Fishery Data Series No. 99-2

Contributions of Coded Wire Tagged Chinook Salmon to the Recreational Fishery in Central Cook Inlet, 1996

by

Timothy R. McKinley

April 1999

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. 99-2

CONTRIBUTIONS OF CODED WIRE TAGGED CHINOOK SALMON TO THE RECREATIONAL FISHERY IN CENTRAL COOK INLET, 1996

by

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ABSTRACT

Coded wire tag recovery projects were conducted from 1 May through 24 June 1996 at two separate public beaches (Deep Creek marine and Anchor Point) that provide access to the central Cook Inlet early-run marine recreational fishery for chinook salmon *Oncorhynchus tshawytscha*. Information collected from these projects is important for addressing conservation and allocation issues about Cook Inlet chinook salmon stocks. We examined 1,470 of the estimated 4,204 (SE= 422) chinook salmon harvested in the sport fishery. Of the chinook salmon examined, 30 were missing the adipose fin, and coded wire tags were recovered and decoded from 24. After expanding these data, the recovered tags accounted for 11.6% (486 fish, SE = 143) of the early-run harvest in this fishery. Among tagged stocks, adult chinook salmon originating from hatchery releases into the adjacent Ninilchik River were the largest single contributor (3.9%, 164 fish, SE = 45). As a group, adult chinook salmon originating from various hatchery releases in British Columbia accounted for 6.4% of the harvest (270 fish, SE = 122). Overall, the early-run harvest was well below average in 1996. Chinook salmon that spent 4 years at sea (4-ocean) accounted for 47% of the harvest, followed by 3-ocean (38%) and 2-ocean (13%) fish. Contribution estimates from coded wire tag returns in 1996 are introductory and biased towards stocks that have a tagged component in all age classes. Most of the stocks tagged in Cook Inlet had only 1- and 2-ocean tagged adults returning in 1996.

The egg diameters of 370 female chinook salmon were measured to estimate the spawning component of the harvest. Egg diameter ranged from 0.9 mm to 6.6 mm. Females with eggs 4.0 mm and larger were considered spawners and accounted for 79% (SE = 2%) of the harvested females. All of the tagged Cook Inlet origin female chinook salmon had eggs that were 4.0 mm or larger. Using egg diameter for maturity estimates is an imperfect compromise, as some chinook salmon with white flesh (not found in Cook Inlet stocks) were found with eggs 4.0 mm and larger.

Key words: Creel survey, angler harvest, coded wire tag, egg diameter, maturity, stock contribution, chinook salmon, *Oncorhynchus tshawytscha*, mixed stock fishery, early run, late run, Central Cook Inlet.

INTRODUCTION

The marine recreational fishery for chinook salmon *Oncorhynchus tshawytscha* in central Cook Inlet has expanded in recent years, with the greatest angler effort occurring in waters adjacent to Deep Creek (Figure 1). The Cook Inlet marine fishery for chinook salmon began in the early 1970s and remained fairly stable through the late 1980s (Nelson 1995). However, increased marketing by the sport fish guiding and tourism industries, availability of commercial boat launching services that accommodate larger vessels, development of sport fishing lodges along Cook Inlet beaches, and restrictions in the Kenai River fishery following implementation of the Kenai River Chinook Salmon Management Plan, resulted in recent growth in this fishery, most notably the guided segment. As this fishery expanded, controversy surrounding the increased harvest and fishing effort, and the stock of origin of chinook salmon in the catch, also increased.

The Cook Inlet marine recreational fishery harvests mixed stocks of chinook salmon that migrate along the east coast of central Cook Inlet from late April through early August (Hammarstrom et al. 1987). Highly productive, highly saline, relatively clear water from the Gulf of Alaska intrudes into this area of Cook Inlet (Figure 2; Evans et al. 1972, Flagg 1992) and probably directs and attracts chinook salmon. Early-run (late April through late June) fish are believed to originate from several small lower Kenai Peninsula drainages adjacent to the fishery (Stariski Creek, Deep Creek, Anchor River, Ninilchik River), and larger drainages in Upper and Northern Cook Inlet (Kasilof, Kenai, and Susitna rivers). The majority of late-run (late June through early August) fish are presumed to originate from the Kenai River and, to a lesser extent, the Kasilof River and late-run hatchery releases into Cook Inlet tributaries. A primary conservation concern is the proximity of the fishery to the natal streams of the small contributing stocks of the

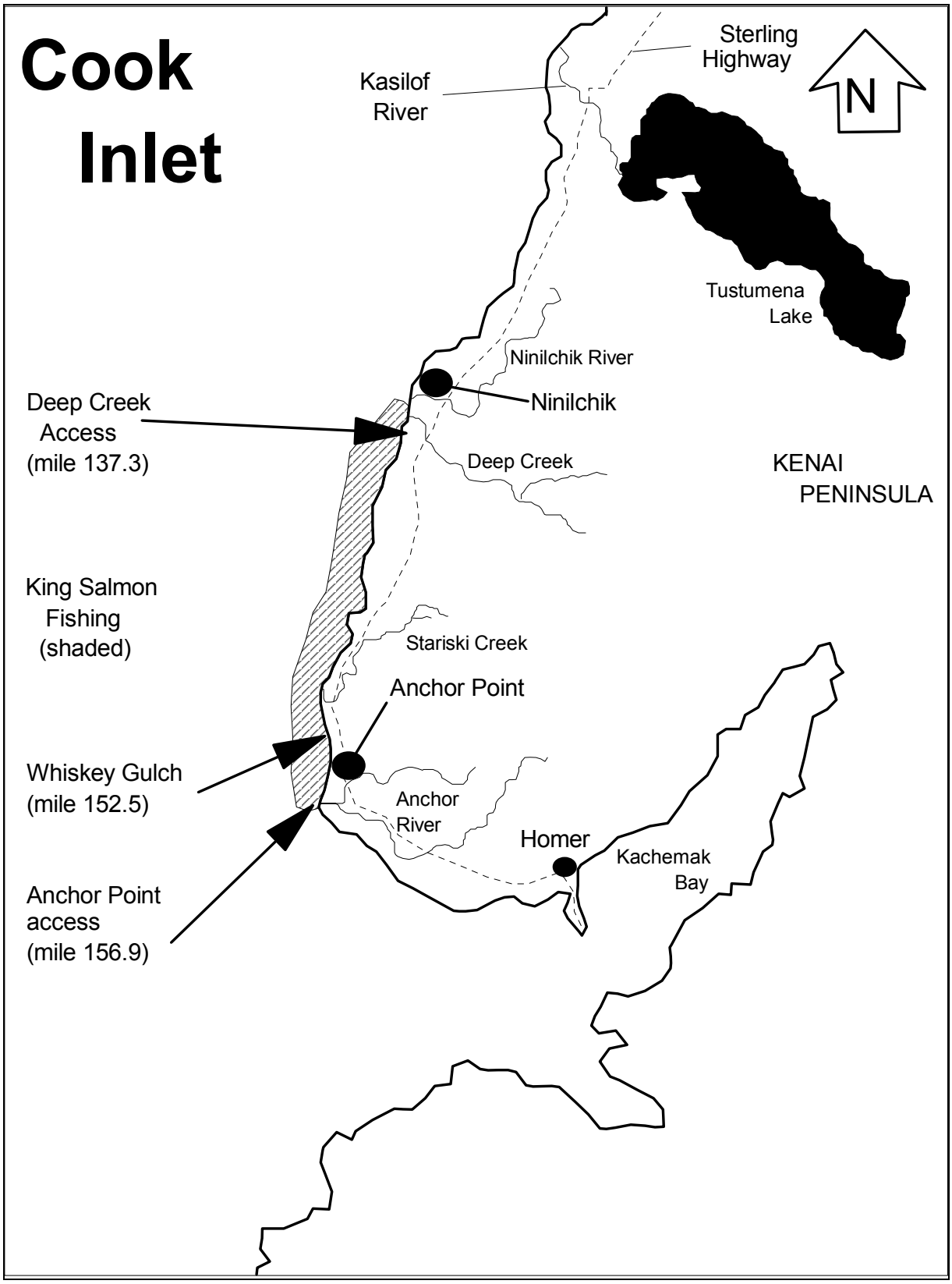

Figure 1.-Map of the central Cook Inlet marine chinook salmon recreational fishery.

