Fishery Data Series No. 11-54

Ninilchik River Chinook Salmon Stock Assessment and Supplementation, 2008

by

Michael D. Booz

and

Carol M. Kerkvliet

November 2011

Alaska Department of Fish and Game **Divisions of Sport Fish and Commercial Fisheries**

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
milliliter	mL
millimeter	mm

Weights and measures (English)

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

Time and temperature

day	d
degrees Celsius	°C
degrees Fahrenheit	°F
degrees kelvin	K
hour	h
minute	min
second	s

Physics and chemistry

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

General

Alaska Administrative Code	AAC
all commonly accepted abbreviations	e.g., Mr., Mrs., AM, PM, etc.
all commonly accepted professional titles	e.g., Dr., Ph.D., R.N., etc.
at	@
compass directions:	
east	E
north	N
south	S
west	W
copyright	©
corporate suffixes:	
Company	Co.
Corporation	Corp.
Incorporated	Inc.
Limited	Ltd.
District of Columbia	D.C.
et alii (and others)	et al.
et cetera (and so forth)	etc.
exempli gratia (for example)	e.g.
Federal Information Code	FIC
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
registered trademark	®
trademark	™
United States (adjective)	U.S.
United States of America (noun)	USA
U.S.C.	United States Code
U.S. state	use two-letter abbreviations (e.g., AK, WA)

Mathematics, statistics

all standard mathematical signs, symbols and abbreviations	
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	CI
correlation coefficient (multiple)	R
correlation coefficient (simple)	r
covariance	cov
degree (angular)	°
degrees of freedom	df
expected value	E
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.
minute (angular)	'
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
variance	
population	Var
sample	var

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By
Michael D. Booz
Alaska Department of Fish and Game, Division of Sport Fish, Homer
and
Carol M. Kerkvliet
Alaska Department of Fish and Game, Division of Sport Fish, Homer

Alaska Department of Fish and Game
Division of Sport Fish, Research and Technical Services
333 Raspberry Road, Anchorage, Alaska, 99518-1565

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Michael D. Booz,
Alaska Department of Fish and Game, Division of Sport Fish,
3298 Douglas Place, Homer, AK 99603-7942, USA

and

Carol M. Kerkvliet,
Alaska Department of Fish and Game, Division of Sport Fish,
3298 Douglas Place, Homer, AK 99603-7942, USA

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ABSTRACT

From 30 June through 7 August 2008, 873 Chinook salmon (*Oncorhynchus tshawytscha*) were counted at the Ninilchik River weir of which 772 were wild and 101 were hatchery-reared. Wild Chinook salmon escapement, corresponding to the Sustainable Escapement Goal (SEG) index monitoring period (3 July through 31 July), was 586 fish. The median run timing date during the SEG index monitoring period for the wild component was 5 days earlier than for hatchery-reared Chinook salmon. Overall, ocean age 3 was the dominant age class for both wild and hatchery-reared Chinook salmon. Approximately 601,000 eggs were collected from 79 wild and 23 hatchery-reared Chinook salmon females during 3 eggtakes. Egg survival to the eyed stage was 82.2%. Stocking goals were met for all locations (Ninilchik River and terminal saltwater locations in Kachemak Bay). Ten coded wire tags were decoded from 13 Chinook salmon that were sacrificed at the weir, and all originated from the Ninilchik River. The Ninilchik River Chinook salmon supplementation program has provided important sport fishing opportunities on the Ninilchik River and saltwater terminal fisheries. Continuation of Chinook salmon assessment at Ninilchik River weir is recommended to ensure that adequate escapement of wild Chinook salmon is maintained.

Key words: Chinook salmon, *Oncorhynchus tshawytscha*, Ninilchik River, wild, hatchery-reared, supplementation, enhancement, run, escapement, weir, adipose finclip, coded wire tag.

INTRODUCTION

The Ninilchik River is located on the Kenai Peninsula in the Lower Cook Inlet management area (LCIMA). It is a small (260 river kilometers [RKM]), non-glacial, anadromous stream with extensive wetlands (122 km^2), and no large tributary lakes (Table 1). There are only 3 road accessible streams in the LCIMA that support Chinook salmon (*Onchorhynchus tshawytscha*) sport fisheries: Ninilchik River, Anchor River, and Deep Creek (Figure 1). Angler effort is focused on Ninilchik River earlier in the season because water conditions are generally less turbid than the Anchor River and Deep Creek. Sport anglers are capable of harvesting a significant portion of the Ninilchik River Chinook salmon run because of its small stream size. From 1999 through 2007, the average annual harvest estimate of Ninilchik River Chinook salmon has been about 1,400 fish (Table 2).

In the mid 1980s, the Alaska Department of Fish and Game (ADF&G) Division of Sport Fish (SF) recognized that Ninilchik River Chinook salmon stock was vulnerable to overharvest from the growing Kenai Peninsula sport fishery. In 1987, SF initiated a supplementation program for the Ninilchik River as a way to create sustainable fishing opportunities through stocking hatchery-reared Chinook salmon smolt (Table 3). As a result of the supplementation program, 2 groups of Chinook salmon (wild and hatchery-reared) now return to the Ninilchik River, which has added an additional level of complexity to the management of escapement and harvest of Ninilchik River Chinook salmon.

The following sections summarize the supplementation program and escapement monitoring, the tools used to evaluate the sport harvest of hatchery-reared fish, and management strategies (for a more thorough review see Kerkvliet and Booz 2010).

SUPPLEMENTATION

The annual supplementation of Chinook salmon for Ninilchik River has remained essentially unchanged since 1995 when stocking levels were reduced to 50,000 smolt (from approximately 200,000 smolt) with 100% of the smolt adipose-clipped and coded-wire-tagged (CWT; Appendix A1).

Since 1988, broodstock collection and egg takes were conducted at a broodstock weir located at Brody Road bridge (7.7 RKM) during the month of July and early August (Figure 2). Only the progeny from wild Chinook salmon broodstock are used for Ninilchik River stockings. From 1988 through 2002, Chinook salmon smolt were stocked as age-0 fish. Since 2003, due to limited hatchery rearing facilities, all stocked Chinook salmon have been overwintered in the hatchery as parr and released in the spring as age-1 smolt. Starting in 1994, additional broodstock from the Ninilchik River was collected to support stocking at the terminal saltwater fisheries in Kachemak Bay (Figure 1) at Nick Dudiak Fishing Lagoon on Homer Spit (NDFL, Table 4), Halibut Cove Lagoon (Table 5), and Seldovia Bay (Table 6). A combination of both wild and hatchery-reared Chinook salmon are used as broodstock for the terminal saltwater fisheries.

ESCAPEMENT MONITORING

ADF&G has monitored Chinook salmon escapement in Ninilchik River since 1962 (Appendix A2). Starting in 1999, all hatchery-reared Chinook salmon returning to Ninilchik River were adipose-clipped and coded-wire-tagged. Since then, all weir counts of wild and hatchery-reared Chinook salmon have been differentiated by examining all Chinook salmon at the weir for the presence or absence of an adipose fin. Currently, escapement is monitored at the broodstock weir during an index monitoring period (3–31 July) and not over the entire run (Table 7). The Chinook salmon escapement is calculated by removing the holding and egg-take mortalities from the Chinook salmon weir count. On average (1999–2005), only 65% of the total wild Chinook salmon weir escapement is counted during the index monitoring period (Table 8). This index fails to account for spawning below the weir which may consist of approximately 35% of the total spawning escapement based on aerial survey data (Marsh *unpublished*[1]).

ESCAPEMENT GOAL

The sustainable escapement goal (SEG) range for wild Ninilchik River Chinook salmon is 550–1,300 fish during the index monitoring period (3–31 July; Appendix A3). This SEG was calculated using the percentile method (Bue and Hasbrouck *unpublished*[2]) and is based on the wild Chinook salmon escapement above the weir during the index monitoring period from 1999 through 2007 (Booz and Kerkvliet 2011b).

SPORT HARVEST

Monitoring the Chinook salmon sport harvest at Ninilchik River has become more complicated since the inception of the supplementation program. Since 1977, ADF&G has conducted an annual mail survey called the Alaska Statewide Harvest Survey (SWHS) to estimate, by area and by fishery, the participation, harvest (fish kept) and catch (fish harvested plus fish released) of sport-caught species (Table 2; Figure 3). Unfortunately, the SWHS only reports total estimates and does not provide the stock composition (wild/hatchery-reared) of the harvest. From 1991 through 2006, periodic assessment of the hatchery-reared contribution to the sport harvest, has been conducted with creel and sport harvest surveys. During high stocking years (1990–1998),

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[1] L. E. Marsh, 1997 memorandum to B. Clark, ADF&G, on preliminary evaluation of the stocking program at the Ninilchik River. Subsequently referred to as the "Marsh, memorandum."

[2] B. G. Bue and J. J. Hasbrouck, October 2001 report to the BOF, on escapement goal review of salmon stocks of Upper Cook Inlet. Subsequently referred to as (Bue and Hasbrouck, BOF report).

these surveys found over 50% of the harvest was hatchery-reared fish (Balland and Begich 2007; Balland et al. 1994; Begich 2006, 2007; Boyle and Alexandersdottir 1992; Boyle et al. 1993; Marsh 1995; Marsh, memorandum). In 2006, the hatchery-reared percentage of the Chinook salmon harvest during the three regulatory 3-day weekend fishery was 39% (Booz and Kerkvliet 2011a).

MANAGEMENT

The sport fishery regulations for Ninilchik River Chinook salmon are designed to conservatively manage for the sustainability of the wild stock. The regulations control harvest by limiting the area open to fishing to the lower 3.2 RKM of the river (to protect the Chinook salmon spawning area), and by limiting fishing openings to three consecutive 3-day weekends (Saturday through Monday) beginning on Memorial Day weekend. Starting in 2008, the regulatory sport Chinook salmon fishery in the Ninilchik River includes opportunity to harvest only hatchery-reared Chinook salmon in the lower 3.2 RKM of the river from July 1 through December 31.

Management of Chinook salmon in the Ninilchik River has been refined since the inception of the supplementation program with a more directed focus towards maximizing the harvest of hatchery-reared fish (Appendix A4). From 1991 through 2001, SF has periodically issued Emergency Orders (EOs) to increase the number of fishing days for both wild and hatchery-reared Chinook salmon. Starting in 2002, EOs increased fishing days for hatchery-reared fish only.

In 2004, the Alaska Board of Fisheries (BOF) adopted a regulation that increased the daily bag limit for Ninilchik River Chinook salmon from 1 to 2 of which no more than 1 fish could be a wild Chinook salmon. The intent of this new regulation was to increase the harvest of hatchery-reared Chinook salmon.

This report is part of a continuing series designed to provide information to evaluate the Ninilchik River Chinook salmon supplementation program, and ensure that the wild Chinook salmon escapement at Ninilchik River is managed according to the *Policy for the Management of Sustainable Salmon Fisheries* (5AAC 39.222) and the *Policy for Statewide Salmon Escapement Goals* (5AAC 39.223).

OBJECTIVES

The objectives of this study were as follows:

1. Census the wild and hatchery-reared Chinook salmon escapement into the Ninilchik River from 30 June through 7 August 2008.
2. Census the sex composition and estimate the age composition of each of the wild and hatchery-reared Chinook salmon components of the run into the Ninilchik River from 30 June through 7 August 2008.

TASKS

1. Collect, hold, and artificially spawn 115 male and 115 female Ninilchik River Chinook salmon (minimum of 60 wild males and 60 wild females to ensure genetic variation) for the production of hatchery-reared smolt to be released into Ninilchik River, Nick Dudiak Fishing Lagoon on Homer Spit (NDFL), Halibut Cove Lagoon, and Seldovia Bay.
2. Release the following number of hatchery-reared Ninilchik River Chinook salmon smolt in May and June 2008: approximately 50,000 smolt at Ninilchik River; 210,000 smolt at NDFL; 52,500 smolt at Halibut Cove Lagoon; and 52,500 smolt at Seldovia Bay.
3. Estimate the within-reader variability of age estimates from scale readings.
4. Assess accuracy of scale age estimates using samples collected from Chinook salmon of a known age determined through coded wire tag (CWT) analysis.
5. Estimate length at age for the wild and hatchery-reared Ninilchik River Chinook salmon runs.
6. Gather daily stream temperature, discharge, and tide height data from other agencies.

METHODS AND ANALYSIS

ESCAPEMENT MONITORING

Weir Counts

A fixed picket weir (Figure 4) was installed approximately 7.7 RKM (Figure 2) from the mouth of the river on 30 June and operated through 7 August 2008. The weir was visually inspected on a daily basis for holes to ensure no fish could pass undetected. The gate to the live box was opened daily at approximately 8:00 AM and closed around 11:00 PM. Technicians periodically checked the live box and processed all fish as quickly as possible to avoid impeding the migration.

All captured fish were identified to species and tallied for the daily weir counts. All Chinook salmon that entered the live box were examined for an adipose finclip to identify origin (wild or hatchery-reared). The upper edge of the caudal fin was clipped on all Chinook salmon examined at the weir to prevent double sampling of fish in the event of weir failure. The wild and hatchery-reared Chinook salmon escapements were calculated by removing the holding and egg-take mortalities from the associated Chinook salmon weir count for the SEG index monitoring period and the total weir operating period. The total Chinook salmon escapement was calculated as the sum of the wild and hatchery-reared Chinook salmon escapement.

Sustainable Escapement Goal (SEG)

Only the wild Chinook salmon escapement count was used to determine if the SEG was met. The contribution of wild Chinook salmon to the escapement during the SEG index monitoring period (3–31 July) was expressed as the percentage of the total Chinook salmon escapement during the SEG index monitoring period. The escapement counts of hatchery-reared and wild Chinook salmon during the SEG index monitoring period in 2008 were compared to their respective averages for the years 1999–2005 and 2006–2007.

Run Timing

The run timing of wild and hatchery-reared Chinook salmon was plotted as a cumulative percentage of weir counts for the SEG index monitoring period. The median run timing date (date nearest to the 50% cumulative count) was identified for each component of the run. The 2008 cumulative percentages of wild and hatchery-reared Chinook salmon were compared to each other and to their respective 1999 to 2007 cumulative averages.

The daily weir counts of Chinook salmon (wild and hatchery-reared) were plotted against daily water temperatures, discharge and tide heights to identify any general patterns. Observed patterns were investigated further and compared to patterns observed in previous years.

WATER TEMPERATURE, DISCHARGE, AND TIDE

Cook Inletkeeper (CIK), a citizen-based nonprofit group, collected water temperature in degrees Celsius once every 15 minutes using a temperature logger at their NR-2 site (described in Mauger 2005). The NR-2 site (RKM 13.7) is located ~6.0 RKM upstream (Figure 2) from the Ninilchik River weir site.

The discharge data presented in this report was collected by the National Weather Service, Alaska Pacific River Forecast Center (RFC) at the Beach Access Road bridge (RKM 0.9; Figure 2). RFC contracted a local citizen to collect a daily stage reading (to the nearest 0.01 feet) at approximately the same time each day (~1900 hours) using a wire weight gauge. Collected stage readings were then converted to discharge in cubic feet per second (ft^3/s) using a rating curve of previous discharge and stage measurements from the same Ninilchik River site. The RFC data is not formally published, and should be considered provisional.

The predicted daily high and low tide heights for Ninilchik River were located on the National Oceanic and Atmospheric Administration (NOAA) tides and current website at http://tidesandcurrents.noaa.gov. Predicted high tides heights were corrected from the Seldovia reference station by adding 1.2ft. No correction factor was used for low tide heights.

BIOLOGICAL SAMPLES

Sample size goals for age and age-sex composition for wild (141) and hatchery-reared (115) Chinook salmon were calculated by combining a finite population correction factor (Cochran 1977) with the sample size determined under the assumption of multinomial sampling (Thompson 1987), assuming an average run size during weir operation dates, and with 20% of the scale samples not readable for age estimates.

Sex was determined for all Chinook salmon by observing sexual characteristics such as a protruding ovipositor on females and a developing kype on males. The sex ratio of each of the wild and hatchery-reared components of the escapement is therefore known without error. The sex composition of the wild and hatchery-reared Chinook salmon run was calculated for each week.

From 30 June to 6 July 2008, technicians systematically sampled every third hatchery-reared Chinook salmon by measuring the mid eye to tail fork (METF) length to the nearest 5 mm and collecting 3 scales from the preferred area (see Welander 1940). On 7 July, the sampling rate was increased to every hatchery-reared Chinook salmon due to a low number of hatchery-reared fish observed at the weir. However, not every hatchery-reared Chinook salmon was sampled because several fish escaped before being processed and, on 18 July, an unusually large number of

Chinook salmon arrived at the weir, preventing the technician from sampling fish without impeding the migration.

For wild Chinook salmon, every seventh fish was sampled for age and length (in the same manner as hatchery-reared salmon). However, there were concerns about size- or behavior-selective sampling when the sampling target (the seventh fish) was present in the live box with other wild fish. Whenever this situation occurred, all fish in the live box were sampled to avoid selective sampling. We refer to fish sampled in this manner as "box sampled". The sample of wild fish therefore consisted of a pseudo-systematic sample (after each box sample, the systematic sample count was reset) and box-sampled fish. The overall sample did not therefore meet the criteria of a multinomial sample and the data analysis was adjusted accordingly (see equations below). It is noted that the run of hatchery-reared fish was not large enough to result in multiple hatchery fish in the live box at once and box sampling did not influence the analysis of hatchery-reared fish.

