Fishery Data Series No. 98-9

Coded Wire Tagging of Coho and Chinook Salmon in the Kenai River and Deep Creek, Alaska, 1996

by

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and

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June 1998

Alaska Department of Fish and Game **Division of Sport Fish**

Symbols and Abbreviations

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Weights and measures (metric)

centimeter	cm
deciliter	dL
gram	g
hectare	ha
kilogram	kg
kilometer	km
liter	L
meter	m
metric ton	mt
milliliter	ml
millimeter	mm

Weights and measures (English)

cubic feet per second	ft^3/s
foot	ft
gallon	gal
inch	in
mile	mi
ounce	oz
pound	lb
quart	qt
yard	yd

Spell out acre and ton.

Time and temperature

day	d
degrees Celsius	°C
degrees Fahrenheit	°F
hour (spell out for 24-hour clock)	h
minute	min
second	s

Spell out year, month, and week.

Physics and chemistry

all atomic symbols	
alternating current	AC
ampere	A
calorie	cal
direct current	DC
hertz	Hz
horsepower	hp
hydrogen ion activity	pH
parts per million	ppm
parts per thousand	ppt, ‰
volts	V
watts	W

General

All commonly accepted abbreviations.	e.g., Mr., Mrs., a.m., p.m., etc.
All commonly accepted professional titles.	e.g., Dr., Ph.D., R.N., etc.
and	&
at	@
Compass directions:	
east	E
north	N
south	S
west	W
Copyright	©
Corporate suffixes:	
Company	Co.
Corporation	Corp.
Incorporated	Inc.
Limited	Ltd.
et alii (and other people)	et al.
et cetera (and so forth)	etc.
exempli gratia (for example)	e.g.,
id est (that is)	i.e.,
latitude or longitude	lat. or long.
monetary symbols (U.S.)	$, ¢
months (tables and figures): first three letters	Jan,...,Dec
number (before a number)	# (e.g., #10)
pounds (after a number)	# (e.g., 10#)
registered trademark	®
trademark	™
United States (adjective)	U.S.
United States of America (noun)	USA
U.S. state and District of Columbia abbreviations	use two-letter abbreviations (e.g., AK, DC)

Mathematics, statistics, fisheries

alternate hypothesis	H_A
base of natural logarithm	e
catch per unit effort	CPUE
coefficient of variation	CV
common test statistics	F, t, χ^2, etc.
confidence interval	C.I.
correlation coefficient	R (multiple)
correlation coefficient	r (simple)
covariance	cov
degree (angular or temperature)	°
degrees of freedom	df
divided by	÷ or / (in equations)
equals	=
expected value	E
fork length	FL
greater than	>
greater than or equal to	≥
harvest per unit effort	HPUE
less than	<
less than or equal to	≤
logarithm (natural)	ln
logarithm (base 10)	log
logarithm (specify base)	$\log_2$, etc.
mideye-to-fork	MEF
minute (angular)	'
multiplied by	x
not significant	NS
null hypothesis	H_O
percent	%
probability	P
probability of a type I error (rejection of the null hypothesis when true)	α
probability of a type II error (acceptance of the null hypothesis when false)	β
second (angular)	"
standard deviation	SD
standard error	SE
standard length	SL
total length	TL
variance	Var

FISHERY DATA SERIES NO. 98-9

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June 1998

This investigation was partially financed by the Federal Aid in Sport Fish Restoration Act (16 U.S.C. 777-777K) under Project F-10-12, Job No. S-2-6b.

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This document should be cited as:
King, B. E. and J. A. Breakfield. 1998. Coded wire tagging of coho and chinook salmon in the Kenai River and Deep Creek, Alaska, 1996. Alaska Department of Fish and Game, Fishery Data Series No. 98-9, Anchorage.

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ABSTRACT

The Alaska Department of Fish and Game, Division of Sport Fish, is currently assessing the harvest of selected wild stocks of chinook salmon *Oncorhynchus tshawytscha* by an expanding mixed-stock marine sport fishery in Cook Inlet. Chinook salmon stocks in the Kenai River and Deep Creek are being assessed using a coded wire tag marking and recovery program. Two rotary smolt traps were used to capture 7,018 chinook salmon smolt in the Kenai River delta during 1996. A total of 6,538 smolt, or 6% of the tagging goal, was marked and released. Chinook salmon smolt were present in the Kenai River delta throughout the summer with peak catches in June. We also marked and released 8,966 chinook salmon and 4,868 coho salmon *Oncorhynchus kisutch* smolt in Deep Creek in 1996. The number of chinook salmon smolt marked using one rotary screw trap was 24% of our goal. Chinook salmon smolt were present in lower Deep Creek throughout the summer with peak numbers emigrating between mid-June and mid-July. Two age-classes of smolt (age 0 and 1) were present in Deep Creek catches.

We estimated the proportion of chinook salmon marked with coded wire tags in previous years by examining adult fish in the inriver escapements. We could not estimate the proportion of Kenai River chinook salmon marked as fry in 1993 because we found no tagged adults in the approximately 1,800 chinook salmon examined. Examination of chinook salmon adults from Deep Creek for adipose fin clips revealed that 14.1% (SE=3.5%) of the fish present in the lower river during sampling were strays from hatchery releases in the adjacent Ninilchik River, and 7.2% (SE = 2.0%) were marked in 1994 in Deep Creek. In 1996, we also captured adult coho salmon in Deep Creek and found that 27.8% (SE = 3.1%) were tagged as smolt in 1995. The proportion of marked adults captured did not change over time, and the marked proportion was used to estimate that 34,351 (SE = 3,779) coho salmon smolt emigrated from Deep Creek in 1995.

Key words: chinook salmon, *Oncorhynchus tshawytscha*, coho salmon, *Oncorhynchus kisutch*, smolt, fingerling, juvenile, coded wire tag, Kenai River, Deep Creek, Slikok Creek, Ninilchik River, Cook Inlet, mixed-stock, recreational fishery.

INTRODUCTION

Chinook salmon *Oncorhynchus tshawytscha* stocks from Cook Inlet are currently thought to be fully utilized in existing fisheries. Escapement goals exist for many of these stocks, and attainment of the goals is assessed annually. Many gillnet and marine sport fisheries harvest mixed stocks of chinook salmon as they return to spawn in Cook Inlet drainages. Since the surplus of this resource is thought to be fully utilized, growth in one fishery may occur at the expense of another, complicating sustained yield management.

The Cook Inlet marine recreational fishery harvests mixed stocks of chinook salmon along eastside Cook Inlet beaches from Ninilchik south to Homer (Figure 1). Most effort in this fishery takes place within 0.8 kilometers from shore from May through July. Harvests are thought to be composed primarily of mature fish returning to Cook Inlet drainages and hatchery release sites. The fishery began in the early 1970s and effort remained relatively stable through the late 1980s. However, increased marketing by sport fish guiding and tourism industries, improved boat launching facilities, and restrictions in other Cook Inlet inriver fisheries resulted in recent growth. Annual harvests of chinook salmon in this fishery more than doubled between 1987 and 1995 (Howe et al. 1996).

Concerns regarding increased exploitation of local stocks in this fishery resulted in several restrictions beginning in 1996. A conservation zone, 4 miles long by 1 mile wide, was established around the mouths of Deep Creek and the Ninilchik River in which no harvest of chinook salmon may occur. In addition, a special harvest area 1 mile wide, extending from the Ninilchik River to Bluff Point, was established in which harvest is limited to only one chinook salmon greater than 16 inches in length daily per angler. Finally, guides are not

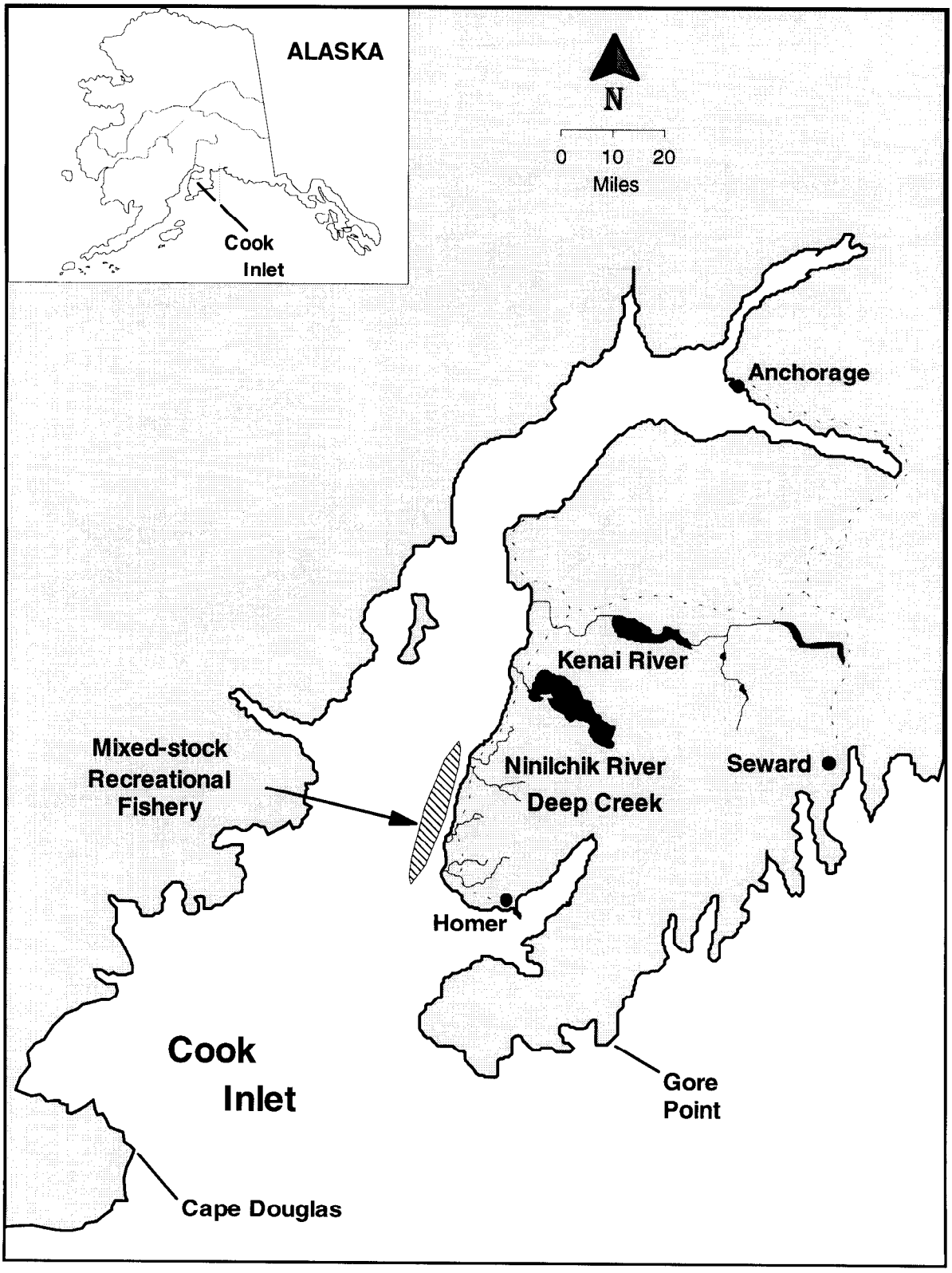

Figure 1.-Map of Cook Inlet showing the locations of the Kenai River, Deep Creek, and the marine recreational fishery.

permitted to fish while guiding within the special harvest area.

Although the marine recreational fishery has grown in recent years, very little is known concerning the origin of stocks that are harvested. Moreover, recent decreases in escapement and restrictions in inriver fisheries may be due to growth of the marine recreational fishery. The lack of stock-specific harvest estimates precludes development of meaningful management objectives for the marine recreational fishery, and compromises our ability to reconstruct stock-specific adult returns of chinook salmon to Cook Inlet drainages.

The Alaska Department of Fish and Game, Division of Sport Fish, initiated a long-term study in 1994 to assess the growth and characteristics of the marine recreational fishery, evaluate on-going efforts to supplement harvests using hatchery fish, and estimate the harvest of specific wild stocks by all marine fisheries. As part of this effort, wild and hatchery chinook salmon smolt exiting the drainages of Cook Inlet are marked using a coded wire tag (CWT) and recovered in marine and freshwater fisheries (McKinley *In prep*). Marking wild chinook salmon originating in the Kenai River and Deep Creek is an essential step in this process and is the subject of this report.

The Kenai River supports the largest freshwater chinook salmon fishery in Alaska (Howe et al. 1996). Exploitation of early- and late-run chinook salmon bound for the Kenai River is governed by management plans adopted by the Alaska Board of Fisheries. These plans contain escapement goals for both the early and late run, and dictate changes in the management of commercial and recreational fisheries in the event of a conservation shortfall.

The Kenai River is also the primary Cook Inlet drainage with late-run chinook salmon. Hence, the majority of all chinook salmon harvested in Cook Inlet after 1 July are assumed to originate from the Kenai River. Other stocks of chinook salmon from Cook Inlet exhibit primarily early-run timing. Estimating the harvest of Kenai River chinook salmon by the marine fisheries will provide harvest data necessary for run reconstruction, and will provide important information for making allocative decisions concerning the harvest of this stock.

Juvenile chinook salmon were first tagged with CWTs on the Kenai River by Litchfield and Flagg (1986). The current CWT program in the Kenai River began with the marking of mainstem age-0. fingerlings in 1993 and 1994 (Bendock 1995). In 1995, the capture of age-1. smolt using rotary screw traps supplanted the marking of fingerlings (Bendock 1996). A comparable program is in place to assess the contribution of Kenai River coho salmon *O. kisutch* to various marine fisheries (Carlon and Hasbrouck 1997).

