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Ninilchik River Chinook Salmon Stock Assessment and Supplementation, 2009

by

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and

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April 2012

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

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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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ABSTRACT

In 2009, the total number of Chinook salmon counted at the Ninilchik River weir was 727 fish, of which 620 were wild and 107 were hatchery-reared. The wild Chinook salmon escapement corresponding to the Sustainable Escapement Goal (SEG) index monitoring period (3 July through 31 July) was 528 fish, which failed to exceed the lower end of the SEG. The median run timing date during the SEG index monitoring period for both wild and hatchery-reared Chinook salmon was 25 July. The dominant age class was ocean age 2 and ocean age 1 for wild Chinook salmon and hatchery-reared Chinook salmon, respectively. Approximately 301,000 eggs were collected from 21 wild and 27 hatchery-reared Chinook salmon females during 2 egg takes. Egg survival to the eyed stage was 92.4%. The stocking goal was met for the Ninilchik River but not for any of the Kachemak Bay terminal saltwater fishery locations. Thirty-six coded wire tags were decoded from 38 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 terminal saltwater fisheries. Continuation of the 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

Ninilchik River is located on the Kenai Peninsula in the Lower Cook Inlet management area (LCIMA; Figure 1). It is a small (anadromous stream length 81 river kilometers [RKM]), non-glacial, stream with extensive wetlands (122 km^2), and no large tributary lakes (Table 1). The Ninilchik River produces annual runs of Chinook (*Onchorhynchus tshawytscha*), coho (*Onchorhynchus kisutch*), and pink (*Onchorhynchus gorbuscha*) salmon; steelhead trout (*Onchorhynchus mykiss*); and Dolly Varden (*Salvelinus malma*). There are only 3 road-accessible streams in the LCIMA that support Chinook salmon sport fisheries: Ninilchik River, Anchor River, and Deep Creek. Angler effort is focused on Ninilchik River earlier in the season because water conditions are generally less turbid than Anchor River or 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 2008, 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 the Brody Road Bridge (7.7 RKM; Figure 2) during the month of July and early August. 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 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 is 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 CWT. 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 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), 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 escapement above the weir during the index monitoring period from 1999 through 2007 (Otis and Szarzi 2007).

SPORT HARVEST

Monitoring the Chinook salmon sport harvest at Ninilchik River has become more complicated since the inception of the supplementation program (Appendix A3). 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, SWHS only reports

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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] Bue, B. G., and J. J. Hasbrouck. Unpublished. Escapement goal review of salmon stocks of Upper Cook Inlet. Alaska Department of Fish and Game, Report to the Alaska Board of Fisheries, November 2001 (and February 2002), Anchorage. Subsequently referred to as *Bue and Hasbrouck, unpublished*.

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 runs from high stocking years (1990–1998), 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 3 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 3 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 included the opportunity to harvest only hatchery-reared Chinook salmon in the lower 3.2 RKM of the river from 1 July through 31 December.

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* (Alaska Administrative Code 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 29 June through 6 August, 2009.

2) Census the sex composition and estimate the age composition of each of the wild and hatchery-reared Chinook salmon components of the escapement into the Ninilchik River from 29 June through 6 August, 2009.

TASKS

1) Collect, hold, and artificially spawn 114 male and 114 female Ninilchik River Chinook salmon (minimum of 60 wild males and 60 wild females to ensure genetic variation) during

July to provide fertilized eggs for releases of hatchery-reared smolt into Ninilchik River, NDFL, Halibut Cove Lagoon, and Seldovia Bay.

2) Release hatchery-reared Ninilchik River Chinook salmon smolt in May and June 2009: 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 the accuracy of scale age estimates using samples collected from Chinook salmon of a known age determined through CWT analysis.

5) Estimate the length-at-age for 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 29 June at 12:00 PM and operated through 6 August. The weir was visually inspected on a daily basis for holes to ensure no fish could migrate past 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) and then given an upper caudal finclip (during the SEG index monitoring period) or a lower caudal finclip (outside the SEG index monitoring period). The caudal finclips served to identify Chinook salmon for 2 purposes: 1) to prevent double sampling in the event of a weir failure; and 2) to provide a method to identify fish that had arrived at the weir during the SEG index monitoring period and had subsequently been used for egg takes, in order to remove these fish from the SEG escapement counts. The wild and hatchery-reared Chinook salmon escapements were calculated for the SEG index monitoring period and total weir operating period by removing the holding and egg-take mortalities from the associated Chinook salmon weir count. The total Chinook salmon escapement was calculated as the sum of the wild and hatchery-reared Chinook salmon escapements.

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 was expressed as the percentage of wild Chinook salmon to the total Chinook salmon escapement during the SEG index monitoring period. The 2009 wild and hatchery-reared percentages of the total Chinook salmon escapement during the SEG index monitoring period were compared to their respective averages from 1999–2008 (Table 7).

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 2009 wild and hatchery-reared cumulative plots were compared to each other and to their respective average (1999–2008) cumulative plots to observe any differences in run timing.

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 approximately 6.0 RKM (Figure 2) from the Ninilchik River weir site. The reported daily mean, minimum, and maximum temperatures were calculated from all 15-minute temperature readings recorded throughout each day.

The discharge data presented in this report were collected by the National Weather Service, Alaska Pacific River Forecast Center (RFC) at a bridge on the Beach Access Road (RKM 0.9; Figure 2). RFC contracted a local citizen to collect a daily stage reading (in 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 1.2 ft. No correction factor was used for low tide heights.

Biological Samples

Age and age-sex composition sample-size goals for wild (134 fish) and hatchery-reared (86 fish) 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 15% 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.

Age and length sampling for wild Chinook salmon was conducted every fourth day throughout the weir operation by applying a sampling rate of 0.128 to the cumulative wild Chinook salmon weir count since the last sampling event and rounded up to the nearest whole number. The sampling rate was estimated by dividing the wild Chinook salmon sampling goal (134 fish) by the 2005–2008 average wild weir counts during weir operation dates (1050 fish). Wild Chinook salmon sampling started immediately in the morning when the live box was opened and were sampled continuously until the sampling number was met. In recent years, the hatchery-reared

Chinook salmon weir counts have been less than 100 fish annually, thus every hatchery-reared Chinook salmon was sampled for age and length.

For age sampling, 3 scale samples were collected from the preferred area (Welander 1940) on the fish's left side and were mounted directly to gum cards. Length was measured from the mid eye to tail fork (METF) to the nearest 5 mm. All wild and hatchery-reared Chinook salmon less than or equal to550 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.

The scale gum cards were 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 (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 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 the reference scale set. The scale reader has aged all Ninilchik River Chinook salmon scale samples since 2006.

In previous years, the age-sex composition estimates for wild and hatchery-reared Chinook salmon were calculated without incorporating the known sex composition (Balland and Begich 2007; Begich 2006, 2007; Kerkvliet 2008). In some years, such as 2007, sampling estimates contained more males than the census and therefore age-sex estimates were biased (Booz and Kerkvliet 2011b*)*. The reason why males were overrepresented in the samples is unknown. The selectivity could be a result of the method used to process fish in the live box, or because of differential behavior between males and females that influenced how they arrived at the weir, or the order in which they were processed in the live box. To reduce bias associated with possible sex-selective sampling, the age-sex composition estimates for wild Chinook salmon were calculated by incorporating the known sex composition as described in equations 1 through 12 below. Because all hatchery-reared Chinook salmon were sampled for age, any selectivity bias was eliminated.

For each component (wild and hatchery-reared) of the Chinook salmon run, the proportion by sex to the weir count is known and was calculated as

$$p_i = \frac{x_i}{N} \tag{1}$$

where

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

N = number of fish in weir count (run)

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

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

where

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

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

with variance estimated as

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

Abundance of fish of age j given sex i was estimated as follows:

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

with variance estimated as

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

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

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

with variance estimated as

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

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

$$\hat{N}_j = \sum_{i=1}^{2} \hat{N}_{j|i} \tag{8}$$

with variance estimated as

$$\text{var}(\hat{N}_j) = \sum_{i=1}^{2} \text{var}(\hat{N}_{j|i}). \tag{9}$$

The proportion of fish in age class j in the run was estimated as follows:

$$\hat{p}_j = \frac{\hat{N}_j}{N} \tag{10}$$

with variance estimated as

$$\mathrm{var}(\hat{p}_j) = \frac{\mathrm{var}(\hat{N}_j)}{N^2}. \quad (11)$$

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):

$$CV_j = 100\% x \frac{\sqrt{\sum_{i=1}^{R} \frac{(X_{ij} - X_j)^2}{R-1}}}{X_j} \quad (12)$$

where

X_{ij} = the *i*th age estimate of the *j*th fish,

X_j = the mean age estimate of the *j*th fish, and

R = the number of times each fish is aged.

For each sex, age, or wild vs. hatchery-reared 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 × 3 ft) were placed on the lower weir during periods of low water to increase the depth of the holding area to provide a rest area for fish. As Chinook salmon were processed at the escapement weir, those fish showing signs of attaining more immediate sexual maturity were placed in the holding area. We began holding fish on 2 July. Due to low weir counts and the likelihood that the egg-take goal for number of wild pairs (60) would not be reached, an exemption was granted from the genetics staff on 10 July to reduce the goal to 15 wild pairs.

Egg takes were conducted on 30 July and 5 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 dip nets. Males and unripe females were sorted into net pens. Ripe females were killed and then 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/L saline solution was added to increase sperm motility. Fertilized eggs were then rinsed and placed into a plastic bag for water hardening and transport.

Only wild Chinook salmon were used to supplement the Ninilchik River salmon runs. 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 all 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 hatchery-reared Chinook salmon smolt released at Ninilchik River were thermal marked, adipose-clipped, and injected with a CWT by hatchery personnel. All smolt released at Halibut Cove Lagoon, Seldovia Bay, and NDFL were only thermal marked. Hatchery personnel also assessed the average length and weight for all smolt released, and the percentage of acceptable adipose finclips and CWT losses was assessed before they were released at the Ninilchik River. The Statewide Stocking Plan (Loopstra 2007) was used to plan and schedule the release of LCIMA smolt.

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 parameters specific to the Ninilchik River Chinook salmon project.

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 guide logbook[4] for each guided trip. The hatchery-reared percentage of Chinook salmon caught and harvested was estimated for each regulatory weekend and 2 five-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):

$$\hat{p}_j = \frac{n_j}{n} \tag{13}$$

where the subscript *j* represents either wild or hatchery-reared salmon.

The variance was estimated as follows:

$$\text{var}(\hat{p}_j) = \frac{\hat{p}_j(1-\hat{p}_j)}{n-1}. \tag{14}$$

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[3] Mark, Tag and Age Laboratory Database [Internet]. Juneau, AK: ADF&G. 2009. [10 December 2009 3:45 PM]. Available from http://tagotoweb.adfg.state.ak.us/CWT/reports/.

[4] 2006 Freshwater Sport Fish Guide Logbook and Vessel Registration. ADF&G, Division of Sport Fish, Anchorage. *Note:* A logbook is required by all sport fish charter and guide services operating in Alaska. It is the responsibility of the business owner to obtain the logbook and assure that all data for fishing activities are submitted to ADF&G.

No finite correction factor was used because the inriver population size during each guided trip was unknown. Chi-square tests were used to identify differences in the proportions of hatchery-reared fish in the Chinook salmon harvest over the regulatory sport fishery. The 2009 catch and harvest compositions were compared to similar logbook-based estimates for the same guide in 2006 through 2008.

RESULTS

ESCAPEMENT MONITORING

Weir Counts

In 2009, the total number of Chinook salmon counted through the Ninilchik River weir from 29 June through 6 August was 727 fish of which 620 were wild and 107 were hatchery-reared (Table 7, Appendix B1). After the subtraction of fish mortality associated with holding (22), egg takes (55), and within the live box (3), the total escapement was 647 Chinook salmon of which 89% (579/647) were wild and 11% (68/647) were hatchery-reared (Table 7).