All wild and hatchery-reared Chinook salmon less than or equal to 550 mm METF were tallied as jacks (ocean-age-1 males). A simple z-test was used to compare the estimated jack abundance (through scale age estimates) with the jack abundance census.

Scale samples were mounted directly to gum cards and later pressed into acetate using a Carver press at 99ºC and 22,500 pounds per square inch (psi) for approximately 2.5 minutes. Scales were read using a microfiche reader and aged with methods described by Welander (1940) and Mosher (1969). Age estimates were produced independently of size, sex, and other age estimates. Scale samples were aged twice to estimate within-reader variability. All scale samples that had conflicting ages for the 2 estimates were re-aged to produce a resolved age which was used for composition and abundance estimates. Original and resolved age estimates were validated, when possible, using samples of a known age from CWT recoveries and expressed as a percent agreement with the known ages. Scale samples collected from fish of a known age were added to a reference scale set. The scale reader had previous experience aging both juvenile and adult salmonid scales and other calcified structures including scale samples from Ninilchik River Chinook salmon.

In previous years, the age-sex composition estimates for wild and hatchery-reared Chinook salmon were calculated based on the estimated sex composition from sampling and not from the census of the sex composition (Balland and Begich 2007; Begich 2006, 2007; Kerkvliet 2008). In some years, such as 2007, it was suspected that sampling may have been selective towards males, biasing the age-sex estimates. Although it is not known why males were over-sampled, this could be a result of the method used to process fish in the live box, the order in which fish are processed in the live box, or because male and female behavior may differ, influencing how or when they arrive at the weir. To reduce bias associated with possible sex-selective sampling, the age-sex composition estimates were calculated by using the known sex composition as described in equations 1 through 15 below.

Wild Fish

To accommodate the sampling design for wild Chinook salmon, the systematic and box samples were pooled within each of 3 strata, each stratum representing an equal portion of the run. The abundance and proportion of the wild Chinook salmon run of age or age-sex class was estimated using a simple stratified design where abundances were summed over strata and stratum-specific proportions were combined by weighting over strata (equations 14–15 below).

Within a stratum, the proportion by sex of the wild run to the weir is known (a census of sex is conducted) and was calculated as

$$\hat{p}_i = \frac{x_i}{N} \tag{1}$$

where

x_i = number of wild fish of sex class i in N, and

N = run to the weir.

The proportion of wild fish of age j given sex i was estimated as

$$\hat{p}_{j|i} = \frac{x_{ij}}{n_i} \tag{2}$$

where

x_{ij} = number of wild fish of age class j in n_i, and

n_i = number of fish of sex class i in wild fish sampled for age,

with variance estimated as

$$\text{var}(\hat{p}_{j|i}) = \left[\frac{N_i - n_i}{N_i}\right] \frac{\hat{p}_{j|i}(1-\hat{p}_{j|i})}{n_i - 1}. \tag{3}$$

Abundance of wild fish of age j given sex i was estimated as

$$\hat{N}_{j|i} = \hat{p}_{j|i} N_i \tag{4}$$

with variance estimated as

$$\text{var}(\hat{N}_{j|i}) = N_i^2 \, \text{var}(\hat{p}_{j|i}). \tag{5}$$

The proportion of wild fish in age class j and sex class i in the run to the weir was estimated as

$$\hat{p}_{ji} = \frac{\hat{N}_{j|i}}{N} \tag{6}$$

with variance estimated as

$$\text{var}(\hat{p}_{ji}) = \frac{1}{N^2} \text{var}(\hat{N}_{j|i}). \tag{7}$$

The abundance of wild fish in age class j and sex class i in the run to the weir was estimated as

$$\hat{N}_{ji} = \hat{p}_{ji} N \tag{8}$$

with variance estimated as

$$\text{var}(\hat{N}_{ji}) = \frac{1}{N^2}\text{var}(\hat{p}_{ji}). \quad (9)$$

The abundance of wild fish in age class j in the run to the weir was estimated by summing over sex i:

$$\hat{N}_j = \sum_{i=1}^{2} \hat{N}_{j|i} \quad (10)$$

with variance estimated as

$$\text{var}(\hat{N}_j) = \sum_{i=1}^{2} \text{var}(\hat{N}_{j|i}). \quad (11)$$

The proportion of wild fish in age class j in the run to the weir was estimated as

$$\hat{p}_j = \frac{\hat{N}_j}{N} \quad (12)$$

with variance estimated as

$$\text{var}(\hat{p}_j) = \frac{\text{var}(\hat{N}_j)}{N^2}. \quad (13)$$

Stratum-specific abundances ($\hat{N}_{ji}$ and $\hat{N}_j$) and their variances (equations 8–11) were summed over strata to provide estimates for the run of wild fish to the weir.

Stratum-specific proportions ($\hat{p}_{ji}$ and $\hat{p}_j$; equations 6, 12) were combined as

$$\hat{p}_X = \sum_{k=1}^{3} p_{Xk} w_k \quad (14)$$

where

$\boldsymbol{X}$ = either ij or j, denoting age-sex or age, respectively, and

w_k = stratum weight (=1/3 for 3 evenly spaced strata)

with variance estimated as

$$\text{var}(\hat{p}_X) = \sum_{k=1}^{3} \text{var}(\hat{p}_{Xk}) w_k^2. \quad (15)$$

Hatchery fish

No stratification was used for hatchery fish and equations 1–13 were used to estimate age and age-sex statistics.

The within-reader variability of scale age estimates was calculated using a coefficient of variation (CV) expressed as the ratio of the standard deviation over the mean age (Campana 2001):

$$CV_j = 100\% \times \frac{\sqrt{\sum_{i=1}^{R} \frac{(X_{ij} - X_j)^2}{R-1}}}{X_j} \tag{16}$$

where

X_{ij} = the ith age estimate of the jth fish,

X_j = the mean age estimate of the jth fish,

R = the number of times each fish is aged.

For each sex, age, wild, and hatchery group, the CV_js were averaged across all fish (j) in the group to produce a mean CV.

EGG TAKES

During escapement monitoring, an inriver holding area was established using a weir upstream of the escapement weir (Figure 4). Plywood boards (2 ft x 3 ft) were placed on the lower weir during periods of low water to increase the water depth in the holding area in order to provide a rest area for fish. As Chinook salmon were processed through the live box, those fish showing signs of attaining more immediate sexual maturity were transferred into the holding area rather than allowing them to escape upstream of the weir. We began transferring fish into the holding area on 1 July. On 18 July, most of the held fish escaped upstream when unusually high water caused the panels connecting the upper and lower weir to fail. On 26 July, the water levels rose again and shifted the live box, creating a break between the panels connecting the 2 weirs. On 28 July, the lower weir failed at the downstream left bank and an unknown number of held fish escaped downstream.

Egg takes were conducted on 28 July, 5 August, and 8 August. All Chinook salmon were spawned in a matrix, 4 at a time, with a sex ratio of 2:2 to ensure egg fertilization (Hoffnagle et al. 2003). Held fish were captured with a seine and dipnets. Males and unripe females were sorted into net pens. Ripe females were killed and placed on their back on an angled rack with their heads tilting downward. Females were bled (bled-out) by ripping a gill arch to prevent blood from mixing with the eggs. To collect and fertilize the eggs, each bled-out female was held above a dry plastic bucket; then, her abdomen was cut open from the vent to the gill plate. Loose eggs were then collected in the bucket. Mature males were randomly selected from the net pens. Immature males were released upstream of the weir and mature males were live spawned before they were released upstream of the weir. To prevent water from the males dripping on the unfertilized eggs causing them to water harden, each male was live spawned into a dry cup. The milt was then poured into the bucket of eggs. Upon mixing the eggs and milt, a 7 g per liter saline solution was added to increase sperm motility. Fertilized eggs were then rinsed and placed into a plastic bag to water harden before being transported to the Fort Richardson hatchery.

Only wild Chinook salmon were used to supplement the Ninilchik River. A combination of wild and hatchery-reared Chinook salmon were used to stock the saltwater terminal release sites. The

head, length, and a scale sample were collected from sacrificed hatchery-reared females for age validation and to detect straying.

STOCKING

Smolt Release and Marking

The Chinook salmon eggs used for stocking were reared to smolt at the Fort Richardson hatchery. All smolt released into Ninilchik River were thermal marked, adipose-clipped, and injected with a CWT by hatchery personnel. All smolt released into Halibut Cove Lagoon, Seldovia Bay, and the NDFL were thermal marked. Hatchery personnel also assessed the average length and weight, and the percentages of adipose finclips and CWT loss of hatchery-reared Chinook salmon smolt prior to stocking into the Ninilchik River. The Statewide Stocking Plan (Loopstra 2007) was used to plan and schedule the release of LCIMA smolt with one exception. Stocking in Halibut Cove Lagoon was delayed from the scheduled date of June 6 until June 19 because a sample of the smolt failed a salinity tolerance test on 5 June.

Straying

Heads were collected from all hatchery-reared females that were sacrificed during egg takes. Collected heads were labeled with a numbered cinch strap, frozen, and sent to the ADF&G Mark, Tag, and Age Laboratory in Juneau for analysis. Results were accessed from the ADF&G tag lab website[3], using "Ninilchik River" as the specifying parameter.

Local Guide Harvest

During the inriver sport fishery, a volunteer sport fishery guide noted the catch and harvest of wild and hatchery-reared Chinook salmon in the freshwater sport fish logbook for each guided trip. The percentage of hatchery-reared Chinook salmon caught and harvested was estimated for each regulatory weekend and two 5-day periods in July during the regulatory hatchery-reared fishery. The percentage of hatchery-reared and wild Chinook salmon in the catch and harvest for each guided trip was estimated as a binomial proportion (Cochran 1977):

$$\hat{p}_j = \frac{n_j}{n} \tag{17}$$

where the subscript j represents wild or hatchery-reared. The variance was estimated as

$$\text{var}(\hat{p}_j) = \frac{\hat{p}_j(1-\hat{p}_j)}{n-1}. \tag{18}$$

No finite correction factor was used because the inriver population size during each guided trip was unknown. The 2008 catch and harvest compositions were compared to similar logbook-based estimates for the same guide in 2006 and 2007.

[3] Mark, Tag and Age Laboratory Database [Internet]. Juneau, AK: ADF&G. 2006. [4/20/09 11:00 AM]. Available from http://tagotoweb.adfg.state.ak.us/CWT/reports/ .

RESULTS

ESCAPEMENT MONITORING

Weir Counts

In 2008, the total number of Chinook salmon counted through the Ninilchik River weir from 30 June through 7 August was 873 fish of which 772 were wild and 101 were hatchery-reared (Table 7; Appendix B1). After subtraction of egg take mortalities (102 spawned and 68 holding mortalities) and 1 live box mortality, the total escapement was 702 Chinook salmon, of which 90% (632/702) were wild and 10% (70/702) were hatchery-reared.

In 2008, below average runs of most non-targeted species were observed at the weir (Table 9), although, a larger than average run of coho salmon (*Onchorhynchus kisutch*) was observed. Overall, 5 species of Pacific salmon (*Onchorhynchus* spp.), Dolly Varden char (*Salvelinus malma)*, and steelhead trout (*Onchorhynchus mykiss)* were observed at the weir in 2008. Dolly Varden char were the most common followed by coho salmon.

Sustainable Escapement Goal (SEG)

During the SEG index monitoring period (3–31 July), 586 wild and 62 hatchery-reared Chinook salmon escaped above the weir. The contribution of wild Chinook salmon to the total escapement during the SEG index monitoring period was 90.4% (586/648) (Table 8; Figure 5). Wild and hatchery-reared escapement counts were lower than the 1999–2005 average escapement count for the SEG index monitoring period by 385 and 310 fish, respectively. The 2008 wild and hatchery-reared escapement counts were also lower than the 2006–2007 averages (by 192 and 65 fish, respectively) although the difference in escapement counts between 2008 and 2007 are less than 50 fish (Table 8).

Run Timing

The cumulative percentage of weir counts of wild and hatchery-reared Chinook salmon showed that both of the Chinook salmon runs started later than average for the first half of the SEG index monitoring period (Figure 6). The wild Chinook salmon run timing during the second half of the SEG index monitoring period was similar to the historic average, while the run timing of hatchery-reared Chinook salmon was later than average. Overall, the 2008 run timing of hatchery-reared fish was roughly 5 days later than the wild run for the second half of the SEG index monitoring period.

WATER TEMPERATURE, DISCHARGE, AND TIDES

Average temperature and discharge fluctuated during the SEG index monitoring period but no general pattern with daily weir counts emerged (Figure 7; Appendices C1, D1–D2)**.** The 2008 average temperature was 2 degrees below the previous 9-year (1999–2007) average (Table 10). During the SEG index monitoring period (3–31 July), the average discharge was 130 ft^3/s (range = 68 ft^3/s to 336 ft^3/s; Table 10; Appendix D1) which was the highest recorded since the collection of this data series (Table 10). There was no general pattern in daily weir counts in relation to tide height (Figure 7; Appendix E1). From 3 July through 31 July, the daily average high tide height ranged from 13.7 ft to 21.3 ft and averaged 17.9 ft (Appendix E1). The daily average low tide height ranged from -4.8 ft to 5.3 ft and averaged 1.6 ft (Appendix E1).

BIOLOGICAL SAMPLES

Age, Sex and Length

The overall sample size goal for systematic age sampling was reached for wild Chinook salmon, but was missed by 50 fish for hatchery-reared Chinook salmon. A total of 83 wild and 65 hatchery-reared Chinook salmon were systematically sampled for age, with 93 additional wild samples from box sampling. Approximately 23% of the wild and 15% of the hatchery-reared scale samples were not readable due to regeneration or poor mounting; thus, 135 wild and 55 hatchery-reared samples were aged (Table 11). Ocean age 3 was the dominant age class for both wild (62.9%, SE = 4.8%) and hatchery-reared (45.8%, SE = 3.1%) Chinook salmon (Table 11; Figure 8). Ocean age 3 was the most common age for both wild and hatchery-reared females. For males, ocean age 3 was the most common age for wild male Chinook salmon, but ocean age 2 was the most common age in hatchery-reared males. Statistically significant differences were detected between the wild and hatchery-reared Chinook salmon age composition ($\chi^2 = 8.3$, df = 3, $P = 0.041$), and between the age composition for wild and hatchery-reared males ($\chi^2 = 26.2$, df = 3, $P = 0.000$; Table 11). The 2008 overall wild ($\chi^2 = 2.5$, df = 3, $P = 0.47$) and hatchery-reared ($\chi^2 = 0.9$, df = 3, $P = 0.83$) age compositions were similar to their respective 1999–2007 averages (Table 12).

The coefficient of variation (CV, Equation 16) of all scale age estimates was 0.7% and was similar to the CV of scale age estimates for both wild (CV = 0.5%) and hatchery-reared (CV = 1.0%) Chinook salmon. Age was determined for 10 hatchery-reared Chinook salmon from coded wire tag (CWT) recoveries (Table 13). There was an 80% agreement between the resolved age estimates and known ages.

The sex composition of the pooled box samples were found to be biased ($\chi^2 = 7.6$, df = 1, $P = 0.005$). More males were found in the box samples than expected. No differences were found in sex composition between the systematic and census samples ($\chi^2 = 1.0$, df = 1, $P = 0.31$). The male to female ratio was similar between wild (370:402) and hatchery-reared (43:58) Chinook salmon (Table 11). Differences existed in the sex composition of both the wild and hatchery-reared Chinook salmon over the 5 weeks of weir operation. Males were more prevalent until week 3; then females were more prevalent in weeks 4 and 5. The weir census of wild (32) and hatchery-reared (21) jack Chinook salmon were similar to their associated estimated abundance (35 fish [SE = 14.6] and 17 fish [SE = 3.9], respectively; Table 11).

The overall mean length (778 mm) of wild Chinook salmon was larger than the overall mean length (730 mm) of hatchery-reared Chinook salmon (Table 11). Mean lengths at age were different between wild and hatchery-reared males ($\chi^2 = 6.4$, df = 2, $P = 0.05$), but not between wild and hatchery-reared females ($\chi^2 = 1.8$, df = 2, $P = 0.41$).

EGG TAKES

Chinook salmon eggs were collected from 102 females of which 79 were wild and 23 were hatchery-reared (Table 14). The average fecundity was 5,396 eggs per female spawned. The egg take conducted on 28 July sacrificed 9 wild and 1 hatchery-reared female and had a 74.5% egg survival to the eyed stage. The egg take conducted on 5 August sacrificed 59 wild and 19 hatchery-reared females and had an 81.4% egg survival to the eyed stage. The egg take conducted on 8 August sacrificed 11 wild and 3 hatchery-reared females and had a 93.1% egg survival to the eyed stage. The average percent survival to the eyed stage of 82.2% was below

the average (84.8%) of the years 1999–2007. The maximum water temperatures recorded during the egg takes were 12°C (28 July), 14°C (5 August) and 15°C (8 August).

STOCKING

Smolt Release and Marking

Stocking goals[4] were reached at all stocking locations (Tables 3–6). Chinook salmon smolt releases in 2008 were apportioned between the Ninilchik River and 3 terminal saltwater fisheries as follows: 56,943 smolt were stocked at Ninilchik River; 212,141 smolt at NDFL; 58,674 smolt at Halibut Cove Lagoon; and 54,464 smolt at Seldovia Bay. In 2008, the average length (mm) and weight (g) of Chinook salmon smolt stocked in the Ninilchik River (96 mm, 10.3 g), NDFL (102 mm, 11.6 g), Halibut Cove Lagoon (102 mm, 11.6 g), and Seldovia Bay (104 mm, 12.0 g) were smaller than their respective length and weight averages from recent years (Tables 3–6).