Deep Creek was selected as a tagging site because of its proximity to the marine recreational fishery. The Deep Creek chinook salmon return supports a weekend-only inriver recreational fishery from Memorial Day through the second week of June. The new marine fishery takes place primarily from April through June in Cook Inlet south of a 1.6 kilometer radius from the mouth of Deep Creek. Additional exploitation of Deep Creek chinook salmon in marine waters may result in the overharvest of this conservatively managed stock. Therefore, estimating the contribution of Deep Creek chinook salmon to the marine fishery will provide important information for managing this stock. A rotary trap was used to capture Deep Creek age-0. and age-1. chinook salmon smolt since the inception of the project in 1994 (Bendock 1995). Coho salmon smolt were also tagged in Deep Creek during 1995 and 1996 to

provide information on the harvest of this stock and magnitude of the smolt production.

The objectives of this study were to:

1. Mark 129,100 Kenai River and 37,300 Deep Creek chinook salmon smolt with coded wire tags and adipose fin clips;
2. Test whether chinook salmon juveniles marked in the Kenai River and Deep Creek in previous years mixed completely with unmarked individuals when they returned as adults;
3. Mark as many Deep Creek coho salmon smolt as possible with coded wire tags and adipose fin clips;
4. Estimate the abundance of chinook salmon smolt that emigrated from the Kenai River and Deep Creek in the previous years of smolt marking; and
5. Estimate the abundance of coho salmon smolt that emigrated from Deep Creek in 1995.

METHODS

To estimate the harvest of Kenai River and Deep Creek chinook salmon by the Cook Inlet marine recreational fishery, juvenile chinook salmon from each drainage were captured, marked using coded wire tags (CWT) and an adipose fin clip (AFC), and released. Marking juvenile salmon in freshwater rearing habitats permits a positive identification of the natal drainage, or stock, in which the fish were produced. The stocks composing mixed-stock fisheries can be identified by examining marked adult salmon in the harvest. Knowledge of the total harvest, proportion of fish marked in each stock, and the numbers of marked fish in the harvest are all necessary elements for estimating stock-specific harvests in the marine fishery.

Since the proportion of marked smolt of each stock is unknown at the completion of marking, it is estimated for the brood year by sampling of the inriver return of adults in succeeding years. Sampling of adults occurred throughout the return because a constant proportion of marked adults observed over time indicates that a representative sample of juveniles was marked. A chi-square statistic was used to test the hypothesis that the proportion of adults missing the adipose fin did not change over time. Failure to reject this hypothesis would indicate that marked adults were a representative sample of the cohort and would allow combining of all inriver recovery data to estimate the overall marked proportion of the cohort.

Chinook salmon from a single cohort return to their natal stream to spawn for 1 to 5 years. Therefore, estimating the marked proportion of chinook salmon also required estimating the age composition of sampled adults. In 1996, only 2-ocean chinook salmon returning to each system were marked with CWTs (Bendock 1995). Because adult coho salmon are predominantly 1-ocean fish, all coho salmon were assumed to come from the same brood year.

KENAI RIVER

CWT Release

We used equipment and procedures outlined in Bendock (1995, 1996) and Moberly et al. (1977) to capture and mark chinook salmon smolt. Our goal, based on the known adult escapement, and assumed survival rates and harvest in the marine recreational fishery, was to capture and tag 129,100 smolt with CWTs. The rotary smolt traps were deployed in the Kenai River delta after deployment of the trap in several locations in the mainstem Kenai River in 1995 revealed this site to be the most feasible for the capture of chinook salmon smolt (Bendock 1996).

The traps were deployed near the mainstem shoreline at river kilometer (rkm) 1.2 (trap site #1) and rkm 1.6 (trap site #2) (Figure 2),

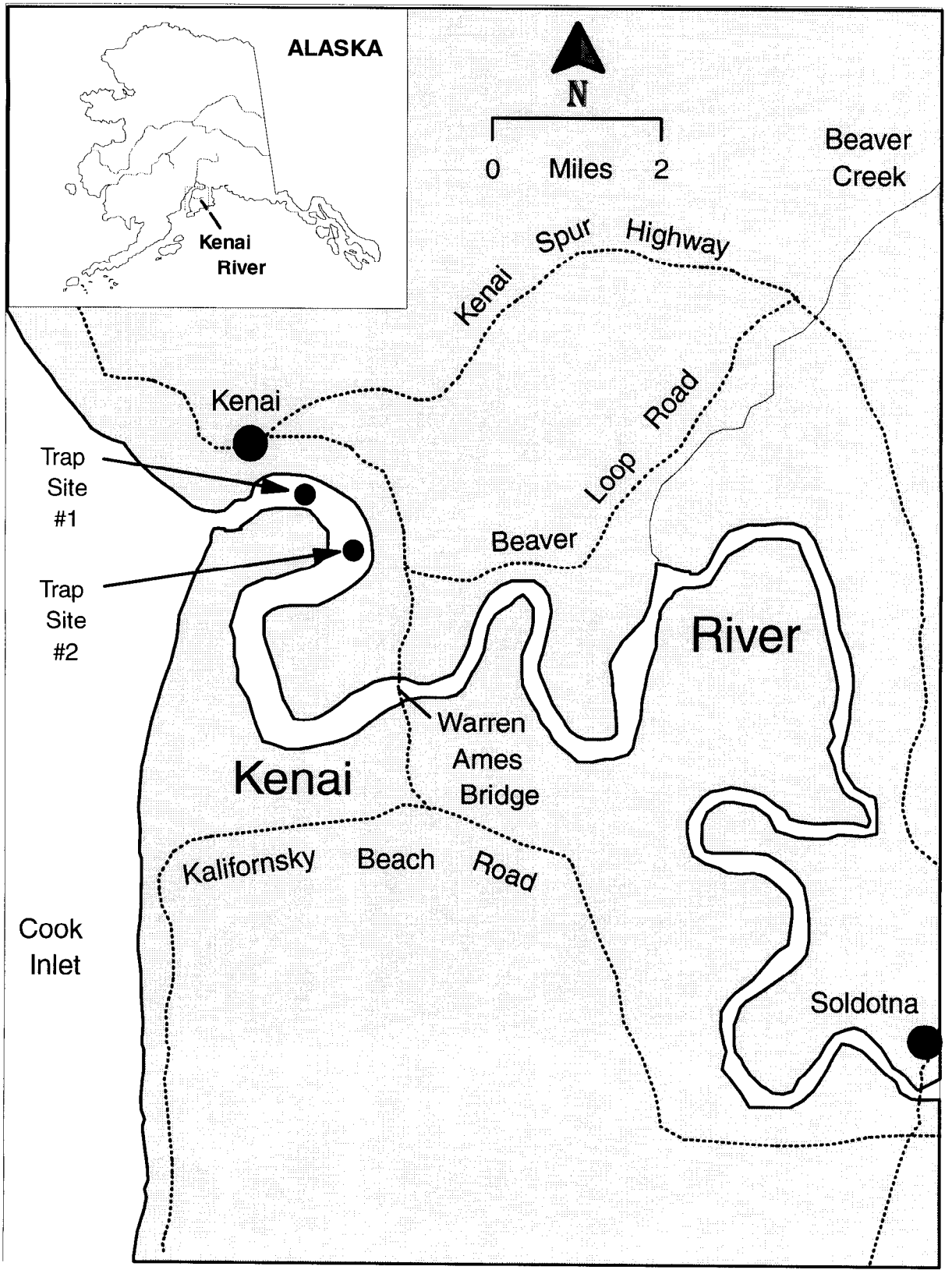

Figure 2.-Kenai River delta smolt trap locations, 1996.

and fished continuously from 9 May through 7 September 1996. Technicians left the traps unattended at night, but inspected them daily, and emptied the live boxes between 0800 hours and 2300 hours depending on the stage of the tide. All captured fish were removed from the live boxes, identified by species, and counted into separate holding containers. Numbers of sockeye salmon *O. nerka* smolt were estimated and rounded to the nearest 10 fish. Species other than chinook salmon smolt were released. Catch composition, water and air temperature, water level (tide stage), and trap revolutions per minute were recorded daily. The fork length (rounded to the nearest 5 mm) of a random sample of chinook salmon smolt was also recorded daily.

Marked Proportion of Inriver Adult Chinook Salmon

Adult chinook salmon captured in gillnets for the Kenai River stock assessment project (King 1997) were used to determine the proportion of the escapement previously marked as smolt. Drift gillnets were fished 5 days per week between rkm 8 and 15.3 of the Kenai River from 16 May through 7 August 1996. Two technicians in a river boat drifted a gillnet downstream to capture adults. Fish entangled in the net were removed and placed in a tagging cradle. Technicians collected scales, length, sex information, and examined each chinook salmon for the presence of the adipose fin. Sex was determined based on external characteristics, and length measured from mid-eye to fork-of-tail to the nearest millimeter. Three scales were collected from the preferred area of each fish (Welander 1940) for age determination later. All AFC fish were sacrificed. All released fish were given a hole punch; any fish subsequently recaptured that had a hole punch was not sampled. A cinch strap was affixed to the head of any fish missing the adipose fin, the head frozen, and later shipped to the Tag Lab to retrieve and decode the tag.

All sport-harvested adult chinook salmon observed in the Kenai River sport fishery creel survey (King 1997) were also examined for a missing adipose fin. The creel survey was conducted from 16 May through 4 August 1996 between rkm 8 and 34. Technicians sampled 6 days per week, and collected the same data as the gillnet crews.

Age data were needed to test the null hypothesis that the proportion of chinook salmon marked with a CWT for each age class k (theta, $\hat{\theta}_k$) did not change over time. The data were stratified into 3-week time intervals to conduct the test. The proportion of each age class was estimated as a binomial proportion (Cochran 1977) by:

$$\hat{p}_{ijk} = \frac{s_{ijk}}{s_{ij}}, \tag{1}$$

with variance:

$$\mathrm{Var}\left(\hat{p}_{ijk}\right) = \frac{\hat{p}_{ijk}\left(1-\hat{p}_{ijk}\right)}{s_{ij}-1}, \tag{2}$$

where:

s_{ijk} = number of chinook salmon of age k collected from sample source i (i.e., sport harvest or gillnetting) during time strata j, and

s_{ij} = number of chinook salmon with an ageable scale collected from sample source i during time strata j.

Not all scale samples could be aged. The total number of chinook salmon sampled from each age class was therefore estimated as:

$$\hat{n}_{ijk} = n_{ij}\hat{p}_{ijk}, \tag{3}$$

where:

n_{ij} = total number of chinook salmon sampled from source i during time strata j.

This procedure assumed that the proportion of fish that could not be aged was the same as the proportion of fish that could be aged. To test this assumption, a Kolmogorov-Smirnov test was conducted to compare the cumulative length distribution of fish that could be aged with those that could not be aged for each sample source-time strata combination.

A spawning ground survey was conducted in Slikok Creek, a tributary of the Kenai River, to look for AFC chinook salmon, recover CWTs, and index the spawning escapement. This foot survey was conducted 6 August, starting approximately 3.2 km upstream and ending at the confluence with the Kenai River. All fish were sampled for scales, length and sex.

DEEP CREEK

CWT Release

We operated a rotary smolt trap in Deep Creek approximately 0.8 km above its confluence with Cook Inlet. This location, as well as the equipment and procedures to capture and handle chinook salmon smolt, were the same as 1995 (Bendock 1996). Our goal, based on the estimated adult escapement, and assumed survival rates and harvest in the marine sport fishery, was to capture and tag 37,300 smolt with CWTs. We also measured the fork length of a random sample of chinook salmon greater than 55 mm daily when feasible. Age composition of the emigrating chinook salmon smolt was determined by length (Bendock 1995), and we used separate tag codes for fish thought to be age 0 and age 1. Bendock (1995) found that age-0. chinook salmon exhibited downstream emigration typical of smolt and that salinity tolerance was also satisfactory for smolting. We also tagged all captured coho salmon smolt with CWTs.

Marked Proportion of Inriver Adult Chinook Salmon

We captured adult chinook salmon in the lower 3.2 rkm of Deep Creek using 15 m pieces of 4 ¼-inch stretch mesh gillnet drifted through pools. We sampled twice weekly from 29 May through 3 July at six locations. We began netting at a site furthest downstream to minimize disturbance to fish that occupy the holes above. Fish entangled in the net were removed, placed in a tagging cradle, and sampled for age, sex, and length. We used the same measurements and data collection procedures as the Kenai River crews except that an additional two scales (five total) were taken from each fish, and sex of AFC fish was determined by examination of the gut cavity. We also examined each fish for the presence of the adipose fin, and prior to release, punched a hole on the lower one-third (ventral side) of the left operculum to prevent repeat sampling. Every fish missing an adipose fin was sacrificed.

During the chinook salmon fishery in the lower 3.2 rkm of Deep Creek, salmon were harvested on weekends and Mondays, from Memorial Day through the second week of June. Heads from AFC adult chinook salmon voluntarily dropped off at our tagging site were sampled, when possible, for data on sex, location caught (salt or fresh water), date caught, and name and address of anglers.

We conducted a spawning ground survey in Deep Creek to look for AFC chinook salmon and to recover CWTs. This survey was conducted on foot and by raft, beginning 7 August at the confluence of the North Fork (approximately rkm 64) and ending on 8 August at the Sterling Highway (rkm 0.8). All fish were inspected for hole punch marks on the left operculum and for an AFC. Fish that did not have a hole punch were sampled for scales, length, and sex. We removed the heads from all AFC fish, and later shipped the

frozen head to the Tag Lab to retrieve and decode the tag.