In 2009, 4 species of Pacific salmon, Dolly Varden, and steelhead trout were observed at the weir (Table 9). Pink salmon were the most abundant and had the highest weir count observed in this data series.

Sustainable Escapement Goal (SEG)

During the SEG index monitoring period, 528 wild and 69 hatchery-reared Chinook salmon escaped above the weir (Table 8). The wild Chinook salmon escapement failed to reach the lower end of the SEG by 22 fish. The contribution of wild Chinook salmon to the total escapement during the SEG index monitoring period was 88.4% (528/597) (Table 8; Figure 5). Wild and hatchery-reared escapement counts were lower than the 1999–2005 escapement average for the SEG index monitoring period by 443 and 303 fish, respectively (Table 8).

Run Timing

The 2009 cumulative run-timing plots of wild and hatchery-reared Chinook salmon showed that both components of the run were later than average until the last 4 days of the SEG index monitoring period (Figure 6). The median cumulative run-timing date for both wild and hatchery-reared Chinook salmon was 25 July.

Water Temperature, Discharge, and Tides

Average water temperature and discharge fluctuated during the SEG index monitoring period but no general pattern with daily weir counts emerged (Figure 7). The average water temperature recorded in 2009 during the SEG period was 1 degree above the recent 10-year average (1999–2008; Table 10, Appendix C1). During the SEG index monitoring period, the average discharge was 85 cfs (range = 71 cfs to 110 cfs), which was similar to the recent 10-year average (Table 10, Appendix D1). The daily average high tide height ranged from 13.4 to 22.9 ft and averaged 18.1 ft. The daily average low tide height ranged from -5.4 to 7.6 ft and averaged 1.6 ft. Approximately 58% of the total Chinook salmon weir count were counted during the larger tide series from 20 July through 27 July (Figure 7, Appendix E1).

Biological Samples

A total of 68 wild and 105 hatchery-reared Chinook salmon were sampled for age and length. The sample-size goal for wild Chinook salmon was not reached by 66 fish. All but 2 hatchery-reared Chinook salmon were sampled for age and length data. Approximately, 15% of the wild and 8% of the hatchery-reared scale samples were not readable due to regeneration or poor mounting (Table 11). Of the samples collected, 58 wild and 97 hatchery-reared samples were aged. Ocean age 2 and ocean age 1 were the dominant age classes for wild (44.3%, SE 6.4%) and hatchery-reared (58.4%, SE 1.4%) Chinook salmon, respectively (Table 11, Figure 8). The majority of age estimates for both wild and hatchery-reared females were ocean age 3. The majority of wild male Chinook salmon age estimates were ocean age 2, while ocean age 1 was most common hatchery-reared male age estimate. Statistically significant differences were detected between the wild and hatchery-reared Chinook salmon age composition ($\chi^2 = 18.8$, df = 3, $P = 0.0003$), and between the age composition for wild and hatchery-reared males ($\chi^2 = 23.0$, df = 3, $P < 0.0001$). The 2009 overall wild ($\chi^2 = 49.4$ df = 3, $P < 0.0001$) and hatchery-reared ($\chi^2 = 54.1$, df = 3, $P < 0.0001$) age compositions were different from their respective 1997–2008 averages (Table 12).

The coefficient of variation (CV, Equation 12) of all scale age estimates was 0.8%. The CVs of scale age estimates for both wild (CV = 2.0%) and hatchery-reared (CV = 0.1%) Chinook salmon were similar to the overall CV for all scale age estimates. Age was determined for 36 hatchery-reared Chinook salmon from CWT recoveries, of which 25 could be aged using scale-age estimates as well (Table 13). There was a 92% agreement between the resolved age estimates and known ages.

The wild jack (ocean age 1) Chinook salmon census at the weir (90 fish) was within the confidence interval of the estimated abundance (128 fish, SE 27.2) of that age class (Table 11). The hatchery-reared jack Chinook salmon census (61) was nearly identical to estimated abundance (62, SE 1.5).

The overall mean length of wild Chinook salmon (643 mm) was larger than the overall mean length of hatchery-reared Chinook salmon (519 mm; Table 11). Mean lengths were different between wild (599 mm) and hatchery-reared (452 mm) males, but not between wild (768 mm) and hatchery-reared (778 mm) females.

EGG TAKES

Chinook salmon eggs were collected from 48 females, of which 21 were wild and 27 were hatchery-reared (Table 14). The average fecundity was 6,146 green eggs per female spawned. The egg take conducted on 30 July sacrificed 16 wild and 18 hatchery-reared females and had a 91.4% egg survival to the eyed stage. The egg take conducted on 5 August sacrificed 5 wild and 9 hatchery-reared females and had a 94.8% egg survival to the eyed stage. The average percent survival to the eyed stage of 92.4% was above the 1999–2008 average (84.8%; Table 14). The maximum water temperatures recorded during the egg takes were 12°C (30 July) and 14°C (5 August).

STOCKING

Smolt Release and Marking

The stocking goal[5] was reached for Ninilchik River but not at the terminal saltwater fisheries (Tables 3–6). In 2009, Chinook salmon smolt releases were apportioned between the Ninilchik River and 3 terminal saltwater fisheries as follows: 54,797 smolt were stocked at Ninilchik River; 164,234 smolt at NDFL; 35,065 smolt at Halibut Cove Lagoon; and 44,487 smolt at Seldovia Bay. In 2009, the average lengths (mm) and weights (g) of Chinook salmon smolt stocked in the Ninilchik River (87.6 mm, 8.2 g), NDFL (96 mm, 9.7 g), Halibut Cove Lagoon (97 mm, 9.6 g) and Seldovia Bay (97 mm, 9.6 g) were smaller than their respective length and weight averages from recent years (Tables 3–6).

Straying

A total of 38 heads were collected for CWT analysis from hatchery-reared Chinook salmon holding mortalities and from female hatchery-reared Chinook salmon sacrificed during egg takes (Table 13, Appendix F1). Coded wire tags were successfully decoded from 36 heads. All of the heads originated from stocking in the Ninilchik River. No other Ninilchik River hatchery-reared Chinook salmon were detected in LCIMA fisheries or escapement projects in 2009.

LOCAL GUIDE HARVEST

The hatchery-reared percentage of Chinook salmon catch and harvest recorded in freshwater sport fish guide logbooks was 16.2% (SE 2.4%) and 67.3% (SE 6.8%), respectively (Table 15). The composition of the Chinook salmon catch was not significantly different ($\chi^2 = 4.75$, df = 4, $P = 0.31$) over the course of the fishery. The catch rate peaked at 4.7 Chinook salmon per angler day (196/42) during the first 5 days of the July fishery. The 2009 hatchery-reared percentage of the Chinook salmon catch in the sport fishery (16.2%, SE 2.4%) was significantly lower ($\chi^2 = 7.1$, df = 1, $P = 0.008$) than 2006–2008 average (25.4%, SE 4.7%).

DISCUSSION

The 2009 Ninilchik River wild Chinook salmon escapement failed to reach the lower end of the SEG (550 fish) for the second time in 3 years. The 2009 Chinook salmon run timing was considerably later than average, which suggests that nearly the entire run passed through the weir during the operation dates. Since 2005, analysis of annual weir counts suggests a decreasing trend in both wild and hatchery-reared Ninilchik River Chinook salmon escapement (Table 7).

In 2009, both the weir count and escapement of hatchery-reared Chinook salmon was similar to 2007 and 2008. Poor Chinook salmon runs were also observed at the Kachemak Bay stocking locations, which suggests poor ocean survival for the 2004–2008 broods that composed the 2009 run. The estimated age composition showed a large reduction in the number of ocean-age-3 fish for both the wild and hatchery-reared components. This was also observed in other Cook Inlet Chinook salmon stocks such as the Anchor River stock (Kerkvliet and Booz 2012), the late-run Kenai River stock (J. Perschbacher, Sport Fish Biologist, ADF&G, Soldotna, personal

[5] 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 (52,500 smolt).

communication), and the Deshka River stock (C. Brockman, Sport Fish Biologist, ADF&G, Palmer, personal communication).

Sport fishery catch and harvest estimates of Chinook salmon in the Ninilchik River suggest the lowest catch and harvest since the inception of the statewide harvest survey in 1977 (Table 2). The 2009 Chinook salmon harvest estimate was over 1,000 fish below average for years where the run is comprised of all low stocking broods (1999–2008). Coupled with the below-average weir counts, the 2009 Ninilchik River Chinook salmon run was poor.

The stocking goals were not met for the terminal saltwater fishery locations within Kachemak Bay. The stocking reduction was a result of a higher than average overwintering morality rate caused by increased bird predation in the outdoor raceways at Fort Richardson Hatchery (D. Loopstra, Sport Fish Biologist, ADF&G, Ft. Richardson, personal communication). Extra measures were put in place to avoid this problem in the future. The decreased average smolt size at stocking was a result of decreased water temperatures throughout 2008. It is unknown how the reduced stocking numbers and size will influence the marine survival of this brood and ultimately the sport fishery.

The below-average run in 2009 hindered our ability to accomplish the egg-take goal. With the genetics waiver, the reduction in the number of wild pairs needed to ensure genetic variation (from 60 to 15 pairs) allowed us to collect enough fertilized eggs to meet the 2011 Ninilchik River stocking goal. Additional broodstock was collected from Crooked Creek egg takes to meet the 2011 stocking goals for the Kachemak Bay terminal saltwater fishery locations (A. Tesch, Sport Fish Culturist, ADF&G, Ft. Richardson, personal communication).

Considerable measures were taken to achieve adequate escapement prior to any egg take being conducted. Although we began holding fish on 2 July, most of the wild Chinook salmon held for egg takes were collected after 23 July. This reduced the overall holding mortality to just a few fish and allowed 93% of the wild Chinook salmon counted during the SEG index monitoring period to escape above the weir. The disadvantage to only using fish from later in the run is the potential to influence the run timing of the hatchery-reared component of future runs.

In 2009, all hatchery-reared Chinook salmon were held for egg takes. Overall, almost every hatchery-reared female was spawned in the egg takes. Although this did not influence the hatchery-reared percentage of the total escapement compared to previous years, it did markedly shift the sex composition of the hatchery-reared escapement. After the egg takes, the remainder of the hatchery-reared escapement was predominantly jacks (ocean-age-1 fish). During low escapement years, there is added value for hatchery-reared Chinook salmon escaping the sport fishery. These fish could be used as broodstock to help achieve egg take goals. If appropriate, an emergency order could be written to close sport fishing of hatchery-reared Chinook salmon in July to allow more hatchery-reared Chinook salmon to escape above the sport fishery and be used for egg takes.

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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: Baird, S., Kachemak Bay Research Reserve in 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, 1977–2009.

			Chinook salmon							
			Harvest			Catch[b]				
	Angler effort-days fished[a]								Percent hatchery harvest[d]	Days open to fishing[e]
Year	Estimate	SE	Estimate	SE	Percent jack[c]	Estimate	SE	Percent jack[c]		
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.–Part 2 of 2.

Year	Angler effort-Day 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]
2009	7,687	1,806	203	61	17.2	560	183	19.1	ND	23
Average										
Pre-stocking (1977–1990)	12,338		990			1,598				
High stocking (1991–1998)	17,427		3,169			6,716			55	
Low stocking (1999–2008)	10,529		1,387			3,307			50	

Source: Alaska Statewide harvest survey (SWHS) estimates gathered from the published reports for each year (Howe et al. 1995-1996, 2001a-d; Jennings et al. 2004, 2006a-b, 2007, 2009a-b, 2010a-b, 2011; Mills 1979-1980, 1981a-b, 1982-1994; Walker et al. 2003).

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 were not calculated until 1996.

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

[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 that were either catch-and-release or harvested. Estimates from Gretchen Jennings, project manager, SWHS unpublished data, ADF&G, SF, Anchorage.

