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Ninilchik River Chinook Salmon Stock Assessment and Supplementation, 2005

by

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and

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May 2010

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)

Measures (fisheries)

fork length	FL
mid eye to fork	MEF
mid eye to tail fork	METF
standard length	SL
total length	TL

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 2005, the total number of Chinook salmon counted at the Ninilchik River was 2,833 of which 2,241 were wild and 642 were hatchery reared. The contribution of hatchery reared Chinook salmon to the escapement in 2005 (16%) was below the 6-year average (26%; 1999 to 2004). The wild Chinook salmon escapement of 814 was within the Sustainable Escapement Goal range of 400 to 850 for the counting period (July 8 through July 24). The median date of the wild component run was 14 days earlier than that of the hatchery component at the weir site. Overall, ocean age 3 was the dominant age class for the Chinook salmon escapement in the wild and hatchery components. Approximately 624,806 Chinook salmon eggs were collected from 105 females. Egg survival to the eyed stage was 89%. Forty nine coded wire tags were decoded from Chinook salmon that were sacrificed at the weir, of which 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 fisheries. Continuation of the Chinook salmon assessment at Ninilchik River weir is recommended to insure that adequate escapement of wild Chinook salmon is maintained.

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

INTRODUCTION

The Ninilchik River is located on the Kenai Peninsula in the Lower Cook Inlet management area (LCIMA) (Figure 1). The Ninilchik River is a small (260 rkm) non-glacial anadromous stream draining extensive wetlands (122 km^2), but with no large contributing lakes (Table 1). There are only three road accessible streams in the LCIMA that support Chinook salmon *Onchorhynchus tshawytscha* sport fisheries: the Ninilchik River, Anchor River, and Deep Creek. Angler effort is focused on the Ninilchik River earlier in the season than the other two streams because water conditions are generally less turbid. Sport anglers are capable of harvesting a significant portion of the total Chinook salmon run to Ninilchik River because of its small stream size. In the mid 1980s the Alaska Department of Fish and Game (ADF&G) Division of Sport Fish (DSF) recognized that Ninilchik River Chinook salmon stocks were vulnerable to overharvest from the growing Kenai Peninsula sport fishery. In 1987, DSF initiated a supplementation program for Ninilchik River as a way to create sustainable fishing opportunities through stocking hatchery-reared Chinook salmon smolt. As a result of the supplementation program, two groups of Chinook salmon (wild and hatchery-reared) now return to the Ninilchik River; which has created an additional level of complexity that managers need to consider in evaluating escapement and harvest. The following sections review the evolution of the supplementation program and escapement monitoring, the tools used to evaluate the sport harvest of hatchery-reared fish, and management strategies.

SUPPLEMENTATION

The primary objective of supplementation was to increase angler effort by 10,000 angler days while maintaining historic levels of wild escapement. The first inriver egg take was conducted in 1987. Biologists used two criteria to select the inriver egg-take site: (1) the availability of mature fish, and (2) vehicle access for transporting the fertilized eggs to the hatchery.

In the first two years (1987 and 1988) of the program, nets were used to capture Chinook salmon for broodstock. Netting occurred near the Brody Road bridge approximately 7.7 rkm upstream from the Ninilchik River mouth (Figure 2). In 1989, instead of using nets to capture Ninilchik River Chinook salmon, DSF installed a weir near the Garrison Ridge Road bridge (~3.2 rkm) to capture and hold broodstock. The weir had limited success because fish would not move upstream into the live box, so beach seines were used to drive fish into the live box. The

Ninilchik River weir was relocated to Brody Road bridge in 1990. The Brody Road bridge weir location was a good site for capturing and holding broodstock until they fully matured. The weir was referred to as "the broodstock weir" from 1989 to 1998 because it only operated for 2 to 3 weeks in July to capture Chinook salmon for egg takes (Table 2). Following each egg take, fertilized eggs were transported to a hatchery, reared to smolt, and then released into Ninilchik River to imprint before emigrating to sea. 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 1995, additional broodstock from Ninilchik River was collected to support stocking of the terminal saltwater fisheries in Kachemak Bay at Nick Dudiak Fishing Lagoon (NDFL) on the Homer Spit, Halibut Cove Lagoon and Seldovia Bay. A combination of wild and hatchery-reared fish are used as broodstock for the terminal saltwater fisheries.

The number of smolt used to supplement the Ninilchik River Chinook salmon fishery has varied (Table 3, Appendix A1). From 1988 through 1994, an average of 182,000 smolt were stocked in Ninilchik River annually; of which ~20% were injected with a coded wire tag (CWT). All coded wire tagged fish also had their adipose fins excised (i.e. finclipped), so that returning adults with CWTs could be visually identified.

The following concerns were raised by DSF regarding the high stocking levels of hatchery-reared Chinook salmon in Ninilchik River: (1) possibility of an unsustainable harvest of wild Chinook salmon in Ninilchik River; (2) hatchery-reared and wild smolt interactions that may be detrimental to the wild population; (3) straying of hatchery-reared Chinook salmon, and (4) genetic impacts on the wild stock by potentially using second generation hatchery-reared fish for broodstock. DSF addressed these concerns in 1995 by: (1) lowering stocking levels to 50,000 smolt; (2) coded-wire-tagging 100% of the smolt (Marsh 1995) to be released; and (3) following the recommendations outlined in the ADF&G Genetic Policy[1]. Once all hatchery-reared smolt were adipose finclipped, ADF&G was only able to use wild broodstock for Ninilchik River stockings. Since 1995, the Ninilchik River egg-take program has expanded to support terminal saltwater fisheries in Kachemak Bay at Nick Dudiak Fishing Lagoon (NDFL), Halibut Cove Lagoon, and Seldovia Bay (Tables 4-6).

ESCAPEMENT MONITORING

ADF&G has monitored the Chinook salmon escapement in Ninilchik River since 1962 (Table 7; Appendix A2). From 1962 through the mid-1990s, escapement was monitored with a combination aerial and foot survey. These surveys provided an index of total escapement and were usually conducted at the end of July or early August during the peak of Chinook salmon spawning. The annual aerial survey was flown over a standard section of river (Sterling Highway bridge to the headwaters) where the majority of spawning was thought to occur. Simultaneous aerial and foot surveys were conducted in a subsection of the aerial survey area from Brody Road bridge to the Sterling Highway bridge to provide an expansion factor to the aerial counts for the entire river. If the foot survey counts were greater than the aerial counts in

[1] ADF&G Genetics Policy [Internet]. Anchorage, AK. ADF&G Genetics Policy Review Team. 1985. [approved 1985 Jun 11; cited 1995 Jan 25]. Available from: http://www.cf.adfg.state.ak.us/geninfo/research/genetics/policy/finfish.php

the subsection, the total aerial count was expanded by the difference[2]. The expansion methods resulted in problematic estimates. First, the Ninilchik River is slightly stained due to tannins making it difficult to count fish (Marsh *unpublished*[3]). Also, rain events quickly raise the Ninilchik River water levels, further reducing visibility, and preventing any surveys from being conducted in some years (e.g., 1992, 1995 and 1996). In addition to fluctuating water conditions, comparing annual index counts was difficult due to unknown bias associated between surveyors. Ninilchik River Chinook salmon escapement estimates were problematic before the supplementation program. However, it became even harder to generate an estimation of wild Chinook salmon escapements to Ninilchik River after hatchery-reared Chinook salmon began returning as adults because of the unknown composition of wild versus hatchery-reared fish.

In the mid-1990s there was a shift from monitoring escapement using aerial index estimates to using counts from the broodstock weir; however, the transition is not well documented. The aerial index estimate before stocking (1962–1990) averaged 816 Chinook salmon. Aerial surveys were only conducted in 3 (1991, 1993, and 1994) of the 6 years (1991–1997) in which the Chinook salmon run included hatchery-reared fish from high stocking years (Table 3). Additionally, the surveys could not evaluate the contribution of hatchery-reared fish to the escapement. Foot and aerial surveys were discontinued in 1994 and 2001, respectively. It is believed that the partial weir counts (July) combined with our ability to differentiate hatchery-reared and wild fish at the broodstock weir gave us a better understanding of Chinook salmon escapement. However, the broodstock weir failed to account for spawning that occurred below the weir which, based on aerial survey data, may have comprised approximately 35% of the total spawning escapement (Marsh, memorandum).

