-Sep	32	25	7	29		1	1			
04-Oct	38	296								
05-Oct	36	91	5	5						
06-Oct	31	89	36	78						
08-Oct					371	85	85	4-33-38	78.2[e]	58
Total 9/10-10/8	507	1,605	979	1,065	1,379	224	222		73.4[f]	165[f]

Overall statistics (lengths in mm)

For wild fish:

Valid tags released: (4-33-38) = 1,367

Catch/trap	3.2
Tag retent.	99.1
Mean length	73.4[f]
95% CI	72.5 to 74.3
Range	55 to 91
SD	6.8
SE	0.48

For hatchery fish:

12.84% of total catch of 10-Sep

Tag retent.	95.7
Mean length	82.5[g]
95% CI	81.0 to 83.9
Range	67 to 92
SD	5.7
SE	0.74

[a] Wild juveniles only, no adipose clipped fish.
[b] Adipose clipped fish released in May, 1990, recaptured August 11, 1990.
[c] Adipose clipped fish released in May, 1990, recaptured September 10, 1990.
[d] Wild juveniles only, no adipose clipped fish.
[e] Wild juveniles only, no adipose clipped fish.
[f] Includes samples of August 6, September 11, and October 8 only.
[g] Includes sample of September 10 only.

Tagging on the Kelsall River took place in the 5-km section above the confluence of the Kelsall and mainstem Chilkat River, from September 18 to October 15. Catch rates were good, ranging from over 15 fish/trap-day on October 10 to ≈5/trap-day on October 15 (Table 5). Average length was 70.3 mm (SE = 0.45), range from 53 to 89 mm. A total of 10,242 YOY chinook salmon were tagged, with an estimated tag retention rate of 98.9% yielding an estimated 10,130 valid tags released.

The mainstem of the Chilkat River between the Wells Bridge and about Mile 17 on the Haines Highway was trapped between October 20 and October 27. Catch rates were low, averaging 6 fish/trap-day over a 7-day period (Table 6). Average length was 66.2 mm (SE = 0.82), range from 50 to 84 mm. A total of 2,230 YOY chinook salmon were captured, adipose-clipped, coded-wire tagged, and released. Adjusting for an estimated tag retention rate of 96.3%, a total of 2,147 valid tags was released.

On May 14, 1990 a total of 29,966 juvenile chinook salmon reared at the Jerry Myers hatchery (formerly Pullen Creek hatchery) was released in the Tahini River. These fish were the result of the 1989 egg-take on the Tahini River, and all were tagged with coded-wire tags (Table 7).

Estimation of Tagging Fractions for 1985 and 1986

Sampling to estimate the fractions of pre-smolt (fresh water age 1) chinook salmon in the Tahini River that had a CWT (after enhancements in 1985 and 1986) was conducted between July 21 and August 28, 1990. Gill net catches peaked in late July (Table 8); 211 adult chinook salmon were captured in the nets. Scales from 186 of these fish were successfully aged; 78 were aged 1.3, and 36 were aged 1.4 (Table 9). The remainder of the aged fish represented other age classes. Twelve of the 78 fish aged 1.3 were missing an adipose fin, and 8 of the 36 fish aged 1.4 were missing an adipose fin.

Seven surveys of spawning areas on the Tahini River occurred between August 7 and August 28. Twenty-five adult chinook salmon without dorsal marks were examined in the surveys. Scales from 19 of these fish were successfully aged; 7 were aged 1.3, and 6 were aged 1.4. None (0) of the fish aged 1.3 or aged 1.4 were missing an adipose fin (Table 9).

On the basis of 1990 data, the fraction of 1984 brood year pre-smolt Tahini River chinook salmon tagged was 0.1905 (SE = 0.061). Similarly, on the basis of 1990 data, the fraction of 1985 brood year pre-smolt Tahini River chinook salmon tagged was 0.1412 (SE = 0.038).