[c] The percentage of the total harvest that is less than 20 in. From 1981 through 1993 and 2008, SWHS estimates were calculated by dividing Chinook salmon into "large" and "small" sizes to account for percentage of jacks. Prior to 1981 and from 1994 through 2007, the SWHS estimates for Chinook salmon were not divided 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 through emergency order (EO) were available for 1991–2007. Starting in 2008, the regulatory fishery was open from 1 July through 31 December. See Appendix A4.

[f] The 2006 sport harvest survey percent hatchery harvest estimate 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 (2011a).

Table 3.–Chinook salmon smolt released at Ninilchik River, 1988–2009.

Release year	Release date	Brood year	Number of smolt[a]	Release location[b]	Hatchery	Mark type[c]	Percent adipose finclip[d]	Percent CWT	CWT tag code	Average length (mm)	Average weight (g)
1988	6 July	1987	248,586	Harbor	Ft. Richardson	Ad, CWT	ND	12.5	311762	ND	12.5
1989	1 June	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 June	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 June	1995	51,688	Harbor	Ft. Richardson	Ad, CWT	ND	98.4	312515	ND	12.9
1997	17 June	1996	50,292	Brody	Ft. Richardson	Ad, CWT, TM	ND	99.2	312608	ND	12.0
1998	15 June	1997	48,798	Brody	Ft. Richardson	Ad, CWT, TM	ND	97.3	312635	ND	11.4
1999	15 June	1998	49,853	Brody	Ft. Richardson	Ad, CWT, TM	ND	98.1	310147	104	13.6
2000	2 June	1999	51,298	Brody	Ft. Richardson	Ad, CWT, TM	ND	97.5	310248	96	10.2
2001	13 June	2000	54,770	Brody	Ft. Richardson	Ad, CWT, TM	ND	99.4	310260	104	13.6
2002	14 June	2001	54,631	Brody	Ft. Richardson	Ad, CWT, TM	ND	99.1	310282	101	12.1
2003	12 June	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
2009	14 May	2007[e]	54,797	Brody	Ft. Richardson	Ad, CWT, TM	100.0	99.1	310376	87.6	8.2
Average (1995–2008)			52,955				99.5	98.0		100.6	12.0

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 Ninilchik River harbor and 50% released at Brody Road bridge.

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

[d] Smolt were checked prior to release for finclip quality 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, 2000–2009.

Nick Dudiak Fishing Lagoon							
Release year	Release date	Brood year	Number of smolt [a]	Hatchery[a]	Mark type[b]	Average length (mm)	Average weight (g)
2000	31 May	1999	102,243	Elm.	NM	117	17.8
2000	7 June	1999	117,741	Elm.	NM	119	17.8
2001	25 May	2000	101,799	Elm.	NM	104	13.9
2001	8 June	2000	106,263	Elm.	NM	112	13.9
2002	30 May	2001	122,444	Elm.	TM	102	12.1
2002	6 June	2001	67,582	Elm.	TM	107	12.1
2003	6 June	2002	80,063	Fort R.	TM	104	12.0
2003	28 May	2002	126,229	Fort R.	TM	102	12.0
2004	7 June	2002[c]	95,105	Fort R.	TM	109	13.9
	10 June		47,932	Fort R.	TM	109	13.9
	10 June	2003	25,706	Elm.	TM	112	15.6
2005	10 June	2003[c]	111,196	Fort R.	TM	107	13.0
2005	13 June	2003[c]	109,626	Fort R.	TM	104	13.0
2006	19 June	2004[c]	111,089	Fort R.	TM	107	13.2
	22 June		112,964	Fort R.	TM	107	13.2
2007	11 June	2005[c]	113,636	Fort R.	TM	102	10.3
	14 June		113,336	Fort R.	TM	102	10.3
2008	13 June	2006[c]	110,802	Fort R.	TM	104	11.6
	17 June		101,339	Fort R.	TM	99	11.6
2009	17 June	2007[c]	107,916	Fort R.	TM	94	9.4
	24 June		56,318	Fort R.	TM	99	10.3
Average (2000–2008)			208,566			106.7	13.2

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, 1995–2009.

Halibut Cove Lagoon								
Release year	Release date	Brood year	Number of smolt [a]	Hatchery [b]	Mark type [c]	CWT tag code	Average length (mm)	Average weight (g)
1995	13 June	1994	37,577	Elm.	Ad, CWT	312430	ND	23.6
1996	4 June	1995	97,729	Elm.	Ad, CWT	312511	ND	18.5
1997	9 June	1996	78,133	Elm.	Ad, CWT	312558	ND	13.4
1998	12 June	1997	65,893	Elm.	Ad, CWT	312632	114	17
1999	1 June	1998	79,221	Elm.	NM		114	16.7
2000	1 June	1999	83,277	Elm.	NM		114	16.5
2001	5 June	2000	106,719	Elm.	NM		104	15.7
2002	28 May	2001	106,279	Elm.	TM		104	12.7
2003	17 June	2002	106,844	Fort R.	TM		104	12.5
2004	4 June	2002	103,771	Fort R.	TM		107	13.6
2005	15 June	2003	112,521	Fort R.	TM		107	13
2006	14 June	2004	117,549	Fort R.	TM		102	11.7
2007	13 June	2005	54,560	Fort R.	TM		97	9.8
2008	19 June	2006	58,674	Fort R.	TM		102	11.6
2009	18 June	2007 [d]	35,065	Fort R.	TM		97	9.6
Average (1995–2008)			86,339				106.2	14.7

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

[a] Number released includes smolts 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, 1996–2009.

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 June	1995	118,274	Elm.	Ad,CWT	312510	ND	18.2
1997	6 June	1996	103,757	Elm.	Ad,CWT	312557	ND	13.6
1998	9 June	1997	69,461	Elm.	Ad,CWT	312631	109	13.8
1999	28 May	1998	74,057	Elm.	NM		117	17.6
2000	6 June	1999	68,114	Elm.	NM		119	19.2
2001	7 June	2000	102,793	Elm.	NM		109	14.2
2002	28 May	2001	83,045	Elm.	TM		107	13.4
2003	11 June	2002	107,521	Fort R.	TM		102	11.4
2004	18 May	2003	88,682	Elm.	TM		107	12.9
2005	7 June	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 June	2005[d]	54,276	Fort R.	TM		99	10.5
2008	3 June	2006[d]	54,464	Fort R.	TM		104	12.0
2009	2 June	2007[d]	44,487	Fort R.	TM		97	9.6
Average (1996–2008)			88,723				107.4	14.0

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

[a] Number released includes smolts 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, 1989–2009.

Year	Weir operating dates	Chinook salmon run: Component	Chinook salmon run: No. fish	Chinook salmon run: %	Egg take mortality (no. Chinook salmon)	Coded wire tagged Chinook salmon: No. fish recovered	Coded wire tagged Chinook salmon: No. strays detected[a]	Chinook salmon escapement: No. fish[b]	Chinook salmon escapement: %
1989	4– 25 Jul	Total[c]	254		ND	ND	ND	ND	
1990	6– 27 Jul	Total[c]	315		ND	ND	ND	ND	
1991	1–17 Jul	Total[c]	338		ND	12	ND	ND	
1992	30 Jun–14 Jul	Total[c]	539		ND	59	ND	ND	
1993	NL		NL	NL	NL	38	1	NL	NL
1994	7–26 Jul	Wild	446	81	ND	NA	NA	446	–
		Hatchery-reared	103[f]	19	ND	43	0	60	–
		Total[d]	549	100	125	43	0	381	
1995	4 Jul–1 Aug	Wild	725	63	ND	NA	NA	725	–
		Hatchery-reared	425[f]	37	ND	135	0	290	–
		Total[d]	1,150	100	194	135	0	821	
1996	2–24 Jul	Wild	654	69	ND	NA	NA	654	–
		Hatchery-reared	290[f]	31	ND	69	0	221	–
		Total[d]	944	100	190	69	0	685	
1997	1 Jul–11 Aug	Wild	579	53	ND	NA	NA	579	–
		Hatchery-reared	517[f]	47	ND	181	2	336	–
		Total[d]	1,096	100	132	181	2	783	
1998	3 Jul–1 Aug	Wild	536	53	ND	NA	NA	536	53
		Hatchery-reared	466[f]	47	ND	0	0	466	47
		Total	1,002	100	196	0	0	1002	
1999	18 May–13 Aug	Wild	1,644	72	68	NA	NA	1,576	73
		Hatchery-reared	641	28	26	42	0	573	27
		Total[e]	2,285	100	94	42	0	2,149	
2000	17 May– 8 Aug	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 Aug	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.–Part 2 of 2.

Year	Weir operating dates	Chinook salmon run: Component	No. fish	%	Egg take mortality (no. Chinook salmon)	Coded wire tagged Chinook salmon: No. fish recovered	No. strays detected[a]	Chinook salmon escapement: No. fish[b]	%
2002	23 May–11 Aug	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 Aug	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 Aug	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 Aug	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 Jun–1 Aug	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 Jul–1 Aug	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 Jun–7 Aug	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]	
2009	29 Jun–6 Aug	Wild	620	85	38	NA	NA	579[g]	89
		Hatchery-reared	107	15	39	0	0	68	11
		Total	727	100	77	0	0	647[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	
2006–2008		Wild	863	86	123	NA	NA	740	88
		Hatchery-reared	152	14	28	11	0	112	12
		Total	1,016	100	152	11	0	852	

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 that the number of strays are included in the CWT recovered total.

[b] 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 wild and hatchery-reared Chinook salmon used in egg take unavailable.

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

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

[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 SEG index monitoring period, 1999–2009.

	Wild Chinook salmon				Hatchery Chinook salmon			
		SEG period[a]				SEG period[a]		
Year	Total run	Weir counts[b]	Escapement counts[c]	Escapement percentage of run	Total run	Weir counts[b]	Escapement counts[c]	Escapement percentage of run
1999	1,576	1,351	1,283	81	573	515	447	78
2000	1,553	1,346	1,265	81	685	786	618	90
2001	1,239	1,072	897	72	543	601	471	87
2002	1,340	1,073	897	67	395	403	238	60
2003	1,127	648	517	46	336	293	204	61
2004	1,393	811	679	49	469	409	342	73
2005	2,076	1,424	1,259	61	409	339	286	70
2006	ND	1,114	1,013	–	ND	260	191	–
2007	ND	672	543	–	ND	83	63	–
2008	ND	721	586	–	ND	83	62	–
2009	ND	551	528	–	ND	97	69	–
Averages								
1999–2005	1,472	1,104	971	65	487	478	372	74
2006–2008		836	714			142	105	

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

[a] "SEG" = Sustainable Escapement Goal established in 2007 based on escapement counts from 3–31 July, 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, 1999–2009.

	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
2009	359	1,118	0	13	31	2
Averages						
1999–2005	279	118	4	177	10	0
2006–2008	257	44	10	8	31	1

Table 10.–Average, maximum, and minimum water temperature, discharge and stage height for Ninilchik River during the SEG index monitoring period, 3–31 July, 1999–2009.

Year	SEG counting period								
	River temperature (°C)			Discharge (ft^3/s)			Stage height (ft)		
	Avg.	Max.	Min.	Avg.	Max.	Min.	Avg.	Max.	Min.
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
2009	14	17	10	85	110	71	3.30	3.48	3.18
1999–2008									
Average	13	18	10	82	149	58	3.27	3.64	3.09
Minimum	11	16	8	63	99	46	3.17	3.40	3.00
Maximum	15	20	11	130	336	73	3.53	4.45	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 composition and length-at-age of wild and hatchery-reared Chinook salmon run at Ninilchik River weir, 2009.