From 1989 through 1998 the broodstock weir was operated from approximately early July to August and only a partial Chinook salmon escapement count was attained because immigration begins in May (Table 2 and Appendix A1). Weir counts from 1989 through 1992 recorded the total number of Chinook salmon but did not enumerate the number of adipose finclipped Chinook salmon. The weir counts from 1994 to 1998 can be used to estimate the number of hatchery-reared versus wild fish because 20% of the stocked fish were adipose finclipped. The estimate of hatchery-reared Chinook salmon is based on CWT expansions. Wild counts were obtained by subtracting the hatchery-reared estimate from the total number of Chinook salmon.

Starting in 1999, all hatchery-reared Chinook salmon returning to the Ninilchik River were both adipose finclipped and coded-wire-tagged. Since then, weir counts of wild and hatchery-reared Chinook salmon were determined by examining all Chinook salmon at the broodstock weir for the presence or absence of an adipose fin. Since 1999, the Chinook salmon escapement to Ninilchik River has been monitored over the entire run (from early May until early August) (Begich 2006, 2007; Balland and Begich 2007; Kerkvliet 2008.

SPORT HARVEST

Monitoring the sport harvest of Chinook salmon at Ninilchik River has become more complicated since the inception of the supplementation program (Appendix A1). The sport fishery for Ninilchik River Chinook salmon is conservatively managed for the sustainability of

[2] Expanded count = total aerial count + [foot survey subsection count – aerial subsection count].

[3] 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).

the wild stock, and the regulations governing the fishery have remained essentially unchanged since 1978. Since 1977, ADF&G has conducted an annual mail survey called the Statewide Harvest Survey (SWHS) to estimate participation, catch (fish harvested plus fish released), and harvest (fish kept) for Alaska sport-caught species statewide, by area, and by fishery. A summary of SWHS estimates for Ninilchik River Chinook salmon is presented in Table 7. Unfortunately, the SWHS only produces total estimates and does not identify the origin of Chinook salmon in the harvest.

The effects of supplementation on the Ninilchik River Chinook salmon harvest and angler effort are reflected in SWHS estimates for (a) the years before stocking (1977–1990), (b) for years when large numbers of adults returned from high-stocking (1991–1997), and (c) for years when fewer hatchery-reared adults returned when stocking levels were lowered (1998 to present) (Table 7). The SWHS estimates indicated an approximate 1.5 fold increase in the average number of days fished and a 3.4 fold increase in the number of Chinook salmon harvested during the high stocking years (Figure 3). After stocking levels were reduced, there was a subsequent decline in effort and harvest. Since then, the average number of days fished has returned to pre-stocking levels but the average harvest of Chinook salmon is roughly 30% higher than the pre-stocking average.

The 1991 Ninilchik River Chinook salmon run was the first year when returns of hatchery-reared fish were significant to the overall run size. To assess the contribution of hatchery-reared fish to the total harvest, DSF conducted Ninilchik River creel surveys from 1991 through 1993 (Boyle and Alexandersdottir 1992; Boyle et al. 1993; Balland et al. 1994; Marsh 1995). The surveys were conducted during the three regulatory Chinook salmon openings. Based on creel survey estimates, the contribution of hatchery-reared fish to the total harvest was 77% (1991), 57% (1992), and 50% (1993). The estimates of total harvest produced from the creel surveys were similar to the SWHS estimates, supporting the view that the SWHS provides a cost-effective and reliable estimate of harvest.

In 1994 the Ninilchik River creel surveys were eliminated and the focus shifted to sampling the inriver Chinook salmon harvest throughout the regulatory sport fishery in order to estimate the stock composition (wild versus hatchery-reared) (Table 7). The estimated percentage of hatchery-reared Chinook salmon in the harvest from 1994 through 1996 (45-50%) was similar to the creel survey estimates (Marsh 1995, Marsh memorandum).

Harvest sampling was discontinued from 1997 to 1999. Sampling of Ninilchik River Chinook salmon harvests in 2000 and 2001 estimated that 49% and 51% (respectively) of the sport harvest were hatchery-reared fish (Table 7). In 2002 and 2003, only the last regulatory weekend opening was sampled and 22% and 32% of the harvest, respectively, were estimated to be hatchery-reared Chinook salmon.

Despite the reduction in stocking levels, the percentage of hatchery-reared fish enumerated at the broodstock weir increased from approximately 19% in 1994 to 47% in 1998 (Table 2). In contrast to the increased percentage of hatchery-reared fish at the broodstock weir, the contribution of hatchery-reared fish in the sport harvest remained fairly stable based on creel survey estimates from 1991 through 1993 and inriver harvest sampling estimates (1994 to 1996).

MANAGEMENT

Escapement Goals

The escapement goal for Ninilchik River Chinook salmon was refined as additional years of escapement and harvest data became available (Table 8). In 1993, a biological escapement goal (BEG) of 830 Chinook salmon was adopted (Szarzi and Begich 2004). The BEG was based on an average of the annual expanded estimates from aerial and foot survey index counts conducted from 1966 to 1969 and 1977 to 1991. In 1998, the BEG was recalculated, based on historical aerial survey estimates and their relationship to the sport fish harvest, and a BEG range of 500 to 900 Chinook salmon was set. After the Alaska Board of Fisheries (BOF) adopted the *Policy for the Management of Sustainable Salmon Fisheries* (5AAC 39.222) and the *Policy for Statewide Salmon Escapement Goals* (5AAC 39.223) in 2001 the BEG for Ninilchik River wild Chinook salmon was replaced by a sustainable escapement goal (SEG). SEGs are established for salmon stocks where a BEG cannot be estimated due to the absence of stock specific catch and or escapement data and are stated as a range. The SEG range of 400 to 850 wild Chinook salmon was calculated from 7 years (1994 to 2000) of weir counts collected from July 8 through July 24 (Bue and Hasbrouck *unpublished*[4]) (Table 8).

Regulations

The sport fishery regulations for Ninilchik River Chinook salmon have remained essentially unchanged since 1978. The regulations are designed to control harvest by limiting the area open to fishing (only the lower 3.2 rkm of the river is open to fishing to protect the spawning area), and by limiting fishing time (Chinook salmon fishing is allowed on three consecutive 3-day weekends beginning with Memorial Day weekend).

In response to the increase in hatchery-reared Chinook salmon returning during the high stocking years, DSF used their emergency order (EO) authority to increase fishing time. Although the liberalization was in response to increased run size from hatchery-reared fish, the EOs issued in the 1990s and 2001 increased fishing time for both hatchery-reared and wild fish. In 1991, an EO was issued that added 9 days of fishing (Boyle and Alexandersdottir 1992). Similar EOs were issued annually from 1992 to 1996 to add more fishing days (10-14 d).

When returns of hatchery-reared fish decreased with lower stocking levels, DSF began using foot surveys upstream of the fishery after the regulatory fishery season to determine if escapement would allow for additional fishing time. From 1997 through 2000, the foot survey counts were too low and the fishery was not liberalized (Szarzi and Begich 2004). In 2001, a fourth 3-day weekend was added for both wild and hatchery-reared fish after it was determined that the SEG would be exceeded.

Run timing data collected from the weir in 1999 (the first time that Chinook salmon escapement in Ninilchik River was monitored over the entire run and the first year that 100% of the hatchery-reared return was identifiable by an adipose finclip) raised concerns that the regulatory openings may not be maximizing the harvest of the later running hatchery-reared fish (Begich 2006). Therefore DSF used their EO authority to increase fishing time and provide additional opportunity to harvest hatchery-reared Chinook salmon.

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

In 2002 there was a shift in the type of EO's issued and fishery extensions only applied to hatchery-reared fish. This action was possible since all returning hatchery adults were marked by this time. The 2002 EO added a fourth 3-day weekend of fishing for hatchery-reared fish only. A single hook gear type restriction was added by EO. The single hook restriction was designed to reduce mortality of wild fish that were captured and subsequently released. In 2003, ADF&G issued an EO that extended the opening for hatchery-reared fish through the end of June for single hook gear. A 2004 EO further liberalized fishing for hatchery-reared fish by opening the fishery continuously for single hook gear beginning Memorial Day weekend.