A number of heads collected in the gillnet samples were hatchery-marked chinook salmon released into the Ninilchik River. These stray fish had to be deducted from the sample data before testing the null hypothesis that the proportion of each age class marked at Deep Creek did not differ over time. Our first step was to determine the total number sampled by age during each week as described above in equations (1) - (3). We then determined the number of chinook salmon in each weekly sample ($\hat{h}_{wk}$) originally stocked into the Ninilchik for each age class by:

$$\hat{h}_{wk} = m_{wk}\theta_{Nk}^{-1}, \quad (4)$$

where:

m_{wk} = number of chinook salmon of age k marked and released into the Ninilchik River and recovered during week w, and

θ_{Nk} = proportion of chinook salmon of age k released into the Ninilchik River marked with a CWT.

Finally, the number of chinook salmon of Deep Creek origin of each age class in each weekly sample ($\hat{n}_{Dwk}$) was estimated as:

$$\hat{n}_{Dwk} = \hat{n}_{wk} - \hat{h}_{wk}, \quad (5)$$

where:

$\hat{n}_{wk}$ = total number of chinook salmon of each age class in each weekly sample.

The estimated number sampled of each age class originally from Deep Creek was then post-stratified into 3-week time intervals. The number sampled and the number of CWT recoveries of chinook salmon marked at Deep Creek were used to test the hypothesis that the marked proportion did not change over time and, if possible, to estimate the total marked proportion.

We sampled Deep Creek adult coho salmon for the presence of an adipose fin clip from 5 August through 13 September. Prespawning coho salmon were captured in the lower 3.2 rkm using 15 m pieces of 4 ¼-inch stretch mesh gillnet. Sampling was conducted twice per week at six locations. Initially, procedures for fish handling and data collected from each fish were identical to those used for chinook salmon. However, the high percentage of AFC coho salmon in the early catches led us to discontinue head collection and begin using a CWT detector wand starting 16 August. We assumed that all positive tag detections were Deep Creek implants from 1995. The proportion of marked coho salmon from three biweekly strata was compared to test the hypothesis that the marked proportion of adults did not change over time.

The coho salmon sport fishery in Deep Creek occurs in the lower 3.2 rkm beginning mid-July. Heads from AFC adult coho salmon were voluntarily dropped off at our tagging site and, when possible, sampled for sex, location caught (salt or fresh water), date caught, and name and address of anglers. A cinch strap was affixed to each fish head collected, the head frozen, and later shipped to the Tag Lab to retrieve and decode the tag.

1995 Coho Salmon Smolt Estimate

We used the number of coho salmon smolt tagged in 1995 and recovered as adults in the 1996 escapement to estimate the number of smolt that emigrated from Deep Creek in 1995. The number of smolt was estimated using the Chapman modified Lincoln-Petersen model (Seber 1982) as:

$$\hat{N} = \frac{(M+1)(C+1)}{(R+1)} - 1, \quad (6)$$

where:

M = the number of marked smolt marked with a coded wire tag in 1995,

C = the number of adult coho salmon examined inriver for a missing adipose fin, and

R = the number of adult coho salmon recovered inriver that were marked in Deep Creek.

The variance was estimated by:

$$\mathrm{Var}(\hat{N}) = \frac{(M+1)(C+1)(M+R)(C-R)}{(R+1)^2(R+2)}. \quad (7)$$

This equation produces an unbiased estimate of abundance if: (1) adult coho salmon examined for marks were a random sample of the inriver return or the marked sample of smolt was a representative sample of the drainage-wide smolt emigration in 1995, and (2) all juveniles marked in 1995 were actually smolt, and (3) survival and catchability were the same for marked and unmarked individuals.

RESULTS

KENAI RIVER

CWT Release

We captured over 47,500 salmonids in two rotary screw traps during the period of operation (Table 1). Sockeye salmon smolt was the numerically dominant salmonid species in the catch (82%), followed by chinook (15%) and coho salmon (3%). Nightly chinook salmon smolt catches ranged from 0 to 348. Coho salmon smolt were captured throughout the operational period, sockeye salmon smolt catches were highest from early June through mid-July, and chinook salmon smolt catches were highest from late June through early July.

Fork length of chinook salmon smolt captured in the Kenai River delta ranged from 65 to 130 mm and averaged 105 mm (Figure 3).

We marked and released a total of 6,538 age-1. chinook salmon smolt with CWTs in the Kenai River at rkm 1.6 in 1996 (Table 2 and Appendix A1). Short-term tag retention was 100% and mortality rate for age-1. smolt was 0%.

Marked Proportion of Inriver Adult Chinook Salmon

A total of 487 early-run (16 May through 30 June) and 602 late-run (1 July through 7 August) chinook salmon were captured in gillnets in the Kenai River (King 1997). Crews examined all of the netted fish for a missing adipose fin. One head from an AFC chinook salmon was recovered, although no tag was detected by the Tag Lab. This fish was from the 1992 brood year (Appendix B1). Creel survey technicians sampled 660 chinook salmon harvested by the inriver sport fishery (King 1997), but did not observe any fish with a missing adipose fin. One AFC Kenai River chinook salmon was subsequently recovered from the sport fishery outside of our sampling program. The 1992 brood year fish was marked as a fingerling in 1993.

Significant temporal differences were detected in the age composition of the inriver escapement and sport harvest (King 1997). However, since no temporal difference was detected for the two age classes that composed 90% of the return, Hammarstrom (1997a and 1997b) pooled all escapement samples. Approximately 61% of the early-run chinook salmon escapement sample were age 1.4. Age-1.3 fish made up 29% of the early-run sample and age-1.2 comprised 8%. In the late-run sample, 57% of the chinook salmon captured were age 1.4, 34% were age 1.3, and 8% were age 1.2. In the early-run harvest, approximately 72% of the chinook salmon were age 1.4, 19% were age 1.3, and 6% were age 1.2. The late-run harvest was 55% age-1.4 chinook salmon, 37% age-1.3, and 6% age-1.2.

Table 1.-Daily and cumulative catches of chinook, coho, and sockeye salmon smolt using two rotary traps in the Kenai River, 1996.

	Location	Chinook		Coho		Sockeye	
Date	rkm	Daily	Cum.	Daily	Cum.	Daily	Cum.
5/09	1.2	1	1	0	0	0	0
5/10	1.2	0	1	1	1	10	10
5/11[a]	1.2		1		1		10
5/12[a]	1.2		1		1		10
5/13	1.2	0	1	0	1	10	20
5/14	1.2	0	1	0	1	0	20
5/15	1.2	2	3	2	3	0	20
5/16	1.2	2	5	0	3	10	30
5/17	1.2	0	5	4	7	10	40
5/18[a]	1.2		5		7		40
5/19[a]	1.2		5		7		40
5/20[a]	1.2		5		7		40
5/21	1.2	0	5	3	10	1,910	1,950
5/22	1.2, 1.6	1	6	3	13	210	2,160
5/23	1.2, 1.6	4	10	1	14	460	2,620
5/24	1.2, 1.6	3	13	5	19	1,310	3,930
5/25[a]	1.2, 1.6		13		19		3,930
5/26[a]	1.2, 1.6		13		19		3,930
5/27[a]	1.2, 1.6		13		19		3,930
5/28	1.2, 1.6	5	18	7	26	1,550	5,480
5/29	1.2, 1.6	11	29	29	55	1,210	6,690
5/30	1.2, 1.6	8	37	15	70	840	7,530
5/31[a]	1.2, 1.6		37		70		7,530
6/01[a]	1.2, 1.6		37		70		7,530
6/02[a]	1.2, 1.6		37		70		7,530
6/03	1.6	1	38	48	118	50	7,580
6/04	1.2, 1.6	8	46	156	274	2,380	9,960
6/05	1.2, 1.6	18	64	82	356	4,100	14,060
6/06[a]	1.6		64		356		14,060
6/07[a]	1.6		64		356		14,060
6/08[a]	1.6		64		356		14,060
6/09[a]	1.6		64		356		14,060
6/10	1.6	2	66	8	364	250	14,310
6/11	1.6	60	126	51	415	1,380	15,690
6/12	1.2, 1.6	132	258	0	415	0	15,690
6/13	1.2, 1.6	70	328	0	415	0	15,690
6/14	1.2, 1.6	115	443	98	513	1,270	16,960
6/15[a]	1.6		443		513		16,960
6/16[a]	1.6		443		513		16,960
6/17	1.2, 1.6	148	591	128	641	1,960	18,920
6/18	1.2, 1.6	204	795	111	752	1,490	20,410
6/19	1.2, 1.6	327	1,122	68	820	2,650	23,060
6/20	1.2, 1.6	237	1,359	73	893	830	23,890
6/21	1.2, 1.6	177	1,536	39	932	760	24,650
6/22[a]	1.6		1,536		932		24,650
6/23	1.2, 1.6	139	1,675	9	941	700	25,350

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Table 1.-Page 2 of 3.

Date	Location rkm	Chinook Daily	Chinook Cum.	Coho Daily	Coho Cum.	Sockeye Daily	Sockeye Cum.
6/24	1.2, 1.6	80	1,755	12	953	450	25,800
6/25	1.2, 1.6	72	1,827	5	958	250	26,050
6/26	1.2, 1.6	191	2,018	9	967	500	26,550
6/27	1.2, 1.6	162	2,180	12	979	600	27,150
6/28	1.2, 1.6	348	2,528	23	1,002	820	27,970
6/29	1.2, 1.6	176	2,704	23	1,025	600	28,570
6/30	1.6	87	2,791	2	1,027	350	28,920
7/01	1.6	99	2,890	3	1,030	350	29,270
7/02	1.2, 1.6	231	3,121	21	1,051	800	30,070
7/03	1.2, 1.6	133	3,254	4	1,055	450	30,520
7/04	1.2, 1.6	201	3,455	3	1,058	250	30,770
7/05	1.2, 1.6	156	3,611	10	1,068	630	31,400
7/06	1.2, 1.6	178	3,789	18	1,086	780	32,180
7/07	1.2, 1.6	251	4,040	9	1,095	800	32,980
7/08	1.2, 1.6	136	4,176	5	1,100	500	33,480
7/09	1.2, 1.6	42	4,218	1	1,101	250	33,730
7/10	1.2, 1.6	56	4,274	3	1,104	350	34,080
7/11	1.2, 1.6	50	4,324	6	1,110	300	34,380
7/12	1.2, 1.6	40	4,364	1	1,111	200	34,580
7/13	1.2, 1.6	134	4,498	4	1,115	350	34,930
7/14	1.2, 1.6	99	4,597	0	1,115	200	35,130
7/15	1.2, 1.6	101	4,698	0	1,115	200	35,330
7/16	1.2, 1.6	54	4,752	2	1,117	200	35,530
7/17	1.2, 1.6	89	4,841	1	1,118	450	35,980
7/18	1.2, 1.6	88	4,929	3	1,121	230	36,210
7/19	1.2, 1.6	81	5,010	10	1,131	70	36,280
7/20	1.2, 1.6	91	5,101	5	1,136	140	36,420
7/21	1.2, 1.6	102	5,203	0	1,136	230	36,650
7/22	1.2, 1.6	42	5,245	1	1,137	130	36,780
7/23	1.2, 1.6	50	5,295	0	1,137	130	36,910
7/24	1.2, 1.6	18	5,313	2	1,139	30	36,940
7/25	1.2, 1.6	10	5,323	0	1,139	40	36,980
7/26	1.2, 1.6	13	5,336	0	1,139	40	37,020
7/27	1.2, 1.6	39	5,375	1	1,140	80	37,100
7/28	1.2, 1.6	78	5,453	0	1,140	80	37,180
7/29	1.2, 1.6	95	5,548	3	1,143	200	37,380
7/30	1.2, 1.6	188	5,736	1	1,144	350	37,730
7/31	1.2	106	5,842	0	1,144	100	37,830
8/01	1.2, 1.6	82	5,924	0	1,144	100	37,930
8/02	1.2, 1.6	37	5,961	0	1,144	130	38,060
8/03	1.2, 1.6	49	6,010	0	1,144	130	38,190
8/04	1.2, 1.6	65	6,075	3	1,147	150	38,340
8/05	1.2, 1.6	53	6,128	1	1,148	100	38,440
8/06	1.2, 1.6	29	6,157	2	1,150	50	38,490
8/07	1.2, 1.6	22	6,179	2	1,152	40	38,530
8/08	1.2, 1.6	10	6,189	3	1,155	40	38,570
8/09	1.2, 1.6	8	6,197	8	1,163	50	38,620

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Table 1.-Page 3 of 3.