	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]	5	0	4	8	1	18	206	0	0	5	18	1	24	24
Estimated percent		0.0	10.3	20.5	2.6	33.4	33.4		0.0	4.7	16.8	0.9		22.4
SE percent		0.0	4.3	4.5	2.5		0.1		0.0	0.0	0.0	0.0		0.0
Estimated abundance[c]		0	64	127	16	207			0	5	18	1	24	
SE abundance		0.0	26.7	28.1	15.4	0.8			0.0	0.0	0.0	0.0	0.0	
Mean length		NA	715	790	880	768			NA	650	803	840	778	
SE length		NA	37.6	11.3	NA	17.6			NA	7.1	9.7	NA	3.0	
Males														
Number sampled[b]	5	14	23	7	1	50	411	8	55	14	4	0	81	83
Estimated percent		20.7	34.0	10.4	1.5	66.6	66.6		58.4	14.9	4.3	0.0		77.6
SE percent		4.4	4.7	3.4	1.4		0.1		1.4	1.3	0.7	0.0		0.0
Estimated abundance[c]		128	211	64	9	413			62	16	5	0	83	
SE abundance		27.2	29.4	21.3	8.7	0.8			1.5	1.3	0.8	0.0	0.0	
Mean length		439	619	829	900	599			377	655	809	NA	452	
SE length		22.1	11.5	23.1	22.9	NA			5.6	8.9	27.9	NA	3.0	
Total														
Number sampled[b]	10	14	27	15	2	68		8	55	19	22	1	105	
Estimated percent		20.7	44.3	30.9	4.1				58.4	19.6	21.1	0.9		
SE percent		4.4	6.4	5.7	2.9				1.4	1.3	0.7	0.0		
Estimated abundance[c]		128	275	192	25	620			62	21	23	1	107	
SE abundance		27.2	39.7	35.3	17.7				1.5	1.3	0.8	0.0		
Jacks counted		90							61					
Mean length		439	641	803	887	643			377	654	804	840	519	
SE length		22.9	12.8	13.0	10.0	17.2			5.6	6.8	9.1	NA	3.2	

[a] "UR" = unreadable scale samples.

[b] Numbered 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, 1997–2009.

	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
2009	20.7	44.3	30.9	4.1	58.4	19.6	21.1	0.9
Average 1997–2008	2.9	26.0	54.8	16.3	12.9	33.6	47.1	6.3

Table 13.–Coded wire tag (CWT) data from hatchery-reared Chinook salmon recovered at Ninilchik River weir, 2009.

CWT code	Brood year	Release Date	Release Site[a]	CWT-age[b]		Number sampled[c]	Ocean age based on scale samples								
							1st age estimate			2nd age estimate			Resolved age estimate		
				Fresh	Ocean		Corr[d]	Incorr[e]	Unaged[f]	Corr[d]	Incorr[e]	Unaged[f]	Corr[d]	Incorr[e]	Unaged[f]
310341	2003	5/19/2005	NIN	1	4	1	1	0	0	1	0	0	1	0	0
310358	2004	5/17/2006	NIN	1	3	15	11	2	2	11	2	2	11	2	2
310366	2005	5/17/2007	NIN	1	2	13	7	0	6	7	0	6	7	0	6
310372	2006	5/15/2008	NIN	1	1	7	4	0	3	4	0	3	4	0	3
No tag[g]				–	–	2	–	–	–	–	–	–	–	–	–
Total						38	23	2	11	23	2	11	23	2	11

Note: "–" = value not applicable.

[a] "NIN" = Ninilchik River.

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

[c] Number of Chinook salmon with a particular CWT code that were sampled for scale age.

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

[e] Number of scale samples where age did not match CWT age.

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

[g] CWT was not detected from sampled Chinook salmon missing adipose fins.

Table 14.–Ninilchik River Chinook salmon egg-take dates, number of females spawned, fecundity, and percent survival to the eyed stage, 1999–2009.

		Egg take	Females	Max. water	Fecundity[b]		Green egg estimates at		Eyed eggs	
Year	Hatchery	date	spawned[a]	temp. (°C)	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.–Part 2 of 3.

Year	Hatchery	Egg take date	Females spawned[a]	Max. water temp. (°C)	Fecundity[b] Assumed	Fecundity[b] Actual	Green egg estimates at Egg take	Green egg estimates at Eyed stage	Eyed eggs Total	Eyed eggs % 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	47	14	5,855	5,685	287,713	269,538	232,656	
		Total	102				601,004	524,214	431,088	82.2

-continued-

Table 14.–Part 3 of 3.

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
2009	Ft. Richardson	30 Jul	34	12	6,476	6,340	220,184	215,563	197,071	91.4
2009	Ft. Richardson	5 Aug	14	14	5,816	5,951	81,424	83,308	78,944	94.8
		Average	24	13	6,146	6,146	150,804	149,436	138,008	
		Total	48				301,608	298,871	276,015	92.4
Average 1999–2008			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, 2009.

				Harvest					Catch				
				Wild		Hatchery-reared			Wild		Hatchery-reared		
Fishery	Period	Dates	Anglers	Number	Percent	Number	Percent	SE[a]	Number	Percent	Number	Percent	SE[a]
3-day weekends	1	23–25 May	8	1	100.0	0	0.0	NA	1	100.0	0	0.0	NA
	2	30 May–1 June	6	5	83.3	1	16.7	16.7	6	85.7	1	14.3	14.3
	3	6–8 June	20	10	100.0	0	0.0	0.0	21	100.0	0	0.0	0.0
	Overall		34	16	94.1	1	5.9	5.9	28	96.6	1	3.4	3.4
July[b]	5-Day	1–5 July	42	0	0.0	29	100.0	0.0	161	82.1	35	17.9	2.7
	5-Day	6–10 July	17	0	0.0	3	100.0	0.0	13	81.3	3	18.8	10.1
	Overall		59	0	0.0	32	100.0	0.0	174	82.1	38	17.9	2.6
Combined Fisheries			93	16	32.7	33	67.3	6.8	202	83.8	39	16.2	2.4

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

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

FIGURES

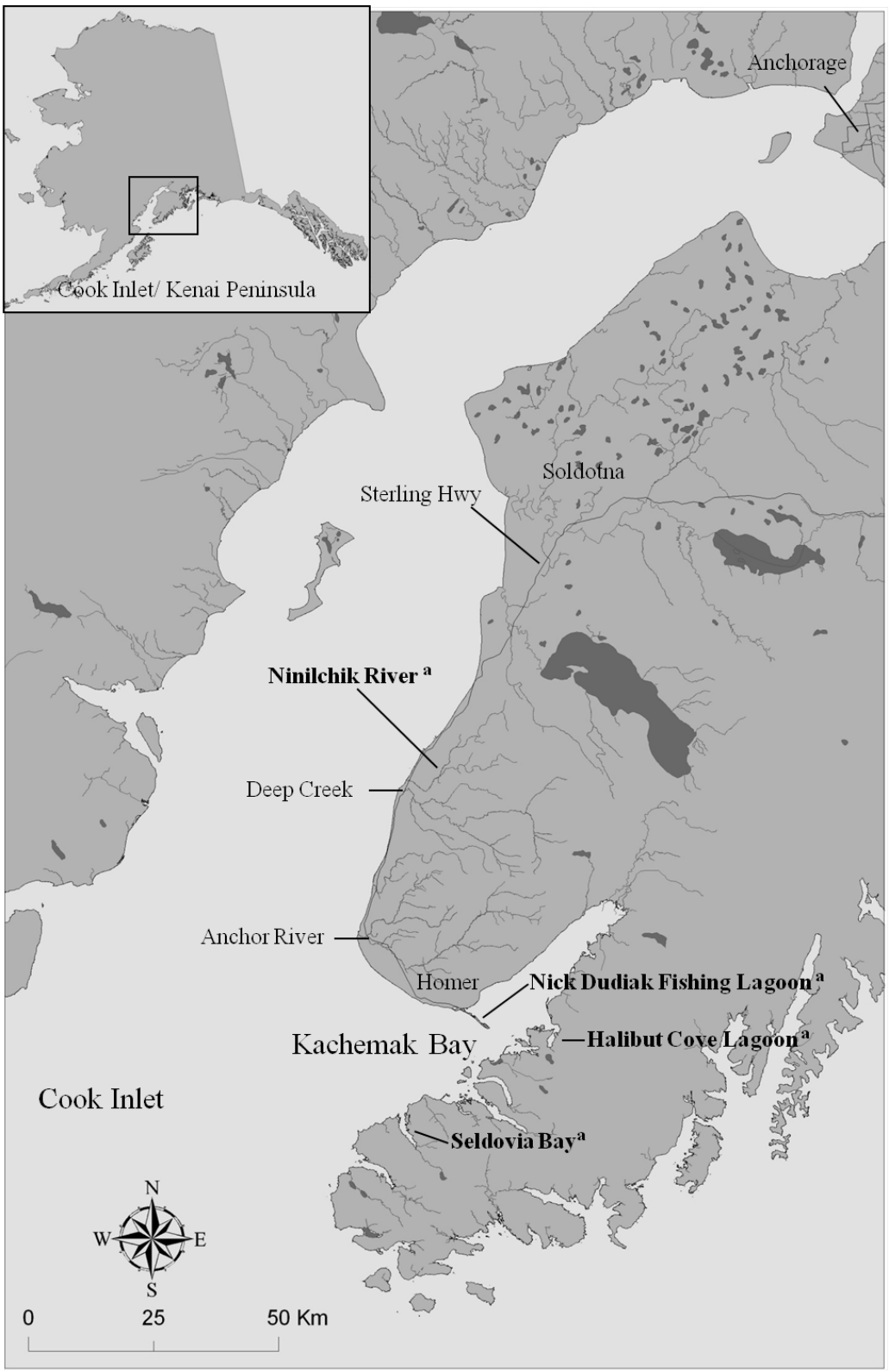

Figure 1.–Map of Kenai Peninsula highway system, Ninilchik River and Kachemak Bay Chinook salmon stocking locations, 1999-2009.

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

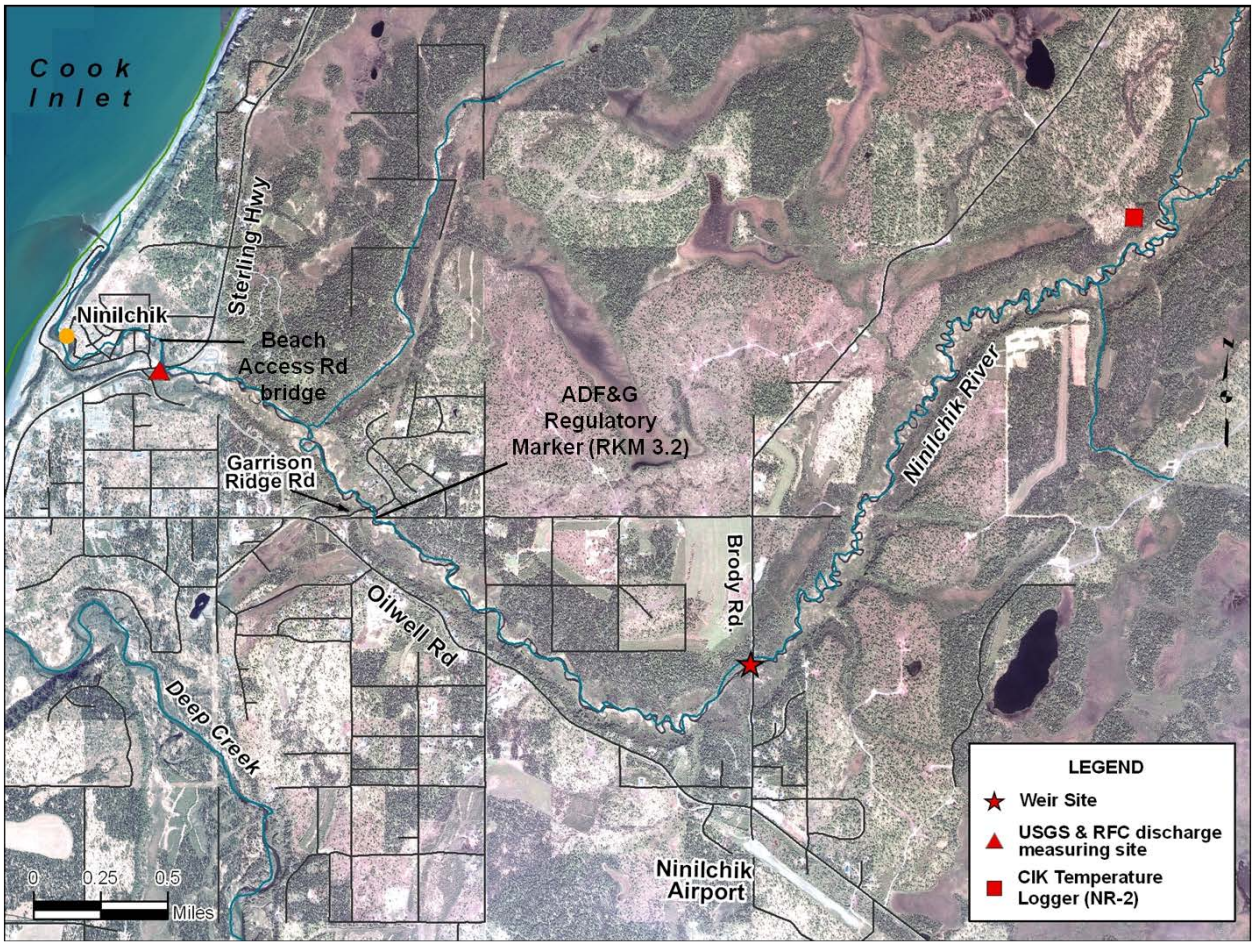

Figure 2.–Map of Ninilchik River sampling locations, 2009.