Straying

A total of 13 heads were collected for CWT analysis from female hatchery-reared Chinook salmon sacrificed during egg takes (Table 13; Appendix F1). Coded wire tags were successfully decoded from 10 heads. All of the samples originated from stocking in the Ninilchik River. In 2008, 4 Ninilchik River hatchery-reared Chinook salmon were detected in the Ninilchik River Tribe's educational fishery (Appendix F2). One other Ninilchik River hatchery-reared Chinook salmon was detected in Lower Cook Inlet Management Area fisheries or escapement projects in 2008.

Local Guide Harvest

In 2008, the guided hatchery-reared Chinook salmon percentage of the total Chinook salmon catch and harvest was 34.1% (SE = 3.2%) and 55.8% (SE = 7.0%), respectively (Table 15). The composition of the Chinook salmon catch differed over the course of the combined fisheries (χ^2 = 9.5, df = 4, P = 0.048). The catch rate peaked at 3.5 Chinook salmon per angler (138/39) during the first 5 days of the July fishery. The 2008 hatchery-reared percentage of the Chinook salmon harvest (55.8%, SE = 7.0) was not significantly different than that found in 2006 (χ^2 = 2.3, df = 1, P = 0.127; 68.4%, SE = 4.8) or in 2007 (χ^2 = 1.7, df = 1, P = 0.190; 67.1%, SE = 5.3%) (Booz and Kerkvliet 2011a, 2011b).

DISCUSSION

The 2008 Ninilchik River wild Chinook salmon escapement (586 fish) exceeded the lower SEG boundary by 36 fish but was below the 1999–2007 average escapement during the SEG index monitoring period (928 fish; Table 8). The 2008 escapement of hatchery-reared Chinook salmon during the SEG index monitoring period (67 fish) was also below this average. From 1999 through 2005, when the weir was operated over the entire Chinook salmon run, between 57% and 87% of the annual wild Chinook salmon run was counted during the SEG index monitoring period (3–31 July; calculated from Table 8). In 2008, a later-than-average wild Chinook salmon run timing was observed. This suggests that an even larger percentage of the total run was

[4] Hatchery-reared Ninilchik River Chinook salmon smolt stocking goals: Ninilchik River (50,000 smolt), NDFL (210,000 smolt), Halibut Cove Lagoon (52,500 smolt), and Seldovia Bay (52,5,000 smolt).

counted during the SEG index monitoring period. It is likely that a greater percentage of the total run was counted during the 2008 SEG index monitoring period due to the low numbers of wild Chinook salmon observed in the first 2 weeks of weir operation (30 June–13 July; Appendix B1).

The number of hatchery-reared Chinook salmon in the escapement was similar to that found in 2007 (Booz and Kerkvliet 2011b) and is the lowest since the inception of the Ninilchik River stocking program. The reduced contribution was likely influenced by the combination of a poor run and the new July fishery for hatchery-reared fish. In 2008, decreased Chinook salmon run sizes were also observed in several other Cook Inlet streams and poor runs were observed at the terminal saltwater fisheries in Kachemak Bay, particularly NDFL.

The new July fishery for hatchery-reared Chinook salmon seems to have functioned similarly to the 2006 and 2007 EO fisheries, when harvesting of additional hatchery-reared fish was allowed. Based on the logbook data, these additional fishing opportunities have been effective in shifting the majority of the Chinook salmon harvest from wild to hatchery-reared fish. The high guided catch rates early in July rapidly decreased to no fish caught after July 11. Anecdotal information from anglers who participated in the July fishery advised managers that a high percentage of captured hatchery-reared Chinook salmon were mature and thus released because of the low quality of the flesh.

The use of a caudal clip to identify fish caught at the weir during the SEG index monitoring period facilitated the identification of those Chinook salmon that subsequently became mortalities associated with holding and spawning for egg takes (the clip also provided better tracking for escapement monitoring). Some clips on mature females were, however, hard to indentify during egg takes. Because most egg-take mortalities were from the SEG index monitoring period, we assumed that any fish without an identifiable caudal clip was from the SEG index monitoring period. A slight increase in the size of the clip should make the clips more identifiable.

Box sampling mitigated the problems associated with maintaining an unbiased sampling order from the live box. However, to obtain representative samples throughout the run, we recommend applying a box-sampling technique at periodic intervals throughout the run. The number of box-sampled fish would be calculated as a pre-determined percentage of the number of Chinook salmon that had arrived at the weir over a pre-determined previous number of days. Sampling would be conducted continuously until the target number is reached.

Problems encountered with unusually high river levels and shifts in sex composition complicated our ability to successfully hold and spawn Chinook salmon for egg takes. Although we failed to meet the egg-take goal by 13 spawning pairs, the number of eggs collected should be adequate to meet the 2010 stocking goals for all locations. In the future, further measures will be taken to ensure the structural integrity of the holding area.

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TABLES

Table 1.–Characteristics of Ninilchik River drainage.

Drainage characteristics	Total
Watershed area	347.9 km^2
Wetland area	122.5 km^2
Percent wetlands	35.2 %
Stream length	260.7 RKM
Anadromous stream length	81.0 RKM
Percent mapped anadromous	31.1%

Source: S. Baird, Kachemak Bay Research, Homer, AK, unpublished data, 2006.

Note: "RKM" = river kilometers.

Table 2.–Statewide Harvest Survey estimates of angler effort and Chinook salmon harvest and catch compared to the number of days open to fishing for Ninilchik River Chinook salmon, 1977–2008.

Year	Angler effort-days fished[a] Estimate	SE	Chinook salmon Harvest Estimate	SE	Percent jack[c]	Catch[b] Estimate	SE	Percent jack[c]	Percent hatchery harvest[d]	Days open to fishing[e]
1977	11,350	–	1,168	–	ND	ND	–	ND	NA	8
1978	14,173	–	1,445	–	ND	ND	–	ND	NA	9
1979	18,282	–	1,493	–	ND	ND	–	ND	NA	9
1980	19,706	–	723	–	ND	ND	–	ND	NA	9
1981	14,184	–	1,523	–	11.0	ND	–	ND	NA	9
1982	11,806	–	1,240	–	14.9	ND	–	ND	NA	9
1983	9,458	–	871	–	7.8	ND	–	ND	NA	9
1984	10,122	–	648	–	20.9	ND	–	ND	NA	9
1985	10,213	–	983	–	12.9	ND	–	ND	NA	9
1986	9,250	–	420	–	14.1	ND	–	ND	NA	9
1987	13,329	–	1,112	–	2.2	ND	–	ND	NA	9
1988	12,533	–	795	–	7.6	ND	–	ND	NA	9
1989	9,997	–	744	–	42.8	ND	–	ND	ND	9
1990	8,323	–	693	–	16.9	1,598	–	16.4	ND	9
1991	19,640	–	3,123	–	13.4	5,260	–	11.5	77	12
1992	27,816	–	5,316	–	8.6	11,425	–	17.4	57	19
1993	20,466	–	4,235	–	9.2	9,491	–	11.3	50	23
1994	21,827	–	3,108	–	ND	5,482	–	ND	45	23
1995	16,160	–	2,451	–	ND	4,313	–	ND	50	23
1996	11,445	1,034	2,401	289	ND	7,481	1,389	ND	50	19
1997	11,064	718	3,263	309	ND	6,879	868	ND	ND	9
1998	10,994	1,871	1,453	179	ND	3,395	538	ND	ND	9
1999	15,344	2,493	1,945	260	ND	4,153	616	ND	ND	9
2000	12,432	1,514	1,782	218	ND	4,648	582	ND	49	9
2001	10,602	1,137	1,399	204	ND	3,014	496	ND	51	12
2002	9,572	1,169	830	180	ND	2,180	418	ND	ND	12
2003	9,843	1,148	1,452	245	ND	4,205	887	ND	ND	26
2004	10,500	1,464	1,240	224	ND	2,961	ND	ND	ND	55
2005	9,003	1,540	1,342	241	ND	2,042	420	ND	ND	9
2006	9,620	1,092	1,329	229	ND	3,004	509	ND	≥39[f]	40
2007	10,211	1,101	1,575	304	ND	4,774	1,108	ND	ND	58
2008	8,158	1,262	976	296	22.5	2,090	493	15.3	ND	23

-continued-

Table 2.–Page 2 of 2.

Year	Angler effort-days fished[a] Estimate	SE	Chinook salmon Harvest Estimate	SE	Percent jack[c]	Catch[b] Estimate	SE	Percent jack[c]	Percent hatchery harvest[d]	Days open to fishing[e]
Average										
Pre-stocking (1977–1990)	12,338		990			1,598				
High stocking (1991–1998)	17,427		3,169			6,716			55	
Low stocking (1999–2007)	10,792		1,433			3,442			50	

Source: Statewide harvest survey estimates gathered from the published reports for each year (Mills 1979-1994; Howe et al. 1995-1996, 2001a-d; Walker et al. 2003; Jennings et al. 2004, 2006a-b, 2007, 2009a-b, 2010a-b).

Note: Standard errors were calculated using the bootstrap method. Because the empirical distribution of derived confidence intervals for these estimates is not symmetrical, valid confidence intervals cannot be obtained directly. Standard errors for estimates not calculated until 1996.

Note: ND = no data; "–" = cannot be computed due to limitations of the data; NA = not applicable.

[a] The estimates for days fished are for the entire season not just for Chinook salmon.

[b] Catch is defined as the number of fish caught and released or harvested. Estimates from Gretchen Jennings, project manager, Alaska Statewide Harvest Survey (SWHS) unpublished data, ADF&G, Division of Sport Fish, Anchorage.

[c] The percentage of the total harvest that is less than 20 in. From 1981 through 1993 and 2008, the SWHS estimates were calculated by large and small Chinook salmon. Prior to 1981 and from 1994 through 2007, the SWHS estimates were for all Chinook salmon, not by size.

[d] Estimated by creel survey 1991–1993; estimated by catch sampling 1994–1996, 2000, 2001, and 2006.

[e] Standardized to end on 14 July. Additional days added through emergency order (EO) for 1991 through 2007. Starting in 2008, the regulatory fishery was open from 1 July through 31 December. See Appendix A4.

[f] The 2006 percent hatchery harvest estimate from the SWHS should be viewed as a minimum because an unknown number of hatchery fish were harvested in an EO fishery that happened after the survey was conducted. See Booz and Kerkvliet (Booz and Kerkvliet 2011a).

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Table 3.–Chinook salmon smolt released at Ninilchik River, 1988–2008.

Release year	Release date	Brood year	Number of smolt[a]	Release location[b]	Hatchery	Mark type[c]	% Finclip[d]	% CWT	CWT tag code	Avg. length. (mm)	Avg. wt. (g)
1988	6 Jul	1987	248,586	Harbor	Ft. Richardson	Ad, CWT	ND	12.5	311762	ND	12.5
1989	1 Jun	1988	200,203	Harbor	Ft. Richardson	Ad, CWT	ND	9.4	311830	ND	11.8
1990	30 May	1989	215,804	Harbor/Brody	Ft. Richardson	Ad, CWT	ND	18.7	311735	ND	12.8
1991	22 May	1990	87,992	Brody	Ft. Richardson	Ad, CWT	ND	23.9	311934	100	12.0
1992	28 May	1991	132,387	Brody	Ft. Richardson	Ad, CWT	ND	31.2	312104	107	12.5
1993	8 Jun	1992	184,585	Brody	Ft. Richardson	Ad, CWT	ND	23.3	312159	107	14.7
1994	31 May	1993	201,513	Brody	Ft. Richardson	Ad, CWT	ND	22.6	312318	ND	12.0
1995	31 May	1994	54,662	Harbor	Ft. Richardson	Ad, CWT	ND	99.0	312435	ND	14.1
1996	13 Jun	1995	51,688	Harbor	Ft. Richardson	Ad, CWT	ND	98.4	312515	ND	12.9
1997	17 Jun	1996	50,292	Brody	Ft. Richardson	Ad, CWT, TM	ND	99.2	312608	ND	12.0
1998	15 Jun	1997	48,798	Brody	Ft. Richardson	Ad, CWT, TM	ND	97.3	312635	ND	11.4
1999	15 Jun	1998	49,853	Brody	Ft. Richardson	Ad, CWT, TM	ND	98.1	310147	104	13.6
2000	2 Jun	1999	51,298	Brody	Ft. Richardson	Ad, CWT, TM	ND	97.5	310248	96	10.2
2001	13 Jun	2000	54,770	Brody	Ft. Richardson	Ad, CWT, TM	ND	99.4	310260	104	13.6
2002	14 Jun	2001	54,631	Brody	Ft. Richardson	Ad, CWT, TM	ND	99.1	310282	101	12.1
2003	12 Jun	2002	47,997	Brody	Ft. Richardson	Ad, CWT, TM	ND	92.4	310256	105	12.6
2004	12 May	2002[e]	51,303	Brody	Ft. Richardson	Ad, CWT, TM	ND	92.4	310193	105	12.6
2005	19 May	2003[e]	55,229	Brody	Ft. Richardson	Ad, CWT, TM	ND	99.9	310318	101	11.9
2006	17 May	2004[e]	57,537	Brody	Ft. Richardson	Ad, CWT, TM	99.2	99.4	310341	102	12.5
2007	17 May	2005[e]	56,368	Brody	Ft. Richardson	Ad, CWT, TM	99.5	99.7	310366	92	8.7
2008	15 May	2006[e]	56,943	Brody	Ft. Richardson	Ad, CWT, TM	99.9	99.5	310372	96	10.3
Average 1995–2007			52,648				99.4	97.8		101.1	12.2

Note: ND = no data.

[a] Number released includes smolt that shed coded wire tags.

[b] Harbor = Ninilchik River harbor located at the mouth; Brody = Brody Road bridge; Harbor/Brody = 50% released in the harbor and 50% released at the bridge.

[c] Ad = adipose finclip; CWT = coded wire tag; TM = thermal mark.

[d] Smolt were checked prior to release for quality of adipose finclip starting in 2006.

[e] Smolt were released as freshwater-age-1 fish beginning in 2004.

Table 4.–Chinook salmon smolt released at Nick Dudiak Fishing Lagoon terminal saltwater fishery on Homer Spit, 2000–2008.

Nick Dudiak Fishing Lagoon							
Release year	Release date	Brood year	Number	Hatchery[a]	Mark type[b]	Average length (mm)	Average weight (g)
2000	31 May	1999	102,243	Elm.	NM	117	17.8
2000	7 Jun	1999	117,741	Elm.	NM	119	17.8
2001	25 May	2000	101,799	Elm.	NM	104	13.9
2001	8 Jun	2000	106,263	Elm.	NM	112	13.9
2002	30 May	2001	122,444	Elm.	TM	102	12.1
2002	6 Jun	2001	67,582	Elm.	TM	107	12.1
2003	6 Jun	2002	126,229	Fort R.	TM	102	12.0
2003	28 May	2002	80,063	Fort R.	TM	104	12.0
2004	7 Jun	2002[c]	95,105	Fort R.	TM	109	13.9
	10 Jun		47,932	Fort R.	TM	109	13.9
2004	10 Jun	2003	25,706	Elm.	TM	112	15.6
2005	10 Jun	2003[c]	111,196	Fort R.	TM	107	13.0
2005	13 Jun	2003[c]	109,626	Fort R.	TM	104	13.0
2006	19 Jun	2004[c]	111,089	Fort R.	TM	107	13.2
	22 Jun		112,964	Fort R.	TM	107	13.2
2007	11 Jun	2005[c]	113,636	Fort R.	TM	102	10.3
	14 Jun		113,336	Fort R.	TM	102	10.3
2008	13 Jun	2006[c]	110,802	Fort R.	TM	104	11.6
	17 Jun		101,339	Fort R.	TM	99	11.6
Average (2000–2007)			208,119			107.3	13.4

Note: All smolt released at Nick Dudiak Fishing Lagoon were produced from the Ninilchik River egg-take project.

[a] Fort R. = Fort Richardson Hatchery; Elm. = Elmendorf Hatchery.

[b] NM = no mark; TM = thermal mark.

[c] Smolt were released as freshwater-age-1 fish beginning in 2004.

Table 5.–Chinook salmon smolt released at Halibut Cove Lagoon terminal saltwater fishery, 1995–2008.

Halibut Cove Lagoon								
Release year	Release date	Brood year	Number[a]	Hatchery[b]	Mark type[c]	CWT tag code	Average length (mm)	Average weight (g)
1995	13 Jun	1994	37,577	Elm.	Ad, CWT	312430	ND	23.6
1996	4 Jun	1995	97,729	Elm.	Ad, CWT	312511	ND	18.5
1997	9 Jun	1996	78,133	Elm.	Ad, CWT	312558	ND	13.4
1998	12 Jun	1997	65,893	Elm.	Ad, CWT	312632	114	17
1999	1 Jun	1998	79,221	Elm.	NM		114	16.7
2000	1 Jun	1999	83,277	Elm.	NM		114	16.5
2001	5 Jun	2000	106,719	Elm.	NM		104	15.7
2002	28 May	2001	106,279	Elm.	TM		104	12.7
2003	17 Jun	2002	106,844	Fort R.	TM		104	12.5
2004	4 Jun	2002[d]	103,771	Fort R.	TM		107	13.6
2005	15 Jun	2003[d]	112,521	Fort R.	TM		107	13
2006	14 Jun	2004[d]	117,549	Fort R.	TM		102	11.7
2007	13 Jun	2005[d]	54,560	Fort R.	TM		97	9.8
2008	19 Jun	2006[d]	58,674	Fort R.	TM		102	11.6
Average (1995–2007)			88,467				106.7	15.0

Note: All smolt released at Halibut Cove Lagoon were produced from the Ninilchik River egg-take project. ND = no data.