	Location	Chinook		Coho		Sockeye	
Date	rkm	Daily	Cum.	Daily	Cum.	Daily	Cum.
8/10	1.2, 1.6	6	6,203	0	1,163	30	38,650
8/11	1.2, 1.6	4	6,207	2	1,165	20	38,670
8/12	1.2, 1.6	6	6,213	2	1,167	40	38,710
8/13	1.2, 1.6	16	6,229	4	1,171	50	38,760
8/14	1.2, 1.6	37	6,266	1	1,172	0	38,760
8/15	1.2, 1.6	77	6,343	5	1,177	10	38,770
8/16	1.2, 1.6	39	6,382	1	1,178	10	38,780
8/17	1.2, 1.6	70	6,452	0	1,178	10	38,790
8/18	1.2, 1.6	63	6,515	10	1,188	50	38,840
8/19	1.2, 1.6	70	6,585	9	1,197	50	38,890
8/20	1.2, 1.6	46	6,631	3	1,200	30	38,920
8/21	1.2, 1.6	27	6,658	1	1,201	0	38,920
8/22	1.2, 1.6	8	6,666	0	1,201	10	38,930
8/23	1.2, 1.6	7	6,673	0	1,201	0	38,930
8/24	1.2, 1.6	9	6,682	0	1,201	0	38,930
8/25	1.2, 1.6	30	6,712	7	1,208	20	38,950
8/26	1.2, 1.6	41	6,753	4	1,212	20	38,970
8/27	1.2, 1.6	45	6,798	4	1,216	0	38,970
8/28	1.2, 1.6	31	6,829	8	1,224	30	39,000
8/29	1.2, 1.6	74	6,903	11	1,235	0	39,000
8/30	1.2, 1.6	19	6,922	1	1,236	0	39,000
8/31	1.2, 1.6	36	6,958	1	1,237	0	39,000
9/01	1.2, 1.6	42	7,000	4	1,241	0	39,000
9/02	1.2, 1.6	12	7,012	0	1,241	0	39,000
9/03	1.2, 1.6	6	7,018	0	1,241	0	39,000
9/04	1.2, 1.6	0	7,018	1	1,242	0	39,000
9/05	1.2, 1.6	0	7,018	0	1,242	0	39,000
9/06	1.2, 1.6	0	7,018	0	1,242	0	39,000
9/07	1.2, 1.6	0	7,018	0	1,242	0	39,000

Note: Total catch of all salmonids (including Dolly Varden and rainbow trout) was 47,500 fish.

[a] Days off, trap moving or debris resulted in incomplete data.

The Kolmogorov-Smirnov tests conducted to compare the cumulative length distribution of fish that could be aged with those that could not be aged for each sample source-time strata combination were not significant ($P \geq 0.10$). These results indicated that using aged fish to represent unaged fish did not result in a bias in estimating the number of chinook salmon sampled by age. When the age composition of the escapement and creel sampling was expanded for the unaged and unageable fish, we examined an estimated 124 two-ocean adults for the absence of an adipose fin (Table 3).

Slikok Creek spawning ground survey crews sampled 87 dead and observed one live chinook salmon. All fish sampled had an adipose fin. Scales were collected from 39 of the chinook salmon, and sex could be determined for 36 fish (Table 4). Scales from only 12 fish were readable, of which 42% were age 1.2 and 58% were age 1.3.

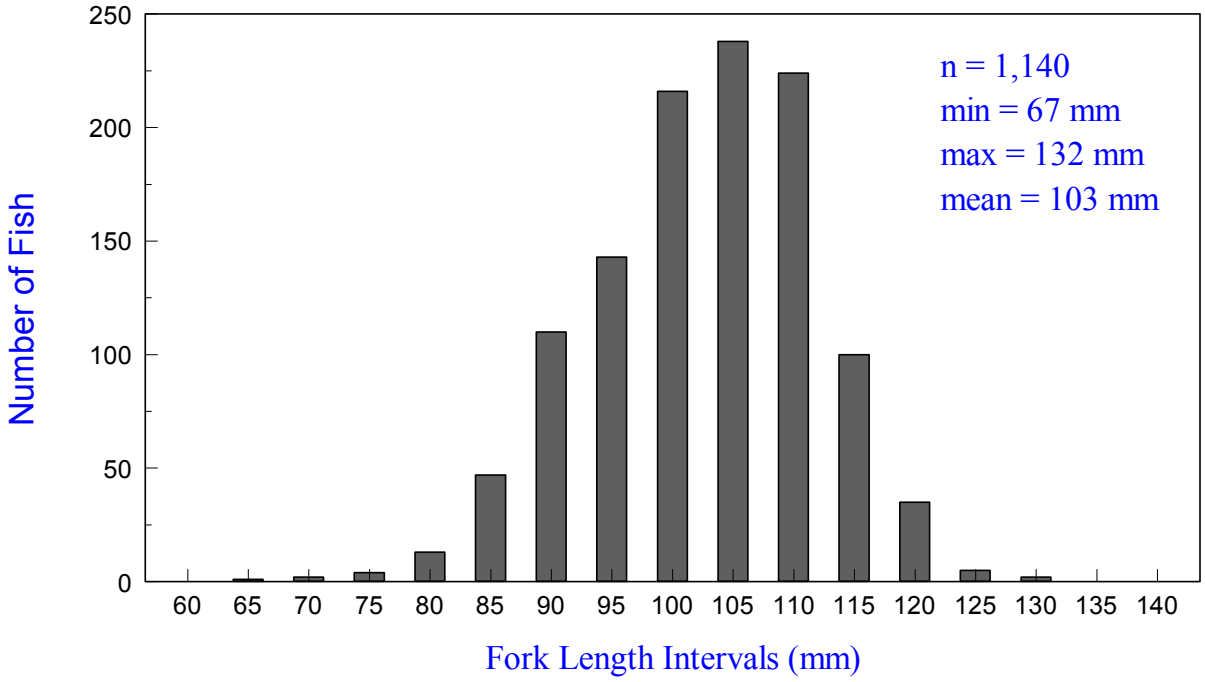

Figure 3.-Length frequency distribution for age-1. chinook salmon smolt captured in the Kenai River delta, 1996.

DEEP CREEK

CWT Release

We operated the Deep Creek rotary smolt trap from 18 May through 13 August. Stream discharge and water temperature fluctuated throughout the operation (Figure 4). Water level declined from 68.6 cm in mid-May to 62.2 cm by early August with interspersed freshets. Water temperature ranged from 4°C to 14.5°C, with an increasing trend from mid-May through early July. There was a significant (P = 0.0001) negative correlation between the two hydrological parameters as chinook and coho salmon catches tended to increase after periodic discharge increases.

Eleven species of fish were captured in the trap. The catch of Dolly Varden *Salvelinus malma*, coho salmon, steelhead *O. mykiss*, and chinook salmon totaled 17,275 (Table 5).

Table 2.-Dates, tag codes, and numbers of chinook salmon marked with coded wire tags at rkm 1.6 of the Kenai River, 1996.

Dates	Coded Wire Tag Codes	Brood Year	Age	No.
6/14-8/20	31-25-45	1994	1	6,152
8/21-9/03	31-25-46	1994	1	386
			Total	6,538

Table 3.-Number of chinook salmon sampled by age for a missing adipose fin in the Kenai River, 1996.

Run	Time Strata	Sample Source		Ageable scales 1.2	1.3	1.4	1.5	Total	Total number sampled 1.2	1.3	1.4	2	Total
Early	5/14-6/07	Sport harvest	n_{ij}	0	9	53	1	63	0	12	72	1	85
			$\hat{p}_{ij}$	0.0000	0.1429	0.8413	0.0159	1.0000					
			$Var(\hat{p}_{ij})$	0.0000	0.0020	0.0022	0.0003						
		Gill netting	n_{ij}	6	37	74	3	120	10	62	123	5	200
			$\hat{p}_{ij}$	0.0500	0.3083	0.6167	0.0250	1.0000					
			$Var(\hat{p}_{ij})$	0.0004	0.0018	0.0020	0.0002						
	6/08-6/30	Sport harvest	n_{ij}	18	47	154	6	225	23	59	194	8	283
			$\hat{p}_{ij}$	0.0800	0.2089	0.6844	0.0267	1.0000					
			$Var(\hat{p}_{ij})$	0.0003	0.0007	0.0010	0.0001						
		Gill netting	n_{ij}	20	58	129	4	211	27	79	175	5	287
			$\hat{p}_{ij}$	0.0948	0.2749	0.6114	0.0190	1.0000					
			$Var(\hat{p}_{ij})$	0.0004	0.0009	0.0011	0.0001						
	Total	Sport harvest		18	56	207	7	288	23	71	265	9	368
		Gill netting		26	95	203	7	331	37	141	299	10	487
		Total		44	151	410	14	619	60	212	564	19	855
Late	7/01-7/23	Sport harvest	n_{ij}	13	61	94	2	170	16	73	113	2	204
			$\hat{p}_{ij}$	0.0765	0.3588	0.5529	0.0118	1.0000					
			$Var(\hat{p}_{ij})$	0.0004	0.0014	0.0015	0.0001						
		Gill netting	n_{ij}	34	113	173	4	324	44	147	225	5	422
			$\hat{p}_{ij}$	0.1049	0.3488	0.5340	0.0123	1.0000					
			$Var(\hat{p}_{ij})$	0.0003	0.0007	0.0008	0.0000						
	7/24-8/07	Sport harvest	n_{ij}	1	25	35	2	63	1	35	49	3	88
			$\hat{p}_{ij}$	0.0159	0.3968	0.5556	0.0317	1.0000					
			$Var(\hat{p}_{ij})$	0.0003	0.0039	0.0040	0.0005						
		Gill netting	n_{ij}	2	46	97	0	145	2	57	120	0	180
			$\hat{p}_{ij}$	0.0138	0.3172	0.6690	0.0000	1.0000					
			$Var(\hat{p}_{ij})$	0.0001	0.0015	0.0015	0.0000						
	Total	Sport harvest		14	86	129	4	233	17	108	162	5	292
		Gill netting		36	159	270	4	469	47	204	346	5	602
		Total		50	245	399	8	702	64	312	507	10	894
Total[a]		Sport harvest		32	142	336	11	521	40	179	427	14	660
		Gill netting		62	254	473	11	800	84	345	645	16	1,089
		Total		94	396	809	22	1,321	124	524	1,071	30	1,749

[a] Total by age is the product of the total number sampled by source and strata and the proportion of each age class estimated from ageable scales.

Table 4.-Summary of marked and unmarked adult chinook salmon sampled in Deep Creek and Slikok Creek, 1996.

Date	Male	Female	Ocean age (all) 1	2	3	4	U[a]	Tag Loss	Deep Ck Marked	Ninilchik Marked[b]
Deep Creek chinook salmon										
5/29	15	6	0	11	9	0	1		0	0
6/06	50	18	1	31	22	4	10		1	2
6/12	25	6	0	17	8	4	2		1	1
6/14	41	20	0	30	24	3	4		6	2
6/19	44	21	0	22	23	13	7	2	2	1
6/21	19	11	0	14	8	6	2		1	2
6/26	32	17	0	23	15	6	5		1	2
7/03	15	7	0	8	8	1	5		0	2
8/07	7	6	0	2	5	5	1		0	0
Total	248	112	1	158	122	42	37	2	12	12
Slikok Creek chinook salmon										
8/06	18	18	0	5	7	0	24			

[a] Unknown age/non-readable

[b] All age classes

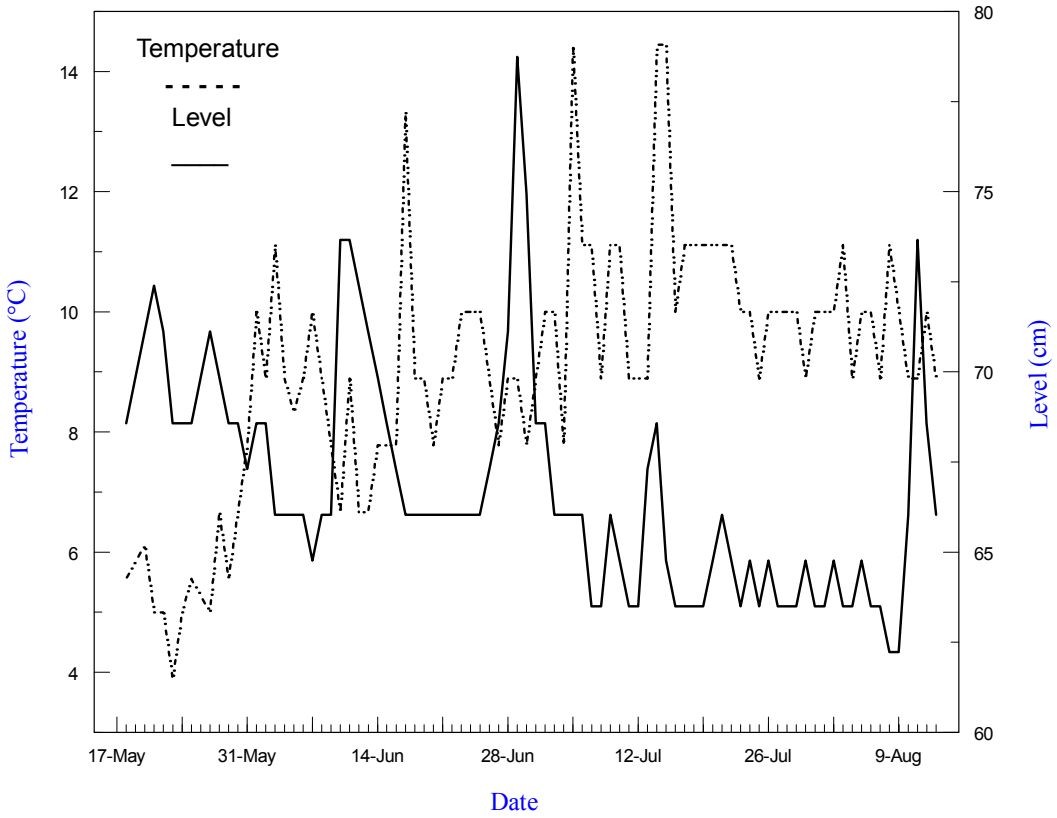

Figure 4.-Daily water level and temperature in Deep Creek, 1996.