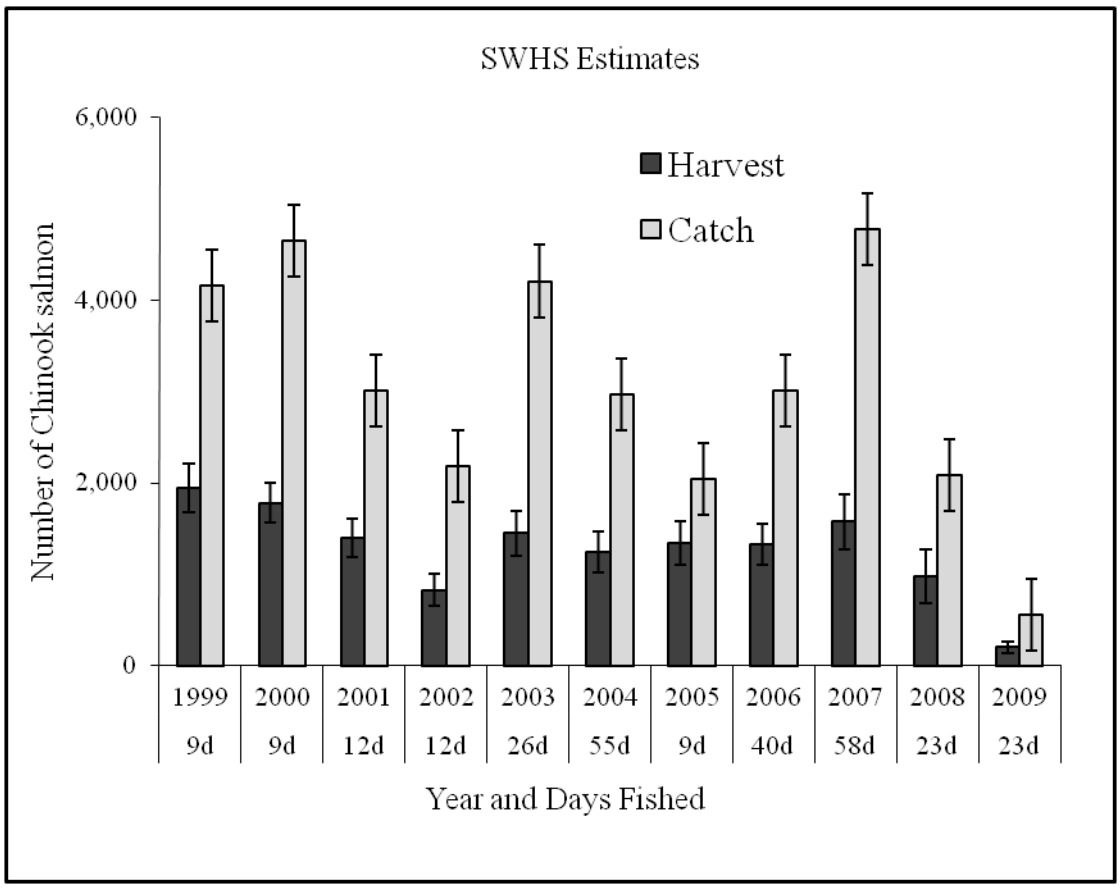

Figure 3.–Statewide harvest survey estimates of catch and harvest of Chinook salmon in the Ninilchik River, 1999–2009.

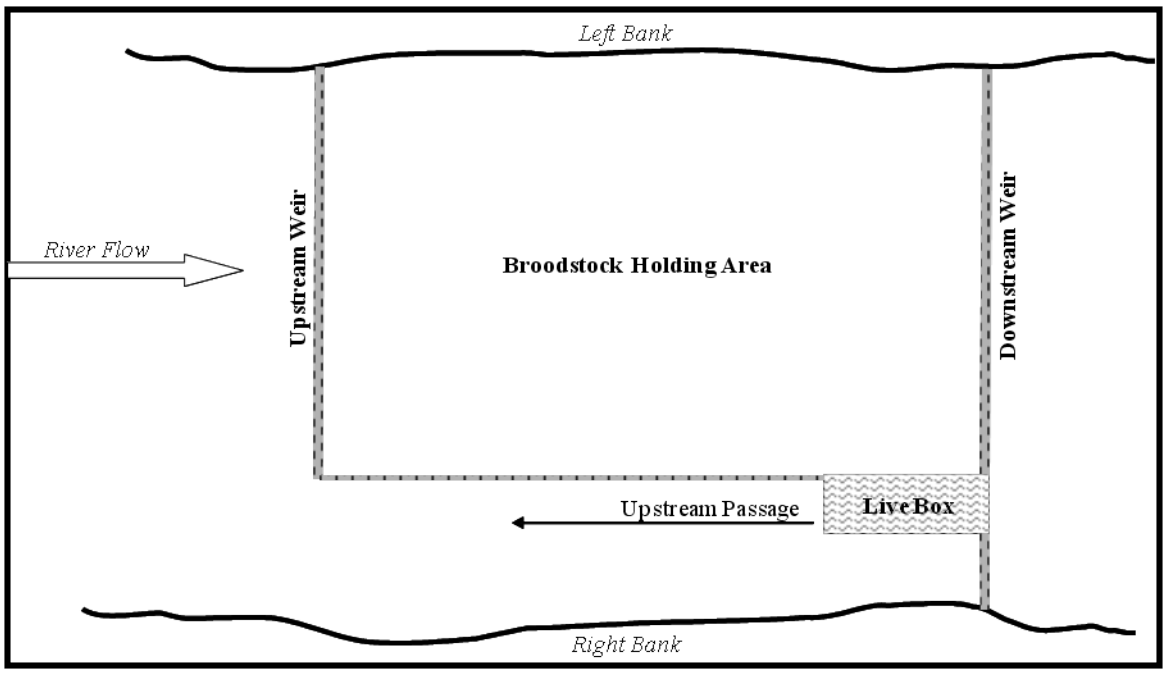

Figure 4.–The configuration of the Ninilchik River weirs and location of the broodstock holding area, 2009.

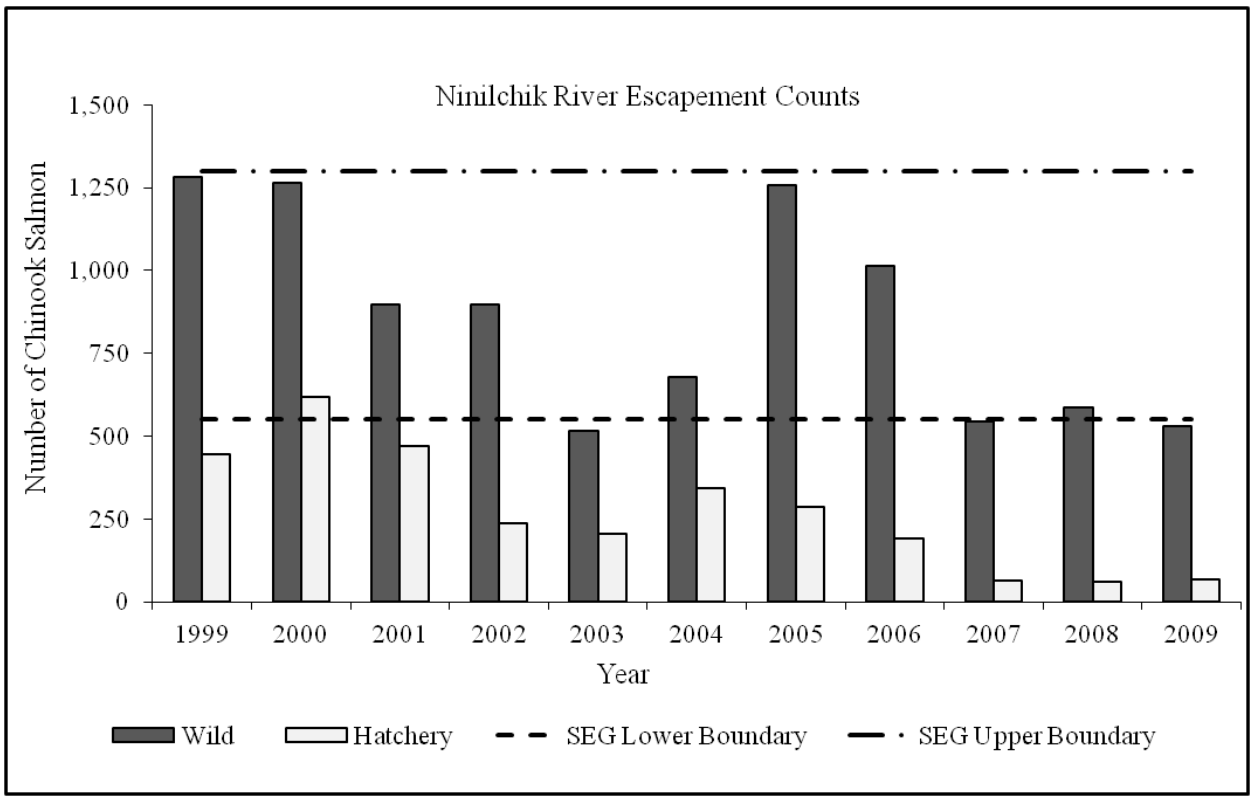

Figure 5.–Comparison of Ninilchik River Chinook salmon escapement counts during the sustainable escapement goal (SEG) index monitoring period (3–31 July) with the upper and lower boundaries of the SEG range, 1999–2009.