In 1989, the tagging fractions were estimated to be 0.229 for brood year 1984 and 0.200 for brood year 1985 (Pahlke et al. 1990). Combining recovery data from 1989 with those from 1990 by brood year gives updated estimates of 0.2143 (SE = 0.039) and 0.1640 (SE = 0.031), respectively, for the 1984 and 1985 tagging fractions.

In total, six tagged fish were recovered during the gill net sampling, and none were recovered on the spawning grounds. Two adipose-clipped fish were sampled on the spawning grounds, but one did not contain a tag, and the head was not recovered from the other. All of the decoded tags were from hatchery reared fish released in the Tahini River in 1985 and 1986 (Table 10).

Table 5. Summary of trapping and coded-wire tagging of YOY chinook salmon on the Kelsall River from September 18 to October 15, 1990.

Date	Traps checked	Estimated catch			Chinook tagged	Number recap.	Tags retained	Tag code	Mean length (mm)	Sample size
		Chin	Coho	DV						
18-Sep	40	210	55	28						
19-Sep	54	288	108	56						
20-Sep	73	401	168	85						
21-Sep	73	250			1,149	38	37	04-33-47	67.3	50
		-high water: no trapping-								
02-Oct	43	147	55	40					70.4	38[a]
03-Oct	50	615	35	10						
04-Oct	60	584	110	50						
05-Oct	58	412	70	75						
06-Oct	62	462	21	15	870	38	38			
07-Oct	56	692	105	95	1,910	77	75	04-33-47	69.9	48
08-Oct	59	922	160	180	872	50	50	04-33-47		
09-Oct	55	687	118	85	586	83	83	04-33-47		
10-Oct	91	1,369	105	145	1,329	94	94	04-33-47		
11-Oct	93	1,164	75	85	1,094	52	52	04-33-47		
12-Oct	90	706	30	50	678	41	41	04-33-47		
13-Oct	91	925	135	207	528	29	28	04-33-47		
14-Oct	75	541	70	215	862	38	36	04-33-47		
15-Oct	67	366	80	145	364	11	11	04-33-47	73.6	50
	1,190	10,741	1,500	1,566	10,242	551	545		70.3	186

Overall statistics (lengths in mm)

Valid tags released:(4-33-47) = 10,130
Catch/trap 9.0
Tag retent. 98.9
Mean length 70.3
95% CI 69.4 to 71.2
Range 53 to 89
SD 6.2
SE 0.45

[a] Adipose-clipped fish from hatchery release in May, sampled September 21.

Table 6. Summary of trapping and coded-wire tagging of YOY chinook salmon on the Chilkat River from October 20 to October 27, 1990.

Date	Traps checked	Estimated catch			Chinook tagged	Number recap.	Tags retained	Tag code	Mean length (mm)	Sample size
		Chin	Coho	DV						
20-Oct	45	220	880	80						
21-Oct	60	273	830	150						
22-Oct	64	426	1,720	210						
23-Oct	74	412	1,150	145						
24-Oct					1,407	17	16	04-33-39	66.2	50
25-Oct	55	387	500	125						
26-Oct	65	434	800	125						
27-Oct					823	10	10	04-33-39		
	363	2,152	5,880	835	2,230	27	26		66.2	50

Overall statistics (lengths in mm)

Valid tags released: (4-33-39) = 2,147
Catch/trap 5.9
Tag retent. 96.3
Mean length 66.2
95% CI 64.6 to 67.8
Range 50 to 82
SD 5.8
SE 0.82

Table 7. Summary of 1990 coded-wire tag releases in the Tahini River of brood year 1989 juvenile chinook salmon reared at Jerry Myers hatchery, Skagway.

Tag code[a]	Number of tagged chinook released	Untagged released	Estimated tag loss
04-01-01-10-10	6,856	41	0.6
04-01-01-10-08	12,155	73	0.6
04-01-01-10-09	10,955	66	0.6
Total	29,966	180	

[a] Replicate codes released on 5/14/90.

Table 8. Daily gill net catch of chinook salmon and CPUE, Tahini River, 1990.