Table 5.-Daily and cumulative catches of chinook salmon, coho salmon, Dolly Varden, and steelhead smolt using a rotary trap in Deep Creek, 1996.

	Chinook									
	Age-1.		Age-0.		Coho		Dolly Varden		Steelhead	
Date	Daily	Cum.	Daily	Cum.	Daily	Cum.	Daily	Cum.	Daily	Cum.
5/18	13	13	0	0	7	7	335	335	0	0
5/19[a]		13		0		7		335		0
5/20	2	15	0	0	7	14	268	603	0	0
5/21	6	21	0	0	12	26	402	1,005	0	0
5/22	14	35	0	0	13	39	341	1,346	1	1
5/23	4	39	0	0	20	59	168	1,514	0	1
5/24	13	52	0	0	20	79	126	1,640	0	1
5/25	5	57	0	0	12	91	86	1,726	0	1
5/26	5	62	0	0	11	102	118	1,844	0	1
5/27	5	67	0	0	11	113	149	1,993	0	1
5/28	0	67	0	0	6	119	91	2,084	0	1
5/29	5	72	0	0	10	129	128	2,212	0	1
5/30	0	72	0	0	23	152	48	2,260	0	1
5/31	2	74	0	0	17	169	31	2,291	0	1
6/01	1	75	0	0	12	181	3	2,294	0	1
6/02	2	77	0	0	19	200	5	2,299	0	1
6/03	2	79	0	0	17	217	3	2,302	0	1
6/04	4	83	0	0	47	264	7	2,309	0	1
6/05	4	87	0	0	75	339	3	2,312	0	1
6/06	8	95	0	0	115	454	3	2,315	0	1
6/07	8	103	0	0	134	588	3	2,318	0	1
6/08	5	108	0	0	127	715	4	2,322	0	1
6/09	17	125	20	20	412	1,127	9	2,331	1	2
6/10	14	139	50	70	575	1,702	6	2,337	2	4
6/11	34	173	100	170	565	2,267	22	2,359	1	5
6/12	27	200	50	220	380	2,647	6	2,365	0	5
6/13	48	248	50	270	225	2,872	2	2,367	1	6
6/14	59	307	50	320	269	3,141	2	2,369	1	7
6/15	47	354	40	360	159	3,300	2	2,371	0	7
6/16	25	379	20	380	136	3,436	0	2,371	0	7
6/17	40	419	10	390	126	3,562	1	2,372	1	8
6/18	44	463	20	410	94	3,656	3	2,375	2	10
6/19	38	501	20	430	126	3,782	1	2,376	0	10
6/20	152	653	20	450	59	3,841	2	2,378	1	11
6/21	75	728	10	460	117	3,958	1	2,379	2	13
6/22	74	802	20	480	118	4,076	3	2,382	1	14
6/23	62	864	0	480	53	4,129	0	2,382	0	14
6/24	43	907	0	480	30	4,159	0	2,382	0	14
6/25	95	1,002	10	490	49	4,208	0	2,382	0	14
6/26	192	1,194	90	580	78	4,286	0	2,382	5	19
6/27	275	1,469	100	680	112	4,398	0	2,382	2	21
6/28	301	1,770	100	780	74	4,472	0	2,382	5	26
6/29	217	1,987	140	920	68	4,540	1	2,383	4	30
6/30	61	2,048	40	960	50	4,590	0	2,383	4	34
7/01	46	2,094	60	1,020	34	4,624	0	2,383	3	37
7/02	38	2,132	30	1,050	21	4,645	0	2,383	1	38

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Table 5.-Page 2 of 2.

	Chinook									
	Age-1.		Age-0.		Coho		Dolly Varden		Steelhead	
Date	Daily	Cum	Daily	Cum.	Daily	Cum.	Daily	Cum.	Daily	Cum.
7/03	107	2,239	30	1,080	8	4,653	0	2,383	3	41
7/04	118	2,357	70	1,150	14	4,667	0	2,383	3	44
7/05	162	2,519	80	1,230	12	4,679	0	2,383	0	44
7/06	90	2,609	60	1,290	18	4,697	0	2,383	4	48
7/07	150	2,759	110	1,400	19	4,716	0	2,383	7	55
7/08	130	2,889	90	1,490	11	4,727	0	2,383	1	56
7/09	149	3,038	110	1,600	30	4,757	0	2,383	7	63
7/10	112	3,150	170	1,770	25	4,782	0	2,383	2	65
7/11	131	3,281	140	1,910	15	4,797	0	2,383	4	69
7/12	159	3,440	180	2,090	37	4,834	1	2,384	9	78
7/13	107	3,547	130	2,220	31	4,865	0	2,384	2	80
7/14	12	3,559	80	2,300	25	4,890	0	2,384	0	80
7/15	101	3,660	90	2,390	14	4,904	0	2,384	2	82
7/16	63	3,723	50	2,440	16	4,920	1	2,385	1	83
7/17	57	3,780	80	2,520	14	4,934	0	2,385	3	86
7/18	16	3,796	40	2,560	10	4,944	0	2,385	0	86
7/19	21	3,817	40	2,600	6	4,950	0	2,385	0	86
7/20	26	3,843	40	2,640	4	4,954	0	2,385	0	86
7/21	83	3,926	220	2,860	15	4,969	0	2,385	2	88
7/22	98	4,024	150	3,010	12	4,981	0	2,385	0	88
7/23	30	4,054	60	3,070	9	4,990	1	2,386	1	89
7/24	36	4,090	120	3,190	10	5,000	3	2,389	1	90
7/25	24	4,114	160	3,350	8	5,008	0	2,389	1	91
7/26	132	4,246	40	3,390	13	5,021	3	2,392	0	91
7/27	96	4,342	40	3,430	4	5,025	0	2,392	0	91
7/28	40	4,382	80	3,510	7	5,032	0	2,392	2	93
7/29	28	4,410	70	3,580	10	5,042	0	2,392	0	93
7/30	27	4,437	90	3,670	8	5,050	0	2,392	1	94
7/31	27	4,464	70	3,740	7	5,057	0	2,392	1	95
8/01	24	4,488	80	3,820	5	5,062	1	2,393	1	96
8/02	16	4,504	120	3,940	9	5,071	0	2,393	3	99
8/03	19	4,523	110	4,050	8	5,079	0	2,393	2	101
8/04	8	4,531	70	4,120	6	5,085	4	2,397	0	101
8/05	21	4,552	80	4,200	17	5,102	2	2,399	0	101
8/06	7	4,559	70	4,270	15	5,117	2	2,401	1	102
8/07	17	4,576	60	4,330	9	5,126	3	2,404	2	104
8/08	28	4,604	50	4,380	25	5,151	4	2,408	0	104
8/09	14	4,618	80	4,460	15	5,166	6	2,414	2	106
8/10	12	4,630	80	4,540	13	5,179	2	2,416	0	106
8/11	28	4,658	160	4,700	42	5,221	6	2,422	2	108
8/12	6	4,664	60	4,760	11	5,232	4	2,426	1	109
8/13	4	4,668	40	4,800	29	5,261	8	2,434	3	112

[a] Debris and high water conditions resulted in incomplete catch data.

Chinook salmon accounted for the majority of the catch (55%), followed by coho salmon (30%), Dolly Varden (14%), and steelhead (1%). We did not attempt to enumerate or tag chinook salmon less than 55 mm in fork length. The remaining species included sockeye salmon, pink salmon *O. gorbuscha*, threespine stickleback *Gasterosteus aculeatus*, ninespine stickleback *Pungitius pungitius*, slimy sculpin *Cottus cognatus*, eulachon *Thaleichthys pacificus*, and Pacific lamprey *Entosphenus tridentatus*.

Emigration timing of each salmonid species was unique, resulting in the presence of salmonid smolt in Deep Creek throughout most of the open water season (Figure 5). Chinook salmon smolt were caught through essentially the entire dates of operation, with the highest catch of age-1. smolt on 28 June, and age-0. smolt larger than 55 mm on 21 July. Coho salmon smolt were also captured throughout the period of operation, but migrated primarily in June, with a peak catch on 10 June. Dolly Varden smolt left the drainage primarily before the end of May. High catch rates of Dolly Varden from the start of operation indicated that emigration of this species had already begun. Steelhead catches peaked on 12 July, but our small total catch (n = 112) precluded clear definition of migratory timing. Nearly all trap catches of all species occurred between 2300 hours and 0700 hours.

Small numbers of post-emergent chinook salmon fry were captured from the onset of trapping. These age-0. fry were typically less than 50 mm in fork length, and were often impinged on the cleaning screen and passed out of the live box. By late July, fingerling (age-0.) chinook salmon began to resemble age-1. smolt in size and appearance, and were the predominant age class in catches. As age-0. chinook salmon increased in length, they became increasingly difficult to distinguish from age-1. smolt. However, the overlap in length frequency distribution of the two age classes occurred after the majority of the age-1. emigration.

Chinook salmon presumed to be age 0. smolt ranged from 45 mm to 85 mm in fork length, with a mean fork length of 70 mm (Table 6). Those presumed to be age 1. ranged from 82 to 115 mm, with an average of 96 mm (Figure 6). Mean length increased from 58 mm in mid-June to 75 mm in mid-July for age-0. chinook salmon smolt.

We marked and released a total of 8,967 chinook salmon in Deep Creek during 1996 (Table 7). Approximately half of this total was age-1. migrants from the 1994 brood year and half were age-0. migrants from the 1995 brood year. Short-term tag retention and mortality rates were 100% and 0%. A complete listing of the CWTs applied during this project is presented in Appendix A1.

We also marked and released a total of 4,868 coho salmon smolt in Deep Creek during 1996 (Table 7). Short-term tag retention and mortality rates for coho salmon smolt were 100% and 0%. An additional 340 fingerlings were captured.

Estimating Inriver Adult CWT Mark Proportion

Chinook Salmon

We sampled 360 adult chinook salmon for a missing adipose fin (Table 4). Twenty-six heads were collected from AFC fish. Twelve of the 26 AFC fish were hatchery-reared fish released in the Ninilchik River. When expanded for unmarked fish, the strays from the Ninilchik River comprised an estimated 51 (SE = 13) or 14.1% (SE = 3.5%) of the 360 chinook salmon sampled in Deep Creek (Table 8). Twelve of the remaining AFC fish were 2-ocean chinook salmon tagged at Deep Creek in 1994 as age-1. smolt (Appendix B2). None of the recovered Deep Creek tags were

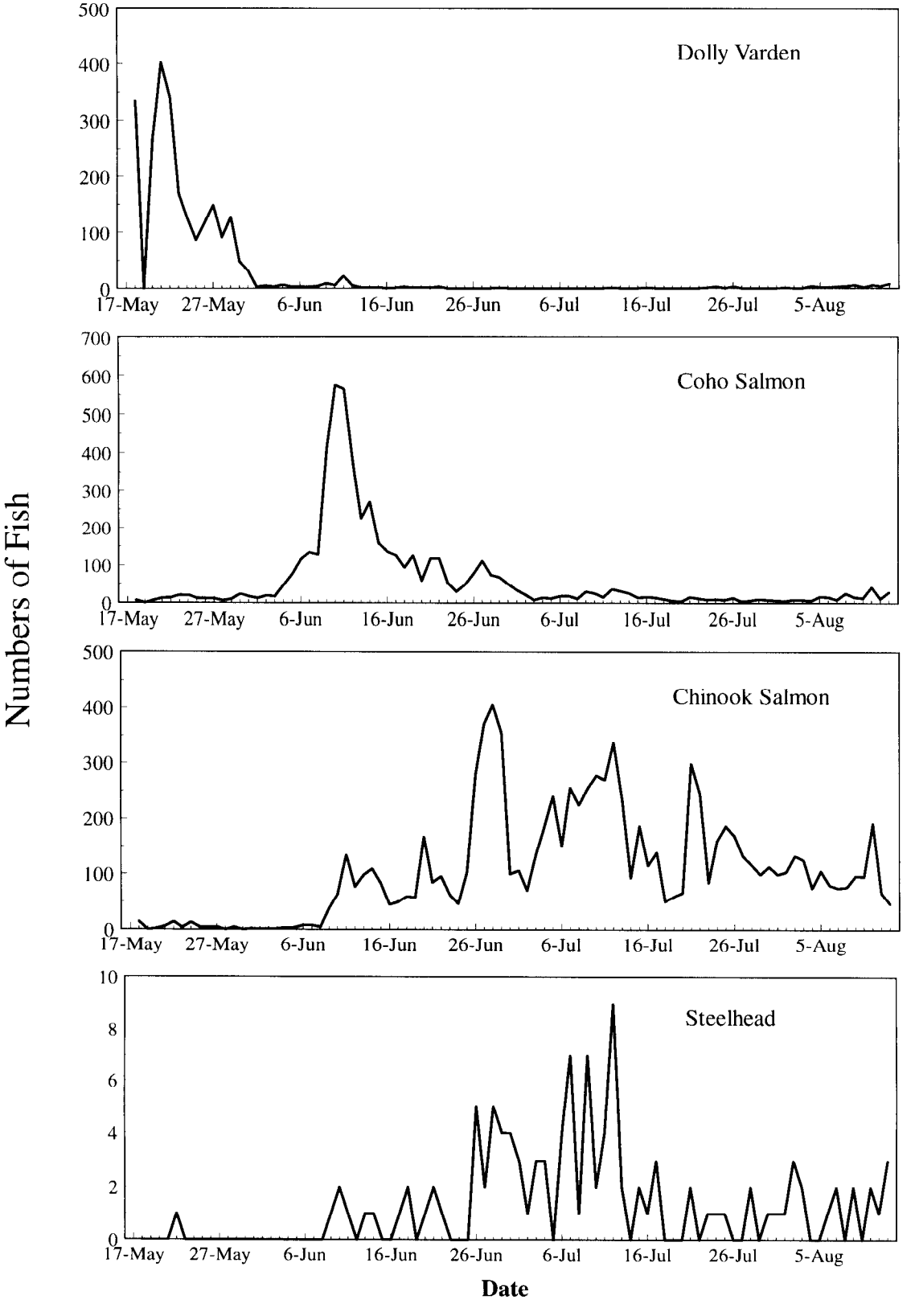

Figure 5.-Emigration timing for salmonid smolt captured in Deep Creek, 1996.