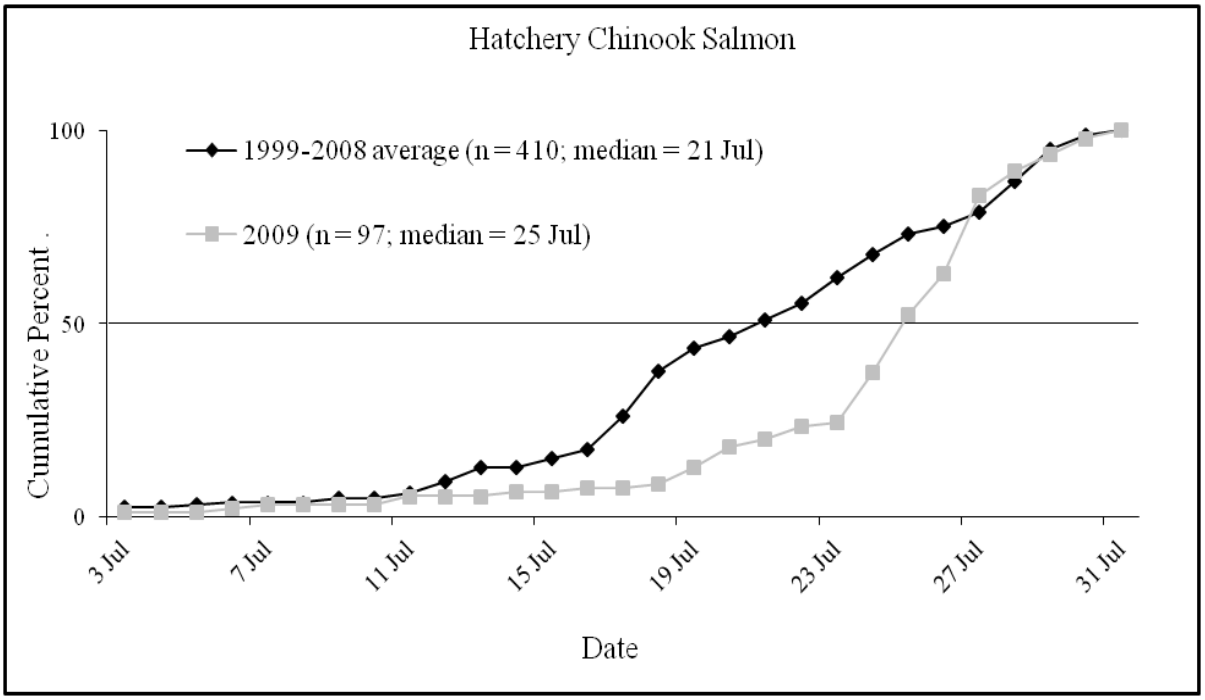

Figure 6.–Run timing cumulative percent of wild and hatchery components of the Chinook salmon weir counts during the SEG index monitoring period, 1999–2009.

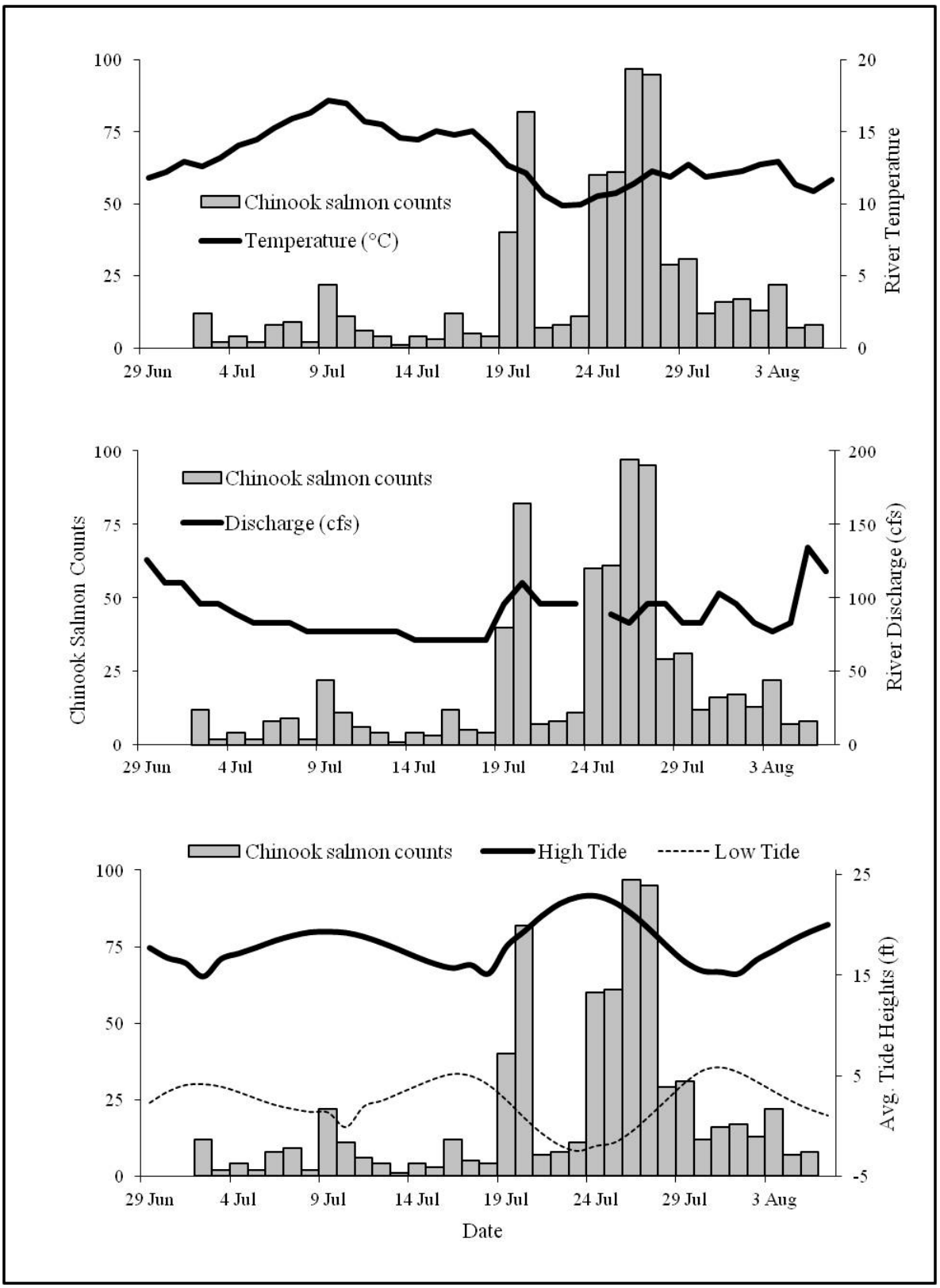

Figure 7.–Daily comparison of Ninilchik River Chinook salmon weir counts with average water temperature, discharge, and tide height, 29 June 29–6 August, 2009.

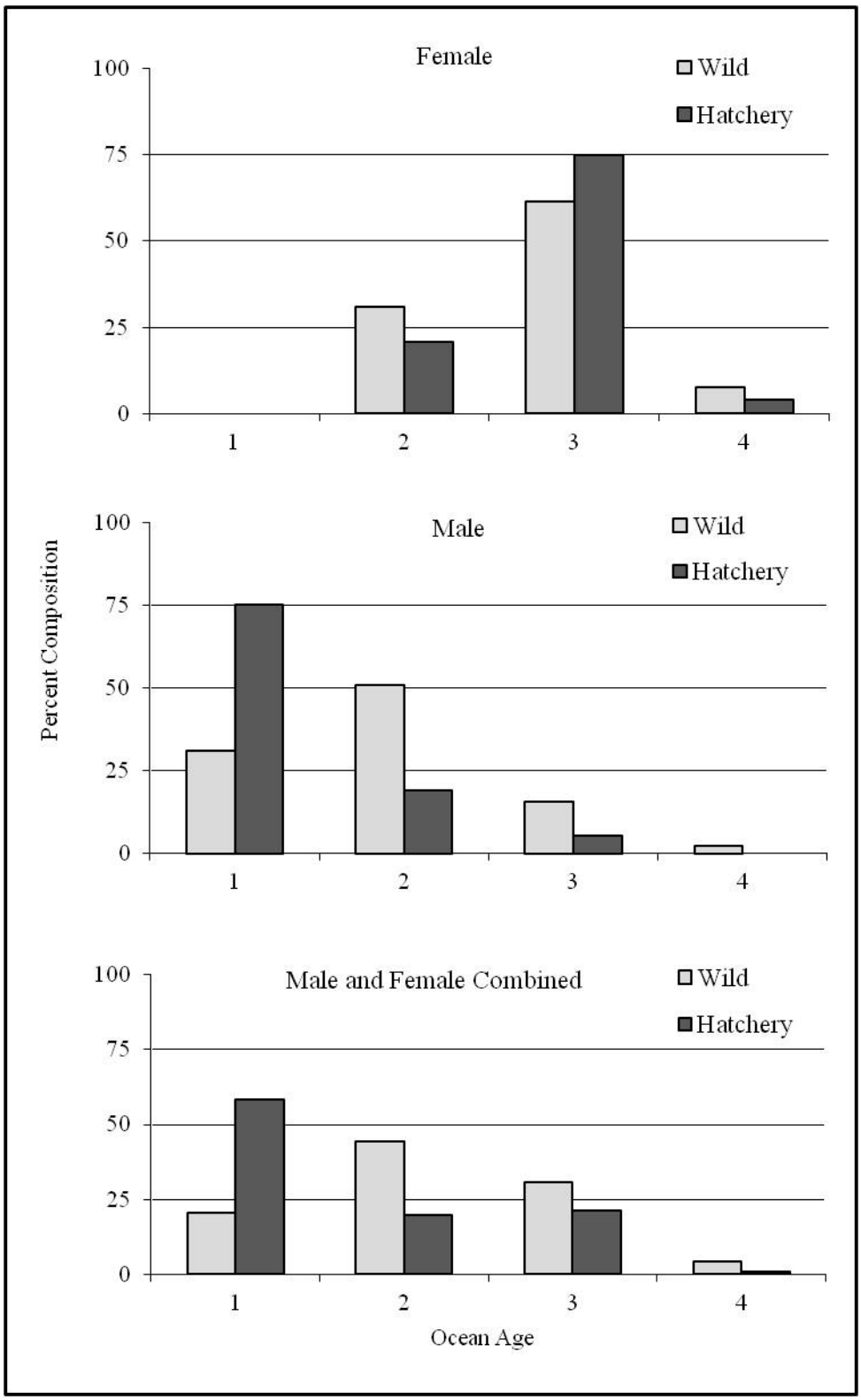

Figure 8.–Ninilchik River wild and hatchery-reared Chinook salmon estimated ocean-age composition, 2009.

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.
1999–2009	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 percentage of adipose-clipped fish counted at the weir, the percentage 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.
2006–2009	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.
2008–2009	No monitoring of sport harvest has occurred since 2007.

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; BEG was replaced with a Sustainable Escapement Goal (SEG) range of 400 to 850 wild Chinook salmon calculated from 7 years (1994–2000) of weir counts collected from 8 July through 24 July.
2007–2009	SEG with a range of 550 to 1,300 wild fish and a new index monitoring period (3–31 July) was adopted. The SEG was calculated using the percentile method[6] 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.

6 Bue, B.G., and J.J. Hasbrouck. Unpublished. Escapement goal review of salmon stocks of Upper Cook Inlet. Alaska Department of Fish and Game, Report to the Alaska Board of Fisheries, November 2001 (and February 2002), Anchorage.

Appendix A4.–Ninilchik River Chinook salmon freshwater fishing regulation and emergency order timelines.

Year	Chinook Salmon Fishing Regulations[7]
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 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 1 July through 31 December.

Year	Emergency Orders (EOs)
1991	EO added a fourth 3-day weekend (June 15–17). EO extended the fishery from June 17 through 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 the 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 15 June at 12:01 AM through Monday, 24 June at 11:59 PM.
2001	EO 2-KS-7-05-02 opened the Ninilchik River downstream of the regulatory marker for an additional 3-day weekend from 16 June at 12:01 AM to 18 June at 11:59 PM.
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, 15 June at 12:01 AM to Monday, 17 June at 11:59 PM, to sport fishing for hatchery king salmon only. The daily bag and possession limit was 1 fish 20 in or greater in length or 10 fish under 20 in. Only unbaited artificial lures were permitted.

-continued-

[7] Assume regulations are carried forward unless stated otherwise. Chinook salmon may be referred to as "king salmon" or "kings."

Appendix A4.–Part 2 of 2.