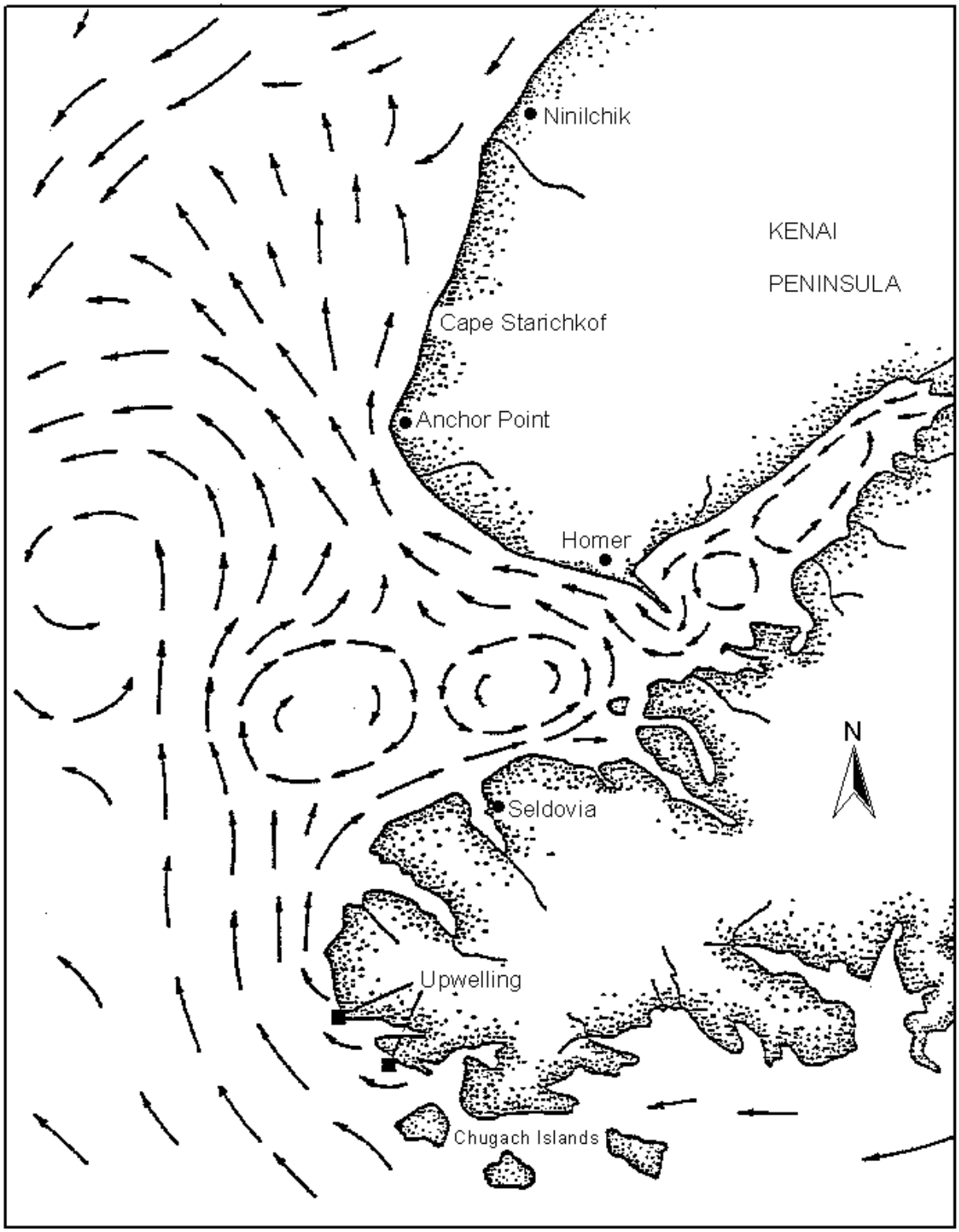

Figure 2.-Circulation patterns of Kachemak Bay.

lower Kenai Peninsula. An allocative concern is the potential harvest of chinook salmon of already fully-exploited stocks from the Kenai Peninsula and Northern Cook Inlet.

There is currently a lack of stock-specific harvest information for this fishery. An annual, onsite creel survey was conducted at Deep Creek Marine from 1972-1986 (Hammarstrom 1974-1981; Hammarstrom and Larson 1982-1984, 1986; and Hammarstrom et al. 1985). Since 1987, estimates of harvest and effort have been provided by the Statewide Harvest Survey (SWHS; Mills 1988-1994, Howe et al. 1995-1997). Estimates of chinook salmon harvest from an onsite creel survey conducted in 1994 and 1995 were similar to estimates from the SWHS (McKinley 1995 and 1996).

The SWHS provides estimates of total annual catch, harvest, and effort for this fishery. This type of information is adequate for managing terminal or single-stock fisheries. However, the effects of increased angler participation and harvest on specific chinook salmon stocks in the Deep Creek marine recreational fishery remain unknown and are therefore of particular concern to fishery managers. The need for stock composition information has led to the initiation of this project and related chinook salmon coded wire tagging projects. Tagging projects in Cook Inlet have involved the capture of rearing juvenile chinook salmon and/or smolt in their natal streams (Bendock 1995 and 1996; King and Breakfield 1998, Table 1), as well as marking hatchery reared smolt before being released (Peltz and Hansen 1994; Starkey et al. 1995-1997; Table 2).

The long-term goal of this study is to estimate the harvest of tagged stocks of chinook salmon in the Deep Creek marine recreational fishery.

The research objectives for 1996 were to estimate:

1. The absolute contribution of tagged chinook salmon stocks to the early-run harvest by anglers exiting at Deep Creek marine (Mile 137.3 Sterling Highway) and Anchor Point (Mile 156.9 Sterling Highway), and
2. The age and maturity composition of the early-run chinook salmon harvest by anglers exiting at the above locations.

Table 1.-Summary of wild stock tagging of chinook salmon on the Kenai Peninsula, and expected age/year of adult recoveries.

	Tagged/Life Stage by Year[a]			Recovery by Year[b]				
Wild Stock	1993	1994	1995	1996	1997	1998	1999	2000
Kenai River	152,397 fingerling	88,279 fingerling	58,741 fingerling 1,479 smolt	2-ocean	2-ocean 3-ocean	2-ocean 3-ocean 4-ocean	**2-ocean** 3-ocean 4-ocean 5-ocean	**2-ocean** **3-ocean** 4-ocean 5-ocean
Deep Creek		13,255 smolt	13,568 smolt	2-ocean	2-ocean 3-ocean	**2-ocean** 3-ocean 4-ocean	**2-ocean** **3-ocean** 4-ocean	**2-ocean** **3-ocean** **4-ocean**

Note: Tagged 1-ocean chinook salmon are not included because they likely comprise a very small component of the harvest.

[a] Fingerlings are assumed to leave the river as smolt roughly 1 year after tagging.

[b] Expected recoveries in bold are assuming that tagging continues.

Table 2.-Summary of tagged chinook salmon hatchery releases into Cook Inlet tributaries, and expected age/year of adult recoveries.

	Tagged/Released by Year[a]				Recovery by Year[b]				
	1992	1993	1994	1995	1996	1997	1998	1999	2000
Deception Creek	33,464 179,724	39,420 160,194	45,919 177,913	41,965 167,643	2-ocean 3-ocean 4-ocean	2-ocean 3-ocean 4-ocean	**2-ocean** 3-ocean 4-ocean	**2-ocean** **3-ocean** 4-ocean	**2-ocean** **3-ocean** **4-ocean**
Homer Spit (early run)	20,614 126,130		25,509 163,963	40,276 216,026	2-ocean 4-ocean	2-ocean 3-ocean	**2-ocean** 3-ocean 4-ocean	**2-ocean** **3-ocean** 4-ocean	**2-ocean** **3-ocean** **4-ocean**
Ninilchik River	41,335 132,387	42,960 184,585	45,546 201,513	54,353 54,902	2-ocean 3-ocean 4-ocean	2-ocean 3-ocean 4-ocean	**2-ocean** 3-ocean 4-ocean	**2-ocean** **3-ocean** 4-ocean	**2-ocean** **3-ocean** **4-ocean**
Twin Falls (late run)		28,392 100,000			2-ocean	3-ocean	4-ocean	5-ocean[c]	
Crooked Creek			43,042 224,784	38,408 184,049	2-ocean	2-ocean 3-ocean	**2-ocean** 3-ocean 4-ocean	**2-ocean** **3-ocean** 4-ocean	**2-ocean** **3-ocean** **4-ocean**
Eagle River			41,649 107,547		2-ocean	3-ocean	4-ocean		
Halibut Cove			21,035 98,872	36,685 37,577	2-ocean	2-ocean 3-ocean	**2-ocean** 3-ocean 4-ocean	**2-ocean** **3-ocean** 4-ocean	**2-ocean** **3-ocean** **4-ocean**
Homer Spit (late run)			91,679 156,873	40,479 123,048	2-ocean	2-ocean 3-ocean	**2-ocean** 3-ocean 4-ocean	**2-ocean** **3-ocean** 4-ocean 5-ocean[c]	**2-ocean** **3-ocean** **4-ocean** 5-ocean[c]
Seldovia Harbor			45,071 107,246	40,694 116,165	2-ocean	2-ocean 3-ocean	**2-ocean** 3-ocean 4-ocean	**2-ocean** **3-ocean** 4-ocean	**2-ocean** **3-ocean** **4-ocean**
Ship Creek			42,858 199,830	38,604 218,487	2-ocean	2-ocean 3-ocean	**2-ocean** 3-ocean 4-ocean	**2-ocean** **3-ocean** 4-ocean	**2-ocean** **3-ocean** **4-ocean**

Note: Tagged 1-ocean chinook salmon are not included because they likely comprise a very small component of the harvest.