Table 6.-Age and length of chinook salmon juveniles in Deep Creek, 1994-1996.

	Age-0.						Age-1.				
	Length (mm)						Length (mm)				
Date	n	Min	Max	Mean	SE	Date	n	Min	Max	Mean	SE
1994						1994					
6/25	100	42	62	51	.4	6/14	44	72	99	86	.8
7/02	116	46	69	57	.4	6/21	100	74	98	87	.5
7/07	148	44	72	59	.5	6/28	150	73	103	87	.5
7/16	100	50	73	63	.5	7/05	150	76	102	89	.4
7/26	100	51	84	71	.6	7/07	164	74	104	89	.4
						7/12	110	77	101	91	.5
						7/19	100	80	108	93	.6
1995[a]						1996[a]					
7/19	240	48	81	65	.4	6/21	240	68	101	88	.3
7/26	200	52	83	70	.4	6/28	240	70	97	88	.3
8/02	220	51	96	72	.5	7/05	214	77	103	89	.3
						7/13	240	68	103	90	.4
1996[a]						1996[a]					
6/27	84	45	65	58	.5	7/22	98	80	115	96	.7
7/22	148	65	85	75	.4	7/23	30	85	115	98	1.2
7/23	55	60	85	75	.7	7/25	24	85	110	96	1.5

[a] No scales taken. Fish sorted into age class by size.

originally implanted in age-0. smolt even though 3,644 were marked in 1994. The remaining two heads did not contain a tag.

After subtracting the estimated number of Ninilchik River fish from the sample, the remaining catch of Deep Creek 2-ocean chinook salmon was tested to see if the proportion of marked fish changed over time. We pooled the data into two 3-week strata covering 29 May through 3 July, and found that there was no difference in the marked proportion over time (χ^2 = 0.3, df = 1, P = 0.59). We therefore pooled all of the tag recovery data, resulting in 12 tags from 167 two-ocean fish (Table 8). Our estimate of $\hat{\theta}$ for this age class of the 1993 brood year was 7.2% (SE = 2.0%). The estimated variance of $\hat{\theta}^{-1}$ was 39.667.

We also received one voluntary return of a head from a sport-caught chinook salmon that had been released from the Twin Falls hatchery, but the date and location caught were unknown. One voluntary sport-caught AFC chinook salmon originating from Deep Creek was returned from the Cook Inlet marine recreational fishery (Appendix B3).

Coho Salmon

We sampled 205 live, unspawned coho salmon in Deep Creek of which 57 were missing the adipose fin (Table 9). Heads were collected from 11 fish prior to 16 August. Five additional AFC fish were assumed to have tags and released during that time period. The 41 AFC coho salmon adults caught after that date had coded wire tags as determined by the tag detection wand, and were released alive. All heads sent to the Tag

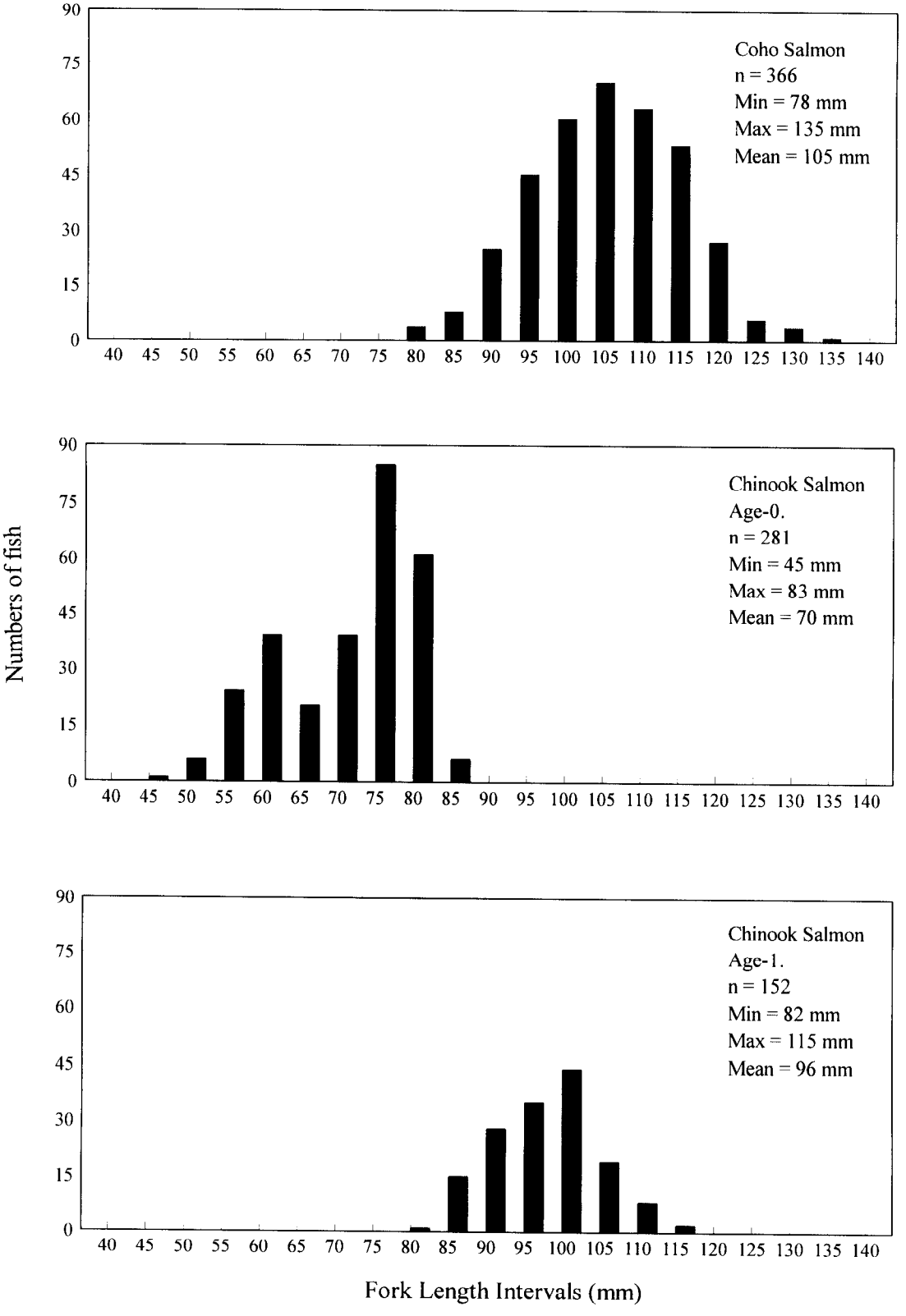

Figure 6.-Length frequency distributions for coho salmon smolt and age-0. and age-1. chinook salmon smolt captured in Deep Creek, 1996.

Table 7.-Dates, codes, and numbers of salmon marked with coded wire tags and released in Deep Creek during 1996.

Species	rkm	Dates	Coded Wire Tag Codes	Brood Year	Age		No.
Chinook	0.8	5/21-8/13	13-01-03-08-11	1994	1		4,608
Chinook	0.8	6/27-8/13	13-01-03-08-12	1995	0		4,359
						Total	8,967
Coho	0.8	5/21-8/13	13-01-03-08-10	1993	2		4,868

Lab contained tags placed in smolt in 1995 at Deep Creek (Appendix B2). All AFC coho salmon released live were assumed to be of Deep Creek origin.

Technicians also received 60 heads from AFC coho salmon voluntarily turned in by anglers (Appendix B4). All were of Deep Creek origin except one fish tagged in the Moose River, a tributary of the Kenai River.

We poststratified inriver sample data into three 2-week intervals covering 5 August through 13 September. There was no significant ($\chi^2 = 2.02$, df = 2, P = 0.37) difference in the proportion of marked coho salmon observed among strata, indicating a representative sample of coho salmon smolt were marked in 1995. We therefore pooled all of the tag recovery data, resulting in 57 tags from 205 fish**.** The proportion of coho salmon marked with a CWT ($\hat{\theta}$) was estimated as 27.8% (SE = 3.1%), and the estimated variance of $\hat{\theta}^{-1}$ was 0.180.

1995 Coho Salmon Smolt Estimate

Estimating $\hat{\theta}$ allowed us to also estimate the smolt emigration in 1995. Based on the number of coho salmon smolt marked with a CWT (9,671), the number of adult coho salmon examined for a CWT (205), and the number of adult coho salmon observed with an AFC (57), the estimated smolt emigration was 34,351 (SE = 3,779).

DISCUSSION

KENAI RIVER

Since we did not meet our sample goal for age-0. chinook salmon fry marking in previous years, and were unsure about the survival rate of age-0. fry to age-1. smolt, we decided to discontinue marking fry in 1996. Preliminary examination of smolt tagging sites in 1995 suggested that we would be most successful by fishing the traps in the Kenai River delta. Therefore, the smolt traps were moved to that location for the 1996 season.

Our trapping experience during 1996 demonstrated that rotary smolt traps anchored to mooring buoys in the Kenai River delta were able to capture sockeye, coho and chinook salmon smolt. Debris loading on the trap cone and other trap maintenance problems were minimal. Since rotary trap cones use current-driven rotation to capture fish, tidal action in the river delta rendered our trap inactive for part of each day (slack tides). When tidal exchanges were low, the trap rotated for a few hours during each ebb tide, but on days with higher tidal exchanges, the

Table 8.-Calculation of marked proportions of Ninilchik River and Deep Creek adult chinook salmon captured in Deep Creek.

	Inriver Adult Chinook Salmon Sample											Estimated Number of Chinook Salmon Adults in the Sample[a]				
	Numbers of Fish							Proportion of Ageable Fish								
Stratum	Age Class							Age Class				Age Class				
Dates	1.1	1.2	1.3	1.4	Unageable	Unaged	Total	1.1	1.2	1.3	1.4	1.1	1.2	1.3	1.4	All Ages
5/26-6/1	0	11	9	0	1	0	21	0.00	0.55	0.45	0.00	0	12	9	0	21
6/2-8	1	31	22	4	10	0	68	0.02	0.53	0.38	0.07	1	36	26	5	68
6/9-15	0	47	32	7	6	0	92	0.00	0.55	0.37	0.08	0	50	34	7	92
6/16-22	0	36	31	19	9	0	95	0.00	0.42	0.36	0.22	0	40	34	21	95
6/23-29	0	23	15	6	5	0	49	0.00	0.52	0.34	0.14	0	26	17	7	49
6/30-7/6	0	8	8	1	2	3	22	0.00	0.47	0.47	0.06	0	10	10	1	22
8/11-17	0	2	5	5	1	0	13	0.00	0.17	0.42	0.42	0	2	5	5	13
Total	1	158	122	42	34	3	360					1	176	136	47	360

	Estimated Number of Ninilchik River Chinook Salmon Adults in the Sample[b]						Estimated Number of Deep Creek Chinook Salmon Adults in the Sample[c]					Estimated Tagged Deep Creek 2-Ocean Adults		
Stratum	Age Class						Age Class					Total	2-ocean	Percent Tagged
Dates	1.1	1.2	1.3	1.4	All Ages	Percent	1.1	1.2	1.3	1.4	Total	Tags	Fish	2-ocean Fish
5/26-6/1	0	0	0	0	0	0.0%	0	12	9	0	21	0	12	0.0%
6/2-8	0	0	9	0	9	12.6%	1	36	17	5	59	1	36	2.8%
6/9-15	0	0	9	3	12	12.8%	0	50	26	4	80	7	50	13.9%
6/16-22	0	0	13	0	13	13.6%	0	40	21	21	82	3	40	7.5%
6/23-29	0	4	4	0	9	17.8%	0	21	12	7	40	1	21	4.7%
6/30-7/6	0	4	4	0	9	39.6%	0	6	6	1	13	0	6	0.0%
8/11-17	0	0	0	0	0	0.0%	0	2	5	5	13	0	2	0.0%
Total	0	9	39	3	51	14.1%	1	167	98	43	309	12	167	7.2%

[a] Product of proportion of fish by age class by week and all fish captured, including unaged, in the sample by week.

[b] Product of the number of marked Ninilchik River chinook salmon adults in the sample and inverse theta for the cohort hatchery release.

[c] Estimated number of chinook salmon in the sample minus the estimated number of Ninilchik River chinook salmon in the sample.

Table 9.-Summary of marked and unmarked adult coho salmon sampled in Deep Creek, 1996.

			Ocean age (all)					Ocean age 1	
Date	Male	Female	1	2	3	4	U	Unmarked	Marked
8/05	5	4	7	0	0	0	2	3	6
8/09	7	4	9	0	0	0	2	7	4[a]
8/12	20	12	29	0	0	0	3	26	6[b]
8/16	11	7	16	0	0	0	2	11	7
8/20	0	1	1	0	0	0	0	1	0
8/22	18	12	24	0	0	0	6	17	13
8/28	25	11	27	0	0	0	9	30	6
9/05	15	7	20	0	0	0	2	18	4
9/06	29	5	30	0	0	0	4	25	9
9/12	8	3	9	0	0	0	2	10	1
9/13	0	1	0	0	0	0	1	0	1
Total	138	67	172	0	0	0	33	148	57

[a] Heads were collected from 2 fish. The remaining 2 AFC fish were released.