Year	Emergency Orders
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, 14 June at 12:01 AM to Monday, 30 June at 11:59 PM, to sport fishing for hatchery Chinook salmon only. The daily bag and possession limit was 1 fish 20 in or greater in length and 10 fish under 20 in. Use of only 1 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 1 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 Saturday, 29 May at 12:01 AM until 31 December at 11:59 PM.
2006	EO 2-KS-7-12-06 opened the Ninilchik River, from its mouth to the regulatory markers located approximately 2 miles upstream, from Wednesday, June 14 at 12:01 AM to Friday, July 14 at 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 in or greater in length and 10 hatchery king salmon under 20 in. Fish 20 in or greater in length must be recorded on the back of the fishing license or harvest record card. Bait was allowed. Use of only 1 single hook was allowed.
2007	EO 2-KS-7-06-07 opened the Ninilchik River, from its mouth to the regulatory markers located approximately 2 miles upstream, from Saturday, May 26 at 12:01 AM to Sunday, July 15 at 11:59 PM, to fishing for hatchery king salmon. The daily bag and possession limit was 2 hatchery king salmon 20 in or greater in length and 10 hatchery king salmon under 20 in. Fish 20 in or greater in length must be recorded on the back of the fishing license or harvest record card. Bait was allowed. Use of only 1 single hook was allowed.

APPENDIX B: NINILCHIK RIVER CHINOOK SALMON WEIR COUNTS, 2009

Appendix B1.–Daily and cumulative counts of wild and hatchery Chinook salmon at the Ninilchik River weir, 2009.

Date	Wild			Hatchery-reared			Total		
	Daily count	Cumulative		Daily count	Cumulative		Daily Count	Cumulative	
		Count	Percent		Count	Percent		Count	Percent
29 Jun	0	0	0	0	0	0	0	0	0
30 Jun	0	0	0	0	0	0	0	0	0
1 Jul	0	0	0	0	0	0	0	0	0
2 Jul	12	12	2	0	0	0	12	12	2
3 Jul [a]	1	13	2	1	1	1	2	14	2
4 Jul [a]	4	17	3	0	1	1	4	18	2
5 Jul [a]	2	19	3	0	1	1	2	20	3
6 Jul [a]	7	26	4	1	2	2	8	28	4
7 Jul [a]	8	34	5	1	3	3	9	37	5
8 Jul [a]	2	36	6	0	3	3	2	39	5
9 Jul [a]	22	58	9	0	3	3	22	61	8
10 Jul [a]	11	69	11	0	3	3	11	72	10
11 Jul [a]	4	73	12	2	5	5	6	78	11
12 Jul [a]	4	77	12	0	5	5	4	82	11
13 Jul [a]	1	78	13	0	5	5	1	83	11
14 Jul [a]	3	81	13	1	6	6	4	87	12
15 Jul [a]	3	84	14	0	6	6	3	90	12
16 Jul [a]	11	95	15	1	7	7	12	102	14
17 Jul [a]	5	100	16	0	7	7	5	107	15
18 Jul [a]	3	103	17	1	8	7	4	111	15
19 Jul [a]	36	139	22	4	12	11	40	151	21
20 Jul [a]	77	216	35	5	17	16	82	233	32
21 Jul [a]	5	221	36	2	19	18	7	240	33
22 Jul [a]	5	226	36	3	22	21	8	248	34
23 Jul [a]	10	236	38	1	23	21	11	259	36
24 Jul [a]	48	284	46	12	35	33	60	319	44
25 Jul [a, b, c]	47	331	53	14	49	46	61	380	52
26 Jul [a]	85	416	67	12	61	57	97	477	66
27 Jul [a]	76	492	79	19	80	75	95	572	79
28 Jul [a]	23	515	83	6	86	80	29	601	83
29 Jul [a]	26	541	87	5	91	85	31	632	87
30 Jul [a]	8	549	89	4	95	89	12	644	89
31 Jul [a]	14	563	91	2	97	91	16	660	91
1 Aug	15	578	93	2	99	93	17	677	93
2 Aug	11	589	95	2	101	94	13	690	95
3 Aug	17	606	98	5	106	99	22	712	98
4 Aug	6	612	99	1	107	100	7	719	99
5 Aug	8	620	100	0	107	100	8	727	100
6 Aug	0	620	100	0	107	100	0	727	100

[a] Sustainable escapement goal (SEG) index monitoring period.

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

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

APPENDIX C: NINILCHIK RIVER WATER TEMPERATURE DATA, 2008

Appendix C1.–Ninilchik River daily mean, minimum, and maximum water temperatures, 1 June–30 September, 2009.

	Daily water temperatures (°C)											
	June			July			August			September		
Day	Mean	Min.	Max.	Mean	Min.	Max.	Mean	Min.	Max.	Mean	Min.	Max.
1	7.5	5.6	9.6	12.9	9.9	16.1	12.3	9.3	15.1	9.8	9.1	10.5
2	7.8	6.6	9.1	12.6	10.4	14.8	12.8	10.8	14.9	9.3	8.9	9.7
3	9.6	7.0	13.0	13.2	10.0	16.5	12.9	10.9	14.9	9.4	8.1	11.3
4	9.9	9.2	11.3	14.1	11.0	17.2	11.4	10.9	13.0	9.4	7.2	11.6
5	9.2	7.4	11.5	14.5	11.2	17.3	10.9	10.1	11.9	10.2	8.4	12.3
6	10.5	7.3	13.9	15.3	12.3	18.4	11.7	9.4	14.2	9.8	7.5	11.8
7	12.0	8.4	15.4	15.9	12.9	18.8	11.9	9.1	14.7	9.1	8.1	10.3
8	12.9	10.2	15.8	16.3	13.2	19.3	11.4	8.9	13.7	9.1	8.1	10.3
9	13.0	9.9	16.2	17.2	14.1	20.2	11.8	9.6	13.8	9.4	8.7	10.1
10	13.6	10.0	17.0	17.0	13.9	19.8	12.7	10.0	15.6	8.9	7.7	10.2
11	11.6	10.6	14.4	15.7	14.2	17.3	13.0	10.0	15.8	9.9	8.3	11.7
12	10.6	9.1	11.8	15.5	13.0	18.3	11.9	9.9	13.3	8.9	7.0	10.3
13	11.7	8.8	15.0	14.6	13.2	16.3	11.2	10.6	11.8	9.0	8.1	10.2
14	12.3	9.9	14.4	14.5	12.9	16.3	10.6	10.2	11.1	8.6	7.9	9.5
15	12.9	10.4	15.9	15.0	11.5	18.6	11.2	9.8	12.8	8.4	6.4	10.1
16	12.1	10.5	13.9	14.8	13.0	16.8	12.0	10.5	14.2	9.4	8.3	10.7
17	10.8	9.1	12.0	15.1	13.1	17.5	12.1	9.6	14.8	9.1	8.3	9.9
18	10.7	9.4	11.6	14.0	13.3	15.5	12.1	10.2	14.4	8.7	7.2	10.2
19	11.6	8.9	14.8	12.7	12.0	13.6	12.2	9.8	14.6	7.5	5.6	9.1
20	10.8	9.1	12.7	12.1	11.4	13.1	11.7	9.0	14.3	6.6	5.5	7.7
21	9.7	8.7	10.9	10.6	10.2	12.1	11.2	8.3	13.8	7.4	6.4	8.7
22	8.4	7.5	9.5	9.9	9.2	10.8	11.4	8.9	14.0	7.0	6.1	7.9
23	8.3	6.7	10.4	10.0	8.9	10.9	11.0	10.4	12.0	5.0	3.8	6.2
24	8.2	7.2	9.4	10.6	9.4	11.8	10.0	9.0	10.9	3.6	3.1	4.3
25	7.5	6.1	8.8	10.8	10.0	11.4	9.4	7.6	11.4	4.8	4.0	6.1
26	7.9	6.0	9.8	11.4	9.7	13.9	9.6	8.5	10.6	5.1	4.0	6.3
27	9.2	6.8	12.0	12.3	10.6	14.4	10.7	9.1	12.6	4.6	3.9	5.1
28	11.3	8.4	14.4	11.9	10.8	13.1	10.9	9.7	11.8	4.3	3.3	5.4
29	11.8	9.3	14.2	12.8	11.2	14.9	11.0	9.6	12.9	4.4	3.6	5.2
30	12.2	9.7	15.1	11.9	11.2	13.2	10.6	8.3	13.1	4.7	4.3	5.4
31				12.1	9.9	14.9	10.7	9.4	12.1			

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

APPENDIX D: NINILCHIK RIVER DISCHARGE AND STAGE HEIGHT DATA, 2009

Appendix D1.–Daily discharge measurements calculated from stage height measurements taken approximately 0.9 river kilometers upstream from the mouth of the Ninilchik River, 2009.

	Discharge (ft^3/s)						
Date	April	May	June	July	August	September	October
1	–	406	182	110	96	83	96
2	–	353	172	96	83	96	96
3	–	289	117	96	77	96	96
4	–	247	117	89	83	96	96
5	–	198	126	83	134	83	96
6	–	177	134	83	118	77	89
7	–	166	126	83	96	77	126
8	–	166	110	77	89	83	194
9	–	147	107	77	89	83	205
10	1055	121	103	77	83	183	229
11	–	121	96	77	71	96	205
12	–	121	96	77	71	103	229
13	–	113	96	77	71	126	183
14	–	113	89	71	83	110	153
15	–	99	89	71	126	103	153
16	–	99	83	71	126	96	134
17	–	99	83	71	96	96	126
18	1810	98	89	71	96	83	126
19	1250	85	110	96	83	83	110
20	1210	79	89	110	83	83	96
21	1250	122	103	96	77	77	110
22	821	93	103	96	71	71	96
23	576	86	77	96	71	71	96
24	–	93	269	–	143	77	96
25	388	93	314	89	143	96	89
26	371	93	283	83	118	110	103
27	–	93	205	96	96	96	96
28	677	107	162	96	96	96	89
29	552	82	126	83	110	89	–
30	507	178	110	83	103	110	61
31		139		103	83		66

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, 2009.

	Stage height (ft)						
Date	April	May	June	July	August	September	October
1	–	4.65	3.88	3.48	3.38	3.28	3.38
2	–	4.50	3.83	3.38	3.28	3.38	3.38
3	–	4.30	3.52	3.38	3.23	3.38	3.38
4	–	4.15	3.52	3.33	3.28	3.38	3.38
5	–	3.95	3.58	3.28	3.63	3.28	3.38
6	–	3.85	3.63	3.28	3.53	3.23	3.33
7	–	3.80	3.58	3.28	3.38	3.23	3.58
8	–	3.80	3.48	3.23	3.33	3.28	3.93
9	–	3.70	3.46	3.23	3.33	3.28	3.98
10	5.85	3.55	3.43	3.23	3.28	3.88	4.08
11	–	3.55	3.38	3.23	3.18	3.38	3.98
12	–	3.55	3.38	3.23	3.18	3.43	4.08
13	–	3.50	3.38	3.23	3.18	3.58	3.88
14	–	3.50	3.33	3.18	3.28	3.48	3.73
15	–	3.40	3.33	3.18	3.58	3.43	3.73
16	–	3.40	3.28	3.18	3.58	3.38	3.63
17	–	3.40	3.28	3.18	3.38	3.38	3.58
18	6.70	3.40	3.33	3.18	3.38	3.28	3.58
19	6.10	3.30	3.48	3.38	3.28	3.28	3.48
20	6.05	3.25	3.33	3.48	3.28	3.28	3.38
21	6.10	3.55	3.43	3.38	3.23	3.23	3.48
22	5.50	3.35	3.43	3.38	3.18	3.18	3.38
23	5.05	3.30	3.23	3.38	3.18	3.18	3.38
24	–	3.35	4.23	–	3.68	3.23	3.38
25	4.60	3.35	4.38	3.33	3.68	3.38	3.33
26	4.55	3.35	4.28	3.28	3.53	3.48	3.43
27	–	3.35	3.98	3.38	3.38	3.38	3.38
28	5.25	3.45	3.78	3.38	3.38	3.38	3.33
29	5.00	3.27	3.58	3.28	3.48	3.33	–
30	4.90	3.85	3.48	3.28	3.43	3.48	3.08
31		3.65		3.43	3.28		3.13

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, 2009

Appendix E1.–Deep Creek predicted daily high and low tides heights, 1 May–31 August, 2009.