[a] Hatchery release data from the tag lab.

[b] Expected recoveries in bold are assuming that tagging continues.

[c] Late run hatchery releases are assumed to have a 5-ocean component, since the brood source (Kasilof River) does.

In addition, the following task was addressed in the 1996 survey:

Collect total harvest data and heads from coded wire tagged chinook salmon harvested by guided anglers accessing the marine chinook salmon fishery via a private beach between the Bluff Point at Homer and the Ninilchik River.

METHODS

To meet the objectives, two separate coded wire tag (CWT) recovery projects were designed. A harvest sampling program of the marine fishery for early-run chinook salmon in central Cook Inlet was conducted from 1 May-24 June 1996 at the primary access sites to the recreational troll fishery (Deep Creek marine wayside and Anchor Point; Figure 1). The absolute contribution to the harvest by tagged chinook salmon stocks, untagged

chinook salmon stocks, and immature chinook salmon was estimated for this fishery. The age and maturity composition of the chinook salmon harvest was also estimated.

DEEP CREEK MARINE

A CWT recovery project was conducted at the Deep Creek marine access site (Mile 137.3 Sterling Highway) from 1 May through 24 June 1996. A systematic daily sampling schedule (5 days per week) was selected to ensure that a consistent proportion of the early-run harvest of chinook salmon was sampled. Only the 8-hour period classified as prime-tide within each sample day was covered. Prime-tide was defined as the 8-hour segment that best matched the time period during the falling tide for that day, within the daylight hours. All chinook salmon harvested by anglers that exited the fishery during any prime-tide period on scheduled days were sampled.

The sampling days within each week were selected to maximize the number of chinook salmon sampled while maintaining a consistent proportional sample fraction, and ensure that the sampling crew had 2 contiguous days off each work week. The sampled days were selected as follows:

1. Every weekend (Friday, Saturday, and Sunday),
2. Every other Monday and Tuesday, and
3. Every other Wednesday and Thursday (during the week with no samples on Monday and Tuesday).

Each sampling day ran from 0800 to 2359 hours. Boat count observations in 1993 indicated that nearly all boat-parties exit the fishery during the defined sampling day, and during the prime-tide period. Eight-hour sampling periods were defined that best matched the 6-hour period following the high tide, and also occurred during daylight hours, within the sampling day. The 8-hour period was sometimes split into two non-contiguous 4-hour periods dependent on the tide patterns for that day.

Four technicians were assigned to sample at the Deep Creek marine access area. Each of the technicians worked the same schedule, covering the entire beach for the assigned 8-hour shift (Appendix A1).

Scale samples were collected from as many chinook salmon as possible during the 3 weekdays scheduled for scale sampling each week.

Sexual maturity was determined by internal examination of as many harvested fish as possible on all days sampled.

Specifics on the data collection, data reduction, and data analysis procedures followed for the Deep Creek area project are outlined in the sections below.

ANCHOR POINT MARINE

A CWT recovery project was conducted at the Anchor Point access site (Mile 156.9 Sterling Highway) from 1 May through 24 June 1996. The survey design was altered from that of the Deep Creek marine location because more boats exit outside of the 8 hours around high tide at Anchor Point, and outside of the sampling day (0800-2400 hrs). Also, we needed to sample more days to examine a similar proportion of the harvest that we examined at Deep Creek. A sampling schedule of 7 days per week was selected to insure that a consistent proportion of the harvest of chinook salmon was sampled. As at Deep Creek, only the 8-hour period classified as prime-tide within each sample day was covered. All chinook salmon harvested by anglers that exited the fishery during the sample period were sampled.

Eight-hour sampling periods were defined that best matched the 6-hour period following the high tide as discerned from a 1996 tide book, that was also within the sampling day. These

8-hour periods were sometimes split into two non-contiguous periods dependent upon the tide patterns for that day.

Two technicians were assigned to sample at the Anchor Point access area (Appendix A2). The two technicians worked the same shift on weekends (Friday, Saturday, Sunday), covering the entire beach for the assigned 8-hour shift. On weekdays only one technician worked each day.

Scale samples were collected from as many chinook salmon as possible on Mondays, Wednesdays, and Fridays of each week.

Sexual maturity was determined by internal examination of as many harvested fish as possible on all days sampled.

Specifics on the data collection, data reduction, and data analysis procedures followed for the Anchor Point area project are outlined in the sections below.

DATA COLLECTION

A full 8 hours of interviews were completed on each sample day at each exit area. Every attempt was made to interview all of the boat-parties that exited the fishery during the scheduled period. To avoid congestion due to the interview process, the interviews were brief and conducted as anglers were securing their boats and gear for exiting the beach.

Data collected from each boat-party included the number of chinook salmon harvested and the number of chinook salmon observed to be missing the adipose fin and possibly containing a CWT. These data were recorded on data forms and later summarized for the day onto a single daily logbook form. In addition a standard CWT recovery form was filled out for each day sampled (Appendix B1). Heads were collected from all chinook salmon that were found to be missing their adipose fin and affixed with a numbered cinch strap. Additional information collected from adipose finclipped fish included: mideye-to-fork of tail length to the nearest millimeter; scale samples for age; sex and maturity; flesh color (either red or white); statistical area in which the fish was harvested; the clip status (good, questionable, or unknown); and the angler's name and mailing address.

With the angler's permission, the body cavities of as many chinook salmon as possible were opened and the gonads examined. Male chinook salmon were recorded as either mature or immature based on the size of the gonads. The length of 10 contiguous eggs of female chinook salmon was measured to the nearest millimeter. On designated days, scales were collected from as many fish as possible. A sample of three scales was collected from the preferred area (Welander 1940) and mounted on gum cards, later to be pressed and aged.

Log books were provided to each lodge owner who operated off of a privately owned beach with no public access, between Whiskey Gulch and Deep Creek marine. Log books were used for recording the daily harvest of chinook salmon (Appendix B2). Lodge operators were also asked to retrieve the heads of any adipose finclipped fish that they harvested. These heads were treated as voluntary recoveries, and were not used for estimating stock contributions.

The final ages and maturity data were keypunched into Microsoft Excel. Data pertaining to coded wire tagged fish and fish examined for a missing adipose fin were keypunched and archived by Coded Wire Tag Lab personnel in Juneau. After final checking of the data set the data were analyzed according to procedures outlined below.

DATA ANALYSIS

Stock Contribution Estimates

Chinook salmon stock contributions to the Deep Creek marine recreational harvest were estimated using procedures adapted from

Bernard and Clark (1996). The first step involved estimating the contribution in the fishery for each particular tag code:

$$\hat{r}_{ij} = \hat{N}_i \hat{p}_{ij} \hat{\theta}_j^{-1}, \quad (1)$$

where:

$\hat{r}_{ij}$ = the estimated number of chinook salmon from a cohort identified by the unique CWT code j, harvested during sampling stratum i (early or late run);

$\hat{N}_i$ = the estimated total harvest of chinook salmon by sampling stratum (as obtained from the SWHS);

$\hat{\theta}_j$ = the proportion of a particular cohort which contained a coded wire tag of the unique tag code j. Note that θ_j was assumed to be known, not estimated, for the hatchery stocks; θ_j was estimated for wild stocks (King and Breakfield 1998);

$$\hat{p}_{ij} = \frac{m_{ij}}{\lambda_i n_i}; \quad (2)$$

n_i = the number of chinook salmon examined for missing adipose fins from the sampled harvest in sampling stratum i;

m_{ij} = the number of CWTs dissected out of the salmon heads and decoded as the unique tag code j, originally sampled from stratum i;

$$\lambda_i = \frac{a_i' t_i'}{a_i t_i}; \quad (3)$$

a_i = the number of chinook salmon with a missing adipose fin which were counted from the sampled fish in each sampling stratum;

a_i' = the subset of a_i for which heads reached the lab;

t_i = number of CWTs detected in the salmon heads sampled in stratum i;

t_i' = subset of t_i for which CWTs were decoded.

Estimates of across sampling stratum contributions by tag code, as well as by combined tag codes (e.g., all Cook Inlet hatchery tag codes) were obtained by summing the estimates across strata and tag codes, as appropriate:

$$\hat{T} = \sum_{i=1}^{2} \sum_{j=1}^{C} \hat{r}_{ij}, \quad (4)$$

where:

C = the number of tag codes to combine.