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

OBJECTIVES

1. Census the wild and hatchery-reared Chinook salmon escapement into the Ninilchik River from May 7 through August 4, 2005.
2. Census the sex composition and estimate the age and length composition of the wild and hatchery-reared Chinook salmon escapement into the Ninilchik River from May 11 through June 30.
3. Census the sex composition and estimate the age and length composition of the wild and hatchery-reared Chinook salmon escapement into the Ninilchik River from July 1 through August 4, 2005.

TASKS:

1. Collect, hold, and artificially spawn 105 male and 105 female wild Ninilchik River Chinook salmon during July to provide the necessary fertilized eggs for early-run hatchery releases to Ninilchik River, Halibut Cove Lagoon, Seldovia, and Homer Spit Lagoon.
2. Release the following hatchery-reared Ninilchik River Chinook salmon smolt in June 2005: approximately 50,000 smolt at Ninilchik River, 105,000 smolt at Halibut Cove Lagoon, 105,000 smolt at Seldovia, and 210,000 smolt at Homer Spit Lagoon.
3. Compare the estimated age, sex, and length composition of the Chinook salmon escapement between May 7 to June 30 and July 1 to August 4 periods.

Estimate the percentage of correctly aged scales using scales sampled from Chinook salmon with coded wire tags.

METHODS

ESCAPEMENT MONITORING

The 2005 Chinook salmon escapement was monitored at Ninilchik River using two weirs located approximately 7.7[5] rkm upstream of the mouth (Figure 4) from May 7 through August 4 by a

[5] This is a correction to the 2004 Ninilchik River Chinook salmon assessment report (Kerkvliet 2008).

joint effort of DSF and the US Geological Survey (USGS) Science Center. The first weir was installed and operated by USGS for a steelhead project from May 7 through June 30. The USGS incorporated Chinook salmon monitoring into their field operations. On June 30, a second weir was installed approximately 10 meters downstream of the USGS weir.

Chinook salmon escapement was counted and biological samples collected as fish entered the live box (Figure 4) to pass through the weir. All Chinook salmon captured were examined for an adipose finclip to determine if it was a wild or hatchery-reared Chinook salmon. Chinook salmon with intact adipose fins were recorded as wild and those with missing adipose fins were recorded as hatchery-reared. The upper edge of the caudal fin was clipped on all Chinook salmon examined at the weir to prevent double sampling of fish in the event of weir failure.

The total escapement was calculated as the sum of the wild and hatchery-reared Chinook salmon escapement. The wild Chinook salmon escapement was calculated as the total number of wild Chinook salmon counted through the weir minus those sacrificed for broodstock during the egg take and mortalities from the live box or holding area. The hatchery-reared Chinook salmon escapement was calculated as the total number of hatchery-reared Chinook salmon counted through the weir minus those sacrificed for CWT analysis.

RUN TIMING

Run timing was measured as the cumulative percent weir counts of the wild and hatchery-reared components. The median run timing date (date nearest to the 50% cumulative count) was identified for each component of the run. The percent of counts occurring in each of 3 temporal strata was calculated to allow comparison among years. The first stratum represented weir counts before the SEG counting period (first day to July 1). The second stratum represented weir counts during the SEG counting period (July 8 through July 24) and the third stratum represented weir counts after the SEG counting period (July 25 through the end of the weir operation).

WATER TEMPERATURE AND DISCHARGE

Cook Inlet Keeper (CIK), a citizen based nonprofit group, collected Ninilchik River water temperatures using a temperature logger programmed to collect data in degrees Celsius every 15 minutes at their NR-2 site (described in Mauger 2004). The NR-2 site was located approximately 6.0^{5} rkm upstream from the weir site. The reported daily mean, minimum, and maximum temperatures were calculated from all 15-min temperature readings recorded throughout each day.

The National Weather Service; Alaska-Pacific River Forecast Center (RFC) collected Ninilchik River stage readings that were converted to discharge. RFC contracted a local citizen to collect a daily stage reading at a site approximately 0.9 rkm upstream from the Ninilchik River mouth; the same location where a USGS gauging station (1521600; Meyer et al. 2004) was operated annually through 2003. The stage readings were collected at approximately 1900 hours each day) with a wire weight gauge.

AGE, SEX AND LENGTH

The age composition and mean length-at-age of the escapement were estimated by subsampling the wild and hatchery-reared Chinook salmon escapement at the weir sites. We attempted to sample every fourth wild and hatchery-reared Chinook salmon for age and length data. To estimate age, three scales were collected from the left side of the body, at a point on a diagonal

from the posterior insertion of the dorsal fin to the anterior insertion of the anal fin, two rows above the lateral line (Welander 1940). All scales were subsequently pressed and age was estimated using procedures described by Mosher (1969). Length was measured from mid eye to tail fork (METF).

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 the wild and hatchery-reared components of the escapement were both determined.

The proportion of Chinook salmon of age, sex, or length class *j* in group *i* (wild vs. hatchery-reared) in the escapement for each of the < July 1 or ≥ July 1 periods was estimated as a binomial proportion (Cochran 1977) by:

$$\hat{p}_{ij} = \frac{n_{ij}}{n_i}, \tag{1}$$

with variance estimated as

$$\text{var}(\hat{p}_{ij}) = \left[\frac{N_i - n_i}{N_i}\right] \frac{\hat{p}_{ij}(1-\hat{p}_{ij})}{n_i - 1}, \tag{2}$$

where:

n_{ij} = the number of fish of age, sex, or length class *j* in n_i,

n_i = the number of group *i* fish sampled, and

N_i = the number of group *i* fish in the escapement count.

The number of Chinook salmon by age (number by sex was a census) in the escapement of each group was estimated by:

$$\hat{N}_{ij} = N_i \hat{p}_{ij}, \tag{3}$$

and its variance estimated by:

$$\text{var}(\hat{N}_{ij}) = N_i^2 \text{ var}(\hat{p}_{ij}). \tag{4}$$

For each of the wild and hatchery-reared components, contingency table analysis was used to test the null hypothesis that the age and age-sex compositions were the same between periods (< July 1, > July 1). Test results were used to determine if the age and age-sex compositions of the stock components (hatchery-reared or wild) should be estimated by weighting the compositions < July 1 and ≥ July 1 with the corresponding weir counts or whether the composition should be estimated after pooling all data. The sex composition of the escapement was calculated by determining the sex of all Chinook salmon that passed the downstream weir. The sex composition of the wild and hatchery-reared components of the escapement was therefore known without error.

EGG TAKES

An area was created between the two weirs to hold Chinook salmon to ripen for egg takes. We began holding Chinook salmon for egg takes on July 1. An egg take was attempted on July 15 but aborted because only one ripe female was found. Egg takes were conducted on July 20, July 26, and August 2 following ADF&Gs standard egg-take procedure (ADF&G *unpublished*[6]). Only wild Chinook salmon were used in the egg takes. The following steps were used to collect and fertilize eggs: two buckets were staged to receive eggs; the eggs from one female were collected in one bucket and the eggs from a second female were collected in the second; and then the sperm from two males were used to fertilize the eggs of both females. Females were sacrificed to collect their eggs, and males were released alive upstream of the weirs after their sperm was collected. Immediately after mixing the eggs and sperm in a bucket, a 7 g per liter saline solution was added to increase sperm motility. Following each egg take, age and length data were collected from the sacrificed females using the procedures described above.

SMOLT RELEASE AND MARKING

Smolt from the 2003 egg takes were reared at the Fort Richardson and Elmendorf hatcheries. All hatchery-reared smolt that were destined to be released in Ninilchik River were thermal marked, adipose finclipped, and coded-wire-tagged prior to release. Hatchery personnel assessed the percentages of CWT loss and adipose finclips prior to stocking Chinook salmon smolt into Ninilchik River. Hatchery-reared smolt released into Halibut Cove Lagoon, Seldovia Bay, and the NDFL were only thermal marked. All of these Lower Cook Inlet smolt releases were planned and scheduled according to the Statewide Stocking Plan (Loopstra 2003).