	Daily Tide Height											
	May						June					
	High			Low			High			Low		
Day	AM	PM	Average	AM	PM	Average	AM	PM	Average	AM	PM	Average
1	17.1	15.5	16.7	4.8	0.3	2.6	15.2	18.8	16.6	2.6	2.5	2.6
2	16.0	16.8	16.3	4.9	1.2	3.1	15.1		–	1.7	3.3	2.5
3	15.7		–	4.0	1.5	2.8	18.2	17.1	16.9	0.6	3.8	2.2
4	17.5	17.2	16.9	2.4	1.6	2.0	18.5	18.2	17.4	-0.4	4.0	1.8
5	18.6	18.6	17.9	0.6	1.6	1.1	18.9	19.0	17.9	-1.2	4.0	1.4
6	19.5	19.7	18.7	-0.9	1.7	0.4	19.1	19.4	18.3	-1.7	4.0	1.2
7	20.2	20.3	19.4	-2.0	1.8	-0.1	19.3	19.4	18.5	-2.0	3.9	1.0
8	20.6	20.3	19.8	-2.7	2.1	-0.3	19.4	19.1	18.6	-2.0	3.9	1.0
9	20.7	19.9	19.8	-2.8	2.5	-0.2	19.2	18.6	18.5	-1.8	4.0	1.1
10	20.4	19.0	19.5	-2.6	3.1	0.3	18.9	18.0	18.2	-1.4	0.0	-0.7
11	19.9	17.9	18.9	-1.9	3.8	1.0	18.3	17.3	17.7	4.3	-0.7	1.8
12	19.1	16.9	18.1	-1.1	0.0	-0.6	17.4	16.7	17.0	4.6	0.2	2.4
13	18.1	16.1	17.1	4.6	0.0	2.3	16.4	16.3	16.4	5.0	1.2	3.1
14	16.9	15.7	16.1	5.4	1.1	3.3	15.3	16.1	15.7	5.2	2.3	3.8
15	15.7	15.8	15.2	6.2	2.3	4.3	14.3	16.2	15.2	5.2	3.4	4.3
16	14.5	17.4	14.5	6.7	3.3	5.0	13.6	17.1	15.0	4.8	4.4	4.6
17	13.7	14.1	14.3	6.7	4.0	5.4	13.5	14.4	15.2	3.9	5.1	4.5
18	13.5	14.8	14.6	6.0	4.4	5.2	14.1		–	2.4	5.3	3.9
19	14.0		–	4.6	4.3	4.5	17.8	16.2	16.6	0.6	5.0	2.8
20	16.7	16.5	15.9	2.7	4.1	3.4	18.9	17.0	17.8	-1.3	4.3	1.5
21	17.9	17.1	17.1	0.7	3.6	2.2	20.1	17.7	19.0	-3.0	3.4	0.2
22	19.2	17.5	18.4	-1.3	3.1	0.9	21.2	18.2	20.2	-4.5	2.4	-1.1
23	20.4	17.7	19.5	-3.0	2.6	-0.2	22.0	18.5	21.0	-5.4	1.6	-1.9
24	21.4	17.5	20.4	-4.3	2.2	-1.1	22.3	18.7	21.4	-5.6	1.1	-2.3
25	21.9	17.3	20.8	-5.0	2.0	-1.5	22.0	18.8	21.3	-5.1	0.0	-2.6
26	22.0	16.9	20.8	-5.1	2.1	-1.5	21.1	18.8	20.7	0.9	-3.9	-1.5
27	21.5	16.6	20.3	-4.5	0.0	-2.3	19.6	18.7	19.7	1.1	-2.2	-0.6
28	20.4	16.5	19.5	2.4	-3.4	-0.5	17.8	18.6	18.5	1.4	-0.2	0.6
29	18.9	16.7	18.6	2.8	-2.0	0.4	16.1	18.5	17.3	1.8	1.9	1.9
30	17.4	17.2	17.6	3.2	-0.3	1.5	14.7	18.6	16.3	2.1	3.8	3.0
31	16.0	17.9	16.9	3.2	1.2	2.2						

-continued

	Daily Tide Height											
	July						August					
	High			Low			High			Low		
Day	AM	PM	Average	AM	PM	Average	AM	PM	Average	AM	PM	Average
1	14.1	18.8	15.8	2.0	5.2	3.6	14.7		–	2.5	7.2	4.9
2	14.4		–	1.5	5.9	3.7	16.4	18.9	16.1	1.6	6.3	4.0
3	17.2	17.4	16.2	0.9	6.0	3.5	17.2	19.8	17.0	0.6	5.3	3.0
4	17.5	18.5	16.7	0.2	5.6	2.9	18.2	20.5	18.0	-0.2	4.2	2.0
5	17.9	19.3	17.3	-0.5	5.0	2.3	19.1	20.7	18.9	-0.8	3.2	1.2
6	18.5	19.7	18.0	-1.1	4.4	1.7	19.8	20.7	19.6	-1.2	2.4	0.6
7	19.0	19.8	18.5	-1.4	3.9	1.3	20.1	20.3	20.0	-1.2	1.9	0.4
8	19.3	19.6	18.8	-1.6	3.5	1.0	20.0	19.6	20.0	-0.8	0.0	-0.4
9	19.3	19.2	18.9	-1.5	3.3	0.9	19.5	18.7	19.7	1.7	0.0	0.9
10	19.1	18.5	18.8	-1.1	0.0	-0.6	18.6	17.6	19.1	1.6	1.1	1.4
11	18.4	17.8	18.4	3.3	-0.3	1.5	17.4	16.5	18.3	1.8	2.5	2.2
12	17.5	17.0	17.8	3.4	0.7	2.1	16.0	15.6	17.2	2.2	4.0	3.1
13	16.4	16.3	17.1	3.6	2.0	2.8	14.6	15.0	16.2	2.7	5.6	4.2
14	15.2	15.8	16.3	3.7	3.4	3.6	13.6	15.5	15.4	3.1	6.9	5.0
15	14.1	15.7	15.7	3.7	4.8	4.3	13.7	18.8	15.4	2.8	7.4	5.1
16	13.4	17.3	15.3	3.4	6.0	4.7	15.1		–	1.6	6.6	4.1
17	13.6	14.8	15.6	2.5	6.5	4.5	18.1	18.3	17.5	-0.2	4.8	2.3
18	14.7		–	1.1	6.1	3.6	19.7	19.9	19.3	-2.0	2.6	0.3
19	18.5	17.4	17.4	-0.8	5.0	2.1	21.4	21.3	21.1	-3.4	0.6	-1.4
20	19.8	18.5	18.9	-2.7	3.4	0.4	22.7	22.3	22.5	-4.2	-1.0	-2.6
21	21.3	19.6	20.5	-4.2	1.8	-1.2	23.2	22.8	23.1	-4.2	-2.0	-3.1
22	22.4	20.3	21.7	-5.2	0.5	-2.4	23.0	22.8	23.1	-3.3	-2.2	-2.8
23	22.9	20.8	22.3	-5.4	-0.4	-2.9	22.1	22.1	22.4	-1.9	0.0	-1.0
24	22.7	21.0	22.4	-4.8	0.0	-2.4	20.5	20.9	21.1	-1.7	0.1	-0.8
25	21.8	20.8	21.8	-0.8	-3.4	-2.1	18.5	19.3	19.3	-0.5	2.4	1.0
26	20.2	20.2	20.7	-0.6	-1.4	-1.0	16.4	17.7	17.4	1.1	4.7	2.9
27	18.3	19.3	19.1	0.2	0.9	0.6	14.6	16.7	15.6	2.8	6.8	4.8
28	16.2	18.4	17.4	1.2	3.2	2.2	13.5	19.7	14.4	4.1	8.3	6.2
29	14.5	17.7	15.9	2.3	5.4	3.9	13.7	16.9	14.3	4.5	8.6	6.6
30	13.6	18.9	15.0	3.1	7.0	5.1	14.8		–	3.8	7.7	5.8
31	13.8	16.2	14.9	3.1	7.6	5.4	15.6	19.5	15.8	2.8	6.3	4.6

Source: NOAA tides & currents website (internet), 2009. 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 RETURNS, 2009

Appendix F1.–Coded wire tag recoveries of hatchery-reared Chinook salmon at Ninilchik River weir, 2009.

Number		Brood	Date		Actual	Scale ocean age estimate[e]				Length
CWT	Head[a]	year[b]	Released[c]	Recovered	Age[d]	First	Second	Resolved	Sex	(mm)[f]
310372	297723	2006	5/15/2008	7/25/2009	1	1	1	1	M	ND
310372	144333	2006	5/15/2008	7/29/2009	1	1	1	1	M	390
310372	297724	2006	5/15/2008	7/29/2009	1	1	1	1	M	370
310366	297726	2005	5/17/2007	7/30/2009	2	NR	NR	NR	F	735
No tag	297727			7/30/2009		3	3	3	F	835
310358	297728	2004	5/17/2006	7/30/2009	3	3	3	3	F	875
310358	297729	2004	5/17/2006	7/30/2009	3	3	3	3	F	730
310358	297730	2004	5/17/2006	7/30/2009	3	2	2	2	F	665
310358	297731	2004	5/17/2006	7/30/2009	3	3	3	3	F	850
310358	297732	2004	5/17/2006	7/30/2009	3	3	3	3	F	840
310358	297733	2004	5/17/2006	7/30/2009	3	4	4	4	F	830
310366	297734	2005	5/17/2007	7/30/2009	2	2	2	2	F	685
310358	297735	2004	5/17/2006	7/30/2009	3	3	3	3	F	770
310358	297736	2004	5/17/2006	7/30/2009	3	3	3	3	F	790
310358	297737	2004	5/17/2006	7/30/2009	3	3	3	3	F	845
310358	297738	2004	5/17/2006	7/30/2009	3	NR	NR	NR	F	660
310358	297739	2004	5/17/2006	7/30/2009	3	3	3	3	F	710
310358	297740	2004	5/17/2006	7/30/2009	3	3	3	3	F	810
310358	297741	2004	5/17/2006	7/30/2009	3	3	3	3	F	775
310366	297742	2005	5/17/2007	7/30/2009	2	2	2	2	F	615
310358	297743	2004	5/17/2006	7/30/2009	3	3	3	3	F	670
310366	297744	2005	5/17/2007	7/30/2009	2	ND	ND	ND	M	ND
310358	297745	2004	5/17/2006	7/30/2009	3	ND	ND	ND	M	ND
310366	297746	2005	5/17/2007	7/30/2009	2	ND	ND	ND	M	ND
310372	144334	2006	5/15/2008	8/5/2009	1	1	1	1	M	355
No tag	144335			8/5/2009		1	1	1	M	310
310341	144336	2003	5/19/2005	8/5/2009	4	4	4	4	F	835
310366	144337	2005	5/17/2007	8/5/2009	2	2	2	2	M	715
310366	144338	2005	5/17/2007	8/5/2009	2	NR	NR	NR	M	625
310366	144339	2005	5/17/2007	8/5/2009	2	2	2	2	M	695
310366	144340	2005	5/17/2007	8/5/2009	2	NR	NR	NR	M	635
310366	144341	2005	5/17/2007	8/5/2009	2	2	2	2	M	670
310366	144342	2005	5/17/2007	8/5/2009	2	NR	NR	NR	M	615
310366	144343	2005	5/17/2007	8/5/2009	2	2	2	2	M	670
310366	297725	2005	5/17/2007	8/5/2009	2	2	2	2	F	670
310372	297756	2006	5/15/2008	8/6/2009	1	ND	ND	ND	M	ND
310372	297757	2006	5/15/2008	8/6/2009	1	ND	ND	ND	F	ND
310372	297758	2006	5/15/2008	8/6/2009	1	ND	ND	ND	M	ND

Note: ND = no data.

[a] Head cinch strap number.

[b] All recovered CWT Chinook salmon were reared at Fort Richardson hatchery.

[c] All recovered CWT Chinook salmon were released at Ninilchik River.

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

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

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