Estimates of the variance for contributions in a sampling stratum were estimated as:

$$\hat{V}\left[\hat{r}_{ij}\right] = \hat{r}_{ij}^2 \left\{ \begin{array}{l} G\left(\hat{p}_{ij}\right) + G\left(\hat{N}_i\right) + G\left(\hat{\theta}_j^{-1}\right) \\ - G\left(\hat{\theta}_j^{-1}\right) G\left(\hat{N}_i\right) \\ - G\left(\hat{\theta}_j^{-1}\right) G\left(\hat{p}_{ij}\right) \\ - G\left(\hat{N}_i\right) G\left(\hat{p}_{ij}\right) \\ + G\left(\hat{\theta}_j^{-1}\right) G\left(\hat{N}_i\right) G\left(\hat{p}_{ij}\right) \end{array} \right\}, \quad (5)$$

where: G() equaled the estimated squared coefficient of variation for the specified estimates, as follows:

$$G\left(\hat{p}_{ij}\right) = \frac{\hat{V}\left[\hat{p}_{ij}\right]}{\hat{p}_{ij}^2}, \quad (6)$$

$$G\left(\hat{N}_i\right) = \frac{\hat{V}\left[\hat{N}_i\right]}{\hat{N}_i^2}, \quad (7)$$

$$G\left(\hat{\theta}_j^{-1}\right) = \frac{\hat{V}\left[\hat{\theta}_j^{-1}\right]}{\left(\hat{\theta}_j^{-1}\right)^2}. \quad (8)$$

The estimated variance $\hat{V}\left[\hat{\theta}_j^{-1}\right]$ for the estimated inverse tagging fraction was obtained from field sampling programs for the wild chinook salmon stocks (King and Breakfield 1998) and was assumed to be zero

for the hatchery stocks of interest; $\hat{V}\left[\hat{N}_i\right]$ equaled the estimated variance of the overall harvest estimate for sampling stratum i which was obtained from the SWHS; and $\hat{V}\left[\hat{p}_{ij}\right]$ was the estimated variance of $\hat{p}_{ij}$ which was estimated approximately using the large-sample approximation formula in Bernard and Clark (1996; their equation [12]):

$$\hat{V}\left[\hat{p}_{ij}\right] \approx \frac{\hat{p}_{ij}}{\lambda_i n_i}\left(1-\lambda_i \hat{\phi}_i \hat{\theta}_j\right), \tag{9}$$

where $\hat{\phi}_i = n_i / \hat{N}_i$.

Estimates of the variance of across sampling stratum contributions by tag code, as well as by combined tag codes was obtained by (equation [3] in Bernard and Clark 1996):

$$\begin{aligned}\hat{V}\left[\hat{T}\right] = &\sum_{i=1}^{2}\sum_{j=1}^{C}\hat{V}\left[\hat{r}_{ij}\right] \\ &+ 2\sum_{i=1}^{2}\sum_{j=1}^{C-1}\sum_{k=j+1}^{C}\hat{C}ov\left[\hat{r}_{ij},\hat{r}_{ik}\right],\end{aligned} \tag{10}$$

where $\hat{C}ov\left[\hat{r}_{ij},\hat{r}_{ik}\right]$ was the covariance between the estimated contribution of tag codes from different hatchery or wild stock releases within one sampling stratum obtained by equation [14] in Bernard and Clark (1996):

$$\hat{C}ov\left[\hat{r}_{ij},\hat{r}_{ik}\right] \approx \hat{r}_{ij}\ \hat{r}_{ik}\ G\left(\hat{N}_i\right). \tag{11}$$

Standard errors (SE's) were obtained as the square root of the appropriate variance.

Estimates of Age and Maturity Composition of the Harvest

The proportion by age and/or maturity of the harvest of chinook salmon for each sampling stratum was calculated as follows:

$$\hat{p}_{(a,m)iz} = \frac{n_{(a,m)iz}}{n_{(a,m)i}}, \tag{12}$$

where:

$\hat{p}_{(a,m)iz}$ = the estimated proportion of the harvest of chinook salmon composed of the z possible categories for either age (a) or maturity (m)[1];

$n_{(a,m)iz}$ = the number of fish sampled that were classified as category z for either age (a) or maturity (m); and

$n_{(a,m)i}$ = the number of chinook salmon sampled for which age (a) or maturity (m) was determined within sampling stratum i.

The variance of $\hat{p}_{(a,m)iz}$ was calculated by:

$$\begin{aligned}\hat{V}\left[\hat{p}_{(a,m)iz}\right] = &\left(1-\frac{n_{(a,m)i}}{\hat{N}_i}\right) \\ &\left(\frac{\hat{p}_{(a,m)iz}\left(1-\hat{p}_{(a,m)iz}\right)}{n_{(a,m)i}-1}\right).\end{aligned} \tag{13}$$

Data files used in these analyses are listed in Appendix C1.

RESULTS

ESTIMATES OF CONTRIBUTION, AGE COMPOSITION, AND MATURITY

Between 1 May and 24 June 1,470 chinook salmon harvested by sport anglers exiting Cook Inlet at Deep Creek marine and Anchor Point were examined for a missing adipose fin (Figure 3). The number of chinook salmon examined daily peaked on 19 May and again on 24 May. After 9 June the number of fish examined each day was 15 or less (Figure 3). Of the fish examined, heads were collected from all 30 that were found to be missing the adipose fin; tags were recovered and decoded from 24 of the 30 heads. In addition, seven voluntary or select recoveries were made of chinook salmon heads from fish that anglers

[1] For example the various categories for z for maturity are either "spawner," "Fall spawner," or "immature."

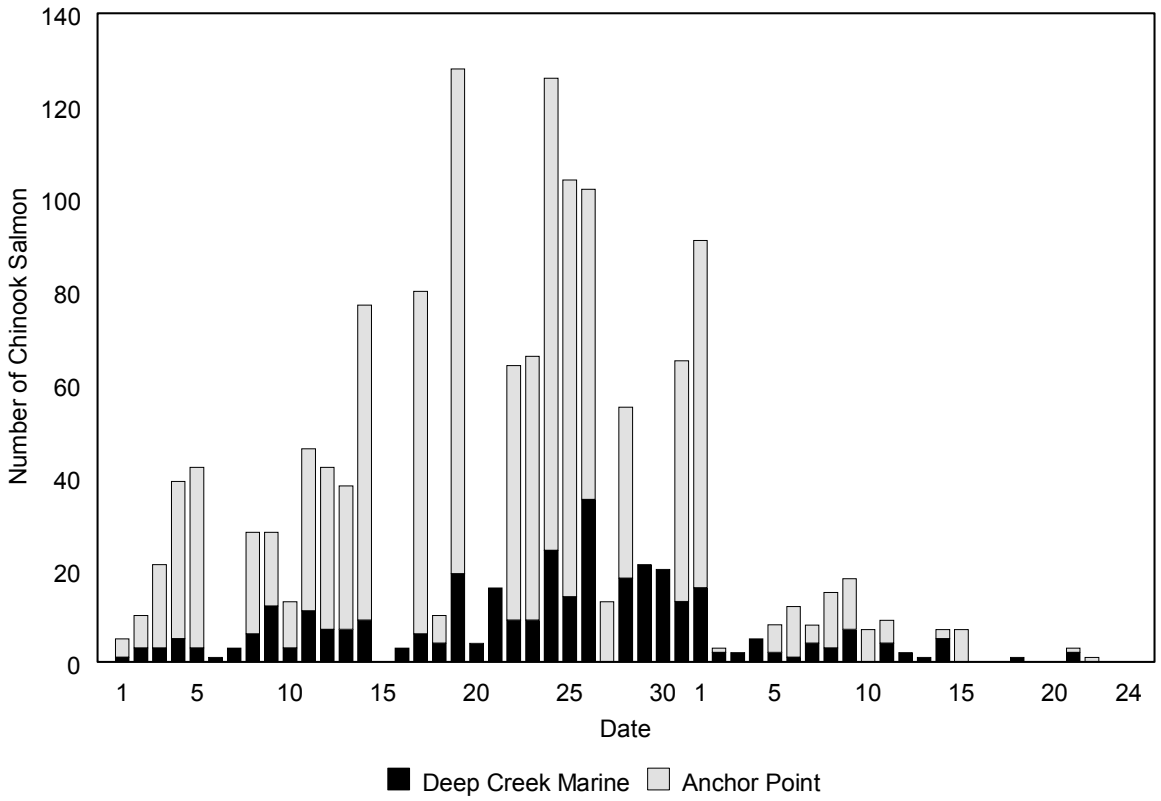

Figure 3.-Numbers of sport-harvested chinook salmon from the central Cook Inlet marine fishery examined for a missing adipose fin in 1996.

reported were missing the adipose fin (Table 3). Six of these heads were subsequently found to contain tags.