[b] Heads were collected from 3 fish. The remaining 3 AFC fish were released.

trap rotated on both the flood and ebb tides. Salinity varied from 0 to 30 ppt during a 12 h period in the Kenai River delta. Fish held in our live box were often subjected to rapid and extreme changes in salinity. Mortality associated with trapping in the delta was limited to eulachon, small numbers of Pacific sandfish *Trichodon trichodon* and a few sockeye salmon smolt. Mortality of the latter species in the live-box was eliminated by decreasing the time interval between trap checks.

We did not, however, catch and mark adequate numbers of smolt to meet project objectives. Our total of marked fish, approximately 6,500, was less than 6% of the desired number. When the planning assumptions for the recovery program were adjusted using preliminary 1996 data, the number of Kenai River wild tags we predicted we would find in the marine recreational harvest was 0 (McKinley *In prep*).

We are also uncertain whether operating in the Kenai River delta resulted in marking of non-Kenai chinook salmon smolt. Our evidence indicates that at least some portion of the catch was of non-Kenai River origin. In 1995, we recaptured 17 previously tagged smolt. Sixteen of these were sacrificed to determine origin of the tag, and all but one were marked as fingerlings in 1994 in the Kenai River. The non-Kenai tag came from a Crooked Creek Hatchery release.

These results lead us to recommend that the tagging operation continue to focus on smolt in 1997, but be moved upstream to a location where we can increase the number of fish tagged, and can be sure that the tagged fish are all of Kenai River origin.

Numerous factors affect the number of marked fish needed to estimate harvest of a cohort in a mixed stock fishery. These include: (1) the desired levels of relative precision and accuracy of the estimate(s), (2) the fraction of the harvest inspected for marks, (3) an *a priori* estimate of the harvest of the cohort by the fishery of interest, (4) the number of juveniles in the drainage at the

time of tagging, and (5) the number of juveniles available to the capture method.

At this stage of the project, the first three factors remain unchanged. The precision and accuracy levels were thought necessary to provide confidence that the estimates can be used for management of fisheries. The effort necessary to inspect the harvest cannot be increased without significant cost. Data necessary to assess the contribution of the stock to the fishery of interest will not be fully available until all age classes of adults containing CWTs are recruited to that fishery. In 1996, the only chinook salmon with CWTs were 2-ocean fish.

The remaining two factors remain unresolved. Since we had no random tag recoveries from returning 2-ocean adults, we cannot estimate the numbers of smolt exiting the drainage in 1994, nor do we have an adequate grasp of the survival rate of either age-0. fry to smolt or age-1. smolt to adults (marine survival). We also cannot estimate the numbers of juveniles available to the capture method.

The lack of inriver recoveries was contrary to our expectations. The 1996 adult sonar count was 53,934 (Burwen and Bosch 1998) of which approximately 8% were 2-ocean fish. We examined 124 of these 2-ocean fish. We estimated that we marked approximately 6.4% of the age-0. fingerlings in the system in 1993 (approximately 152,000 out of 2.4 million). We therefore expected to see eight tagged adults in the 1996 escapement and creel programs. We actually recovered only one AFC fish, and it did not contain a tag. Possible explanations for this discrepancy include an error in the estimate of fry in the drainage, an error in the assumed age-0. fry to age-1. smolt survival rate, or differential survival of tagged and non-tagged fish. Further sampling of this cohort in 1997, 1998, and 1999 will help resolve this question.

DEEP CREEK CHINOOK SALMON

Our results from Deep Creek suggested that chinook salmon smolt emigrate throughout much of the open water season with peak movements in early summer during mid-June through mid-July. Similar chinook salmon peak emigration times are reported for other Cook Inlet drainages including the Anchor River (Allin 1957), Kasilof River (Waite 1979) and the Kenai River (King et al. 1996). Emigration times for Cook Inlet chinook salmon stocks are later than those reported for stocks in more southern latitudes (Healey 1991). Increases in smolt captures did accompany freshets following rain events.

Juvenile chinook salmon in Alaska typically rear in fresh water for at least 1 year before migrating to sea as "stream-type" smolt. Large downstream movements of age-0. fry immediately following emergence are typical of most chinook salmon populations, but age-0. smolt are only reported from the Situk River (Johnson et al. 1992) and other Yakutat area rivers (S. McPherson, Alaska Department of Fish and Game, Douglas, personal communication) in Alaska. Stream- and ocean-type salmon occupying the same tributary have only been reported in large systems such as the Columbia River and Washington coastal rivers. They are often spatially or temporally isolated, and associated with distinct seasonal adult spawning times or areas and ocean migration patterns (Taylor 1990). Return timing and other characteristics of adults in Deep Creek reflect the presence of a single chinook salmon race and the absence of age-0. smolt returns. Hence, the existence of both races of juveniles in Deep Creek is inconsistent with the current hypothesis that different early life-history types reflect different adult behaviors and is, at least in part, genetically controlled (Taylor 1990, Healey 1991). Our evidence suggested that age-1. smolt leave Deep Creek during June and July, and age-0. smolt leave

beginning in late July, upon reaching approximately 70 mm in fork length (Bendock 1995, 1996).

In our 1994 CWT sample, 73% of the markable (larger than 55 mm) fish were age-1. If the age-0. migrants survived at the same rate as the age-1. smolt, 27%, or approximately four additional AFC adults should have been recaptured that were tagged as age 0. None of this year's recoveries were from age-0. fish. More work is needed to confirm the success of age-0. migrants from Deep Creek. Since this age-class was marked with unique tag codes during 1994, 1995, and 1996, the next 2 years should answer questions regarding the viability of this strategy.

The adult sampling identified significant straying of Ninilchik River chinook salmon into Deep Creek. All of the chinook salmon were captured within 2 miles of the saltwater terminus of the creek and the captures occurred over a 5-week period. They did not appear different morphologically than their Deep Creek counterparts, and many were ready to spawn or were actively spawning. The sampling plan was not, however, designed to answer questions regarding the final destination of these fish. An extensive carcass recovery program or weir is necessary to determine the extent of spawning of Ninilchik River chinook salmon in Deep Creek.

We also recovered enough tags to estimate $\hat{\theta}$ for the 2-ocean return from the 1992 brood year. Since we determined that the CWT marked proportion of the returning adults did not change over time, our assumption that the marked individuals were a representative sample of the drainage-wide smolt emigration was not rejected. Our data indicated that approximately 7.2% of the age-1. smolt migrating out of the drainage in 1994 was tagged.

As in the Kenai portion of this project, we do not yet have complete information to evaluate if we marked enough fish to obtain the desired levels of relative precision and accuracy for the marine recreational fishery harvest estimate. When the planning assumptions for the recovery program were adjusted using preliminary 1996 data, the number of Deep Creek wild tags we predicted we would find in the marine recreational harvest was one (McKinley *In prep*). Data necessary to assess the contribution of the stock to the fishery will not be fully available until all age classes of adults containing CWTs are recruited to that fishery. In 1996, only the 2-ocean fish with CWTs were present.

Based on our age-1. smolt marking total in 1994 (9,600 smolt), and measured θ in 1996 (0.072), our preliminary estimate of the smolt emigration in 1994 was approximately 130,000. If our assumptions of the harvest of Deep Creek chinook salmon in the marine recreational fishery (150 fish) and percent of the marine recreational fishery that we will examine for CWTs (50%) are valid, then marking at the 1994 level will provide estimates of harvest in the marine recreational fishery with $\pm$ 70% relative precision 90% of the time (90% confidence interval of 45 to 255 fish).

Our interpretation of the results is preliminary with regard to the adequacy of the number of marks put out in 1994. However, it appears that we marked adequate numbers of smolt to ultimately estimate the smolt emigration in 1994, but not enough to estimate the contribution of this species to the marine recreational sport harvest at our desired level of precision.

In addition, if we subtract the age-0. component from the tagging totals, our percent of the annual goal tagged was 18% in 1996, 25% in 1995, and 28% in 1994. The trap was moved in 1995 to a location thought

likely to increase the catch rate, but an evaluation of the change will not occur until the return of 2-ocean fish in 1997. Also, the marine harvest tag recovery program results in 1997 will be incorporated into our future assessment of the tagging goals. Until these data can be looked at over several returns, we suggest that future tagging work should include attempts to increase the catch rate.

DEEP CREEK COHO SALMON

Coho salmon smolt were captured throughout the period of operation, with highest catches in June. The emigration timing was consistent with the previous 2 years. Their presence in the catch on the last day of operation is indicative of a protracted low-level emigration throughout most of the open water season. Both the migration timing and duration were similar to that of other Kenai Peninsula stocks (King et al. 1996, Carlon and Hasbrouck 1997). As with chinook salmon smolt, highest catches occurred during freshets immediately following rains.

Concerns regarding the high proportion of adults returning to the drainage with missing adipose fins led us to suspend the sacrifice of fish early in the sampling. We were satisfied that external detection of a tag was sufficient to consider these fish as originating in Deep Creek. We based this conclusion on the presence of only Deep Creek fish in the initial 16 fish sacrificed, and the knowledge that no other stocks in the lower Peninsula were marked. The presumed lack of non-Deep Creek coho salmon straying into the drainage was in part reinforced by the 59 of 60 voluntary recoveries from the sport harvest. The lone non-Deep Creek fish head was deposited at the site during a time when technicians were not in attendance, and no information regarding the stream of harvest was known.

We recovered enough tags to estimate the marked proportion for the smolt marked in 1995. Since we determined that the CWT marked proportion of the returning adults did not change over time, our assumption that the marked individuals were a representative sample of the drainage-wide smolt emigration was not rejected. Since we also found no evidence that any of the remaining assumptions were violated, our estimate of the smolt population emigrating from Deep Creek in 1996 appears reasonable.

We now have in place a project which successfully tagged adequate numbers of smolt to estimate the total smolt emigration. The statewide harvest survey currently provides an estimate of the inriver sport harvest. The addition of an escapement estimate and an estimate of the marine recreational harvest could, in future years, provide the basic compliment of data to estimate the marine survival and harvest rates of a wild coho salmon stock in Cook Inlet.

ACKNOWLEDGMENTS

We would like to thank Terry Evans, Greg Corner, Shane Nicholson, and Kurt Strausbaugh who were responsible for capturing and tagging the fish used in this study. Tim McKinley assisted with data collection and analysis. Patti Berkhahn aged the adult scales. Jim Hasbrouck, the project biometrician, participated in the project planning and design, data analysis, and report review. Swede Freden and Paul Zimmerman at the Kenai City dock were extremely helpful with logistics and provided useful advice on setting mooring buoys in the Kenai River Delta.

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APPENDIX A. HISTORICAL TAGGING SUMMARY

Appendix A1.-Dates, coded wire tag codes, and numbers of wild salmon tagged and released in Deep Creek and the Kenai River during 1993 through 1996.