[a] Number released includes smolt that had shed their coded wire tags.

[b] Fort R. = Fort Richardson Hatchery; Elm. = Elmendorf Hatchery.

[c] Ad = adipose finclip; CWT = coded wire tag; TM = thermal mark; NM = no mark.

[d] Smolt were released as freshwater-age-1 fish beginning in 2004.

Table 6.–Chinook salmon smolt released at Seldovia Bay terminal saltwater fishery, 1996–2008.

Seldovia Bay								
Release year	Release date	Brood year	Number of smolt[a]	Hatchery[b]	Mark type[c]	CWT tag code	Average length (mm)	Average weight (g)
1996	12 Jun	1995	118,274	Elm.	Ad,CWT	312510	ND	18.2
1997	6 Jun	1996	103,757	Elm.	Ad,CWT	312557	ND	13.6
1998	9 Jun	1997	69,461	Elm.	Ad,CWT	312631	109	13.8
1999	28 May	1998	74,057	Elm.	NM		117	17.6
2000	6 Jun	1999	68,114	Elm.	NM		119	19.2
2001	7 Jun	2000	102,793	Elm.	NM		109	14.2
2002	28 May	2001	83,045	Elm.	TM		107	13.4
2003	11 Jun	2002	107,521	Fort R.	TM		102	11.4
2004	18 May	2003	88,682	Elm.	TM		107	12.9
2005	7 Jun	2003[d]	114,984	Fort R.	TM		107	13.2
2006	30 May	2004[d]	113,974	Fort R.	TM		102	11.4
2007	5 Jun	2005[d]	54,276	Fort R.	TM		99	10.5
2008	3 Jun	2006[d]	54,464	Fort R.	TM		104	12.0
Average (1996–2007)			91,578				107.7	14.1

Note: All smolt released at Seldovia Bay were produced from the Ninilchik River egg-take project. ND = no data.

[a] Number released includes smolt that had shed their coded wire tags.

[b] Fort R. = Fort Richardson Hatchery; Elm. = Elmendorf Hatchery.

[c] Ad = adipose finclip; CWT = coded wire tag; TM = thermal mark; NM = no mark.

[d] Smolt were released as freshwater-age-1 fish beginning in 2005.

Table 7.–Ninilchik River Chinook salmon weir data, 1989–2008.

		Chinook salmon run			Egg take	CWT Chinook salmon		Escapement	
Year	Weir operating dates	Component	No. of fish	%	mortality	Fish recovered	Strays detected[a]	Fish[b]	%
1989	4– 25 July	Total[c]	254		ND	ND	ND	ND	
1990	6– 27 July	Total[c]	315		ND	ND	ND	ND	
1991	1–17 July	Total[c]	338		ND	12	ND	ND	
1992	30 June–14 July	Total[c]	539		ND	59	ND	ND	
1993	NL		NL	NL	NL	38	1	NL	NL
1994	7–26 July	Wild	446	81	ND	NA	NA	446	–
		Hatchery-reared	103[d]	19	ND	43	0	60	–
		Total[e]	549	100	125	43	0	381	
1995	4 July–1 August	Wild	725	63	ND	NA	NA	725	–
		Hatchery-reared	425[d]	37	ND	135	0	290	–
		Total[e]	1,150	100	194	135	0	821	
1996	2–24 July	Wild	654	69	ND	NA	NA	654	–
		Hatchery-reared	290[d]	31	ND	69	0	221	–
		Total[e]	944	100	190	69	0	685	
1997	1 July–11 August	Wild	579	53	ND	NA	NA	579	–
		Hatchery-reared	517[d]	47	ND	181	2	336	–
		Total[e]	1,096	100	132	181	2	783	
1998	3 July–1 August	Wild	536	53	ND	NA	NA	536	53
		Hatchery-reared	466[d]	47	ND	0	0	466	47
		Total	1,002	100	196	0	0	1002	
1999	18 May–13 August	Wild	1,644	72	68	NA	NA	1,576	73
		Hatchery-reared	641	28	26	42	0	573	27
		Total[f]	2,285	100	94	42	0	2,149	
2000	17 May– 8 August	Wild	1,634	66	81	NA	NA	1,553	69
		Hatchery-reared	853	34	60	108	1	685	31
		Total	2,487	100	141	108	1	2,238	
2001	30 May–5 August	Wild	1,414	68	175	NA	NA	1,239	70
		Hatchery-reared	673	32	0	130	0	543	30
		Total	2,087	100	175	130	0	1,782	

-continued-

Table 7.–Page 2 of 3.

Year	Weir operating dates	Chinook salmon run Component	No. of fish	%	Egg take mortality	CWT Chinook salmon Fish recovered	Strays detected[a]	Escapement Fish[b]	%
2002	23 May–11 August	Wild	1,516	73	176	NA	NA	1,340	77
		Hatchery-reared	559	27	55	109	0	395	23
		Total	2,075	100	231	109	0	1,735	
2003	16 May–5 August	Wild	1,258	75	131	NA	NA	1,127	77
		Hatchery-reared	425	25	52	37	5	336	23
		Total	1,683	100	183	37	5	1,463	
2004	18 May–5 August	Wild	1,525	74	132	NA	NA	1,393	75
		Hatchery-reared	536	26	0	67	1	469	25
		Total	2,061	100	132	67	1	1,862	
2005	6 May–4 August	Wild	2,241	83	165	NA	NA	2,076	84
		Hatchery-reared	462	17	0	53	0	409	16
		Total	2,703	100	165	53	0	2,485	
2006	30 June–1 August	Wild	1,139	81	101	NA	NA	1,038	84
		Hatchery-reared	273	19	35	34	1	204	16
		Total	1,412	100	136	34	1	1,242	
2007	2 July–1 August	Wild	679	89	129	NA	NA	550	90
		Hatchery-reared	83	11	20	0	0	63	10
		Total	762	100	149	0	0	613	
2008	30 June–7 August	Wild	772	88	140	NA	NA	632	90
		Hatchery-reared	101	12	30	0	0	70[g]	10
		Total	873	100	170	0	0	702[g]	
Averages									
1999–2005		Wild	1,605	73	133	NA	NA	1,472	75
		Hatchery-reared	593	27	28	78	1	487	25
		Total	2,197	100	160	78	1	1,959	
2006–2007		Wild	909	84	115	NA	NA	794	86
		Hatchery-reared	178	16	28	17	1	134	14
		Total	1,087	100	143	17	1	928	

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Table 7.–Page 3 of 3.

Note: NL = no data located; ND = no data; "–" = value cannot be computed due to limitations of the data; NA = not applicable.

[a] Number of Chinook salmon strays from other drainages that were recovered in Ninilchik River. Note: the number of strays are included in the coded wire tag (CWT) recovered total.

[b] Chinook salmon escapement = [total run - (egg take mortality + CWT recovered)].

[c] Number of wild and hatchery-reared Chinook salmon used in egg take unavailable; therefore total escapement does not account for mortality.

[d] Number of hatchery-reared Chinook salmon in the weir counts were expanded by the percent of CWT fish.

[e] Number of wild and hatchery-reared Chinook salmon used in egg take unavailable.

[f] Run includes the 31 wild and 38 hatchery-reared Chinook salmon that were captured in nets below the weir.

[g] Escapement was subtracted by additional fish that died in the live box.

Table 8.–Number and escapement of wild and hatchery-reared Chinook salmon counted at the Ninilchik River weir during the SEG index monitoring period, 1999–2008.

	Wild Chinook salmon				Hatchery-reared Chinook salmon			
		SEG period[a]				SEG period[a]		
Year	Total run	Weir counts[b]	Escapement counts[c]	Escapement % of run	Total run	Weir counts[b]	Escapement counts[c]	Escapement % of run
1999	1,576	1,351	1,283	81.4	573	515	447	78.0
2000	1,553	1,346	1,265	81.5	685	786	618	90.2
2001	1,239	1,072	897	72.4	543	601	471	86.7
2002	1,340	1,073	897	66.9	395	403	238	60.3
2003	1,127	648	517	45.9	336	293	204	60.7
2004	1,393	811	679	48.7	469	409	342	72.9
2005	2,076	1,424	1,259	60.6	409	339	286	69.9
2006	ND	1,114	1,013	–	ND	260	191	–
2007	ND	672	543	–	ND	83	63	–
2008	ND	721	586	–	ND	83	62	–
Average 1999–2005	1,472	1,104	971	65	487	478	372	74
Average 2006–2007		893	778			172	127	

Note: ND = no data, "–" = value cannot be calculated due to limitations of the data.

[a] SEG = Sustainable Escapement Goal established in 2007 based on weir counts July 3–July 31, 1999–2007.

[b] Weir counts are the number of Chinook salmon that arrive to the weir during the SEG period.

[c] Escapement counts are [weir counts - (sacrificed for egg take + CWT recovered)].

Table 9.–Summary of non-targeted species captured at the Ninilchik River weir, 1999–2008.

	Species					
Year	Dolly Varden	Pink salmon	Chum salmon	Sockeye salmon	Coho salmon	Steelhead trout
1999	0	0	0	300	0	0
2000	134	31	0	0	0	0
2001	309	369	0	707	20	0
2002	723	21	12	150	18	0
2003	175	101	2	19	15	0
2004	181	27	9	16	0	2
2005	429	275	4	45	14	1
2006	435	68	12	9	9	2
2007	201	35	14	1	3	1
2008	135	28	4	14	80	1
Average 1999–2005	279	118	4	177	10	0
Average 2006–2007	318	52	13	5	6	2

Table 10.–Average, maximum, and minimum water temperature, discharge and stage height for Ninilchik River during the SEG index monitoring period, 3–31 July, 1999–2008.

	Ninilchik River								
	River temperature (°C)			Discharge (ft^3/s)			Stage height (ft)		
Year	Average	Maximum	Minimum	Average	Maximum	Minimum	Average	Maximum	Minimum
1999	ND	ND	ND	63	101	52	ND	ND	ND
2000	12	19	9	97	199	59	ND	ND	ND
2001	13	17	10	101	197	58	ND	ND	ND
2002	14	18	11	64	115	46	ND	ND	ND
2003	15	20	11	66	129	54	ND	ND	ND
2004	14	19	10	71	106	54	3.17	3.45	3.00
2005	14	19	11	72	99	60	3.18	3.40	3.07
2006	12	16	9	84	113	73	3.30	3.50	3.20
2007	12	17	9	73	99	58	3.19	3.40	3.05
2008	11	17	8	130	336	68	3.53	4.45	3.15
1999–2007									
Average	13	18	10	77	129	57	3.21	3.44	3.08
Minimum	12	16	9	63	99	46	3.17	3.40	3.00
Maximum	15	20	11	101	199	73	3.30	3.50	3.20

Source: Temperature data collected at the NR-2 site by Sue Mauger of Cook Inletkeeper; provisional discharge data collected by the National Weather Service Alaska Pacific Weather Forecast Center.

Note: ND = No Data.

Table 11.–Estimated ocean age and length-at-ocean age of wild and hatchery-reared Chinook salmon runs, Ninilchik River weir, 2008.

	Wild							Hatchery						
		Ocean age							Ocean age					
	UR[a]	1	2	3	4	Total	Sex composition	UR[a]	1	2	3	4	Total	Sex composition
Females														
Number sampled[b]	18	0	11	40	4	73	402	7	0	7	28	2	44	58
Estimated percent		0.0	9.6	38.1	4.4		52.1		0.0	10.9	43.4	3.1		57.4
SE percent		0.0	2.6	3.1	2.1		0.0		0.0	3.1	4.6	1.7		0.0
Estimated abundance[c]		0	74	294	34	402			0	11	44	3		
SE abundance		0.0	20.2	24.2	16.2				0.0	2.3	2.5	1.3		
Mean length		NA	731	797	903	787				748	809	850	798	
SE length			10.7	6.0	15.8	5.7				13.3	6.2	0.0	2.9	
Males														
Number sampled[b]	23	5	22	43	10	103	370	3	7	10	1	0	21	43
Estimated percent		3.4	13.0	24.7	6.8		47.9		16.6	23.7	2.4	0.0		42.6
SE percent		1.3	2.2	2.5	1.9		0.0		3.1	3.5	1.2	0.0		0.0
Estimated abundance[c]		26	101	191	52	370			17	24	2	0		
SE abundance		10.4	16.9	19.1	14.3				3.9	4.0	1.8	0.0		
Mean length		527	724	820	899	768			431	697	820		602	
SE length		30.8	14.0	7.2	8.9	12.0			37.7	16.4	0.0		24.5	
Total														
Number sampled[b]	41	5	33	83	14	176	772	10	7	17	29	2	65	101
Estimated percent		3.4	22.6	62.9	11.1				16.6	34.5	45.8	3.1		
SE percent		2.1	3.8	4.8	3.4				3.8	4.5	3.1	1.3		
Estimated abundance[c]		35	173	479	85	772			17	35	46	3	101	
SE abundance		14.6	24.8	30.8	20.5				3.9	4.6	3.1	1.3		
Jacks counted		32							21					
Mean length		527	723	808	899	778			431	713	810	850	730	
SE length		NA	7.7	4.2	11.2	6.3			37.7	12.5	6.0	0.0	10.0	

[a] UR = unreadable scale samples.

[b] Number sampled for age and length data.

[c] Estimated abundances were calculated using the rounded estimated percent presented in this table.

Table 12.–Estimated annual age composition (percent of total) for wild and hatchery-reared Chinook salmon from the Ninilchik River, 1997–2008.

	Wild				Hatchery			
	Ocean age				Ocean age			
Year	1	2	3	4	1	2	3	4
1997	0.9	9.1	85.5	4.5	12.2	34.5	45.0	8.3
1998	1.5	33.5	36.1	28.9	7.8	29.8	53.9	8.5
1999	0.0	36.4	46.7	16.9	2.5	53.5	33.8	10.2
2000	2.3	10.5	59.3	27.9	4.6	26.7	60.8	7.9
2001	0.9	40.6	41.5	17.0	8.1	41.4	37.9	12.6
2002	3.0	39.1	52.3	5.6	19.4	33.0	46.6	1.0
2003	1.1	26.9	60.0	12.0	9.7	41.7	47.2	1.4
2004	0.0	21.0	50.3	28.7	1.8	31.9	62.8	3.5
2005	6.2	18.2	68.2	7.4	13.0	12.2	67.5	7.3
2006	9.3	30.0	40.0	20.7	32.8	32.8	22.3	11.9
2007	6.1	24.2	54.5	15.2	26.3	31.6	42.1	0.0
2008	3.4	22.6	62.9	11.1	16.6	34.5	45.8	3.1
Average 1999–2007	3.2	27.4	52.5	16.8	13.1	33.9	46.8	6.2

Table 13.–Coded wire tag (CWT) data from hatchery-reared Chinook salmon recovered at Ninilchik River weir, 2008.

CWT code	Brood year	Release		Number of samples	CWT-age[a]		Ocean age based on scale samples								
							1st age estimate			2nd age estimate			resolved age estimate		
		Date	Site		Fresh	Ocean	Corr[b]	Incorr[c]	Unaged[d]	Corr[b]	Incorr[c]	Unaged[d]	Corr[b]	Incorr[c]	Unaged[d]
310341	2003	19 May 2005	Ninilchik River	10	1	3	8	2	0	9	1	0	8	2	0
No tag[e]				3	–	–	–	–	–	–	–	–	–	–	–
Total				13			8	2	0	9	1	0	8	2	0

Note: "–" = value not applicable.

[a] Fresh and ocean ages were determined by comparing brood year, release year, and recovery year.

[b] Number of scale samples where age matched CWT age.

[c] Number of scale samples where age did not matched CWT age.

[d] Number of scale samples that were not aged due to un-readable scales.

[e] CWT was not detected from Chinook salmon samples missing adipose fins.

Table 14.–Ninilchik River Chinook salmon egg take dates, number of females spawned, fecundity, and percent survival to the eyed stage, 1999–2008.