Date	Hours fished	Catch				Total	Catch/ hour	Cum. catch
		Unmarked		Ad clipped				
		Males	Females	Males	Females			
21-Jul	16.5	8	0	0	0	8	0.48	8
22-Jul	16.5	7	0	1	1	9	0.55	17
23-Jul	18.0	15	2	2	0	19	1.06	36
24-Jul	12.0	9	0	1	0	10	0.83	46
25-Jul	14.5	15	8	4	2	29	2.00	75
26-Jul	14.8	18	1	2	3	24	1.63	99
27-Jul	13.5	17	6	0	3	26	1.93	125
28-Jul	15.0	18	4	2	0	24	1.60	149
29-Jul	11.0	15	1	3	1	20	1.82	169
30-Jul	0.0	high water: no fishing				0		169
31-Jul	7.5	9	2	2	0	13	1.73	182
01-Aug	7.5	23	4	0	2	29	3.87	211
Total	146.8	154	28	17	12	211	1.44	211

Table 9. Summary of chinook salmon sampled for CWTs on the Tahini River by age and gear type, 1990.[a]

Source	Number sampled	Number aged	Age-1.3		Age-1.4	
			Total	Adipose clipped	Total	Adipose clipped
Set gill net	211	186	78	12	36	8
Carcass samples	25	19	7	0	6	0
Total	236	205	85	12	42	8

[a] Does not include recaptures of fish sampled by gill net.

Table 10. Spawning ground recoveries of CWT tagged chinook salmon on the Tahini River, 1990.

Brood year	Tag code	Statistical week	Sample source	Head number	Length	
1984	B41114	31	egg take	27979	905	
					Age-1.3 Subtotal	1
1985	B30612	31	egg take	27978	860	
1985	B30612	31	egg take	27981	865	
1985	B30612	31	egg take	27977	905	
1985	B30613	31	egg take	27976	780	
1985	B30613	31	egg take	27980	865	
					Age-1.4 Subtotal	5
Total						6

Age, Length, and Abundance

Age composition of the Tahini River escapement of chinook salmon was estimated from 205 ageable scales collected (Table 11). This estimated composition may be biased toward older age classes, since the gill net may have undersampled fish aged 1.2 relative to fish aged 1.3 and older. The percentage of age-1.2 males (jacks) was high, as it was in 1989, indicating good survival of the poor escapement in 1986. Approximately 81% of the escapement examined were male chinook salmon. Age classes 1.2 and 1.3 composed over 75% of the total return, but 20% of the return and over half of the female chinook salmon were aged 1.4. Average length by age of the escapement is shown in Table 12.

A total of 48 scales was collected in 1990 from commercial gill net catches of chinook salmon in District 115, and 53 scales were collected from sport harvested chinook salmon from the Haines area. Age composition of the gill net sample was similar to the escapement sample; 73% of the fish were aged 1.2 and 1.3, and about 14% aged 1.4 (Table 13). The sport fish sample showed an older age composition; 41% of the sample was aged 1.4 (Table 14). The sport fish catch is expected to consist of older fish because anglers target on larger fish and many age-1.2 chinook salmon do not exceed the minimum legal length of 28 inches and cannot be kept.

A total of 66 fish $\geq$ 660 mm MEF length was captured by set gill net on the Tahini River, marked, and released. On the spawning grounds, 5 of 23 fish examined were marked, giving a Petersen estimate of chinook salmon escapement of 267 age-1.3 and older fish (SE = 84, 95% C.I. 103-431). An additional 22 age-1.3 and -1.4 fish were killed to provide eggs for the Jerry Myers hatchery, giving a total return of age class 1.3-1.5 fish to the area sampled of 289 chinook salmon.

Fishery Contributions

Two tags from the 1985 release (1984 brood) and 6 tags from the 1986 release (1985 brood) were recovered during random sampling of sport and commercial fisheries in 1990 (Table 15). Select and voluntary tag recoveries provided an additional 3 tags. Select and voluntary tags are shown in Table 16 but do not contribute to total harvest estimates, because expansions for sampling rates and variances cannot be estimated for these types of recoveries. Four tags were recovered from sport fishers; all but one was from the 1985 brood year, and 3 (75%) were random recoveries from ADFG sampling. Seven tags were recovered from commercial fisheries, and all but 2 of these are from ADFG sampling. Commercial catch recoveries occurred in several areas, primarily the Lynn Canal gill net (District 115) and Northern Inside (Districts 109, 112, 114) troll fisheries (see Figure 1). Parameters from the fisheries which are required to estimate the contributions and update them as estimates of θ_b improve are shown in Table 16.