STRAYING

Chinook salmon were systematically examined for missing adipose fins throughout the immigration. Heads were removed from every eighth Chinook salmon that was missing an adipose fin, labeled with a numbered cinch strap, frozen, and sent to the ADF&G Mark, Tag and Age Laboratory (tag lab) in Juneau for analysis. Results were accessed from the tag lab website[7], using parameters specific to the Ninilchik River Chinook salmon project.

RESULTS

ESCAPEMENT MONITORING

In 2005, the total number of Chinook salmon counted at Ninilchik River weir from May 6 to August 4 was 2,703 fish of which 2,241 were wild and 462 were hatchery-reared (Table 2, Appendix C1). After subtraction of fish sacrificed during egg takes (105 fish), CWT recoveries (53 fish), and mortalities associated with Chinook salmon held for egg takes (60 fish), the total escapement was 2,485 Chinook salmon, of which 84% were wild (2,076/2,485) and 16% were hatchery-reared (409/2,485). The number of wild Chinook salmon (814 fish) counted through the weir from July 8 through July 24 was near the upper end of the SEG range (400-850 fish; Table 8, Figure 5).

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[6] ADF&G. *Unpublished*. Generalized egg-take procedures for ADF&G Sport Fish hatchery program. Alaska Department of Fish and Game, Division of Sport Fish, Hatchery Program, Anchorage.

[7] Mark, Tag and Age Laboratory Database [Internet]. Juneau, AK: ADF&G. 2006. [10:27:04 AM 26 Jan 2006 update]. Available from http://tagolabweb.adfg.state.ak.us/CWT/reports/.

RUN TIMING

The median run timing for Chinook salmon (wild and hatchery-reared combined) was July 15 (Table 9, Figure 6). Median run timing of the wild component (July 12) was 14 days earlier than the median run timing of the hatchery-reared component (July 26). From May 7 to July 7, 35% of the wild Chinook salmon escapement had been counted past the weir while only 16% of the hatchery-reared component had been counted (Figure 7). Weir counts during the SEG counting period indicated a 3-day difference between the wild (July 15) and hatchery-reared (July 18) component of the run.

WATER TEMPERATURE DISCHARGE AND TIDES

The temperature logger was deployed June 8. The average water temperature from June 8 to August 4, when the weir was removed, was 14°C (Table 10, Figure 8, and Appendix D1). During the SEG counting period the average water temperature was 15°C. Water temperatures reached a high of 19°C on 6 days (June 29, and July 7 to 11). On the hottest days, the high temperature was usually reached by 1600 hours and persisted for approximately 4 to 5 hours thereafter.

The average river discharge was 95 cfs during the weir operation and 68 cfs during the SEG counting period.

Heavy rainfall on July 31 increased the discharge and decreased the water temperature during the August 2 egg take (Figure 8 and Appendices D1 and D2). The average discharge was 73 cfs and average water temperature was 13°C on July 31. After the heavy rains on August 2 the average discharge peaked at 187 cfs and average water temperature dropped to 11°C. The integrity of the holding area was compromised by the high water and some of the Chinook salmon held for the egg take escaped upstream.

Ninilchik River Chinook salmon daily weir counts tended to fluctuate with the variations in the tides. Daily counts generally increased on days with higher tides and decreased on days with lower tides (Figure 8 and Appendix D3).

AGE, SEX AND LENGTH

Age-sex compositions were not significantly different between periods (before and after July 1) for either wild ($p = 0.15$) or hatchery-reared ($p = 0.24$) Chinook salmon. Ocean-age-3 was the dominant age class for wild (68.2%, SE = 2.3%) and hatchery-reared (67.5%, SE = 3.6%) Chinook salmon (Table 11). Ocean age distributions were not significantly different between wild and hatchery-reared populations ($p>0.05$). The male-to-female ratio was different between the wild (55.3%: 44.7%) and hatchery-reared (45.6%: 54.4%) components (Table 11, $p<0.05$).

Known ages from decoded CWTs for hatchery-reared Chinook salmon sampled at the weir in 2005 were used to compare the scale aging accuracy of two scale readers (Table 12 and Appendix E1). When the scale reader's age estimates were compared with all samples of known ages, Reader A aged 81% of the scales correctly and Reader B aged 75% correctly. However, the accuracy for both scale readers was lower for ocean-age-3 Chinook salmon. Reader A accuracy dropped to 63% and Reader B accuracy dropped to 45% when aging ocean-age-3 scales. Although Reader A was not significantly better at reading scales than Reader B ($p = 0.47$), the ages interpreted by Reader A were used for the age composition.

EGG TAKES

Four egg takes were conducted in 2005 to collect 624,806 wild Chinook salmon eggs from 105 females (Table 13). The first scheduled egg take on July 15 was canceled because too few of the approximately 330 Chinook salmon being held were mature. Following the second egg take on July 20, hatchery personnel determined that fecundities were lower than expected and therefore increased the number of males and females needed for the egg takes from 92 fish to 105 fish.

The average percent survival from green eggs to eyed eggs was the highest (88.7%) since 1999. Egg survival increased for the second (July 26) and third (August 2) egg takes to 88% and 93%, respectively. The improved survival was attributed to a combination of quality control measures during the egg takes and to the use of a saline solution for sperm activation.

The average high water temperatures recorded during the egg takes were: 16°C (July 20), 13°C (July 26), and 11°C (August 2) (Appendix D1).

SMOLT RELEASE AND MARKING

In 2005, a total of 503,556 Chinook salmon smolt from Ninilchik River egg takes were reared at Fort Richardson hatchery (Tables 3-6). Chinook salmon smolt releases in 2005 were apportioned between the Ninilchik River and three terminal saltwater fisheries as follows: 55,229 smolt were stocked at Ninilchik River; 220,822 smolt were stocked at NDFL; 112,521 smolt were stocked at Halibut Cove Lagoon; and 114,984 smolt were stocked at Seldovia Bay. Stocking goals[8] were reached at all stocking locations.

STRAYING

Fifty-three of 462 hatchery-reared Chinook salmon counted through Ninilchik River weir were sacrificed for CWT analysis (Appendix E1). The tag lab recovered CWTs in 49 of these fish and all originated from the Ninilchik River. No CWTs were found or detected in the remaining four fish.

In 2005, one Chinook salmon originating from the Ninilchik River was captured by the Anchor River Chinook salmon escapement project. This hatchery-reared fish was stocked in the Ninilchik River in 2001, and subsequently captured at Anchor River as an ocean-age-4 fish (Table 14).

DISCUSSION

In 2005, the Ninilchik River Chinook salmon escapement was monitored over the entire run for the seventh consecutive year. This is the final year that the Ninilchik River weir will be operated from May through August. This 7-year data series has provided valuable data on the overall run size, run timing of both wild and hatchery-reared Chinook salmon to the weir, and provides comparisons for SEG counts to the total run.

The 2005 escapement of wild Chinook salmon was the highest on record. Overall, 1999 through 2005 escapements should be viewed as adequate to maintain a sustainable sport fishery. By summing the annual escapement and harvest estimates, the Ninilchik River Chinook salmon inriver run would range from approximately 2,900 to 4,200 fish (wild and hatchery-reared

[8] Hatchery-reared Ninilchik River Chinook salmon smolt stocking goals: Ninilchik River (50,000 smolt), NDFL (210,000 smolt), Halibut Cove Lagoon (105,000 smolt), and Seldovia Bay (105,000 smolt).

combined). The overall exploitation rate ranges from 28% to 46% suggesting that the Ninilchik River Chinook salmon stock is harvested at a moderate rate.

From 1999 through 2005 the overall run timing of Chinook salmon at Ninilchik River weir was fairly similar. The median run timing date for both wild and hatchery-reared Chinook salmon usually occurred during the SEG counting period. However, the median run timing date for wild Chinook salmon in 2003 and 2004 occurred before the SEG period (July 4) (Kerkvliet 2008).