Tagged fish accounted for 11.6% (486 fish, SE = 143; Table 4) of the 1996 early-run chinook salmon harvest of 4,204 fish (SE = 422; Table 5; Howe et al. 1997). Among tagged stocks, adult chinook salmon resulting from hatchery releases into the Ninilchik River were the largest single contributor to the harvest (3.9%, 164 fish, SE = 45). Adults from hatchery releases in British Columbia combined to account for 6.4% of the harvest (270 fish, SE = 122). The only other tag recoveries were of one fish from the Deception Creek hatchery release (a Susitna River tributary stream) and one fish from a hatchery release into Bear Cove (near Sitka). No tagged fish were recovered from other hatchery releases into Cook Inlet, or of wild fish from the Kenai River or Deep Creek.

We collected scales from 678 chinook salmon, and determined ages for 545 (80%; Table 6). Chinook salmon that spent 4 years in the ocean were predominant in the harvest (47%), followed by 3-ocean (38%) and 2-ocean (13%) fish. The majority (98.5%) were estimated to have spent one winter (age-1. fish) in fresh water and the remainder were aged as having spent two winters in fresh water (age-2. fish). No fish were aged as having left fresh water before spending one winter (age-0. fish) However, all 24 fish with CWTs were age-0. by actual age (comparison of brood year to release year). Ages derived from scales from all 12 of the 24 tagged fish successfully aged were compared to actual ages to validate our scale reading. Actual

Table 3.-Summary of information collected from coded wire tagged chinook salmon recovered from the central Cook Inlet early-run recreational fishery, 1996.

SAMPLE#	Sample Type[a]	Port of Recovery	Date	Tag code	Brood year	Actual Age[b] Fresh	Actual Age[b] Ocean	Scale Age[c] Fresh	Scale Age[c] Ocean	State or Province	Hatchery or Wild Stock	Release Year	Release Site	Inverse Theta[d]	Clip Status[e]	Length (mm)[f]	Sex	Egg diam. (mm) or maturity	Run Type
96DU5502	R	ANCHOR P	5/9/96	180826	1991	0	4			BC	SNOOTLI CREEK	1992	ATNARKO R LOWER	4.409	GOOD	830	Fem		Summer
96DU5503	R	ANCHOR P	5/14/96	181011	1992	0	3	R	R	BC	OWEEKENO CDP	1993	RIVERS INL SEAPENS	2.382	GOOD	760			Fall
96DU5505	R	ANCHOR P	5/19/96	NO TAG				R	R						GOOD	783			
96DU5506	R	ANCHOR P	5/24/96	180827	1991	0	4	1	4	BC	SNOOTLI CREEK	1992	ATNARKO R LOWER	8.348	GOOD	838	Fem	3.6	Summer
96DU5507	R	ANCHOR P	5/26/96	634245	1990	1	4	1	4	WA	SOLDUC HATCHERY	1992	SOLEDUCK RIVER	5.688	GOOD	830	Male	Imm	Spring
96DU5508	R	ANCHOR P	5/29/96	312160	1992	0	3	R	R	AK	FT RICHARDSON	1993	DECEPTION CR 247-41	4.063	GOOD	771	Male	Mature	Spring
96DU5509	R	ANCHOR P	5/30/96	180461	1991	0	4	1	4	BC	NITINAT RIVER	1992	NITINAT RIVER	19.431	GOOD	785	Fem	3.2	Fall
96DU5510	R	ANCHOR P	6/1/96	180433	1991	0	4	1	4	BC	KITIMAT RIVER	1992	KILDALA RIVER	4.42	GOOD	980	Male	Medium	Summer
96DT5501	R	DEEP CR	5/3/96	401010303	1990	1	4			AK	MEDVEJIE	1992	BEAR COVE 113-41	14.312	GOOD	830			Spring
96DT5502	R	DEEP CR	5/5/96	NO TAG											GOOD	930	Male	Mature	
96DT5503	R	DEEP CR	5/8/96	312159	1992	0	3			AK	FT RICHARDSON	1993	NINILCHIK R 244-20	4.296	GOOD	850	Male	Mature	Spring
96DT5504	R	DEEP CR	5/11/96	NO TAG											GOOD	865			
96DT5505	R	DEEP CR	5/12/96	180462	1991	0	4	1	4	BC	NITINAT RIVER	1992	NITINAT RIVER	19.431	GOOD	830	Male	Imm	Fall
96DT5507	R	DEEP CR	5/17/96	312159	1992	0	3	1	3	AK	FT RICHARDSON	1993	NINILCHIK R 244-20	4.296	GOOD	680	Fem	4.2	Spring
96DT5506	R	DEEP CR	5/17/96	312159	1992	0	3	R	R	AK	FT RICHARDSON	1993	NINILCHIK R 244-20	4.296	GOOD	755	Fem	4.2	Spring
96DT5509	R	DEEP CR	5/23/96	312159	1992	0	3			AK	FT RICHARDSON	1993	NINILCHIK R 244-20	4.296	GOOD	780	Male	Mature	Spring
96DT5510	R	DEEP CR	5/23/96	312318	1993	0	2			AK	FT RICHARDSON	1994	NINILCHIK R 244-20	4.424	GOOD	530	Fem	4.5	Spring
96DT5508	R	DEEP CR	5/23/96	NO TAG											GOOD	540	Male	Imm	
96DT5512	R	DEEP CR	5/24/96	181363	1993	0	2	1	2	BC	CONUMA RIVER	1994	CONUMA ESTUARY	30.277	GOOD	640	Fem	0.9	Fall
96DT5511	R	DEEP CR	5/25/96	NO TAG				1	3						QUEST	910			
96DT5513	R	DEEP CR	5/26/96	NO TAG				R	R						GOOD	870	Male		
96DT5515	R	DEEP CR	5/28/96	312159	1992	0	3			AK	FT RICHARDSON	1993	NINILCHIK R 244-20	4.296	GOOD	770	Fem	5.8	Spring
96DT5516	R	DEEP CR	5/31/96	312159	1992	0	3	1	4	AK	FT RICHARDSON	1993	NINILCHIK R 244-20	4.296	GOOD	775	Male	Mature	Spring
96DT5517	R	DEEP CR	6/1/96	312318	1993	0	2			AK	FT RICHARDSON	1994	NINILCHIK R 244-20	4.424	GOOD	520	Male	Mature	Spring

-continued-

Table 3.-Page 2 of 2.

SAMPLE#	Sample Type[a]	Port of Recovery	Date	Tag code	Brood year	Actual Age[b] Fresh	Actual Age[b] Ocean	Scale Age[c] Fresh	Scale Age[c] Ocean	State or Province	Hatchery or wild stock	Release year	Release Site	Inverse Theta[d]	Clip Status[e]	Length (mm)[f]	Sex	Egg diam. (mm) or maturity	Run Type
96DT5519	R	DEEP CR	6/6/96	312104	1991	0	4	R	R	AK	FT RICHARDSON	1992	NINILCHIK R 244-20	3.202	GOOD	790	Fem	4.5	Spring
96DT5518	R	DEEP CR	6/6/96	312159	1992	0	3	1	3	AK	FT RICHARDSON	1993	NINILCHIK R 244-20	4.296	GOOD	740	Fem	4	Spring
96DT5521	R	DEEP CR	6/8/96	312104	1991	0	4	R	R	AK	FT RICHARDSON	1992	NINILCHIK R 244-20	3.202	GOOD	745	Fem	4.8	Spring
96DT5520	R	DEEP CR	6/8/96	312104	1991	0	4	1	4	AK	FT RICHARDSON	1992	NINILCHIK R 244-20	3.202	GOOD	730	Male	Mature	Spring
96DT5522	R	DEEP CR	6/9/96	312159	1992	0	3	2	3	AK	FT RICHARDSON	1993	NINILCHIK R 244-20	4.296	GOOD	680			Spring
96DT5523	R	DEEP CR	6/11/96	312159	1992	0	3	1	3	AK	FT RICHARDSON	1993	NINILCHIK R 244-20	4.296	GOOD	890	Male	Mature	Spring
96DU5501	S	ANCHOR P	5/9/96	180429	1991	0	4			BC	KITIMAT RIVER	1992	HIRSCH CREEK	2.322	UNKN	1041			Summer
96DU5504	S	ANCHOR P	5/17/96	NO TAG											GOOD				
96DT5514	S	DEEP CR	5/24/96	23116	1991	0	4			BC	TERRACE CDP	1992	KITSUMKALUM R LWR	1.075	UNKN				Summer
96DT5524	S	DEEP CR		312206	1991	1	3			AK	CROOKED CREEK	1993	TWIN FALLS CR 244-70	3.522	UNKN				Spring
96175509	V	SOLDOTNA	5/23/96	312159	1992	0	3			AK	FT RICHARDSON	1993	NINILCHIK R 244-20	4.296	UNKN	750			Spring
96175501	V	SOLDOTNA	6/11/96	312159	1992	0	3			AK	FT RICHARDSON	1993	NINILCHIK R 244-20	4.296	UNKN				Spring
96175501	V	SOLDOTNA	6/11/96	312361	1992	1	2			AK	(W) DEEP CR 244-20	1994	DEEP CR 244-20	13.917	UNKN				Spring

[a] R = random recovery (CWT recoveries made during the course of random sampling for a creel survey); S = select recovery (CWT recoveries made in an area having a creel survey, but not taken in the random sampling process); V = voluntary recovery (CWT recoveries made in an area which is not covered by a random creel survey).