The unexpanded contribution estimate of age-1.4 tagged fish (from 1984 brood) to commercial and sport fisheries in 1990 is 2 fish. Expanded for the fishery sampling rate and by the tagging fraction of 21.4%, the overall contribution is 25 fish (SE = 17).

The unexpanded contribution estimate of age-1.3 tagged fish (from 1985 brood) to commercial and sport fisheries in 1990 is 6 fish. Expanded for the fishery sampling rate and by the tagging fraction of 16.4%, the overall contribution is 85 fish (SE = 38).

Table 11. Age composition of chinook salmon sampled in the Tahini River escapement, by sex and age class, 1990.

	Brood year and age class					Total
	1987	1986	1985	1984	1983	
	1.1	1.2	1.3	1.4	2.4	
Statistical weeks	30 - 33 (July 22 - 28) & August 12 - 18					
Male						
Sample size	7	70	67	22		166
Percent	3.4	34.1	32.7	10.7		81.0
SE	1.3	3.3	3.3	2.2		2.7
Female						
Sample size			18	20	1	39
Percent			8.8	9.8	0.5	19.0
SE			2.0	2.1	0.5	2.7
All fish						
Sample size	7	70	85	42	1	205
Percent	3.4	34.1	41.5	20.5	0.5	100.0
SE	1.3	3.3	3.4	2.8	0.5	

Approximate summary of ageing error codes (AEC's)

Code number	1	2	3	4	5	6	7	8	9	Total
Encountered	0	0	23	0	0	0	0	0	0	23
Percent scales	0.0	0.0	10.1	0.0	0.0	0.0	0.0	0.0	0.0	10.1

Code numbers are listed on the reverse of the MS AWL forms as: (1) otolith; (2) inverted; (3) regenerated; (4) illegible; (5) missing; (6) resorbed; (7) wrong species; and (8) outside preferred area.

Table 12. Length composition of chinook salmon sampled in the Tahini River escapement, by sex and age class, 1990.

	Brood year and age class					Total
	1987	1986	1985	1984	1983	
	1.1	1.2	1.3	1.4	2.4	
Statistical weeks 30 - 33 (July 22 - 28) & August 12 - 18						
Male						
Sample size	7	70	67	22		166
Avg. length	479	633	798	920		731
SE	34.0	5.9	8.2	15.1		10.1
Female						
Sample size			18	20	1	39
Avg. length			846	906	890	878
SE			9.4	13.6		9.4
All fish						
Sample size	7	70	85	42	1	205
Avg. length	479	633	808	913	890	759
SE	34.0	5.9	7.1	10.2		9.3

Table 13. Age composition of chinook salmon sampled in the District 115 gill net catch, by sex and age class, 1990.

	Brood year and age class					Total
	1987	1897	1986	1985	1984	
	0.2	1.1	1.2	1.3	1.4	
Statistical weeks 25 - 30 (June 17 - 23) & July 22 - 28						
All fish						
Sample size	4	2	18	14	6	44
Percent	9.1	4.5	40.9	31.8	13.6	100.0
SE	4.2	3.0	7.1	6.8	5.0	

Table 14. Age composition of chinook salmon sampled in the Haines Area marine sport harvest, by sex and age class, 1990.

	Brood year and age class					Total
	1986	1986	1985	1985	1984	
	0.3	1.2	0.4	1.3	1.4	
Statistical weeks 19 - 25 (May 1 - June 28)						
All fish						
Sample size	1	8	1	21	22	53
Percent	1.9	15.1	1.9	39.6	41.5	100.0
SE		2.6		1.7	1.3	

Table 15. Summary of expanded tag recoveries from 1990 sport and commercial harvest of 1984 and 1985 brood Tahini River chinook salmon.