In 2005, the peak of the wild Chinook salmon run was 11 days earlier than the hatchery-reared fish (July 12 versus July 26). This pattern is consistent with the 1999–2004 average (July 10 versus July 21). The reason for this difference in run timing is unknown but it is consistent with run timing differences for wild and hatchery-reared Chinook salmon in Crooked Creek (Kasilof tributary) (J. Breakfield, ADF&G, personal communication). One explanation for the run timing difference could be that hatchery-reared Chinook salmon were produced from egg takes conducted later in the run which may be genetically predisposed to return later. Our stocking methods may also influence observed run timing differences at the weir. Currently, smolt are stocked at the weir site and quickly move downstream. Hatchery-reared smolt imprint to the Ninilchik River when stocked. Salmon spawning migrations are generally precise and salmon display fidelity to their natal site (Dittman and Quinn 1996). It is likely that wild Chinook salmon have a greater spatial spawning distribution than hatchery-reared Chinook salmon in Ninilchik River and must pass the weir site at an earlier date to arrive at their natal site further upstream. Additionally, the number of hatchery-reared Chinook salmon spawning below the weir is unknown but may be similar to the weir counts.

From 1999 to 2005, an average of 41% of the total run passed the weir during the SEG index counting period. This suggests that a sizable portion of the run can pass the weir outside of the SEG period. The relationship between SEG counts to the total run is poor ($R^2 = 0.37$). This can be explained by variation in run timing observed at the weir.

Some of the variability in wild and hatchery-reared Chinook salmon SEG counts are due to differences in the overall run size and run timing for each group. A more thorough understanding of the inriver run timing of hatchery-reared fish would be helpful to determine better management strategies for harvesting hatchery-reared fish.

Reasons for the exceptional run in 2005 are unknown but it was not a result of a decrease in the inriver sport harvest. A regulation (5 AAC 56.122) passed by the Alaska Board of Fisheries in October 2004 went into effect at the beginning of the 2005 Ninilchik River Chinook salmon fishery. This regulation increased the bag and possession limit to 2 Chinook salmon, of which only one could be wild, prohibited anglers from fishing after they had processed their fish, and restricted anglers from filleting or mutilating fish within 100 yards from Ninilchik River. No emergency orders were issued in 2005 for Ninilchik River. This new regulation is the first for Ninilchik River that specifically liberalized the harvest of hatchery-reared fish.

According to CIK, the Ninilchik River had warmer than usual water temperatures in 2005. CIK documented 4 days where water temperatures were above 20^{o} C at the lower river NR-3 site and they voiced concerns that these warmer water temperatures may adversely impact migrating salmon and egg and fry survival (Mauger 2005).

Numerous studies report that water temperature during development plays a major role in salmonid survival and rate of development (Beacham and Murray 1990). Neitzel and Becker

(1985) found few deaths in any developmental stage for Chinook salmon exposed to 22°C or below for up to 8 hours. However, above this temperature, detrimental effects appear to be a function of temperature, duration of exposure, and development phase. An experiment conducted by Olson and Foster (1957) indicated percent survival of Chinook salmon eggs, fry, and fingerlings were not significantly different from the control when exposed to temperatures from 11°C to 16°C. However, early embryological damage was indicated in late development to the fry stage for Chinook salmon exposed to 18°C.

The effects of water temperature on green to eyed egg survival from 2000–2005 Ninilchik River Chinook salmon egg takes was evaluated and no significant correlation (p>0.05) was detected. A comparison of brood return between years and water temperatures might provide some additional information, but would be limited by uncertainty about fluctuations in other environmental conditions such as marine environment. Evaluating temperature effects on Ninilchik River Chinook salmon production would be a costly and time consuming endeavor. It is likely that increased water temperatures influence survival at all freshwater life stages, but given the recent stability of the Ninilchik River Chinook salmon stock, the overall effects are limited. From a management perspective, additional temperature effect studies on Ninilchik River Chinook salmon production may not be warranted unless future Chinook salmon runs fail to meet the SEG.

In 2005, the average river temperature during the Chinook salmon run was higher (14°C) than the 6-year average (12°C) temperature. The increased water temperatures in 2005 were accompanied by low water levels in Ninilchik River. Comparisons between daily Chinook salmon counts with average water temperatures, discharge, and tide heights showed a greater number of Chinook salmon were present during bigger tides. This general pattern may also be influenced by a combination of other factors including travel distance to the weir, other river conditions, and diel migration patterns.

Aging of scale samples from Chinook salmon collected at Ninilchik River weir later in the run can be difficult because of scale reabsorption. Comparison between the known age based on CWT data and the interpreted age based on scales provided insight on the accuracy of interpreted ages. We recommend the continued yearly comparison of known and interpreted ages.

The 1999 to 2005 data set has provided valuable information about the Chinook salmon run in Ninilchik River. Although escapement goals were met in 2005, managers continued to carefully watch run timing differences between wild and hatchery-reared Chinook salmon so that wild Chinook salmon are not overexploited. We recommend that future freshwater harvests be sampled in order to determine harvest composition. Due to the variation of Chinook salmon run timing observed at the Ninilchik River weir from 1999–2005 and the brief SEG monitoring period, assessment of the current SEG and monitoring period should be reviewed to determine the most appropriate time period that would incorporate the variation in run timing.

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TABLES

Table 1.-Characteristics of the 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 in Homer, AK, *unpublished data*, 2006.

Note: "rkm" = river kilometers.

Table 2.-Ninilchik River Chinook salmon weir data, 1989–1992 and 1994–2005.

		Chinook salmon run				Coded wire tagged Chinook salmon		Chinook salmon escapement	
Year	Weir operating dates	Component	No. of fish	Percent	Egg take mortality (no. of Chinook salmon)	No. of fish recovered	No. of strays detected [a]	No. of fish [b]	Percent
1989	7/04 - 7/25	Total [c]	254		ND	ND	ND	ND	
1990	7/06 - 7/ 27	Total [c]	315		ND	ND	ND	ND	
1991	7/01 - 7/17	Total [c]	338		ND	12	ND	ND	
1992	6/30 - 7/14	Total [c]	539		ND	59	ND	ND	
1993	NL		NL	NL	NL	38	1	NL	NL
1994	7/07 - 7/26	Wild	446	81	ND	NA	NA	446	-
		Hatchery	103[e]	19	ND	43	0	60	-
		Total [d]	549	100	125	43	0	381	
1995	7/04 - 8/01	Wild	725	63	ND	NA	NA	725	-
		Hatchery	425[e]	37	ND	135	0	290	-
		Total [d]	1,150	100	194	135	0	821	
1996	7/02 - 7/24	Wild	654	69	ND	NA	NA	654	-
		Hatchery	290[e]	31	ND	69	0	221	-
		Total [d]	944	100	190	69	0	685	
1997	7/01 - 8/11	Wild	579	53	ND	NA	NA	579	-
		Hatchery	517[e]	47	ND	181	2	336	-
		Total [d]	1,096	100	132	181	2	783	
1998	7/03 - 8/01	Wild	536	53	ND	NA	NA	536	53
		Hatchery	466[e]	47	ND	0	0	466	47
		Total	1,002	100	196	0	0	1002	
1999	5/18 - 8/13	Wild	1,644	72	68	NA	NA	1,576	73
		Hatchery	641	28	26	42		573	27
		Total [f]	2,285	100	94	42	0	2,149	
2000	5/17 - 8/08	Wild	1,634	66	81	NA	NA	1,553	69
		Hatchery	853	34	60	108	1	685	31
		Total	2,487	100	141	108	1	2,238	
2001	5/30 -8/05	Wild	1,414	68	175	NA	NA	1,239	70
		Hatchery	673	32	0	130		543	30
		Total	2,087	100	175	130	0	1,782	
2002	5/23 -8/11	Wild	1,516	73	176	NA	NA	1,340	77
		Hatchery	559	27	55	109		395	23
		Total	2,075	100	231	109	0	1,735	
2003	5/16 -8/05	Wild	1,258	75	131	NA	NA	1,127	77
		Hatchery	425	25	52	37	5	336	23
		Total	1,683	100	183	37	5	1,463	
2004	5/18 -8/05	Wild	1,525	74	132	NA	NA	1,393	75
		Hatchery	536	26	0	67	1	469	25
		Total	2,061	100	132	67	1	1,862	
2005	5/06 -8/04	Wild	2,241	83	165	NA	NA	2,076	84
		Hatchery	462	17	0	53	0	409	16
		Total	2,703	100	165	53	0	2,485	
Average (1999–2004)		Wild	1,499	71	127	NA	NA	1,371	74
		Hatchery	615	29	32	82	1	500	26
		Total	2,113	100	159	82	1	1,872	0

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

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

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

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

[d] Number of wild and hatchery Chinook salmon used in egg take unavailable.