Year	Hatchery	Egg take date	Females spawned[a]	Max. water temp. (°C)	Fecundity[b]		Green egg estimates at		Eyed eggs	
					Assumed	Actual	Egg take	Eyed stage	Total	% survival
1999	Ft. Richardson	7 Jul	6	ND	6,000	6,399	36,000	38,396	34,707	90.4
1999	Ft. Richardson	14 Jul	23	ND	6,000	6,380	138,000	146,734	124,751	85.0
1999	Ft. Richardson	21 Jul	41	ND	6,000	6,179	246,000	253,329	217,827	86.0
1999	Ft. Richardson	27 Jul	19	ND	6,000	5,630	114,000	106,970	98,492	92.1
Average			22	ND	6,000	6,147	133,500	136,357	118,944	
Total			89				534,000	545,429	475,777	87.2
2000	Ft. Richardson	7 Jul	8	14	5,591	5,533	44,726	44,267	35,496	80.2
2000	Ft. Richardson	17 Jul	10	14	5,381	5,660	53,815	56,598	49,257	87.0
2000	Ft. Richardson	24 Jul	36	12	5,421	5,663	195,174	203,876	161,326	79.1
2000	Ft. Richardson	28 Jul	24	14	5,400	5,900	129,600	141,606	127,624	90.1
2000	Ft. Richardson	28 Jul	41	14	5,400	5,794	221,400	237,536	214,659	90.4
Average			24	14	5,439	5,710	128,943	136,777	117,672	
Total			119				644,715	683,883	588,362	86.0
2001	Ft. Richardson	10 Jul	7	14	5,793	5,680	40,551	39,757	26,050	65.5
2001	Ft. Richardson	17 Jul	56	16	5,793	5,843	324,408	327,181	241,786	73.9
2001	Ft. Richardson	25 Jul	42	15	5,793	6,365	243,306	267,331	237,211	88.7
Average			35	15	5,793	5,962	202,755	211,423	168,349	
Total			105				608,265	634,269	505,047	79.6
2002	Ft. Richardson	12 Jul	6	18	6,000	5,852	36,000	35,109	21,112	60.1
2002	Ft. Richardson	16 Jul	11	15	6,000	5,331	66,000	58,644	45,700	77.9
2002	Ft. Richardson	23 Jul	12	14	6,000	5,937	72,000	71,241	60,738	85.3
2002	Ft. Richardson	26 Jul	36	13	6,000	5,576	216,000	200,753	164,910	82.1
2002	Ft. Richardson	30 Jul	32	18	6,000	5,771	192,000	184,672	162,332	87.9
2002	Ft. Richardson	2 Aug	17	18	6,000	5,884	102,000	100,032	84,357	84.3
2002	Elemendorf	19 Jul	16	14	5,888	6,160	94,200	98,557	30,150	30.6
2002	Elemendorf	23 Jul	12	14	5,269	5,863	63,232	70,350	28,140	40.0
2002	Elemendorf	26 Jul	35	13	4,900	4,767	171,520	166,830	123,280	73.9
2002	Elemendorf	30 Jul	32	18	4,950	5,825	158,388	186,394	138,288	74.2
2002	Elemendorf	2 Aug	17	18	4,035	4,997	68,608	84,956	41,540	48.9
Average			21	16	5,549	5,633	112,723	114,322	81,868	
Total			226				1,239,948	1,257,538	900,547	71.6

-continued-

Table 14.–Page 2 of 2.

Year	Hatchery	Egg take date	Females spawned[a]	Max. water temp. (°C)	Fecundity[b]		Green egg estimates at		Eyed eggs	
					Assumed	Actual	Egg take	Eyed stage	Total	% survival
2003	Ft. Richardson	22 Jul	27	18	5,800	6,323	156,600	170,723	147,530	86.4
2003	Ft. Richardson	29 Jul	55	13	5,800	6,240	319,000	343,177	293,695	85.6
2003	Ft. Richardson	1 Aug	41	17	5,800	6,703	237,800	274,834	249,242	90.7
2003	Elemendorf	17 Jul	27	15	7,128	7,251	182,764	195,774	153,162	78.2
Average			38	16	6,132	6,629	224,041	246,127	210,907	
Total			150				896,164	984,508	843,629	85.7
2004	Ft. Richardson	15 Jul	3	16	6,000	5,005	18,000	15,016	7,186	47.9
2004	Ft. Richardson	20 Jul	26	14	6,000	5,941	156,000	154,461	110,634	71.6
2004	Ft. Richardson	26 Jul	57	12	6,000	6,139	343,000	349,937	319,414	91.3
2004	Ft. Richardson	30 Jul	40	13	6,000	5,396	240,000	215,859	195,000	90.3
Average			32	14	6,000	5,620	189,250	183,818	158,059	
Total			126				757,000	735,273	632,234	86.0
2005	Ft. Richardson	20 Jul	14	16	5,811	4,968	81,354	69,550	56,165	80.8
2005	Ft. Richardson	26 Jul	60	14	5,972	5,375	358,320	322,470	284,845	88.3
2005	Ft. Richardson	2 Aug	31	12	5,972	5,365	185,132	166,324	154,087	92.6
Average			35	14	5,918	5,236	208,269	186,115	165,032	
Total			105				624,806	558,344	495,097	88.7
2006	Ft. Richardson	19 Jul	44	11	5,858	6,359	279,796	267,527	229,151	86.0
2006	Ft. Richardson	26 Jul	47	11	5,858	5,142	241,674	277,003	259,843	94.0
2006	Ft. Richardson	1 Aug	11	12	5,858	4,295	47,245	51,845	49,200	95.0
Average			34	11	5,858	5,265	189,572	198,792	179,398	
Total			102				568,715	596,375	538,194	90.2
2007	Ft. Richardson	23 Jul	30	11	6,630	5,934	192,270	172,096	159,808	92.9
2007	Ft. Richardson	30 Jul	62	17	6,219	6,015	372,924	372,924	319,194	85.6
Average			46	14	6,425	5,975	282,597	272,510	239,501	
Total			92				565,194	545,020	479,002	87.9
2008	Ft. Richardson	28 Jul	10	12	4,045	6,048	40,450	54,429	40,564	74.5
2008	Ft. Richardson	5 Aug	78	14	6,175	5,122	481,650	399,542	325,147	81.4
2008	Ft. Richardson	8 Aug	14	15	5,636	5,017	78,904	70,243	65,377	93.1
Average			34	14	5,285	5,396	200,335	174,738	143,696	
Total			102				601,004	524,214	431,088	82.2
Average (1999–2007)			115	14	5,902	5,798	715,423	726,738	606,432	84.8

Note: ND = no data collected.

[a] Only ripe females were counted, and this number does not necessarily match the number of fish sacrificed during the egg take.

[b] Number of green eggs per female.

Table 15.–Ninilchik River wild and hatchery-reared Chinook salmon inriver harvest and catch reported in freshwater sport fish guide logbooks for regulatory 3-day weekend and July fisheries, 2008.

				Chinook salmon									
				Harvest					Catch				
				Wild		Hatchery-reared			Wild		Hatchery-reared		
Fishery	Period	Dates	Anglers	Number	%	Number	%	SE[a]	Number	%	Number	%	SE[a]
Weekends	1	24-26 May	12	1	100.0	0	0.0	0.0	1	100.0	0	0.0	0.0
	2	31 May–2 Jun	37	7	87.5	1	12.5	12.5	8	88.9	1	11.1	11.1
	3	7–9 Jun	30	15	83.3	3	16.7	9.0	22	88.0	3	12.0	6.6
	Overall		79	23	85.2	4	14.8	7.0	31	88.6	4	11.4	5.5
July[b]	5-Day	1–5 Jul	39	0	0.0	15	100.0	0.0	85	61.6	53	38.4	4.2
	6-Day	1–6 Jul	42	0	0.0	10	100.0	0.0	31	62.0	19	38.0	6.9
	Overall		81	0	0.0	25	100.0	0.0	116	61.7	72	38.3	3.6
Combined fisheries			160	23	44.2	29	55.8	7.0	147	65.9	76	34.1	3.2

[a] Binomial proportion; the calculated standard error applies for both wild and hatchery-reared percentages.

[b] Closed to the harvest of wild Chinook salmon.

FIGURES

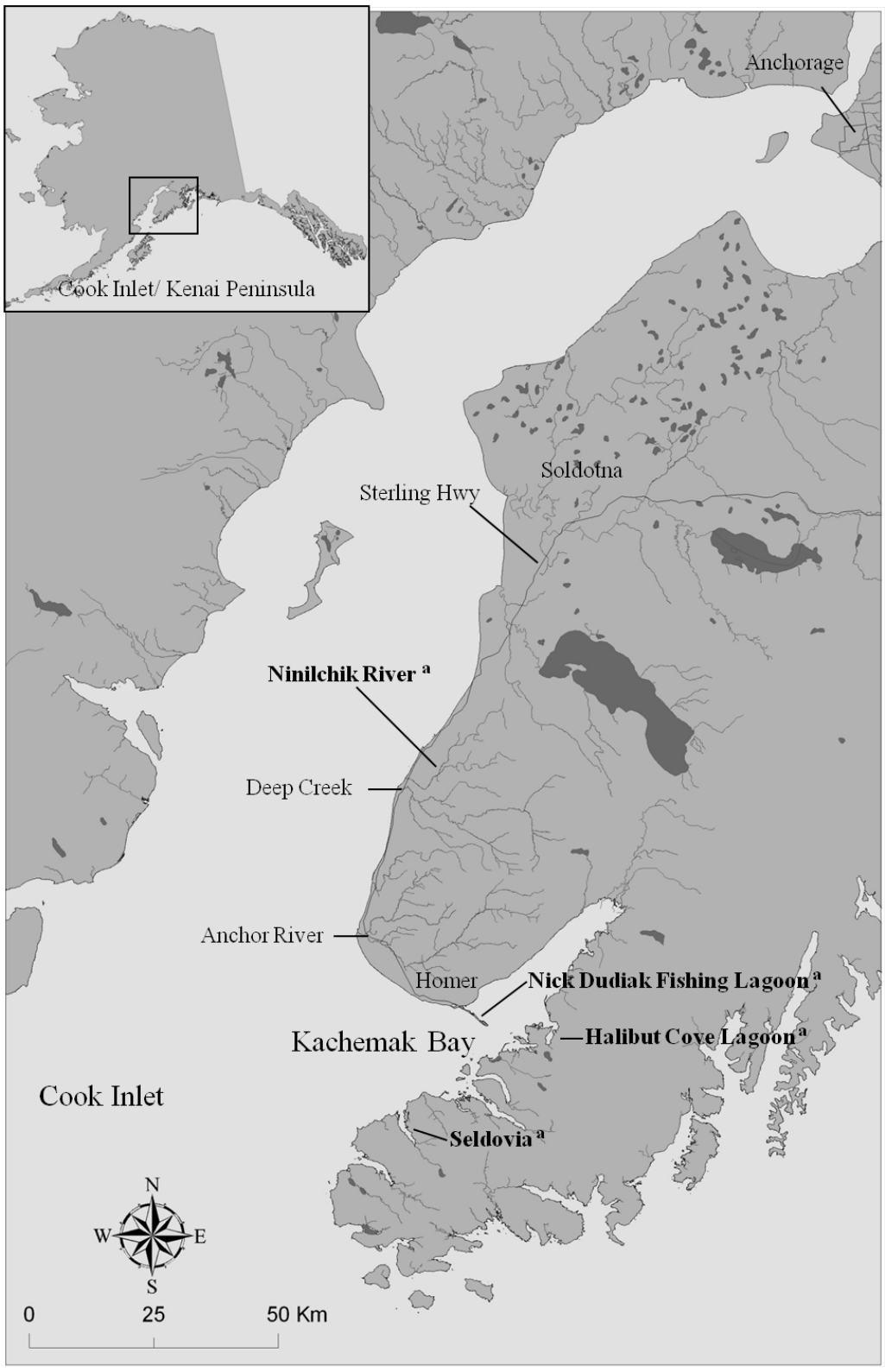

Figure 1.–Map of Kenai Peninsula highway system, Ninilchik River, and Kachemak Bay Chinook salmon stocking locations, 1999–2008.

[a] Stocking locations for Ninilchik River Chinook salmon broodstock.

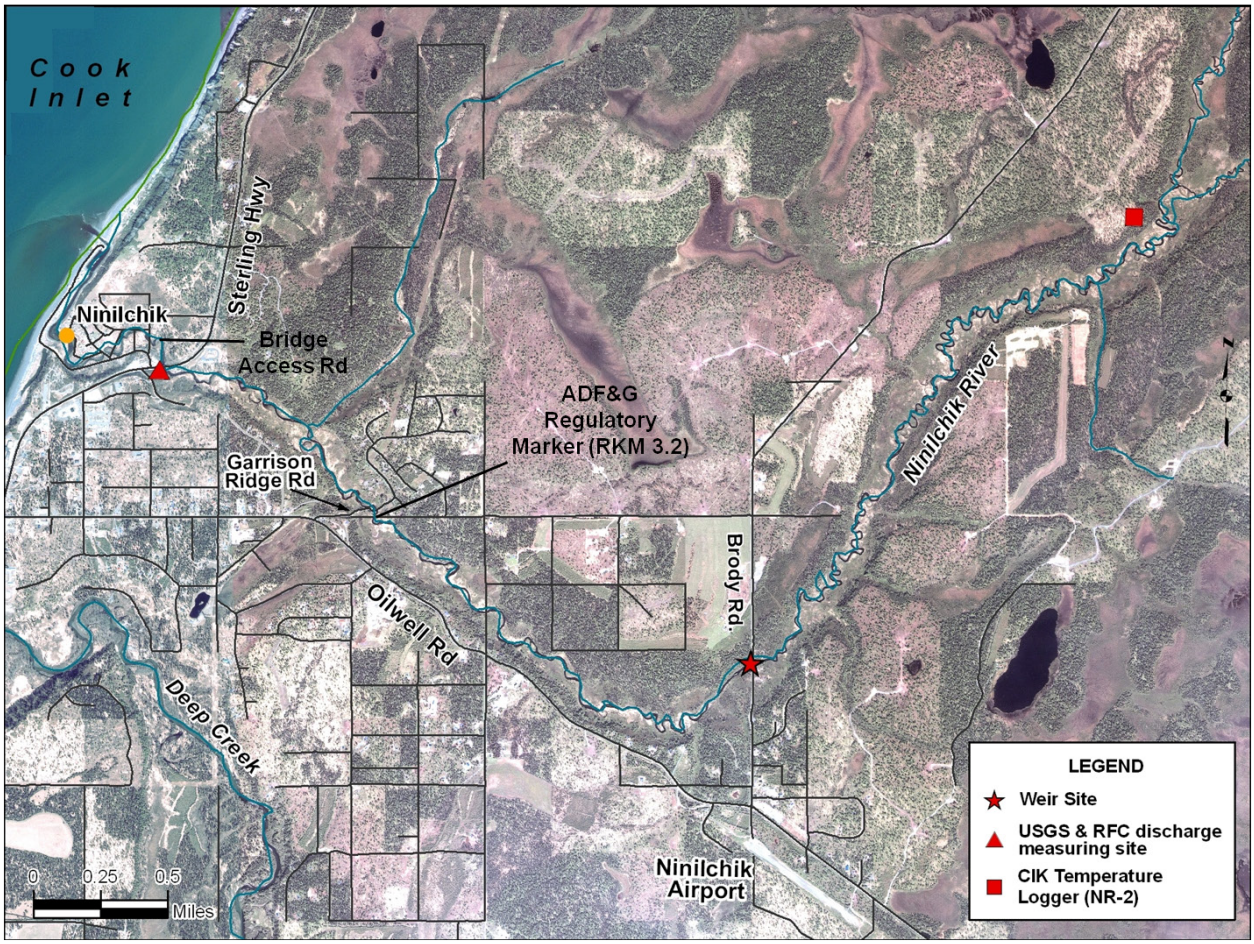

Figure 2.–Map of Ninilchik River sampling locations, 2008.

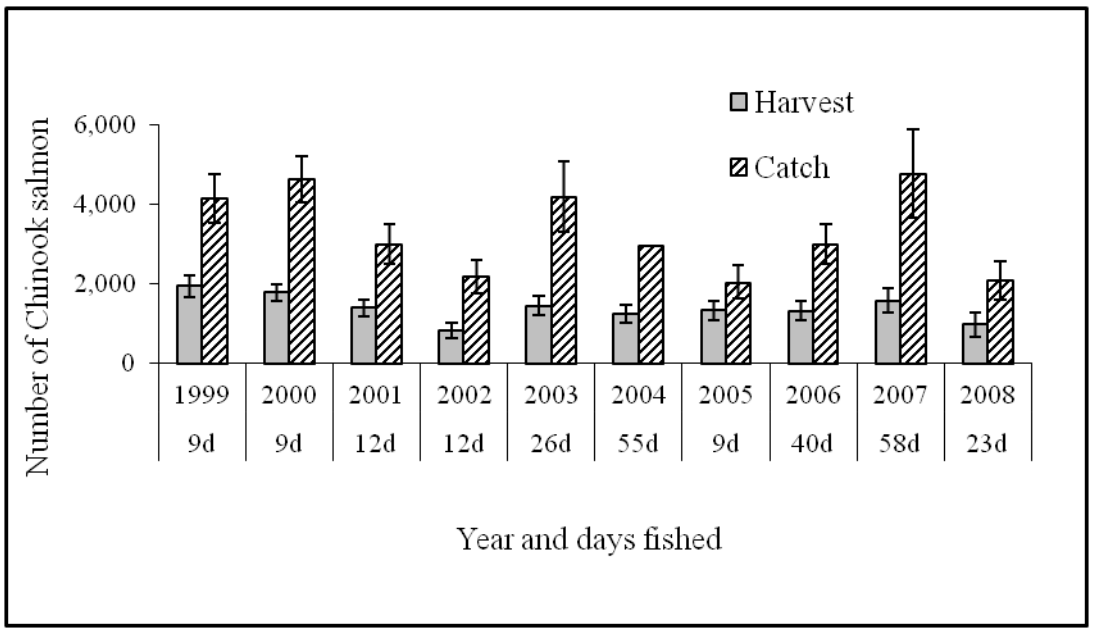

Figure 3.–Statewide harvest survey estimates of catch and harvest of Chinook salmon in the Ninilchik River, 1999–2008.