	Observed	Total[a] expansion	Variance	SE
	1984 Brood			
Sport				
District 115	1	16	233	15
Commercial				
District 115 gill net	1	9	72	8
Total sport and commercial random	2	25	305	17
	1985 Brood			
Sport				
District 115	2	45	1,040	32
Commercial				
District 112 troll	1	14	189	14
District 114 troll	3	26	236	15
Subtotal commercial random	4	40	425	21
Total sport and commercial random	6	85	1,465	38

[a] Using the best estimate of theta, the tagging fraction from the combined recoveries in 1989 and 1990. Theta for brood year 1984 = 0.214 and 1985 = 0.164.

Table 16. Summary of parameters obtained from sport and commercial fisheries sampling programs for 1990 recoveries of Tahini River chinook salmon reared at Crystal Lake Hatchery and released in the Tahini River.

Stat week	Sample source	Head number	Sample type	Area	Port	Heads received a_2	Heads marked a_1	Tags decoded m_1	Tags detected m_2	Total harvest N_h	Number sampled n_2	m_c	Harvest variance $V(N_h)$[a]
						1985 Brood							
23	Troll	02805	random	114	XIP	20	20	20	20	470	200	1	
26	Troll	04035	random	114	Hoonah	24	24	22	22	221	221	1	
26	Troll	04036	random	114	Hoonah	24	24	22	22	221	221	1	
34	Troll	33466	random	112	Ptsbg	73	74	70	70	854	390	1	
23	Sport	53364	random	115	Haines	2	2	2	2	89	24	1	895
24	Sport	53365	random	115	Haines	2	2	2	2	89	24	1	895
27	Troll	04064	select	114	Hoonah								
30	Sport	54053	volunteer	115	Skgway								
40	Troll	82256	select	109	Juneau								
						1984 Brood							
26	Gill net	11257	random	115	Ptsbg	4	4	3	3	75	39	1	
22	Sport	53370	random	115	Haines	2	2	1	1	138	41	1	2,378

The Tahini River escapement of 267 plus 22 fish for the hatchery plus a catch of 25 age-1.4 and 97 age-1.3 fish yields a minimum return of 411 age-1.3 and older fish in 1990.

Note that harvests estimated in this study do not include harvests in some unsampled and unreported fisheries, in particular the Skagway area sport fishery.

DISCUSSION

The contribution estimates presented in this report are based on several assumptions. First, we assume that survival and behavior of Tahini River fry reared in a hatchery and released in the river is similar to that of Tahini River wild fish. At this time we have no reason to believe otherwise. Second, we assume that the tagging proportion estimated from the carcass and set gill net samples on the Tahini is accurate. This assumption is probably valid since sample sizes are now fairly large (t_{1984} = 112 and t_{1985} = 142, combining 1989 and 1990 data).

Estimation of the contribution of age-1.2 chinook salmon is difficult. Age-1.2 chinook salmon are not fully recruited to the troll fishery, but are vulnerable to the drift gill net fishery. Many age-1.2 fish are not legal size (28 inches in total length, or about 615 mm MEF) for commercial troll or recreational fisheries, but there are no size restrictions on gill net catches. An unknown number of chinook salmon, mostly immature fish, are harvested in drift gill net fisheries but are not sold or reported in catch records. The price paid for immature salmon is often poor and some gill net fishermen choose not to sell those chinook salmon.

Mature chinook salmon harvested in early June in the northern inside waters of Southeast Alaska have been assumed to be returning to Alaskan or transboundary Rivers, primarily the Chilkat, Taku and Stikine (Kissner 1986). Chinook salmon harvested after late June have been assumed to be either immature Alaskan, or non-Alaskan, fish. Of 58 Tahini River or Pullen Creek CWT tagged fish recovered in 1989 and 1990, 43 were harvested after July 1 (week 26), and many as late as August, leading me to believe that most of the reported harvest of Tahini River chinook salmon in District 115 are immature fish.