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

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

Table 3.-Chinook salmon smolt releases at Ninilchik River, 1988–2005.

Release year		Number of smolt	Brood year	Release date		Hatchery	Mark type [a]		Percent marked
1988	[b]	248,586	NA	NA		NA	Ad, CWT		12
1989	[b]	200,203	NA	NA		NA	Ad, CWT		9
1990	[b]	215,804	NA	NA		NA	Ad, CWT		19
1991	[b]	87,992	NA	NA		NA	Ad, CWT		24
1992	[b]	132,387	NA	NA		NA	Ad, CWT		31
1993	[b]	184,585	NA	NA		NA	Ad, CWT		23
1994	[b]	201,513	NA	NA		NA	Ad, CWT		23
1995	[b]	54,662	NA	NA	[c]	NA	Ad, CWT		99
1996	[b]	51,688	NA	NA	[c]	NA	Ad, CWT		98
1997	[b]	50,292	1996	6/17	[d]	Fort Richardson	Ad, CWT, TM		99
1998	[b]	48,798	1997	6/15	[d]	Fort Richardson	Ad, CWT, TM		97
1999	[b]	49,853	1998	6/15	[d]	Fort Richardson	Ad, CWT, TM		98
2000	[b]	51,298	1999	6/02	[d]	Fort Richardson	Ad, CWT, TM		98
2001	[b]	54,770	2000	6/13	[d]	Fort Richardson	Ad, CWT, TM		99
2002	[b]	54,631	2001	6/14	[d]	Fort Richardson	Ad, CWT, TM		99
2003	[b]	47,997	2002	6/12	[d]	Fort Richardson	Ad, CWT, TM		92
2004	[b]	51,303	2002	5/12	[d]	Fort Richardson	Ad, CWT, TM		100
2005	[b e]	55,229	2003	5/19	[d]	Fort Richardson	Ad, CWT, TM	[f]	100
Average (2000–2004)		52,000							

Note: NA = not available.

[a] Ad,CWT=adipose finclipped and coded-wire-tagged; TM=thermal marked.

[b] Number released includes smolt that shed coded wire tags; beginning in 2005 smolt were checked prior to release for finclip quality.

[c] Half of the smolt were released at intertidal and half at Brody Road bridge (rkm 7.7).

[d] 1988, 1995, and 1996 smolt were released in Ninilchik Harbor intertidal-saltwater area; in 1989 half were released in the harbor and half at Brody Road bridge (7.7 rkm); from 1990 to 1994 and 1997 to 2005 all smolt were released at Brody Road bridge.

[e] Smolt were released at freshwater age 1 beginning in 2004.

[f] Smolt were checked prior to release for finclip quality.

Table 4.-Chinook salmon smolt releases at Nick Dudiak Fishing Lagoon terminal saltwater fishery on Homer Spit from the Ninilchik River egg-take project, 2000–2005.

Release year	Number of smolt	Brood year		Release date	Hatchery	Mark type [a]	Percent marked
2000	102,243	1999	[b]	5/31	Elmendorf	TM	100
	117,741	1999	[b]	6/07	Elmendorf	TM	100
2001	101,799	2000	[b]	5/25	Elmendorf	TM	100
	106,263	2000	[b]	6/08	Elmendorf	TM	100
2002	122,444	2001	[b]	5/30	Elmendorf	TM	100
	67,582	2001	[b]	6/06	Elmendorf	TM	100
2003	80,063	2002	[b]	6/06	Fort Richardson	TM	100
	126,229	2002	[b]	5/28	Fort Richardson	TM	100
2004	95,105	2002	[c]	6/07	Fort Richardson	TM	100
	47,932	2002	[c]	6/10	Fort Richardson	TM	100
	25,706	2003	[b]	6/10	Elmendorf	TM	100
2005	111,196	2003	[c]	6/10	Fort Richardson	TM	100
	109,626	2003	[c]	6/13	Fort Richardson	TM	100
Average (2000–2004)	90,282						

[a] TM=thermal mark.

[b] Smolt were released at freshwater age 0.

[c] Eggs were incubated at Elmendorf Hatchery, reared at Fort Richardson Hatchery, and released as freshwater age-1 smolt due to cooler water temperatures.

Table 5.-Chinook salmon smolt releases at Halibut Cove Lagoon terminal saltwater fishery from the Ninilchik River egg-take project, 1995–2005.

Release year		Number of smolt	Brood year	Release date	Hatchery	Mark type [a]	Percent marked
1995	[b]	37,208	1994	6/13	Elmendorf	TM	100
1996	[b]	105,975	1995	6/04	Elmendorf	TM	100
1997	[b]	78,133	1996	6/09	Elmendorf	TM	100
1998	[b]	65,893	1997	6/12	Elmendorf	TM	100
1999	[b]	79,221	1998	6/01	Elmendorf	TM	100
2000	[b]	83,277	1999	6/01	Elmendorf	TM	100
2001	[b]	106,719	2000	6/05	Elmendorf	TM	100
2002	[b]	106,279	2001	5/28	Elmendorf	TM	100
2003	[b]	106,844	2002	6/17	Fort Richardson	TM	100
2004	[b]	103,771	2002	6/04	Fort Richardson	TM	100
2005	[c]	112,521	2003	6/15	Fort Richardson	TM	100
Average (2000-2004)		101,378					

[a] TM=thermal mark.

[b] Smolt were released at freshwater age 0.

[c] Eggs were incubated at Elmendorf Hatchery, reared at Fort Richardson Hatchery, and released as freshwater age-1 smolt due to cooler water temperatures.

Table 6.-Chinook salmon smolt releases at Seldovia Bay terminal saltwater fishery from the Ninilchik River egg-take project, 1996–2005.

Release year		Number of smolt	Brood year	Release date	Hatchery	Mark type [a]	Percent marked
1996	[b]	106,251	1995	6/12	Elmendorf	TM	100
1997	[b]	103,757	1996	6/06	Elmendorf	TM	100
1998	[b]	69,461	1997	6/09	Elmendorf	TM	100
1999	[b]	74,057	1998	5/28	Elmendorf	TM	100
2000	[b]	68,114	1999	6/06	Elmendorf	TM	100
2001	[b]	102,793	2000	6/07	Elmendorf	TM	100
2002	[b]	83,045	2001	5/28	Elmendorf	TM	100
2003	[b]	107,521	2002	6/11	Fort Richardson	TM	100
2004	[c]	88,682	2003	5/18	Elmendorf	TM	100
2005	[c]	114,984	2003	6/7	Fort Richardson	TM	100
Average (2000-2004)		90,031					

[a] TM=thermal mark.

[b] Smolt were released at freshwater age 0.

[c] Eggs were incubated at Elmendorf Hatchery, reared at Fort Richardson Hatchery, and released as freshwater age-1 smolt due to cooler water temperatures.

Table 7.-Estimated angler effort, harvest, escapement, and stocking summary for Ninilchik River Chinook salmon, 1962–2005.