[b] Actual fresh age and actual ocean age are the ages determined by comparing the brood year, release year, and the year of harvest (1996).

[c] The estimated fresh age and estimated ocean age as determined from scales. R = regenerated scale.

[d] Inverse theta is the number of fish released divided by the number of fish released with a coded wire tag.

[e] The finclips were recorded as either good (fin completely removed); questionable (fin partially removed); or unknown (fish not observed by ADF&G personnel).

[f] Length is mideye-to-fork of tail.

Table 4.-Summary of contribution statistics from coded wire tagged chinook salmon recovered in the Central Cook Inlet marine recreational fishery during the early run, 1996.

Tag Code	Release site	State or Province	# Tags Recovered m_{ij}	Inverse Theta[a] $\hat{\theta}_j^{-1}$	Absolute Contribution r_{ij}	SE	Relative Contribution	SE	Age Comp of Harvest	SE	Relative Contribution to Age Class Harvest	SE	Sum of Relative Contributions to the Age Class Harvest	SE
					OCEAN AGE = 2									
181363	CONUMA ESTUARY	BC	1	30.277	86.6	86.6	2.1%	2.1%			15.4%	15.5%		
312318	NINILCHIK R 244-20	AK	2	4.425	25.3	18.0	0.6%	0.4%			4.5%	3.2%		
SUBTOTAL			3		111.9		2.7%		13.4%	1.5%			19.9%	15.8%
					OCEAN AGE = 3									
181011	RIVERS INL SEAPENS	BC	1	2.382	6.8	6.8	0.2%	0.2%			0.4%	0.4%		
312159	NINILCHIK R 244-20	AK	9	4.296	110.6	38.3	2.6%	0.9%			6.9%	2.3%		
312160	DECEPTION CR 247-41	AK	1	4.063	11.6	11.6	0.3%	0.3%			0.7%	0.7%		
SUBTOTAL			11		129.0		3.1%		38.3%	2.1%			8.0%	2.5%
					OCEAN AGE = 4									
180433	KILDALA RIVER	BC	1	4.420	12.6	12.6	0.3%	0.3%			0.6%	0.6%		
180461	NITINAT RIVER	BC	1	19.431	55.6	55.6	1.3%	1.3%			2.8%	2.8%		
180462	NITINAT RIVER	BC	1	19.431	55.6	55.6	1.3%	1.3%			2.8%	2.8%		
180826	ATNARKO R LOWER	BC	1	4.409	12.6	12.6	0.3%	0.3%			0.6%	0.6%		
180827	ATNARKO R LOWER	BC	1	8.348	23.9	23.9	0.6%	0.6%			1.2%	1.2%		
312104	NINILCHIK R 244-20	AK	3	3.202	27.5	16.0	0.7%	0.4%			1.4%	0.8%		
634245	SOLEDUCK RIVER	BC	1	5.688	16.3	16.3	0.4%	0.4%			0.8%	0.8%		
401010303	BEAR COVE 113-41	AK	1	14.312	40.9	40.9	1.0%	1.0%			2.1%	2.1%		
SUBTOTAL			10		245.0		5.9%		46.8%	2.1%			12.5%	4.9%
TOTAL			24		485.8	143.1	11.6%	3.2%	98.5%					

[a] Inverse theta is the number of fish released divided by the number of fish released with a coded wire tag.

Table 5.-Harvests of early- and late-run chinook salmon in the central Cook Inlet marine recreational fishery, 1987-1996.

Year	Early run[a]	Late run[a]	Total
1987	3,613	1,512	5,125
1988	4,243	1,775	6,018
1989	3,858	1,615	5,473
1990	4,687	1,961	6,648
1991	4,824	2,019	6,843
1992	5,979	2,502	8,481
1993	7,991	3,344	11,335
1994	6,867	2,301	9,168
1995	7,687	3,216	10,903
1996	4,204	1,996	6,200

Source: Mills 1988-1994; Howe et al. 1995-1997.

[a] Harvest was apportioned 70.5% to the early run and 29.5% to the late run for 1987-1995 based on estimates from onsite creel surveys from 1972-1986 (Hammarstrom 1974-1981; Hammarstrom and Larson 1982-1984, 1986; and Hammarstrom et al. 1985). Harvest was estimated separately for the two runs in the 1996 SWHS.

freshwater and ocean age was determined for these fish by subtracting the brood year from the year of release minus one, and subtracting the year of release from 1996, respectively. The estimated ocean age from scales was correct for all but one of the aged tagged fish, however the freshwater age was incorrect for all (Table 3). The randomly recovered tagged fish were aged (from scales) as being 1-fresh (11 fish), and 2-fresh (1 fish), as well as 5 fish with regenerated scales and no scales from 7 fish (Table 3).

Most Cook Inlet stocks had only one of the three major age classes (2-ocean fish) represented as tagged adults in 1996 (Table 1 and 2). Of the three Cook Inlet stocks that had more than one major age class tagged, tagged fish were recovered from two (Ninilchik River and Deception Creek). Correspondingly, tagged stocks recovered in 1996 account for approximately 20% of the 2-ocean harvest, 8% of the 3-ocean harvest, and 13% of the 4-ocean harvest (Table 4).

Sex was determined for 754 chinook salmon; 370 (49%) were female and 384 (51%) were male (Table 7).

Sexual maturity was determined for 370 female chinook salmon. Egg diameters ranged from 0.9 mm to 6.6 mm (Table 8). Following the procedures of Kissner (1973), females were classified as either immature,

Table 6.-Age data collected from sport harvested chinook salmon in the central Cook Inlet marine recreational fishery during the early run, 1 May-24 June 1996.

	1-ocean			2-ocean			3-ocean			4-ocean			5-ocean			Illegible Scales						Grand Total
																Inverted			Regen			
Week	AP[a]	DCM[a]	Total	AP	DCM	Total	AP	DCM	Total	AP	DCM	Total	AP	DCM	Total	AP	DCM	Total	AP	DCM	Total	
May 1 - 5	0	0	0	0	1	1	1	2	3	3	15	18	0	2	2	0	0	0	0	10	10	34
May 6 - 12	0	0	0	0	1	1	3	3	6	4	29	33	0	2	2	0	1	1	1	9	10	53
May 13 - 19	0	0	0	3	9	12	4	49	53	4	69	73	0	2	2	0	3	3	3	27	30	173
May 20 - 26	0	1	1	2	32	34	14	62	76	14	67	81	0	0	0	0	1	1	7	34	41	234
May 27 - June 2	0	0	0	1	14	15	12	38	50	7	34	41	1	0	1	2	2	4	9	14	23	134
June 3 - 9	0	0	0	1	6	7	1	7	8	2	1	3	0	0	0	0	1	1	1	7	8	27
June 10 - 16	0	0	0	3	0	3	3	8	11	1	4	5	0	0	0	0	0	0	0	1	1	20
June 17 - 24	0	0	0	0	0	0	1	1	2	0	1	1	0	0	0	0	0	0	0	0	0	3
Grand Total	0	1	1	10	63	73	39	170	209	35	220	255	1	6	7	2	8	10	21	102	123	678
% Composition			0.2%			13.4%			38.3%			46.8%			1.3%							
SE			0.2%			1.4%			1.9%			2.0%			0.5%							

[a] AP = Anchor Point; DCM = Deep Creek Marine.

Table 7.-Summary of maturity classifications for chinook salmon examined at Deep Creek marine and Anchor Point, 1996.

	Female[a]	SE	Male[b]	SE	Total	SE
Immature	9 (2.4%)	0.8%	55 (14.3%)	1.7%	64 (8.5%)	0.9%
Fall spawner	70 (18.9%)	1.9%			70 (9.3%)	1.0%
Spring spawner	291(78.6%)	2.0%	329 (85.7%)	1.7%	620 (82.2%)	1.3%
Grand Total	370		384		754	

[a] Females classified based on egg diameter classifications of Kissner (1973).

[b] Males were classified as either immature or spawner based on gonad size.

Table 8.-Summary of egg diameters of female chinook salmon sampled in the early run at Deep Creek marine and Anchor Point, 1996.