Finally, note that contribution estimates presented in this report are not estimates of the total contribution of Tahini River chinook salmon from the 1984 and 1985 brood years, since only two age classes from each brood are reported, and since unsampled and unreported strata exist. While the latter problem may be small, the contribution of unsampled and/or unreported age classes is not small.

There is a correlation between set gill net catch/hour on the Tahini River and peak escapement counts to index areas on the Chilkat River (Table 17), except in 1987 when Tahini River CPUE was low but the index in other areas was high, and in 1990 when the CPUE was high and the index in other areas was low (Figure 3). One explanation may be that the unsurveyed Tahini River may contribute significant numbers of chinook salmon to the Chilkat drainage some years, and spawner distribution to index areas may vary from year to year. It is also apparent that the aerial survey index area counts are inconsistent as indicators of total escapement. A standardized gill net CPUE on the Tahini River may provide additional information for an index of abundance for the Chilkat River.

Table 17. Tahini River set gill net catch/hour of chinook salmon in comparison to peak chinook salmon escapement to index areas on Big Boulder and Stonehouse creeks.

Year	Dates	Tahini R. gill net catch/hour	Peak observed chinook escapement
1983	July 15 - August 2	0.87	247
1984	July 17 - July 25	1.13	333
1985	July 18 - August 2	0.59	120
1986	July 20 - July 29	0.64	29
1987	July 16 - August 1	0.52	288
1988		no fishing	175
1989	July 19 - August 1	0.94	305
1990	July 21 - August 1	1.44	61

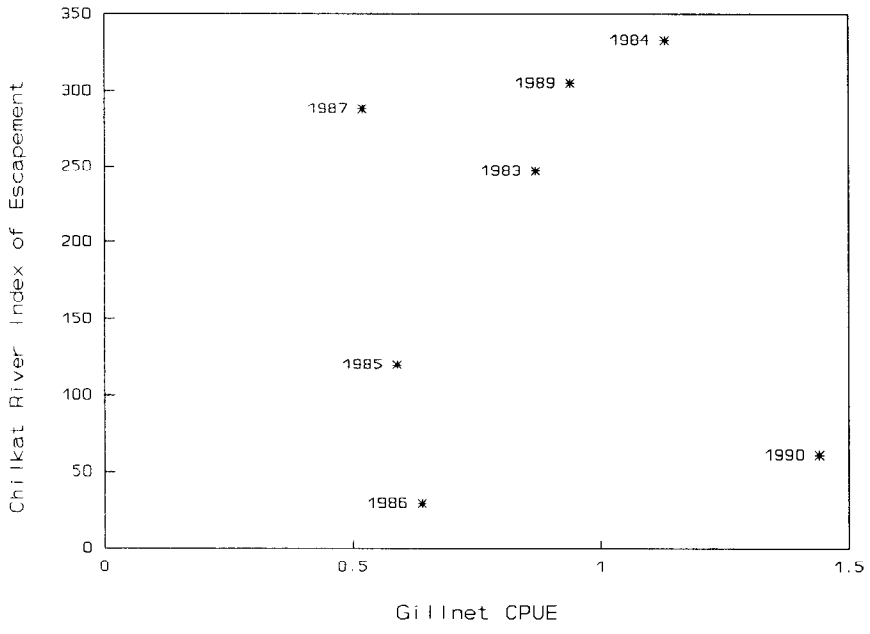

Figure 3. Tahini River set gill net catch/hour of chinook salmon vs. the peak aerial survey escapements to index areas in Big Boulder and Stonehouse creeks.

In estimating abundance with the Peterson equations, we assume: (a) the population is closed (there is no immigration or emigration between sampling events); (b) all fish have the same probability of capture during the first or during the second sample; (c) that marking does not affect the probability of recapture; (d) that fish do not lose marks between sampling events; and (e) that all marks are recognizable during the second sampling event.