		Harvest		Escapment (no. of fish)				Stocking		
				Survey [a]						
Year	Angler effort (days fished) [b]	Number of fish [b]	Percent hatchery-reared fish [c]	Foot	Aerial [d]	Expanded estimate [e]	Total weir count [f]	Number of smolt Released [g]	Marked [h]	Percent marked
1962				193	179	530				
1963				143	47	450				
1964				347	200	910				
1965				219	224	1,030				
1966				231		670				
1967				213	100	360				
1968				126	31	450				
1969				191	87	760				
1970										
1971										
1972										
1973				203						
1974										
1975							816			
1976				470	956	1,180				
1977	11,350	1,168		719	1169	1,400				
1978	14,173	1,445		457	724	990				
1979	18,282	1,493		183	854	1,390				
1980	19,706	723				720				
1981	14,184	1,523		232	552	830				
1982	11,806	1,240		568	947	1,430				
1983	9,458	871		313	445	710				
1984	10,122	648		208	346	600				
1985	10,213	983		243	582	650				
1986	9,250	420		277	307	790				
1987	13,329	1,112		239	523	600				
1988	12,533	795		444	569	1,080		247,327	30,809	12.5
1989	9,997	744		241	280	400	254	199,831	18,772	9.4
1990	8,323	693		414	288	840	315	215,804	40,319	18.7
1991	19,640	3,123	77	362	594		338	87,992	21,074	23.9
1992	27,816	5,316	57				539	132,387	41,335	31.2
1993	20,466	4,235	50		688	2,400		184,585	42,960	23.3
1994	21,827	3,108	45	261	252	859	539	201,513	45,535	22.6
1995	16,160	2,451	50				1,150	54,662	54,115	99.0
1996	11,445	2,401	50		158		944	51,688	50,866	98.4
1997	11,064	3,263			393		1,096	50,698	50,292	99.2
1998	10,994	1,453			316		1,002	48,798	47,480	97.3
1999	15,344	1,945			357		2,285	49,853	48,906	98.1
2000	12,432	1,782	49		578		2,487	51,298	50,016	97.5
2001	10,602	1,399	51		268		2,087	54,770	54,441	99.4
2002	9,572	830					2,075	54,631	54,139	99.1
2003	9,843	1,452					1,683	47,997	44,349	92.4
2004	10,500	1,240					2,061	51,303	51,252	99.9
2005	9,003	1,341					2,703	55,229	54,898 [i]	99.4
Average (1999–2004)	11,042	1,441			401		2,113	51,642	50,517	97.7
Average (1977–2004)	13,429	1,709	54		509		1,257	105,008	43,921	66.0

-continued-

[a] Estimates of total number of angler days fished and sport fish freshwater harvest (Mills 1979-1980, 1981a-b, 1982-1994; Howe et al. 1995, 1996, 2001a-d; Walker et al. 2003; Jennings et al. 2004, 2006a-b, 2007, 2009).

[b] Estimated by creel survey 1991–1993; estimated by catch sampling from 1994–1996 and 2000–2001.

[c] Available data.

[d] Aerial survey aircraft: 1962–1973 (Super Cub), 1974 (Super Cub or helicopter), and 1975–2001 (helicopter).

[e] Annual expanded estimates of escapement from foot and aerial surveys (Szarzi and Begich 2004); Raw survey data are not available for the 1980 expanded estimate.

[f] Complete counts began in 1999; 1989–1992 and 1994–1998 are partial counts from broodstock weir; no data available for 1993.

[g] Smolt releases in 1988, 1995 and 1996 in Ninilchik Harbor intertidal-saltwater area; in 1989 half were released in harbor and half at Brody Road bridge prior to release. Smolt from 1997–2004 were released approximately 4.5 rkm upstream of Ninilchik River mouth.

[h] Number with adipose finclip and coded wire tag; beginning in 1997, all releases were also thermal marked.

[i] In 2005, an estimated 54,806 smolt (99.2%) had acceptable quality adipose finclips.

Table 8.-Wild and hatchery-reared Chinook salmon counts at Ninilchik River weir, 1994–2005.

	Weir count (number of fish)					
	Wild Chinook salmon			Hatchery-reared Chinook salmon		
Year	July 8-24 subtotal [a]	Annual total	Percent of total	July 8-24 subtotal [a]	Annual total	Percent of total
1994	423	-	-	40	-	-
1995	503	-	-	342	-	-
1996	591	-	-	264	-	-
1997	235	-	-	358	-	-
1998	422	-	-	268	-	-
1999	799	1,644	49	277	641	43
2000	834	1,634	51	426	853	50
2001	716	1,414	51	363	673	54
2002	655	1,516	43	169	559	30
2003	393	1,258	31	150	425	35
2004	416	1,525	27	158	536	29
2005	814	2,241	36	129	462	28
Average (1999–2004)	636	1,499	42	257	615	40
SEG [b]	400-850					

Note: "-" = value cannot be computed due to limitations of the data.

[a] July 8-24=the Sustainable Escapement Goal (SEG) counting period.

[b] This SEG range was established in 2001 based on wild Chinook salmon counts at Ninilchik River weir from July 8-24, for 1994–2000.

Table 9.-Run timing of wild Chinook salmon, hatchery-reared Chinook salmon, and wild and hatchery-reared Chinook salmon combined at Ninilchik River weir, 1999–2005.

Wild Chinook salmon

	Counting periods										
	Full operation [a]				Start to July 7 [b] cumulative		SEG counting period (July 8 to July 24) [c]			July 25 to End [d] cumulative	
Year	Start date	End date	Weir count	Median date	Count	Percent	Weir count	Median date	Percent of return	Count	Percent
1999	18-May	13-Aug	1,613	13-Jul	584	36	799	16-Jul	49	230	14
2000	17-May	8-Aug	1,634	12-Jul	507	31	834	13-Jul	51	293	18
2001	30-May	5-Aug	1,414	13-Jul	539	38	716	15-Jul	51	169	12
2002	23-May	11-Aug	1,516	17-Jul	547	36	655	19-Jul	43	314	21
2003	16-May	5-Aug	1,258	4-Jul	696	55	393	16-Jul	31	169	13
2004	18-May	5-Aug	1,525	4-Jul	898	59	416	17-Jul	27	211	14
2005	7-May	4-Aug	2,241	12-Jul	794	35	814	15-Jul	36	633	28
6-year (1999–2004)											
Average			1,493	10-Jul	629	43	636	16-Jul	42	288	15
Minimum			1,258	4-Jul	507	31	393	13-Jul	27	169	12
Maximum			1,634	17-Jul	898	59	834	19-Jul	51	633	21

Hatchery-reared Chinook salmon

	Counting periods										
	Full operation [a]				Start to July 7 [b] cumulative		SEG counting period (July 8 to July 24) [c]			July 25 to End [d] cumulative	
Year	Start date	End date	Weir count	Median date	Count	Percent	Weir count	Median date	Percent of return	Count	Percent
1999	18-May	13-Aug	603	24-Jul	25	4	277	21-Jul	43	301	50
2000	17-May	8-Aug	853	24-Jul	52	6	426	19-Jul	50	375	44
2001	30-May	5-Aug	673	21-Jul	57	8	363	17-Jul	54	253	38
2002	23-May	11-Aug	559	24-Jul	118	21	169	19-Jul	30	272	49
2003	16-May	5-Aug	425	16-Jul	134	32	150	16-Jul	35	141	33
2004	18-May	5-Aug	536	21-Jul	162	30	158	19-Jul	29	216	40
2005	7-May	4-Aug	462	26-Jul	72	16	129	18-Jul	28	261	56
6-year (1999–2004)											
Average			608	21-Jul	91	17	257	18-Jul	40	260	42
Minimum			425	16-Jul	25	4	150	16-Jul	29	141	33
Maximum			853	24-Jul	162	32	426	21-Jul	54	375	50

Wild and hatchery-reared Chinook salmon combined

	Counting periods										
	Full operation [a]				Start to July 7 [b] cumulative		SEG counting period (July 8 to July 24) [c]			July 25 to End [d] cumulative	
Year	Start date	End date	Weir count	Median date	Count	Percent	Weir count	Median date	Percent of return	Count	Percent
1999	18-May	13-Aug	2,216	17-Jul	609	27	1,076	19-Jul	49	531	24
2000	17-May	8-Aug	2,487	18-Jul	559	22	1,260	18-Jul	51	668	27
2001	30-May	5-Aug	2,087	15-Jul	586	28	1,079	16-Jul	52	422	20
2002	23-May	11-Aug	2,075	18-Jul	665	32	824	19-Jul	40	586	28
2003	16-May	5-Aug	1,683	8-Jul	830	49	543	16-Jul	32	310	18
2004	18-May	5-Aug	2,061	5-Jul	1,060	51	574	17-Jul	28	427	21
2005	7-May	4-Aug	2,703	15-Jul	866	32	943	15-Jul	35	894	33
6-year (1999–2004)											
Average			2,102	13-Jul	718	35	893	17-Jul	42	548	23
Minimum			1,683	5-Jul	559	22	543	16-Jul	28	310	18
Maximum			2,487	18-Jul	1,060	51	1,260	19-Jul	52	894	28

[a] Full operation is duration of weir operation.

[b] From the first day of the weir operation to July 7.

[c] SEG counting period is from July 8 through July 24.

[d] From July 25 to the last day of the weir operation.

Table 10.-Comparison of water temperature and discharge at Ninilchik River weir for all weir operating dates versus the SEG counting period, 1999–2005.