Year	Species	Location	rkm	Dates	Code	Brood Year	Age	Number Tagged
1993	Chinook	Kenai R.	71	7/28 – 8/04	31-22-23	1992	0	4,373
1993	Chinook	Kenai R.	71	8/05 – 8/12	31-22-60	1992	0	11,411
1993	Chinook	Kenai R.	71	8/16 – 8/24	31-22-61	1992	0	12,830
1993	Chinook	Kenai R.	71	8/25 – 8/31	31-22-62	1992	0	10,521
1993	Chinook	Kenai R.	71	9/01 – 9/13	31-22-63	1992	0	13,567
1993	Chinook	Kenai R.	24	7/21 – 7/28	31-22-30	1992	0	5,845
1993	Chinook	Kenai R.	24	7/28 – 8/03	31-22-31	1992	0	5,788
1993	Chinook	Kenai R.	24	8/03 – 8/09	31-22-44	1992	0	12,087
1993	Chinook	Kenai R.	24	8/09 – 8/17	31-22-45	1992	0	11,888
1993	Chinook	Kenai R.	24	8/17 – 8/24	31-22-46	1992	0	11,639
1993	Chinook	Kenai R.	24	8/24 – 8/30	31-22-47	1992	0	11,721
1993	Chinook	Kenai R.	24	8/31 – 9/07	31-22-56	1992	0	11,843
1993	Chinook	Kenai R.	24	9/07 – 9/10	31-22-57	1992	0	11,611
1993	Chinook	Kenai R.	24	9/10 – 9/14	31-22-58	1992	0	12,048
1993	Chinook	Kenai R.	24	9/14 – 9/15	31-22-59	1992	0	5,225
1994	Chinook	Kenai R.	24	7/18 – 7/27	31-22-18	1993	0	5,885
1994	Chinook	Kenai R.	24	7/27 – 8/01	31-22-36	1993	0	5,980
1994	Chinook	Kenai R.	24	8/01 – 8/04	31-22-38	1993	0	6,158
1994	Chinook	Kenai R.	24	8/04 – 8/08	31-22-39	1993	0	6,222
1994	Chinook	Kenai R.	24	8/08 – 8/09	31-22-37	1993	0	6,258
1994	Chinook	Kenai R.	24	8/09 – 8/12	31-22-50	1993	0	11,581
1994	Chinook	Kenai R.	24	8/12 – 8/18	31-22-49	1993	0	11,512
1994	Chinook	Kenai R.	24	8/18 – 8/24	31-22-48	1993	0	11,695
1994	Chinook	Kenai R.	24	8/24 – 9/02	31-22-51	1993	0	11,373
1994	Chinook	Kenai R.	24	9/02 – 9/14	31-24-09	1993	0	11,445
1995	Chinook	Kenai R.	24	6/22 – 7/19	13-01-03-08-03	1993	1	1,479
1995	Chinook	Kenai R.	24	7/25 – 8/03	13-01-03-08-04	1994	0	14,030
1995	Chinook	Kenai R.	24	8/03 – 8/14	13-01-03-08-05	1994	0	13,724
1995	Chinook	Kenai R.	24	8/14 – 8/22	13-01-03-08-06	1994	0	13,745
1995	Chinook	Kenai R.	24	8/22 – 8/30	13-01-03-08-07	1994	0	13,752
1995	Chinook	Kenai R.	24	8/30 – 8/31	13-01-03-08-08	1994	0	2,011
1996	Chinook	Kenai R.	1.6	6/14 – 8/20	31-25-45	1994	1	6,152
1996	Chinook	Kenai R.	1.6	8/21 – 9/03	31-25-46	1994	1	386
1994	Chinook	Deep Cr	0.8	5/20 – 6/28	31-22-16	1992	1	2,430
1994	Chinook	Deep Cr	0.8	6/28 – 7/04	31-23-60	1992	1	2,684
1994	Chinook	Deep Cr	0.8	7/04 – 7/10	31-23-61	1992	1	2,678
1994	Chinook	Deep Cr	0.8	7/10 – 8/03	31-23-62	1992	1	1,819
1994	Chinook	Deep Cr	0.8	7/21 – 7/29	31-23-63	1993	0	2,837
1994	Chinook	Deep Cr	0.8	7/29 – 8/03	31-24-01	1993	0	807
1995	Chinook	Deep Cr	0.8	5/17 – 6/25	31-24-02	1993	1	2,183
1995	Chinook	Deep Cr	0.8	6/25 – 7/21	31-22-35	1993	1	5,719
1995	Chinook	Deep Cr	0.8	7/21 – 8/02	13-01-03-08-15	1993	1	492
1995	Chinook	Deep Cr	0.8	7/14 – 8/12	13-01-03-08-09	1994	0	5,174
1995	Coho	Deep Cr	0.8	5/18 – 6/17	31-22-33	1992	2	5,760
1995	Coho	Deep Cr	0.8	6/17 – 7/20	31-22-34	1992	2	3,911
1996	Chinook	Deep Cr	0.8	5/21 – 8/13	13-01-03-08-11	1994	1	4,608
1996	Chinook	Deep Cr	0.8	6/27 – 8/13	13-01-03-08-12	1995	0	4,359
1996	Coho	Deep Cr	0.8	5/21 – 8/13	13-01-03-08-10	1993	2	4,868

APPENDIX B. SUMMARY OF INRIVER CODED WIRE TAG RECOVERIES

Appendix B1.-Summary of coded wire tagged adult chinook salmon sampled in the Kenai River, 1996.

Kenai River:

Date	Species	Sex	Ocean Age	Length	Tag Code	Release Location	Brood Year	Age at Tagging
6/10/96	Chinook	M	2	625	tag loss		1992	
7/23/96	Chinook	M	2		312244	Kenai River	1992	0

Appendix B2.-Summary of coded wire tagged adult chinook and coho salmon sampled with seines in Deep Creek, 1996.

Deep Creek:

Date	Species	Sex	Ocean Age	Length	Tag Code	Release Location	Brood Year	Age at Tagging
6/6/96	Chinook	M	3	770	312159	Ninilchik	1992	0
	Chinook	F	3	745	312159	Ninilchik	1992	0
	Chinook	M	2	585	312360	Deep Creek	1992	1
6/12/96	Chinook	M	2	548	312360	Deep Creek	1992	1
	Chinook	M	4	855	312104	Ninilchik	1991	0
6/14/96	Chinook	M	2	640	312361	Deep Creek	1992	1
	Chinook	M	2	475	312362	Deep Creek	1992	1
	Chinook	F	3	735	312159	Ninilchik	1992	0
	Chinook	M	2	674	312361	Deep Creek	1992	1
	Chinook	M	2	625	312216	Deep Creek	1992	1
	Chinook	M	2	660	312216	Deep Creek	1992	1
	Chinook	M	2	560	312360	Deep Creek	1992	1
	Chinook	F	3	783	312159	Ninilchik	1992	0
6/19/96	Chinook	M	2	495	312362	Deep Creek	1992	1
	Chinook	F	3	738	312159	Ninilchik	1992	0
	Chinook	M	2	580	tag loss		1992	
	Chinook	F	3	760	tag loss		1991	
	Chinook	M	2	620	312216	Deep Creek	1992	1
6/21/96	Chinook	M	3	780	312159	Ninilchik	1992	0
	Chinook	M	2	685	312360	Deep Creek	1992	1
	Chinook	F	3	835	312159	Ninilchik	1992	0
6/26/96	Chinook	F	2	620	312159	Ninilchik	1992	0
	Chinook	M	2	660	312318	Ninilchik	1993	0
	Chinook	M	2	580	312361	Deep Creek	1992	1
7/3/96	Chinook	F	3	775	312159	Ninilchik	1992	0
	Chinook	M	2	590	312318	Ninilchik	1993	0
8/5/96	Coho	M	1	515	312234	Deep Creek	1992	2
	Coho	F	1	585	312233	Deep Creek	1992	2
	Coho	M	1	550	312233	Deep Creek	1992	2
	Coho	F	R[a]	550	312233	Deep Creek	1992	2
	Coho	F	1	595	312233	Deep Creek	1992	2
	Coho	M	1	530	312233	Deep Creek	1992	2
8/9/96	Coho	F	1	535	312234	Deep Creek	1992	2
	Coho	M	1	520	312233	Deep Creek	1992	2
	Coho	F	1	605	sampled[b]	Deep Creek[c]	1992	2
	Coho	M	1	520	sampled	Deep Creek	1992	2
8/12/96	Coho	F	R	540	312233	Deep Creek	1992	2
	Coho	M	1	555	312233	Deep Creek	1992	2
	Coho	F	1	560	312233	Deep Creek	1992	2

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Date	Species	Sex	Ocean Age	Length	Tag Code	Release Location	Brood Year	Age at Tagging
	Coho	M	1	560	sampled	Deep Creek	1992	2
	Coho	M	1	490	sampled	Deep Creek	1992	2
	Coho	M	1	590	sampled	Deep Creek	1992	2
8/16/96	Coho	M	1	560	Wand[d]	Deep Creek	1992	2
	Coho	M	1	540	Wand	Deep Creek	1992	2
	Coho	M	1	605	Wand	Deep Creek	1992	2
	Coho	F	1	560	Wand	Deep Creek	1992	2
	Coho	F	1	570	Wand	Deep Creek	1992	2
	Coho	F	1	545	Wand	Deep Creek	1992	2
	Coho	F	R	520	Wand	Deep Creek	1992	2
8/22/96	Coho	M	1	585	Wand	Deep Creek	1992	2
	Coho	F	1	545	Wand	Deep Creek	1992	2
	Coho	F	1	490	Wand	Deep Creek	1992	2
	Coho	F	1	610	Wand	Deep Creek	1992	2
	Coho	M	1	585	Wand	Deep Creek	1992	2
	Coho	M	1	550	Wand	Deep Creek	1992	2
	Coho	F	R	540	Wand	Deep Creek	1992	2
	Coho	F	1	585	Wand	Deep Creek	1992	2
	Coho	M	1	610	Wand	Deep Creek	1992	2
	Coho	F	R	545	Wand	Deep Creek	1992	2
	Coho	M	1	570	Wand	Deep Creek	1992	2
	Coho	F	R	540	Wand	Deep Creek	1992	2
	Coho	M	R	635	Wand	Deep Creek	1992	2
8/28/96	Coho	M	1	595	Wand	Deep Creek	1992	2
	Coho	M	1	610	Wand	Deep Creek	1992	2
	Coho	M	1	600	Wand	Deep Creek	1992	2
	Coho	M	1	650	Wand	Deep Creek	1992	2
	Coho	F	R	465	Wand	Deep Creek	1992	2
	Coho	M	1	625	Wand	Deep Creek	1992	2
9/5/96	Coho	F	1	573	Wand	Deep Creek	1992	2
	Coho	M	1	635	Wand	Deep Creek	1992	2
	Coho	F	1	550	Wand	Deep Creek	1992	2
	Coho	F	1	605	Wand	Deep Creek	1992	2
9/6/96	Coho	M	1	430	Wand	Deep Creek	1992	2
	Coho	M	1	590	Wand	Deep Creek	1992	2
	Coho	M	1	570	Wand	Deep Creek	1992	2
	Coho	M	1	455	Wand	Deep Creek	1992	2
	Coho	M	1	600	Wand	Deep Creek	1992	2
	Coho	M	1	585	Wand	Deep Creek	1992	2
	Coho	M	1	650	Wand	Deep Creek	1992	2
	Coho	M	1	675	Wand	Deep Creek	1992	2
	Coho	M	R	600	Wand	Deep Creek	1992	2
9/12/96	Coho	M	1	600	Wand	Deep Creek	1992	2
9/13/96	Coho	F	R	575	Wand	Deep Creek	1992	2

[a] Scales were regenerated

[b] Adipose finclipped, heads were not collected

[c] Assumed to be Deep Creek origin

[d] Adipose finclipped, tag detected, but heads were not collected

Appendix B3.-Summary of coded wire tagged adult chinook salmon caught by sport fishermen in Cook Inlet, and voluntarily returned to the Deep Creek facility, 1996.

Cook Inlet and Unknown:

Date	Species	Sex	Ocean Age	Length	Tag Code	Release Location	Brood Year	Age at Tagging
unknown	Chinook		3		312206	Twin Falls	1991	1
6/11/96	Chinook		2		312361	Deep Creek	1992	1

Appendix B4.-Summary of coded wire tagged adult coho salmon voluntarily turned in by sport fishermen to the Deep Creek tagging facility, 1996.

Deep Creek voluntary sport caught CWT coho salmon:

Date	Species	Sex	Ocean Age	Length	Tag Code	Release Location	Brood Year	Age at Tagging
7/27/96	Coho				312234	Deep Creek	1992	2
	Coho				312234	Deep Creek	1992	2
7/28/96	Coho				tag loss	Deep Creek	1992	2
	Coho				312234	Deep Creek	1992	2
	Coho				312234	Deep Creek	1992	2
	Coho				312233	Deep Creek	1992	2
7/30/96	Coho				312234	Deep Creek	1992	2
	Coho				312233	Deep Creek	1992	2
	Coho				312233	Deep Creek	1992	2
	Coho				312233	Deep Creek	1992	2
8/03/96	Coho				312233	Deep Creek	1992	2
	Coho				312233	Deep Creek	1992	2
	Coho				312234	Deep Creek	1992	2
	Coho				312234	Deep Creek	1992	2
	Coho				312233	Deep Creek	1992	2
	Coho				312233	Deep Creek	1992	2
	Coho				312233	Deep Creek	1992	2
	Coho				312234	Deep Creek	1992	2
8/04/96	Coho				312233	Deep Creek	1992	2
	Coho				312234	Deep Creek	1992	2
	Coho				tag loss	Deep Creek	1992	2
	Coho				312234	Deep Creek	1992	2
8/05/96	Coho				312411	Kenai River	1992	2
	Coho				312234	Deep Creek	1992	2
8/06/96	Coho				312233	Deep Creek	1992	2
	Coho				312233	Deep Creek	1992	2
	Coho				312234	Deep Creek	1992	2
8/07/96	Coho				312233	Deep Creek	1992	2
8/08/96	Coho				312234	Deep Creek	1992	2
	Coho				312234	Deep Creek	1992	2
8/09/96	Coho				312233	Deep Creek	1992	2
	Coho				312234	Deep Creek	1992	2
	Coho				312233	Deep Creek	1992	2
	Coho				312233	Deep Creek	1992	2
	Coho				312233	Deep Creek	1992	2
	Coho				312233	Deep Creek	1992	2
	Coho				312233	Deep Creek	1992	2
	Coho				312234	Deep Creek	1992	2
8/10/96	Coho				312233	Deep Creek	1992	2
	Coho				312233	Deep Creek	1992	2
	Coho				312233	Deep Creek	1992	2
	Coho				312233	Deep Creek	1992	2
	Coho				312233	Deep Creek	1992	2

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Date	Species	Sex	Ocean Age	Length	Tag Code	Release Location	Brood Year	Age at Tagging
8/11/96	Coho				312234	Deep Creek	1992	2
	Coho				312234	Deep Creek	1992	2
	Coho				312234	Deep Creek	1992	2
8/13/96	Coho				312233	Deep Creek	1992	2
	Coho				312234	Deep Creek	1992	2
8/16/96	Coho				312233	Deep Creek	1992	2
	Coho				312234	Deep Creek	1992	2
8/17/96	Coho				312233	Deep Creek	1992	2
8/18/96	Coho				312234	Deep Creek	1992	2
8/19/96	Coho				tag loss	Deep Creek	1992	2
8/20/96	Coho				312233	Deep Creek	1992	2
	Coho				312233	Deep Creek	1992	2
8/23/96	Coho				312233	Deep Creek	1992	2
8/31/96	Coho				312233	Deep Creek	1992	2
	Coho				312233	Deep Creek	1992	2
	Coho				312234	Deep Creek	1992	2