Some of the assumptions required by the Peterson estimator could not be strictly tested in this study. The gill net was fished over the major period of upstream migration, but some fish probably entered the river after the termination of gill net fishing on August 1. In contrast, the carcass sampling may have included the total population, but emigration may have occurred between events. All the sampling trips were combined into one recapture event, and fish were carefully marked to prevent resampling (assumptions a and b). To minimize injuries (assumption c) the gill net was fished only during daylight and was closely monitored. We did not observe tag loss during the experiment (assumption d). Finally, dorsal fin clips were applied less than 3 weeks before the carcass sampling, and we recognized them easily during the second sampling event (assumption e).

The Petersen estimate of escapement to the Tahini River is over four times the index of escapement of large fish obtained from a helicopter survey (Mecum 1990) and even the lower 95% confidence interval exceeds the number of fish observed in the aerial survey. When the index expansion was developed, it was understood that there were many spawning areas in the Chilkat River that could not be surveyed, and the survey counts were expanded to account for the unsurveyed areas; the validity of the expansion factors have yet to be quantitatively assessed.

The 1990 average catches per trap-day of juvenile chinook salmon in all areas of the Chilkat River were much lower than those observed in 1989 (Pahlke et al. 1990). Catch rates in the Tahini River were low and few of the almost 30,000 tagged fry released in May were recaptured in the Tahini River during fall trapping. The 1990 trap catches on the Kelsall River were also low, averaging only 9 fish per trap-day. Overall, the escapement index to the Chilkat drainage (and Stonehouse Creek which flows into the Kelsall River) in 1989 was good (Mecum 1990), making the low numbers of juvenile encountered in 1990 quite unexpected.

Juvenile chinook tagged at the Jerry Myers hatchery and released in May could be distinguished from fish tagged in the fall by the appearance of the fin clip. We verified this by sending 5 "suspect" clipped fish recaptured at the mouth of the Kelsall and in the mainstem Chilkat River to the tag lab for decoding. All 5 fish recaptured at the Kelsall and 3 from the mainstem were hatchery fish planted in the Tahini River. The remaining two tagged fish recaptured in the mainstem had been tagged earlier at the Kelsall River. These recoveries indicate that not all of the hatchery release remained in the Tahini River, but migrated to other areas of the Chilkat River to rear.

The average length of juvenile chinook salmon from the Kelsall River captured during late October 1990 was 73.6 mm, compared to 63.8 mm over the same period in 1989, and 72.9 mm in 1988. The difference could be the result of greater competition in 1989, as juvenile abundance on the Tahini, Kelsall and mainstem Chilkat Rivers was much higher in 1989 than in 1990 or 1988. Other factors could be winter conditions, stream flow, and competition with coho salmon and Dolly Varden *Salvelinus malma*.

Hatchery released fished recaptured on the Tahini River on September 10 averaged 82.5 mm; unmarked fish averaged 74.8 mm. The larger size of the hatchery fish 3 months after their release could increase their survival rates over wild fish or allow them to out-compete the smaller fish.

Information on migratory timing and areas of harvest of Chilkat River chinook salmon can be obtained from continued coded-wire tagging of juveniles and recovery of adults in commercial and recreational fisheries and on the spawning grounds. Escapement goals and indices can be refined with more information, and, if necessary, new fishery regulations can be developed to insure rebuilding of this stock. The interest of sport and commercial fishing groups and ADFG Sport Fish, Commercial Fisheries and FRED divisions ensures that Chilkat River chinook salmon will continue to be the focus of major research programs in northern Southeast Alaska.

ACKNOWLEDGMENTS

The author wishes to acknowledge the assistance of ADFG employees Larry Derby, Paul Kissner, Dave Magnus, Al Didier, Betsy Wilson, and Becky Wilson for field data collection on the Chilkat River. Ron Josephson (FRED) and Lon Garrison (Northern Southeast Regional Aquaculture Association) supervised the egg take on the Tahini River. Randy Ericksen (Sport Fish) and Ray Staska (Commercial Fisheries, CF) provided logistic support from the Haines office. Mark Olsen (CF) aged the chinook scales and provided preliminary data analysis, and Iris Frank (CF) drew the map. Sam Bertoni and the FRED Tag Lab decoded the CWTs. Bob Marshall assisted with the analysis and provided helpful comments on the report.

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