Maturity classification[a]	Mean egg diameter (mm)	Total	Percent of sample
	<1	1	
	1 - 1.4	3	
	1.5 - 1.9	5	
Immature (<2 mm)		9	2.4% (SE = 0.8%)
	2.0 - 2.4	4	
	2.5 - 2.9	5	
	3.0 - 3.4	28	
	3.5 - 3.9	33	
Fall spawner (2 - 3.9 mm)		70	18.9% (SE = 1.9%)
	4.0 - 4.4	95	
	4.5 - 4.9	114	
	5.0 - 5.4	56	
	5.5 - 5.9	18	
	6.0 - 6.4	6	
	6.5+	2	
Spring spawner (4 mm+)		291	78.7% (SE = 2.0%)
		370	

[a] Based on egg diameter classifications of Kissner (1973).

Fall spawner (intermediate or maturing), or Spring spawner. The 1996 female chinook salmon harvest comprised 2% immature, 19% Fall spawner (intermediate), and 79% sexually mature fish (Table 8).

Of the 384 male chinook salmon examined, 329 (86%) were classified as spawners, and the rest as immature fish (Table 7). This number is biased high, as males at an intermediate stage of development were also classified as spawners. The female maturity estimate is likely more accurate than that for males, so our most accurate estimate is that 79% of the total early-run harvest in 1996 was spawning fish (3,321 of 4,204).

Maturity was determined for 20 of the 24 random CWT recoveries (Table 3). All of the recovered fish with CWTs of Cook Inlet origin for which maturity was determined were found to be sexually mature. Egg diameters for Cook Inlet tagged females ranged from 4.0 to 5.8 mm (Table 3). None of the recoveries of non-local fish were classified as mature. Egg diameter for non-Cook Inlet origin fish ranged from 0.9 to 3.6 mm (Table 3). Tag recoveries of Cook Inlet hatchery releases accounted for 5% of the estimated harvest of spawning fish (Ninilchik River and Deception Creek; 176 of 3,321). Tagged British Columbia hatchery releases accounted for 31% of the estimated non-spawner harvest (270 of 883 fish).

There is limited information that, based on the maturity information and age of the tagged fish recoveries, male non-local fish may mature later in the season than female fish. As an example, sample #96DU5507 (Table 3), a male, 4-ocean, Spring-run fish from Washington State, is likely in its last summer in salt water, but at the time of harvest was determined to be immature. In comparison, sample #DU5506, a female, 4-ocean Summer-run fish from British Columbia, had an egg diameter of 3.6 mm, nearly mature (Table 3).

DISCUSSION AND RECOMMENDATIONS

The results of the tag contribution component of this study in 1996 are introductory, and are biased towards the stocks such as the Ninilchik River and Deception Creek that have a tagged component in the 3- and 4-ocean cohort. Although we had no random recoveries of Deep Creek or Kenai River origin coded wire tagged fish, pooling the information collected from this project and King and Breakfield (1998) suggests that our chances of doing so were poor (Table 9). However, there was one voluntary recovery of a coded wire tagged 2-ocean Deep Creek fish. In 1997, all of the Cook Inlet origin tagged stocks have a 2- and 3-ocean component coming back (including Deep Creek and Kenai River), and are much more likely to be recovered in our sampling. As conservation/ allocation concerns develop about more chinook salmon stocks in Cook Inlet, they should be coded wire tagged so that they can be identified in the harvest in mixed-stock fisheries such as the Cook Inlet recreational fishery.

The estimated freshwater ages of the tagged fish recovered were incorrect; however, this may be due to the fact that all of the tagged fish were from hatcheries, and they may have produced false annuli. The estimated ocean ages were accurate and are probably more important in describing the harvest.

Most of the fish harvested were mature, but we were able to account for more non-spawning fish and a higher percentage of the harvest of non-spawning fish. By coded wire tagging our Cook Inlet hatchery fish and a few of our wild stocks, we should be able to explain more of the mature fish harvest component in the next few years. However, because there are still many wild stocks of chinook salmon in Cook Inlet that are not tagged, we will never be able to explain 100%

Table 9.-Summary of criteria that influenced the likelihood of recovering Deep Creek and Kenai River origin coded wire tagged chinook salmon in the central Cook Inlet recreational fishery, 1996.

	Deep Creek Stock	Kenai River Stock
Total number of chinook salmon examined at Deep Creek and Anchor Point	1,470	1,470
Number of 2-ocean fish examined	197	197
Number of 2-ocean fish (from each stock) examined if contribution is 5%	197 X 0.05 = 10	10
To recover 1 tag, the marked fraction of the stock (theta) would have to be	1 / 10 = 0.10	.10
Actual marked fraction (theta) for 2-ocean fish in each stock	0.07[a]	unknown, likely < .01[a]

[a] Data from King and Breakfield 1998.

of the harvest, and the actual percentage will likely be much less than that.

Our egg size-based classification of maturity is an imperfect compromise for estimating the maturity of chinook salmon harvested in Cook Inlet; some of the tagged fish that would be classified as Fall spawners based on egg size were actually Summer or Fall chinook salmon based on the tag codes (Table 3). In addition, white-fleshed (non-local) chinook salmon with spawner-size egg diameters (4.8 and 4.2 mm) were sampled at Anchor Point on 1 June and 9 June, respectively; no white chinook salmon are known to spawn in Cook Inlet drainages (Hard et al. 1989). The egg measurements we made are different than those made by Kissner (1973); he dissected five of the eggs at random and measured them; we measured 10 contiguous eggs while still in the skein. However, it is unlikely that this small difference in technique is significant; it is more likely that the egg diameter of our Spring spawning fish naturally overlaps with fish that will be spawning in a few months in drainages further South. We will continue to sample the egg diameter of females and investigate these relationships.

In previous years almost all of the fishing occurred within approximately 1/4 mile of the shoreline. Regulations implemented for the 1996 fishery by the Board of Fisheries and the apparent lack of fish near shore in 1996 gave many anglers incentive to fish further offshore than usual, up to 1 or 2 miles. Anecdotal evidence in 1996 suggests that a higher percentage of the fish caught further offshore were non-spawner fish. In 1997, we will keep track of where fish are caught relative to shore, in order to discern if there is any pattern relative to maturity. If so, this could be useful in creating regulations that direct fishing effort and harvest towards or away from spawning fish.

The early-run chinook salmon harvest in 1996 is the lowest since 1989, and nearly one-half of the harvest in 1995 (Table 5). Although the new more restrictive regulations likely accounted for some of this drop, anecdotal information suggests that fewer fish were available than in previous years.

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APPENDIX A. SUMMARY OF 1996 SAMPLING SCHEDULE

Appendix A1.-Summary of sampling schedule for the 1996 early-run chinook salmon coded wire tag recovery project at the Deep Creek marine access area.

Week	Day	Date	Shift time (hrs)	Number of Days in Week	Number of Days Sampled
1	Wed.	May 1	1400 - 2200	5	5
1	Thurs.	May 2	1400 - 2200	5	5
1	Fri.	May 3	1400 - 2200	5	5
1	Sat.	May 4	1400 - 2200	5	5
1	Sun.	May 5	1500 - 2300	5	5
2	Wed.	May 8	800-1300, 2000-2300	7	5
2	Thur.	May 9	800-1300, 2000-2300	7	5
2	Fri.	May 10	800-1300, 2000-2300	7	5
2	Sat.	May 11	900 - 1700	7	5
2	Sun.	May 12	1100 - 1900	7	5
3	Mon.	May 13	1200 - 2000	7	5
3	Tues.	May 14	1300 - 2100	7	5
3	Fri.	May 17	1500 - 2300	7	5
3	Sat.	May 18	1600 - 2400	7	5
3	Sun.	May 19	1600 - 2400	7	5
4	Wed.	May 22	800-1100,1900-2400	7	5
4	Thur.	May 23	800-1300,2000-2300	7	5
4	Fri.	May 24	800-1200,2000-2400	7	5
4	Sat.	May 25	900-1400,2100-2400	7	5
4	Sun.	May 26	900 - 1700	7	5
5	Mon.	May 27	1100 - 1900	7	5
5	Tues.	May 28	1200 - 2000	7	5
5	Fri.	May 31	1300 - 2100	7	5
5	Sat.	June 1	1500 - 2300	7	5
5	Sun.	June 2	1500 - 2300	7	5
6	Wed.	June 5	800-1200,2000-2400	7	5
6	Thur.	June 6	900-1300,2000-2400	7	5
6	Fri.	June 7	1000 - 1800	7	5
6	Sat.	June 8	800 - 1600	7	5
6	Sun.	June 9	900 - 1700	7	5
7	Mon.	June 10	1200 - 2000	7	5
7	Tues.	June 11	1300 - 2100	7	5
7	Fri.	June 14	1400 - 2200	7	5
7	Sat.	June 15	1500 - 2300	7	5
7	Sun.	June 16	1600 - 2400	7	5
8	Wed.	June 19	1600 - 2400	8	6
8	Thur.	June 20	1600 - 2400	8	6
8	Fri.	June 21	1600 - 2400	8	6
8	Sat.	June 22	1600 - 2400	8	6
8	Sun.	June 23	1600 - 2400	8	6
8	Mon.	June 24	0900 - 1700	8	6

Appendix A2.-Summary of sampling schedule for the 1996 early-run chinook salmon coded wire tag recovery project at the Anchor Point marine access area.