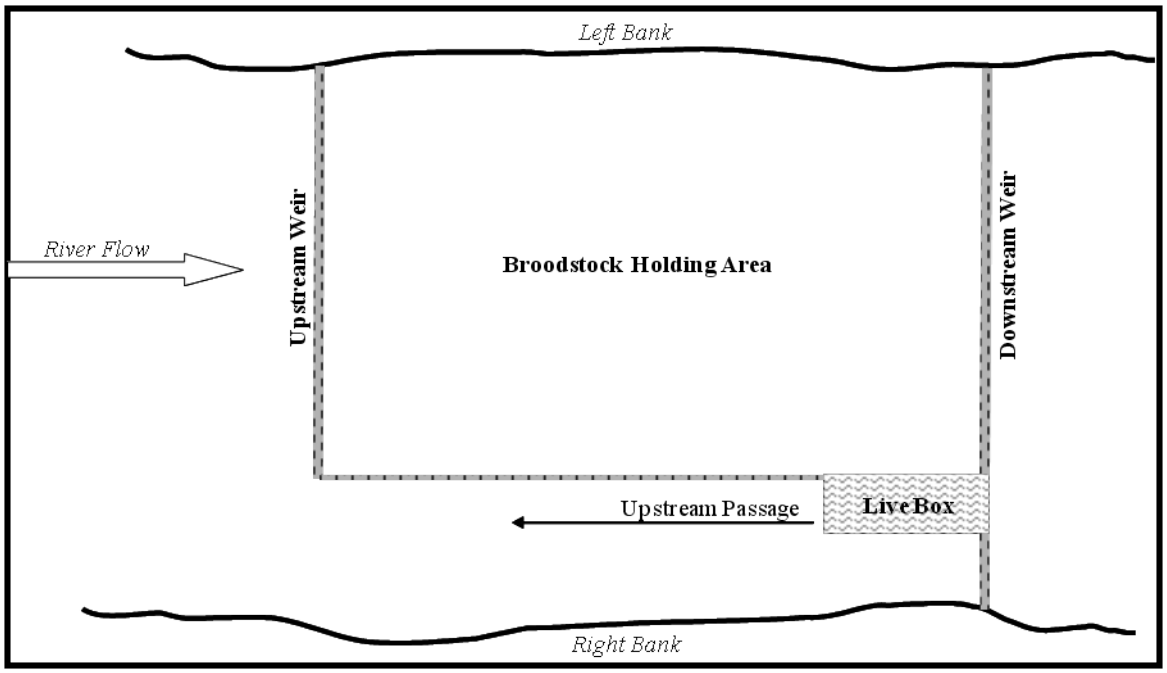

Figure 4.–The configuration of the Ninilchik River weirs and location of the broodstock holding area, 2008.

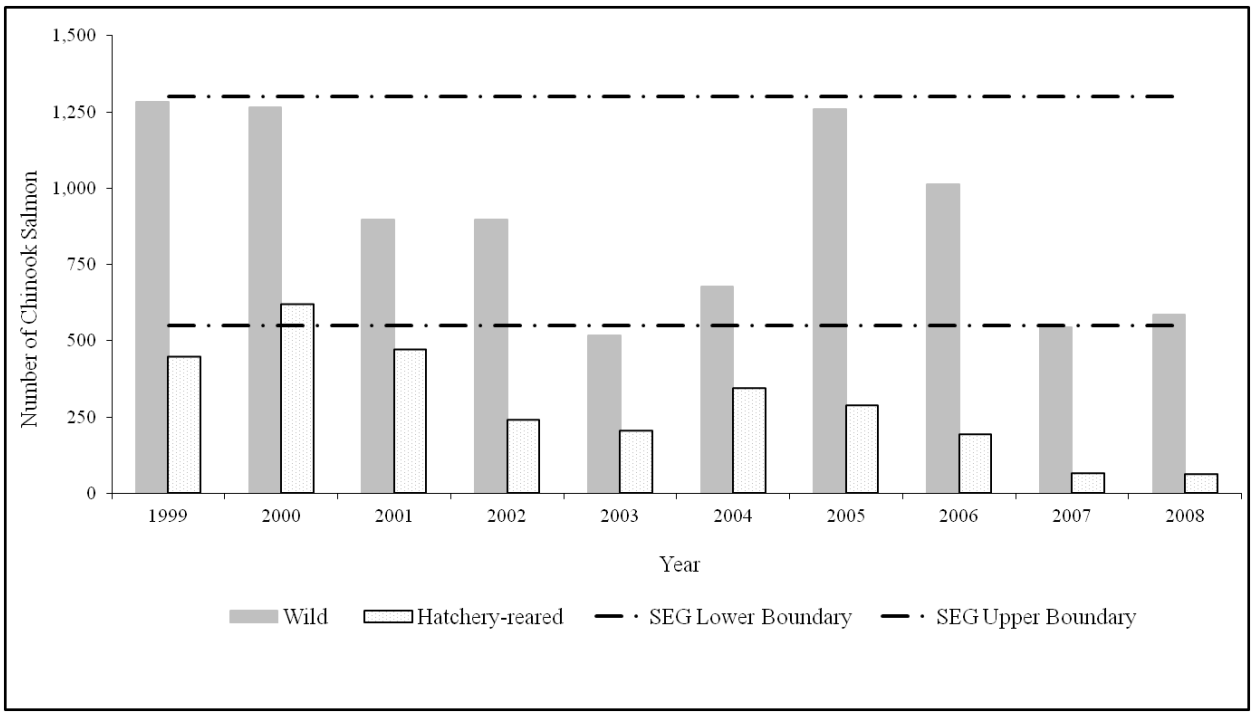

Figure 5.–Comparison of Ninilchik River Chinook salmon weir counts during the sustainable escapement goal (SEG) index monitoring period (July 3–31) with the upper and lower boundaries of the SEG range, 1999–2008.

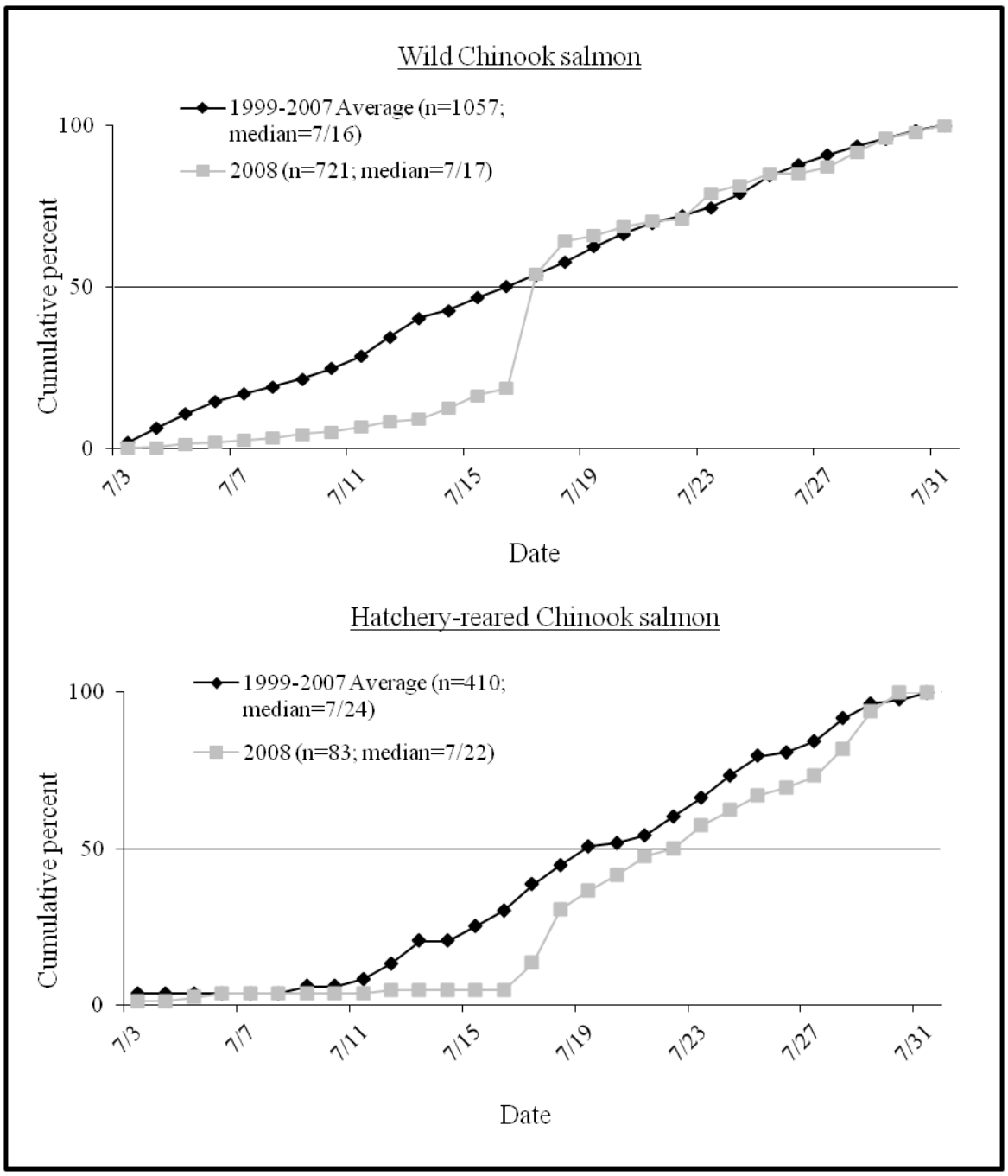

Figure 6.–Run timing cumulative percent of wild (top) and hatchery-reared (bottom) components of the Chinook salmon weir counts during SEG index monitoring period, 1999–2008.

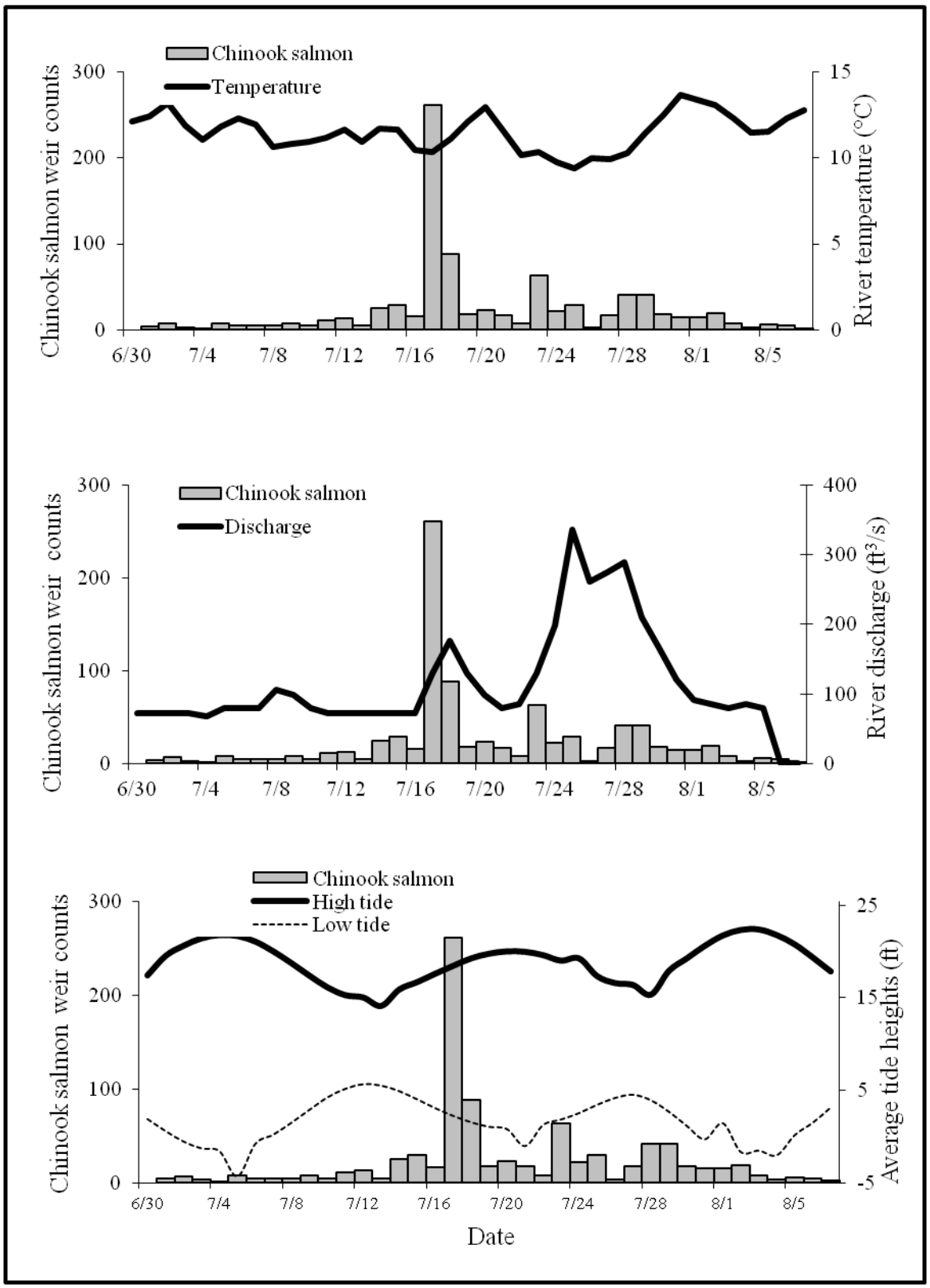

Figure 7.–Daily comparison of Ninilchik River Chinook salmon weir counts with average water temperature (top), discharge (middle), and tide height (bottom), 30 June–7 August 2008.

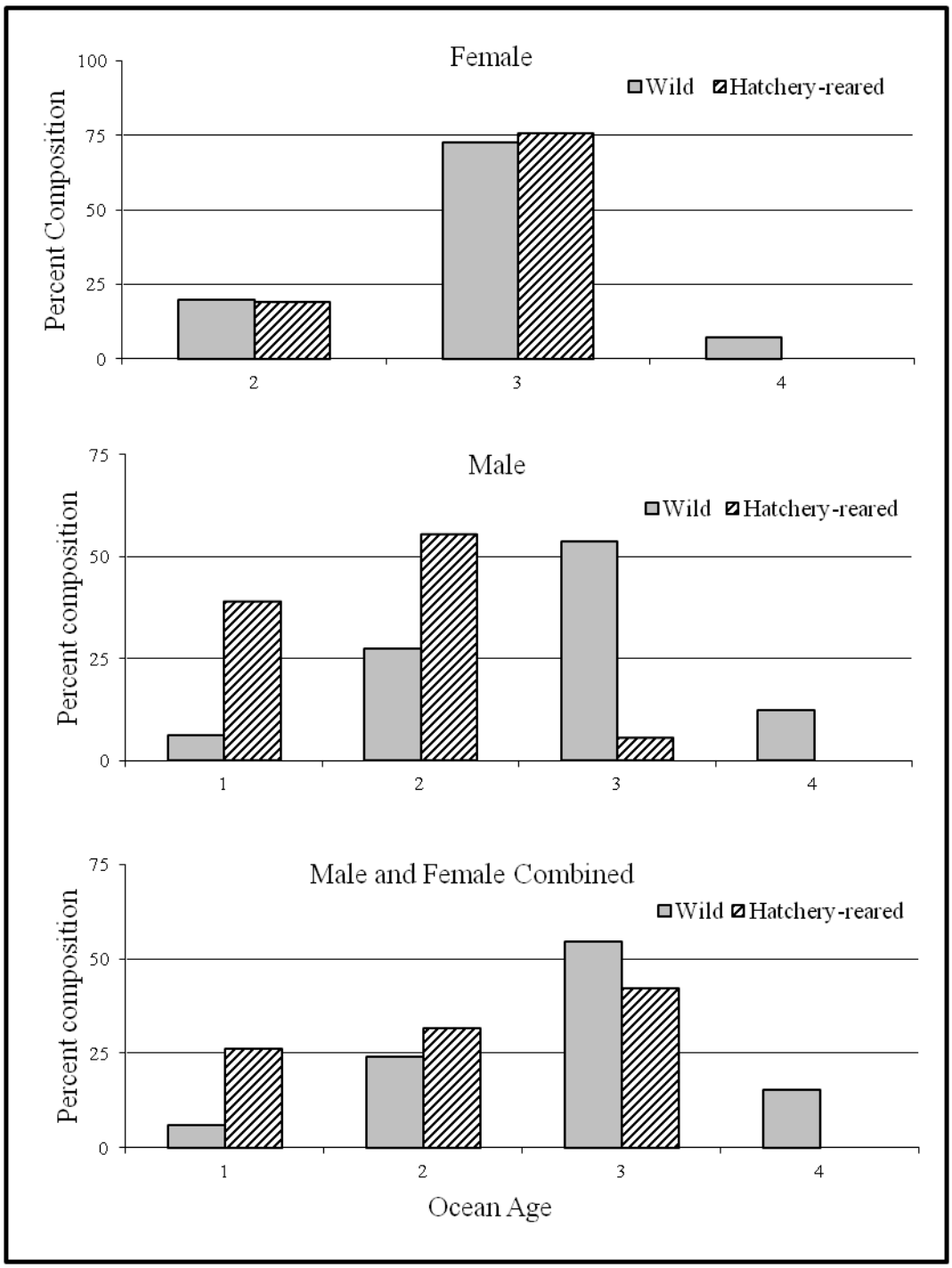

Figure 8.–Ninilchik River wild and hatchery-reared Chinook salmon estimated ocean age compositions for female (top), male (middle), and combined (bottom) Chinook salmon sexes, 2008.

APPENDIX A: TIMELINES FOR NINILCHIK RIVER CHINOOK SALMON SUPPLEMENTATION AND MONITORING PROGRAM

Appendix A1.–Ninilchik River Chinook salmon supplementation program timeline.

Year(s)	Supplementation
1987	Supplementation program initiated with Ninilchik River Chinook salmon. Site selected at 7.7 river kilometers (RKM) (Brody Road bridge) upstream from the mouth of Ninilchik River for first egg take. The site was selected because of the availability of spawning Chinook salmon and it was accessible by road. Nets used to capture Chinook salmon for egg takes. Fertilized eggs transported to hatchery and reared to smolt.
1988	Egg take conducted in similar fashion to 1987. First year smolt were stocked into the Ninilchik River (~20% were adipose-clipped and coded-wire-tagged). All smolt were released in the harbor.
1989	Broodstock weir began operating only in July at Garrison Road bridge (~3 RKM) to capture Chinook salmon for egg takes; a seine was used to force fish into the trap because they refused to move upstream. A containment area was also created to hold fish so they could ripen. Fertilized eggs transported to hatchery and reared to smolt. Smolt released and quantity split equally between Brody Road bridge and Sterling Highway bridge.
1990–1992	Broodstock weir was moved upstream to Brody Road bridge (RKM 7.7) and operated only in July. A containment area was also created to hold fish so they could ripen. All smolt released at Brody Road bridge.
1993–1994	Genetic policy enacted to require that 60 wild pairs be spawned for Ninilchik River stocking. Separated wild from hatchery-reared fish for egg take. Broodstock weir, egg takes, and stocking conducted similar to 1990. All smolt released at Brody Road bridge.
1995–1998	Beginning in 1995, Ninilchik River stocking rate was reduced to ~50,000 smolt and coded wire tag (CWT) rate increased to 100%. In 1995 and 1996 smolt released in harbor, thereafter all Ninilchik River smolt released at Brody Road bridge. Program expanded to use smolt from Ninilchik River to support terminal saltwater fisheries in Kachemak Bay. Broodstock weir and egg takes were conducted similar to 1990.
1999–2008	100% of adult hatchery-reared Chinook salmon observed at the broodstock weir were visually indentified by an adipose finclip. Broodstock weir operated throughout the entire run with a holding area only established in July. Egg takes used hatchery-reared fish for saltwater stocking locations. Stocking was conducted similar to 1995. All Ninilchik River smolt released at Brody Road bridge.

Appendix A2.–Ninilchik River Chinook salmon escapement monitoring timeline.

Year (s)	Escapement Monitoring
1962–1973	Annual Chinook salmon escapement estimated with a combination aerial and ground index survey. Survey conducted once annually over a standard length of river. Aerial surveys were done from a fixed wing aircraft (super cub). Foot surveys were conducted in only a subsection from the Sterling Highway bridge upstream approximately 9 RKM (upstream of Brody road). If the foot survey counts were greater than the aerial counts in the subsection, the total aerial count was expanded by the difference. No surveys were conducted for several years due to poor viewing conditions.
1974	Aerial survey conducted with both fixed and rotary wing aircraft. Escapement estimate produced in similar fashion to 1962–1973.
1976–1988	Subsection for ground survey reduced to 7.7 RKM above mouth at Brody Road Bridge. Escapement estimate produced in similar fashion to 1962–1973.
1975	Rotary wing aircraft replaces fixed wing aircraft as the viewing platform for all aerial surveys. Escapement estimate produced in similar fashion to 1962–1973.
1989	In addition to the aerial and foot survey, escapement data were opportunistically collected from broodstock weir located at Garrison Road Bridge (approximately 3 RKM). Weir was not operated over the entire run.
1990–1993	In addition to the aerial and foot survey, escapement data were opportunistically collected from broodstock weir located at Brody Road Bridge. No attempt was made to identify and enumerate hatchery-reared fish. Weir was not operated over the entire run.
1994	In addition to the aerial and foot survey, escapement counts at broodstock weir were used to estimate the number of wild and hatchery-reared Chinook salmon. The annual estimate of hatchery-reared Chinook salmon was based on the percent of adipose-clipped fish counted at the weir, the percent of each brood year detected at the weir through CWT recoveries, and the percentage that each brood year was adipose-clipped. Wild counts equaled the difference between the total number of Chinook salmon counted at the broodstock weir and the hatchery-reared estimate. Weir was not operated over the entire run.
1995–1998	Foot survey discontinued because counts didn't appear to have a relationship to escapement—likely due to poor visibility. Escapement was monitored at the broodstock weir similar to 1994..
1999–2000	In addition to the aerial survey, broodstock weir operated over the entire Chinook salmon run. First year where 100% of hatchery-reared fish identified by adipose finclip. Escapement counts of both wild and hatchery-reared fish enumerated by subtracting fish sacrificed for egg takes and CWT analysis.
2001–2005	Aerial survey discontinued in 2001 because counts didn't appear to have a relationship to escapement—likely due to poor visibility. Escapement was monitored at broodstock weir similar to 1999.
2006–Present	Weir operated only during the month of July and early August, not over the total run.

Appendix A3.–Ninilchik River Chinook salmon sport harvest monitoring and escapement goal timelines.

Year (s)	Sport Harvest
1977–present	Alaska Statewide Harvest Survey conducted, which produced estimates of total catch and harvest for Chinook salmon in the Ninilchik River.
1991–1993	Creel surveys of freshwater harvest were conducted to estimate the hatchery-reared harvest.
1994–1996 & 2000–2003	Inriver harvest sampling was conducted to estimate the percentage of hatchery-reared fish in the harvest.
2006	Inriver harvest sampling was conducted throughout the area open for sport fishing to estimate the percentage of hatchery-reared fish in the harvest.
2007	Beach seine surveys and floy tagging conducted throughout the area open for sport fishing to estimate the percentage of hatchery-reared fish in the inriver Chinook salmon run below RKM 3.2.

Year (s)	Escapement Goals
1993–1997	First escapement goal adopted (Biological Escapement Goal [BEG] = 830 wild Chinook salmon, which was based on average annual aerial and foot survey average counts and expanded estimates from 1966 to 1969 and 1977 to 1991).
1998	BEG range of 500 to 900 wild Chinook salmon was adopted, which was based on historic aerial survey counts and their relationship to the sport harvest.
2001–2006	Escapement goal policy adopted, and BEG was replaced with a Sustainable Escapement Goal (SEG) range of 400 to 850 wild Chinook salmon calculated from 7 years (1994 to 2000) of weir counts collected from July 8 through July 24.
2007	SEG with a range of 550 to 1,300 wild fish and a new index monitoring period (July 3–31) was adopted. The SEG was calculated using the percentile method (Bue and Hasbrouck *Unpublished*) and is based on the wild escapement above the weir during the index monitoring period from 1999 through 2007. The SEG period increased the number of monitoring days by 12 at no additional costs.

Appendix A4.–Ninilchik River Chinook salmon freshwater fishing regulations and emergency orders timelines.

Year	Chinook salmon Fishing Regulations Assume the regulations are carried forward unless otherwise stated. Chinook salmon may be referred to as "king salmon" or "kings."
1977	Harvest Recording Requirement. Open period: 4 two-day weekend openings beginning in the last week of May. Open area: mouth upstream 2 miles Season limit: 5 kings from fresh and salt water combined. Bag and size limit: 1 king salmon 20 inches (in) or larger; 10 kings under 20 in.
1978	Open period changed to 3 three-day weekend openings beginning in the last week of May.
1985	Bag and size limit: 1 king salmon 16 in or larger; 10 kings under 16 in.
2001	Bag and size limit: 1 king salmon 20 in or larger; 10 kings under 20 in.
2005	Bag and size limit: 2 king salmon 20 in or larger, of which only 1 can be wild; 10 kings under 20 in. A person may not fillet, mutilate, or otherwise disfigure a king salmon in a manner that prevents determination whether the fish is a wild or hatchery fish until the person has stopped fishing in the Ninilchik River drainage for the day and has moved more than 100 yards away from the Ninilchik River.
2007	Extended open season for hatchery fish from July 1 through December 31.

Year	Emergency Orders (EOs)
1991	EO: added a fourth 3-day weekend (June 15, 16, 17). EO: extended the fishery to from June 17 to June 24.
1992	EO: extended fishery by 10 days.
1993	EO: opened the fishery continuously from June 15 through June 28.
1994	EO: opened the fishery continuously from June 14 through June 27.
1995	EO: extended fishery by 14 days.
1996	EO 2-KS-1-20-96 extended the king salmon fishery on the Ninilchik River on a continual basis effective June 15, 12:01 AM through Monday June 24, 1996, 11:59PM.
2001	EO 2-KS-7-05-02 opened the Ninilchik River downstream of the regulatory marker for an additional 3-day weekend, June 16, 2001, 12:01AM to June 18, 2001, 11:59 PM.

Year	Emergency Orders
2002	EO 2-KS-7-08-02 opened the Ninilchik River from its mouth to the downstream edge of the Sterling Highway Bridge, from Saturday, June 15, 12:01 AM to Monday, June 17, 11:59 PM, to sport fishing for hatchery king salmon only. The daily bag and possession limit was 1 fish 20 inches or greater in length or 10 fish under 20 inches. Only unbaited artificial lures were permitted.
2003	EO 2-KS-7-03-03 opened the Ninilchik River from its mouth to the downstream edge of the Sterling Highway Bridge, from Saturday, June 14, 2003, 12:01 AM, to Monday, June 30, 2003, 11:59 PM to sport fishing for hatchery Chinook salmon only. The daily bag and possession limit was 1 fish 20 inches or greater in length and 10 fish under 20 inches. Use of only one single hook was allowed.
2004	EO 2-KS-7-03-04 opened the Ninilchik River from its mouth upstream to the regulatory marker located approximately 2 miles upstream, to fishing for hatchery king salmon 7 days per week. Bait was allowed. Only one, single hook could be used. A person could not possess a king salmon that had been filleted, headed, mutilated, or otherwise disfigured in a manner that prevented identification of hatchery or wild origin until permanently transported away from the fishing site if the fish was taken from the riverbank. "Fishing site" meant the riverbank where the fish was hooked and removed from the water. The emergency order was effective 12:01 AM, Saturday, May 29, 2004 until 11:59 PM. December 31, 2004.
2006	EO 2-KS-7-12-06 opened the Ninilchik River from its mouth upstream to the regulatory markers located approximately 2 miles upstream, from Wednesday, June 14, 12:01 AM to Friday, July 14, 11:59 PM, to fishing for hatchery king salmon. Hatchery king salmon can be recognized by the healed adipose finclip scar. Anglers were prohibited from removing king salmon with an adipose fin from the water and were required to release them immediately. The daily bag and possession limit was 2 hatchery king salmon 20 inches or greater in length and 10 hatchery king salmon under 20 inches. Fish 20 inches or greater in length must be recorded on the back of the fishing license or harvest record card. Bait was allowed. Use of only one single hook was allowed.
2007	EO 2-KS-7-06-07 opened the Ninilchik River from its mouth upstream to the regulatory markers located approximately 2 miles upstream, from Saturday, May 26, 12:01 AM to Sunday, July 15, 11:59 PM, to fishing for hatchery king salmon. The daily bag and possession limit was 2 hatchery king salmon 20 inches or greater in length and 10 hatchery king salmon under 20 inches. Fish 20 inches or greater in length must be recorded on the back of the fishing license or harvest record card. Bait was allowed. Use of only one single hook was allowed.

APPENDIX B: NINILCHIK RIVER CHINOOK SALMON WEIR COUNTS, 2008

Appendix B1.–Daily and cumulative weir counts of wild and hatchery-reared Chinook salmon, Ninilchik River weir, 2008.

	Wild			Hatchery-reared			Total		
		Cumulative			Cumulative			Cumulative	
Date	Daily	Number	%	Daily	Number	%	Daily	Number	%
30 Jun	0	0	0	0	0	0	0	0	0
1 Jul	4	4	1	0	0	0	4	4	0
2 Jul	7	11	1	0	0	0	7	11	1
3 Jul [a]	2	13	2	1	1	1	3	14	2
4 Jul [a]	1	14	2	0	1	1	1	15	2
5 Jul [a]	7	21	3	1	2	2	8	23	3
6 Jul [a]	4	25	3	1	3	3	5	28	3
7 Jul [a]	5	30	4	0	3	3	5	33	4
8 Jul [a]	5	35	5	0	3	3	5	38	4
9 Jul [a]	8	43	6	0	3	3	8	46	5
10 Jul [a]	5	48	6	0	3	3	5	51	6
11 Jul [a]	11	59	8	0	3	3	11	62	7
12 Jul [a]	12	71	9	1	4	4	13	75	9
13 Jul [a]	5	76	10	0	4	4	5	80	9
14 Jul [a]	25	101	13	0	4	4	25	105	12
15 Jul [a]	29	130	17	0	4	4	29	134	15
16 Jul [a]	16	146	19	0	4	4	16	150	17
17 Jul [a,b]	254	400	52	7	11	11	261	411	47
18 Jul [a]	74	474	61	15	26	26	89	500	57
19 Jul [a]	13	487	63	5	31	31	18	518	59
20 Jul [a]	19	506	66	4	35	35	23	541	62
21 Jul [a]	12	518	67	5	40	40	17	558	64
22 Jul [a, c]	6	524	68	2	42	42	8	566	65
23 Jul [a]	57	581	75	6	48	48	63	629	72
24 Jul [a]	18	599	78	4	52	51	22	651	75
25 Jul [a]	25	624	81	4	56	55	29	680	78
26 Jul [a]	1	625	81	2	58	57	3	683	78
27 Jul [a]	14	639	83	3	61	60	17	700	80
28 Jul [a]	34	673	87	7	68	67	41	741	85
29 Jul [a]	31	704	91	10	78	77	41	782	90
30 Jul [a]	13	717	93	5	83	82	18	800	92
31 Jul [a]	15	732	95	0	83	82	15	815	93
1 Aug	10	742	96	5	88	87	15	830	95
2 Aug	14	756	98	5	93	92	19	849	97
3 Aug	7	763	99	1	94	93	8	857	98
4 Aug	3	766	99	0	94	93	3	860	99
5 Aug	2	768	99	4	98	97	6	866	99
6 Aug	2	770	100	3	101	100	5	871	100
7 Aug	2	772	100	0	101	100	2	873	100

[a] Sustainable escapement goal (SEG) counting period.

[b] Median run timing date during the SEG counting period for wild Chinook salmon.

[c] Median run timing date during the SEG counting period for hatchery-reared Chinook salmon.

APPENDIX C: NINILCHIK RIVER WATER TEMPERATURE DATA, 2008

Appendix C1.–Ninilchik River daily mean, minimum, and maximum water temperatures, 1 June–21 October 2008.

	Water temperatures (°C)														
	June			July			August			September			October		
Date	Mean	Min.	Max.	Mean	Min.	Max.	Mean	Min.	Max.	Mean	Min.	Max.	Mean	Min.	Max.
1	8.0	7.1	8.9	12.4	8.9	15.8	13.4	11.5	14.6	8.7	7.7	9.7	3.1	1.9	4.5
2	7.5	6.6	8.6	13.2	10.0	16.4	13.1	11.7	14.6	8.8	8.0	9.4	2.7	1.6	3.6
3	7.8	6.6	8.9	11.9	10.9	14.6	12.3	11.5	13.2	9.1	8.3	10.3	2.4	1.6	3.4
4	8.0	6.6	9.4	11.0	10.0	12.0	11.5	10.6	12.0	10.1	8.9	11.5	2.9	1.9	3.6
5	7.5	6.6	8.6	11.8	10.0	14.1	11.5	10.3	13.5	9.8	8.6	10.9	2.7	1.9	3.6
6	9.1	6.3	12.3	12.3	10.6	13.8	12.3	10.3	15.2	9.4	8.9	10.3	2.1	1.3	3.1
7	9.7	7.4	11.7	11.9	10.9	12.9	12.8	9.7	15.5	8.7	8.3	8.9	2.1	1.6	3.1
8	10.7	8.6	13.5	10.6	10.0	11.7	12.5	9.4	15.2	8.8	8.3	9.4	2.2	1.3	3.4
9	11.4	8.9	14.1	10.8	9.4	12.3	12.0	9.2	14.4	9.0	8.3	10.0	0.9	0.1	2.2
10	10.8	8.6	12.9	10.9	9.2	12.9	12.1	10.0	14.1	9.6	8.9	10.6	1.9	1.3	2.8
11	9.5	8.6	10.9	11.2	9.7	12.9	11.5	8.6	14.4	10.0	9.2	11.5	2.2	1.9	2.8
12	9.6	6.6	12.6	11.6	10.0	13.8	10.5	9.4	12.3	9.8	9.2	10.3	2.6	2.5	2.8
13	10.0	8.6	11.5	10.9	10.3	11.7	10.4	9.4	11.5	9.1	8.9	9.4	1.9	1.6	2.2
14	10.1	8.6	12.6	11.7	9.7	14.4	10.8	9.7	12.0	8.8	8.3	9.4	1.5	1.3	1.9
15	10.1	8.0	12.6	11.7	10.9	12.6	10.7	10.0	11.2	8.6	8.0	9.2	1.6	1.3	2.2
16	11.4	8.3	14.6	10.4	10.0	11.5	10.3	9.7	11.2	8.1	8.0	8.6	1.6	1.3	1.9
17	12.8	9.4	16.1	10.3	9.2	12.0	9.6	8.6	10.3	7.4	6.8	7.7	1.1	0.7	1.6
18	13.5	10.6	16.4	11.1	8.6	14.1	9.5	8.3	10.6	7.9	7.4	8.9	0.8	0.4	1.3
19	12.8	10.9	14.6	12.1	10.0	14.4	10.4	8.9	12.3	8.1	7.4	9.2	0.7	0.4	1.3
20	12.1	10.6	13.5	12.9	10.6	15.8	11.4	9.4	13.5	7.3	6.5	8.3	0.4	-0.2	1.3
21	12.0	10.0	14.6	11.5	10.6	13.2	11.2	10.3	12.0	6.4	5.4	7.7	0.3	-0.2	0.7
22	11.0	9.7	12.9	10.2	9.4	11.2	10.6	10.0	11.5	5.9	4.8	6.8			
23	10.8	9.2	12.9	10.3	8.9	12.3	10.5	9.7	11.5	5.8	5.4	6.3			
24	10.2	8.0	11.7	9.7	9.4	10.9	10.9	9.4	12.9	6.3	5.7	6.8			
25	10.7	9.2	12.3	9.4	8.3	10.6	11.1	10.3	12.0	6.6	6.3	7.1			
26	9.8	8.9	10.9	10.0	9.4	10.6	11.2	9.7	12.9	6.8	6.3	7.7			
27	9.9	8.6	11.2	9.9	9.4	10.3	10.4	9.2	11.5	5.6	4.8	6.5			
28	10.9	8.6	13.2	10.3	8.3	12.3	10.7	9.2	12.9	4.5	3.4	5.7			
29	12.0	9.7	14.9	11.4	9.4	13.8	10.0	8.0	12.0	3.9	3.1	4.8			
30	12.1	9.4	14.9	12.5	10.9	14.4	9.5	7.4	11.7	3.6	2.5	4.8			
31				13.7	11.2	16.7	8.8	8.0	9.7						

Source: Temperature data collected at the NR-2 site by Sue Mauger of Cook Inletkeeper.