Week	Day	Date	Shift time (hrs)	Number of Days in Week	Number of Days Sampled
1	Wed.	May 1	1400 – 2200	5	5
1	Thur.	May 2	1400 –2200	5	5
1	Fri.	May 3	1400 - 2200	5	5
1	Sat.	May 4	1400 - 2200	5	5
1	Sun.	May 5	1500 - 2300	5	5
2	Mon.	May 6	800-1300,2000-2300	7	7
2	Tues.	May 7	800-1300,2000-2300	7	7
2	Wed.	May 8	800-1300,2000-2300	7	7
2	Thur.	May 9	800-1300,2000-2300	7	7
2	Fri.	May 10	800-1300,2000-2300	7	7
2	Sat.	May 11	900 - 1700	7	7
2	Sun.	May 12	1100 - 1900	7	7
3	Mon.	May 13	1200 - 2000	7	7
3	Tues.	May 14	1300 - 2100	7	7
3	Wed.	May 15	1300 - 2100	7	7
3	Thur.	May 16	1300 - 2100	7	7
3	Fri.	May 17	1500 - 2300	7	7
3	Sat.	May 18	1500 - 2300	7	7
3	Sun.	May 19	1600 - 2400	7	7
4	Mon.	May 20	1600 - 2400	7	7
4	Tues.	May 21	800-1200,2000-2400	7	7
4	Wed.	May 22	800-1200,2000-2400	7	7
4	Thur.	May 23	800-1200,2000-2400	7	7
4	Fri.	May 24	800-1200,2000-2400	7	7
4	Sat.	May 25	800-1200,2000-2400	7	7
4	Sun.	May 26	1000 - 1700	7	7
5	Mon.	May 27	1000 - 1800	7	7
5	Tues.	May 28	1100 - 1900	7	7
5	Wed.	May 29	1200 - 2000	7	7
5	Thur.	May 30	1300 - 2100	7	7
5	Fri.	May 31	1400 - 2200	7	7
5	Sat.	June 1	1500 - 2300	7	7
5	Sun.	June 2	1500 - 2300	7	7
6	Mon.	June 3	1500 - 2300	7	7
6	Tues.	June 4	800-1200,2000-2400	7	7
6	Wed.	June 5	800-1200,2000-2400	7	7
6	Thur.	June 6	800-1200,2000-2400	7	7
6	Fri.	June 7	800-1200,2000-2400	7	7
6	Sat.	June 8	800-1200,2000-2400	7	7
6	Sun.	June 9	900 – 1700	7	7

-continued-

Appendix A2.-Page 2 of 2.

Week	Day	Date	Shift time (hrs)	Number of Days in Week	Number of Days Sampled
7	Mon.	June 10	1000 – 1800	7	7
7	Tues.	June 11	1100 – 1900	7	7
7	Wed.	June 12	1200 – 2000	7	7
7	Thur.	June 13	1200 – 2000	7	7
7	Fri.	June 14	1400 – 2200	7	7
7	Sat.	June 15	1500 – 2300	7	7
7	Sun.	June 16	1600 – 2400	7	7
8	Mon.	June 17	1600 – 2400	7	8
8	Tues.	June 18	1600 – 2400	8	8
8	Wed.	June 19	1600 – 2400	8	8
8	Thur.	June 20	800-1200,2000-2400	8	8
8	Fri.	June 21	800-1200,2000-2400	8	8
8	Sat.	June 22	800-1200,2000-2400	8	8
8	Sun.	June 23	800-1200,2000-2400	8	8
8	Mon.	June 24	800-1200,2000-2400	8	8

APPENDIX B. SAMPLING FORMS

Appendix B1.-Coded wire tag sport sampling form used in 1996.

Alaska Department of Fish and Game

Coded Wire Tag Sampling Form

Personal Use, Sport and Subsistence Fisheries
Central, South Central, Westward and AYK Regions

INTERVIEWER INFORMATION

SAMPLE NUMBER: 9 6 _ _ _ _ _ _ PROJECT CODE (TAG LAB USE- ONLY): PAGE _ OF PAGES _

HARVEST TYPE: (circle one) personal use sport subsistence

SURVEY SITE: _____

SAMPLE TYPE: random select voluntary

SAMPLER: _____

NAME OF PLACE SAMPLED: _____

DATE SAMPLED: _ _ - _ _ - 9 6

EXPLANATION OF SAMPLE TYPES

random: CWT recoveries made during the course of random sampling for a creel survey.

select: CWT recoveries made in an area having a creel survey, but not taken in the random sampling process.

voluntary: CWT recoveries made in an area which isn't covered by a random creel survey (e.g. Seldovia)

STRATIFICATION INFORMATION - RANDOM, SPORT SAMPLES ONLY

FISHERY TYPE

DE Derby Entered
DT Derby Takehome
FF Freshwater Fishery
MB Marine Boat
MR Marine Roadside
TF Terminal Fishery

ANGLER INFORMATION

ANGLER'S NAME: _____

COMPLETE MAILING ADDRESS: _____

_____

DATE CAUGHT: _ _ - _ _ - 9 6

FISHING ACCESS: saltwater boat / saltwater shoreline / freshwater

NAME OF PLACE FISHED: _____

AREA INFORMATION: (DISTRICT(S) - SUBDISTRICT(S)) _ _ _ – _ _ _ _ _ – _ _

ANADROMOUS STREAM# (FRESHWATER- ONLY)

_ _ _ - _ _ - _ _ _ _ _ - _ _ _ _ - _ _ _ _ - _ _ _ _ - _ _ _ _ - _ _ _ _ - _ _ _ _

SAMPLING INFORMATION

THIS BOX IS TO BE COMPLETED ONLY FOR RANDOM SAMPLES

SPECIES (CODE)	TOTAL # FISH COUNTED	# ADIPOSE CLIPS SEEN	WERE ALL SAMPLED?
(410)CHIN	_ _ _	_ _ _	y n
(411)JACK (CHIN-ONLY)	_ _ _	_ _ _	y n
(420)SOCK	_ _ _	_ _ _	y n
(430)COHO	_ _ _	_ _ _	y n
(440)PINK	_ _ _	_ _ _	y n
(450)CHUM	_ _ _	_ _ _	y n
(540)STHD	_ _ _	_ _ _	y n

HEAD RECOVERY INFORMATION

✓	HEAD NUMBER	SPECIES CODE	FORK LENGTH (mid-eye to fork in mm)	CLIP STATUS	CHINOOK Flesh Color
				good ??? unkn	red white
				good ??? unkn	red white
				good ??? unkn	red white
				good ??? unkn	red white
				good ??? unkn	red white
				good ??? unkn	red white
				good ??? unkn	red white
				good ??? unkn	red white
				good ??? unkn	red white
				good ??? unkn	red white

T:\FORMS\SPTCWA96.VSD - 4/96

(PUT COMMENTS ON BACK)

Appendix B2.-Voluntary logbook form for private lodges.

DATE	NUMBER OF KINGS KEPT	NUMBER OF KINGS MISSING THE ADIPOSE FIN (tagged fish)

NUMBER OF KINGS KEPT the number of kings that were kept and killed, includes kings with and without adipose fins

NUMBER OF KINGS MISSING THE ADIPOSE FIN (tagged fish)

the number of kings that were harvested that day that were missing their adipose fins. The fin is clipped when it is coded wire tagged as a juvenile. The tag is only 1 millimeter long; there are 25 millimeters in an inch. Please save the entire heads from these fish, label them as to the date of capture, length and weight, sex, and put in the freezer.

This year we want to estimate the proportion of the chinook salmon harvested in this fishery that originate in streams of the Kenai Peninsula, upper Cook Inlet, and from hatchery releases. We will do this by recovering coded wire tagged fish from anglers at Deep Creek Marine, Anchor Point, and Homer. By collecting heads from tagged fish that are caught by your clients, we can learn more about this fishery and better manage it.

Thank you for taking part in our survey of the central Cook Inlet chinook salmon fishery. I'd like to assure you that any and all information that you provide the Department will be strictly confidential and not a part of the public record.

Sincerely,

APPENDIX C. DATA FILE LISTING

Appendix C1.-Data files used to estimate stock contributions, and age and maturity composition, of the chinook salmon harvest in the central Cook Inlet early-run recreational fishery, 1996.

Data File	Description
CICHIN96.xls	Raw age, maturity, tag recovery, and tagged fish info; and estimates of age & maturity composition
96DCMCWTEST.xls	Contribution estimates from coded wire tag sampling

[a] Data files available from the author: Alaska Department of Fish and Game, Division of Sport Fish, 43961 K-Beach Road, Suite B, Soldotna AK 99669.