APPENDIX D: NINILCHIK RIVER DISCHARGE AND STAGE HEIGHT DATA, 2008

Appendix D1.–Daily discharge measurements taken approximately 0.9 river kilometers upstream from the mouth of the Ninilchik River, 2008.

	Discharge (ft^3/s)						
Date	April	May	June	July	August	September	October
1	–	465	121	73	92	85	99
2	507	425	113	73	85	73	92
3	–	465	99	73	79	79	99
4	–	465	106	68	85	79	99
5	507	445	106	79	79	73	106
6	507	465	99	79	–	92	113
7	353	445	99	79	–	106	113
8	507	465	92	106	73	106	99
9	–	353	85	99	68	210	113
10	–	388	85	79	–	353	371
11	–	388	85	73	79	465	625
12	–	371	85	73	79	388	425
13	–	388	99	73	85	388	353
14	–	371	92	73	–	353	247
15	–	353	85	73	92	371	247
16	–	371	84	73	187	371	222
17	187	353	85	129	234	406	177
18	129	305	85	177	166	353	147
19	187	353	79	129	147	275	129
20	187	275	73	99	121	210	121
21	177	289	73	79	99	147	113
22	388	388	73	85	58	120	113
23	353	353	99	129	147	113	85
24	507	305	85	198	113	187	68
25	552	261	79	336	106	234	85
26	388	210	73	261	92	247	92
27	552	166	73	275	138	187	63
28	486	166	85	289	113	147	73
29	445	156	79	210	129	113	73
30	465	138	73	166	106	106	–
31		138		121	85		

Source: Provisional data collected by the National Weather Service Alaska Pacific Weather Forecast Center.
Note: "–" = value can't be calculated due to limitations of the data.

Appendix D2.–Stage height measurements taken approximately 0.9 river kilometers upstream from the mouth of the Ninilchik River, 2008.

Date	Stage height (ft)						
	April	May	June	July	August	September	October
1	–	4.80	3.55	3.20	3.35	3.30	3.40
2	4.90	4.70	3.50	3.20	3.30	3.20	3.35
3	–	4.80	3.40	3.20	3.25	3.25	3.40
4	–	4.80	3.45	3.15	3.30	3.25	3.40
5	4.90	4.75	3.45	3.25	3.25	3.20	3.45
6	4.90	4.80	3.40	3.25	–	3.35	3.50
7	4.50	4.75	3.40	3.25	–	3.45	3.50
8	4.90	4.80	3.35	3.45	3.20	3.45	3.40
9	–	4.50	3.30	3.40	3.15	4.00	3.50
10	–	4.60	3.30	3.25	–	4.50	4.55
11	–	4.60	3.30	3.20	3.25	4.80	5.15
12	–	4.55	3.30	3.20	3.25	4.60	4.70
13	–	4.60	3.40	3.20	3.30	4.60	4.50
14	–	4.55	3.35	3.20	–	4.50	4.15
15	–	4.50	3.30	3.20	3.35	4.55	4.15
16	–	4.55	3.30	3.20	3.90	4.55	4.05
17	3.90	4.50	3.30	3.60	4.10	4.65	3.85
18	3.60	4.35	3.30	3.85	3.80	4.50	3.70
19	3.90	4.50	3.25	3.60	3.70	4.25	3.60
20	3.90	4.25	3.20	3.40	3.55	4.00	3.55
21	3.85	4.30	3.20	3.25	3.40	3.70	3.50
22	4.60	4.60	3.20	3.30	3.05	3.55	3.50
23	4.50	4.50	3.40	3.60	3.70	3.50	3.30
24	4.90	4.35	3.30	3.95	3.50	3.90	3.15
25	5.00	4.20	3.25	4.45	3.45	4.10	3.30
26	4.60	4.00	3.20	4.20	3.35	4.15	3.35
27	5.00	3.80	3.20	4.25	3.65	3.90	3.10
28	4.85	3.80	3.30	4.30	3.50	3.70	3.20
29	4.75	3.75	3.25	4.00	3.60	3.50	3.20
30	4.80	3.65	3.20	3.80	3.45	3.45	–
31		3.65		3.55	3.30		

Source: Provisional data collected by the National Weather Service Alaska Pacific Weather Forecast Center.
Note: "–" = value can't be calculated due to limitations of the data.

APPENDIX E: NINILCHIK PREDICTED DAILY AVERAGE HIGH AND LOW TIDE HEIGHTS DATA, 2008

Appendix E1.–Deep Creek predicted daily high and low tides heights, 1 May–31 August 2008.

	Daily tide height											
	May						June					
	High			Low			High			Low		
Day	AM	PM	Average	AM	PM	Average	AM	PM	Average	AM	PM	Average
1	16.3	15.8	16.1	3.7	2.4	3.1	19.6	17.5	18.6	-1.8	2.9	0.6
2	18.0	17.3	17.7	1.3	1.7	1.5	20.9	18.6	19.8	-3.7	2.4	-0.7
3	19.7	18.8	19.3	-1.2	1.2	0.0	21.8	19.5	20.7	2.0		–
4	21.2	19.9	20.6	-3.3	0.8	-1.3	22.4	19.9	21.2	1.8	-5.7	-2.0
5	22.3	20.5	21.4	0.8	-4.8	-2.0	22.4	19.9	21.2	1.8	-5.6	-1.9
6	22.9	20.5	21.7	1.1	-5.5	-2.2	21.8	19.5	20.7		-4.9	–
7	22.8	20.0	21.4	1.7	-5.4	-1.9	20.6	19.0	19.8	2.1	-3.7	-0.8
8	22.0	19.1	20.6		-4.6	–	19.1	18.3	18.7	2.6	-2.0	0.3
9	20.7	18.0	19.4	2.6	-3.2	-0.3	17.3	17.8	17.6	3.1	-0.2	1.5
10	18.9	17.0	18.0	3.6	-1.5	1.1	15.7	17.3	16.5	3.5	1.6	2.6
11	17.1	16.5	16.8	4.5	0.2	2.4	17.0	14.5	15.8	3.5	3.2	3.4
12	16.5	15.6	16.1	4.9	1.5	3.2	17.0	14.0	15.5	3.1	4.4	3.8
13	16.9	14.9	15.9	4.4	2.3	3.4		14.2	–	2.3	5.2	3.8
14		15.0	–	3.3	2.8	3.1	17.1	14.8	16.0	1.5	5.5	3.5
15	17.5	15.6	16.6	1.9	3.1	2.5	17.4	15.5	16.5	0.6	5.5	3.1
16	18.1	16.3	17.2	0.7	3.3	2.0	17.8	16.2	17.0	-0.2	5.2	2.5
17	18.6	17.0	17.8	-0.3	3.4	1.6	18.3	16.8	17.6	4.9		–
18	19.1	17.5	18.3	-1.1	3.5	1.2	18.8	17.3	18.1	4.5	-1.3	1.6
19	19.4	17.8	18.6	3.6	-1.6	1.0	19.1	17.5	18.3	4.3	-1.6	1.4
20	19.5	17.9	18.7	3.8	-1.7	1.1	19.1	17.6	18.4	4.2	-1.7	1.3
21	19.5	17.6	18.6	4.1	-1.7	1.2	18.9	17.6	18.3		-1.5	–
22	19.1	17.2	18.2	4.6	-1.3	1.7	18.4	17.4	17.9	4.2	-1.0	1.6
23	18.5	16.5	17.5		-0.7	–	17.7	17.3	17.5	4.3	-0.3	2.0
24	17.7	15.9	16.8	5.1	0.0	2.6	16.8	17.2	17.0	4.3	0.7	2.5
25	16.8		–	5.7	0.8	3.3	17.2	15.7	16.5	4.2	1.8	3.0
26	15.3	15.7	15.5	6.1	1.7	3.9	17.4	14.8	16.1	3.8	3.1	3.5
27	15.5	14.8	15.2	6.1	2.5	4.3	17.8	14.2	16.0	3.1	4.2	3.7
28	16.1	14.2	15.2	5.6	3.1	4.4	18.3	14.4	16.4	1.8	4.9	3.4
29	17.1	14.3	15.7	4.4	3.5	4.0		15.2	–	0.2	4.9	2.6
30		15.0	15.0	2.5	3.6	3.1	19.2	16.5	17.9	-1.5	4.4	1.5
31	18.3	16.2	17.3	0.3	3.3	1.8						

-continued-

	Daily tide height											
	July						August					
	High			Low			High			Low		
Day	AM	PM	Average	AM	PM	Average	AM	PM	Average	AM	PM	Average
1	20.2	17.9	19.1	-3.2	3.5	0.2	21.8	20.7	21.3	0.9	1.1	1.0
2	21.2	19.1	20.2	-4.5	2.5	-1.0	22.3	21.4	21.9	0.1	-4.4	-2.2
3	22.0	19.9	21.0	1.7	-5.2	-1.8	22.2	21.6	21.9	-0.2	-3.8	-2.0
4	22.2	20.4	21.3	1.2	-5.3	-2.1	21.3	21.3	21.3		-2.5	–
5	21.9	20.5	21.2		-4.8	–	20.0	20.6	20.3	0.1	-0.7	-0.3
6	21.0	20.2	20.6	1.0	-3.5	-1.3	18.3	19.5	18.9	0.8	1.3	1.1
7	19.5	19.6	19.6	1.3	-1.8	-0.3	16.5	18.3	17.4	1.9	3.5	2.7
8	17.8	18.8	18.3	1.9	0.2	1.1	17.0	14.7	15.9	3.1	5.6	4.4
9	16.0	17.9	17.0	2.5	2.4	2.5	15.8	13.3	14.6	4.1	7.4	5.8
10	17.0	14.4	15.7	3.2	4.4	3.8	15.1	12.7	13.9	4.7	8.5	6.6
11	16.3	13.4	14.9	3.5	6.0	4.8	15.2	13.4	14.3	4.4	8.6	6.5
12	16.0	13.2	14.6	3.4	7.1	5.3		14.6	–	3.3	7.7	5.5
13		13.7	–	2.9	7.3	5.1	16.1	15.9	16.0	2.0	6.5	4.3
14	16.2	14.7	15.5	2.0	7.0	4.5	17.4	17.1	17.3	0.8	5.0	2.9
15	16.8	15.7	16.3	1.0	6.2	3.6	18.7	18.4	18.6	3.7		–
16	17.6	16.7	17.2	0.0	5.3	2.7	19.9	19.5	19.7	2.4	-1.2	0.6
17	18.5	17.5	18.0	4.5	-0.9	1.8	20.7	20.3	20.5	1.3	-1.7	-0.2
18	19.3	18.3	18.8	3.7	-1.5	1.1	21.0	21.0	21.0	0.5	-1.7	-0.6
19	19.8	18.8	19.3	3.1	-1.9	0.6	20.9	21.2	21.1		-1.1	–
20	19.9	19.2	19.6	2.6	-1.9	0.4	20.2	21.1	20.7	0.0	-0.1	-0.1
21	19.7	19.3	19.5		-1.5	–	19.1	20.7	19.9	0.0	1.3	0.7
22	19.0	19.3	19.2	2.3	-0.7	0.8	17.5	19.8	18.7	0.4	3.1	1.8
23	18.0	19.1	18.6	2.2	0.6	1.4		18.8	–	1.1	4.9	3.0
24		18.8	–	2.1	2.1	2.1	17.7	14.5	16.1	1.9	6.6	4.3
25	18.4	15.4	16.9	2.2	3.8	3.0	17.2	14.2	15.7	2.2	7.3	4.8
26	18.0	14.3	16.2	2.2	5.3	3.8		15.4	–	1.5	6.6	4.1
27	17.9	14.0	16.0	1.9	6.3	4.1	17.8	17.1	17.5	0.1	4.9	2.5
28		14.9	–	0.8	6.2	3.5	19.2	18.8	19.0	-1.3	2.9	0.8
29	18.5	16.4	17.5	-0.7	5.2	2.3	20.6	20.4	20.5	-2.4	1.1	-0.7
30	19.6	18.0	18.8	-2.3	3.7	0.7	21.7	21.5	21.6	-2.9	-0.3	-1.6
31	20.8	19.5	20.2	-3.6	2.1	-0.8	22.2	22.2	22.2	-2.5	-1.0	-1.8

Source: NOAA tides and currents website [Internet], 2007. Available from : http://tidesandcurrents.noaa.gov.
Note: "–" = value can't be calculated due to limitations of the data.

APPENDIX F: NINILCHIK RIVER CHINOOK SALMON CODED WIRE TAG DATA, 2008

Appendix F1.–Coded wire tag recoveries of hatchery-reared Chinook salmon at Ninilchik River weir, 2008.

Number		Brood	Rearing	Release	Date		Actual[b]	Scale ocean age estimate[c]				Length
CWT	Head[a]	year	Hatchery	site	Released	Recovered	Age	First	Second	Resolved	Sex	(mm)[d]
310341	277007	2003	Ft. Richardson	Ninilchik	19 May 2005	28 Jul 2008	3	3	3	3	F	760
310341	319805	2003	Ft. Richardson	Ninilchik	19 May 2005	5 Aug 2008	3	4	3	4	F	870
310341	319811	2003	Ft. Richardson	Ninilchik	19 May 2005	5 Aug 2008	3	3	3	3	F	840
310341	319806	2003	Ft. Richardson	Ninilchik	19 May 2005	5 Aug 2008	3	3	4	3	F	840
310341	319803	2003	Ft. Richardson	Ninilchik	19 May 2005	5 Aug 2008	3	3	4	3	F	830
310341	319808	2003	Ft. Richardson	Ninilchik	19 May 2005	5 Aug 2008	3	3	3	3	F	820
310341	319802	2003	Ft. Richardson	Ninilchik	19 May 2005	5 Aug 2008	3	3	3	3	F	815
310341	319804	2003	Ft. Richardson	Ninilchik	19 May 2005	5 Aug 2008	3	3	3	3	F	790
310341	319809	2003	Ft. Richardson	Ninilchik	19 May 2005	5 Aug 2008	3	3	3	3	F	735
310341	319810	2003	Ft. Richardson	Ninilchik	19 May 2005	5 Aug 2008	3	3	3	3	F	780
No tag	319801	2003	–	–	–	5 Aug 2008	–	2	3	2	F	705
No tag	319807	2003	–	–	–	5 Aug 2008	–	NR	NR	NR	F	790
No tag	319812	2003	–	–	–	5 Aug 2008	–	4	3	4	F	825

Note: "–" = value can't be calculated due to limitations of the data.

[a] Head cinch strap number.

[b] Ocean ages were determined by comparing brood year, release year, and recovery year.

[c] NR = Not readable scale sample due to regeneration or poor mounting.

[d] Length measurements were recorded from mid-eye to tail fork (METF).

Appendix F2.–Ninilchik River hatchery-reared Chinook salmon coded wire tag recoveries outside of Ninilchik River, 2008.

Number		Brood	Rearing	Release			Recovery		Recovery	Actual age[d]	
CWT	Head[a]	year	hatchery	site	Release date	Recovery site[b]	method[c]	Water type	date	Fresh	Ocean
310341	277009	2003	Ft. Richardson	Ninilchik	19 May 2005	Cook Inlet	Subsistence	Saltwater	Not recorded	1	3
310341	277010	2003	Ft. Richardson	Ninilchik	19 May 2005	Cook Inlet	Subsistence	Saltwater	Not recorded	1	3
310341	277011	2003	Ft. Richardson	Ninilchik	19 May 2005	Cook Inlet	Subsistence	Saltwater	Not recorded	1	3
310341	277012	2003	Ft. Richardson	Ninilchik	19 May 2005	Cook Inlet	Subsistence	Saltwater	Not recorded	1	3
310341	297722	2003	Ft. Richardson	Ninilchik	19 May 2005	Anchor River	Sport	Freshwater	11 Jun 2008	1	3

[a] Head cinch strap number.

[b] Cook Inlet recovery site was approximately 1 mile north and ¼ mile offshore from the mouth of the Ninilchik River.

[c] Subsistence recovery method was from the Ninilchik educational fishery.

[d] Ocean ages were determined by comparing brood year, release year, and recovery year.