			Water temperature (°C)					
	Weir operating dates		During all weir operating dates			During the SEG counting period [a]		
Year	Start	End	Min	Average	Max	Min	Average	Max
1999	18-May	13-Aug	[b]	[b]	[b]	[b]	[b]	[b]
2000	17-May	8-Aug	4	11	15	10	12	15
2001	30-May	5-Aug	9	13	16	11	12	13
2002	23-May	11-Aug	7	12	16	13	14	16
2003	16-May	5-Aug	6	12	17	14	16	17
2004 [c]	18-May	5-Aug	12	14	17	12	14	17
2005 [c]	8-Jun	4-Aug	9	14	19	12	15	19
5-year (2000-2004)								
Average			8	12	16	12	13	16
Minimum			4	11	15	10	12	13
Maximum			12	14	17	14	16	17

			Discharge (cfs) [d]					
	Weir operating dates		During all weir operating dates			During the SEG counting period [a]		
Year	Start	End	Min	Average	Max	Min	Average	Max
1999	18-May	13-Aug	52	101	252	52	60	81
2000	17-May	8-Aug	59	108	219	59	106	199
2001	30-May	5-Aug	59	115	292	76	111	197
2002	23-May	11-Aug	46	73	155	46	61	105
2003	16-May	5-Aug	73	91	246	54	58	67
2004	18-May	5-Aug	54	87	261	54	63	73
2005	7-May	4-Aug	29	95	210	60	68	99
5-year (2000-2004)								
Average			58	95	235	58	80	128
Minimum			46	73	155	46	58	67
Maximum			73	115	292	76	111	199

[a] SEG counting period is from July 8-24.

[b] Water temperature data unavailable.

[c] Water temperature data unavailable from May 18 to May 24, 2004 and May 7 to August 7, 2005.

[d] Daily discharge for 1999 to 2003 was retrieved on 2007-11-29 17:47:05 EST from http://waterdata.usgs.gov/nwis/dv. The provisional 2004 discharge data was provided by the National Weather Service, Alaska-Pacific River Forecast Center.

Table 11.-Estimated ocean age composition and length-at-ocean age of wild Chinook salmon, hatchery-reared Chinook salmon, and wild Chinook salmon used for egg takes at Ninilchik River weir, 2005.

	Wild [a]					Hatchery-reared [a]					Egg take			
	Ocean age				Sex	Ocean age				Sex	Ocean age			
	1	2	3	4	composition [b]	1	2	3	4	composition [b]	2	3	4	Total
Females														
Number sampled [c]	0	7	140	16	873	0	4	62	5	222	1	73	22	105
Estimated percent	0.0	2.1	41.3	4.7	44.7	0.0	3.3	50.8	4.1	54.4	1.0	76.0	22.9	-
SE percent	0.0	0.7	2.5	1.1	0.4	0.0	1.4	3.9	1.6	0.8	0.5	1.9	1.9	4.2
Estimated abundance	0	46	925	106	1,003	0	15	235	19	251	1	90	27	-
SE abundance	0.0	16.0	55.3	23.8	9.1	0.0	6.4	18.0	7.1	3.9	0.5	2.2	2.2	-
Mean length (mm)	-	618	769	858	766	-	605	757	824	750	695	771	843	788
SE mean length (mm)	-	13.7	3.4	5.1	4	-	34.0	6.4	14.9	5.3	NA	3.5	5.4	4.0
Males														
Number sampled [c]	20	55	92	9	1,078	16	11	20	4	186	ND	ND	ND	ND
Estimated percent	5.9	16.2	27.1	2.7	55.3	13.1	9.0	16.4	3.3	45.6	ND	ND	ND	ND
SE percent	1.2	1.9	2.2	0.8	0.4	2.6	2.2	2.9	1.4	0.8	ND	ND	ND	ND
Estimated abundance	132	364	608	59	1,238	61	42	76	15	211	ND	ND	ND	ND
SE abundance	26.5	41.4	49.9	18.1	9.1	12.2	10.3	13.3	6.4	3.9	ND	ND	ND	ND
Mean length (mm)	476	635	774	867	705	398	602	760	818	636	ND	ND	ND	ND
SE mean length (mm)	21.7	8.4	5.6	11.5	7	11.3	13.7	12.3	23.8	17.9	ND	ND	ND	ND
Both sexes combined														
Number sampled [c]	21	62	232	25	1,951	16	15	82	9	408	-	-	-	-
Estimated percent	6.2	18.2	68.2	7.4	-	13.0	12.2	67.5	7.3	-	-	-	-	-
SE percent	1.2	1.9	2.3	1.3	-	2.6	2.5	3.6	2.0	-	-	-	-	-
Estimated abundance	138	409	1,529	165	2,241	60	56	312	34	462	-	-	-	-
SE abundance	27.0	43.3	52.2	29.3	0.0	12.1	11.7	16.8	9.3	0.0	-	-	-	-
Mean length (mm)	477	633	771	861	733	398	603	757	821	705	-	-	-	-
SE mean length (mm)	20.7	7.6	3.0	5.2	5	11.3	12.9	5.6	12.6	10	-	-	-	-

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

[a] Sex/age components do not necessarily sum to sex pooled over age or age pooled over sex due to missing sex for age data and missing age for sex data.

[b] The Chinook salmon that passed through Ninilchik River weir were counted and sexed.

[c] A subsample (e.g., every 4th wild and hatchery fish) of Chinook salmon that passed through Ninilchik River weir was sampled for age and length data.

Table 12.-Coded wire tag data of adipose finclipped Chinook salmon recovered at Ninilchik River weir, 2005.

CWT code	Brood year	Hatchery	Smolt release		Adult recoveries (no. of fish)				CWT age [a]		Scale age					
											Ager A			Ager B		
			Date	Location [b]	Female	Male	Unk [c]	Total	Fresh water	Ocean	Correctly [d]	Incorrect [e]	Unaged [f]	Correctly [d]	Incorrect [e]	Unaged [f]
310193	2002	Fort Richardson	12-Jun-03	Ninilchik R	0	2	0	2	0	2	2	0	0	2	0	0
310256	2002	Fort Richardson	13-Jun-03	Ninilchik R	0	3	0	3	0	2	2	1	0	2	1	0
310260	2000	Fort Richardson	13-Jun-01	Ninilchik R	4	1	0	5	0	4	1	2	2	0	4	1
310282	2001	Fort Richardson	14-Jun-02	Ninilchik R	23	9	1	33	0	3	24	5	4	24	5	4
310318	2002	Fort Richardson	12-Jun-04	Ninilchik R	0	6	0	6	1	1	6	0	0	5	1	0
No tag [g]					2	2	-	4	-	-	-	-	-	-	-	-
				Total	29	23	1	53			35	8	6	33	11	5

Note: "-" = value not applicable.

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

[b] Statistical location code = 244-20.

[c] Unk = unknown sex.

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

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

[f] Number of scale samples that were not aged due to illegible scale.

[g] CWT was not detected and scales were not aged for these Chinook salmon with a missing adipose fin.

Table 13.-Ninilchik River Chinook salmon egg-take dates, number of females spawned, fecundity and percent survival to the eyed stage, 1999–2005.

			Females		Fecundity (no. of fish) [b]		Green egg estimates		Eyed eggs	
		Egg take	spawned [a]	Water						
Year	Hatchery	date	(no. of fish)	temp (^{o}C) [c]	Assumed	Actual	Egg take	At eye	Actual	% survival
1999	Fort Richardson	07/07/99	6	ND	6,000	6,399	36,000	38,396	34,707	90
		07/14/99	23	ND	6,000	6,380	138,000	146,734	124,751	85
		07/21/99	41	ND	6,000	6,179	246,000	253,329	217,827	86
		07/27/99	19	ND	6,000	5,630	114,000	106,970	98,492	92
		Total	89				534,000	545,429	475,777	
		Average								87
2000	Fort Richardson	07/07/00	8	14	5,591	5,533	44,726	44,267	35,496	80
		07/17/00	10	14	5,381	5,660	53,815	56,598	49,257	87
		07/24/00	36	12	5,421	5,663	195,174	203,876	161,326	79
		07/28/00	24	14	5,400	5,900	129,600	141,606	127,624	90
		07/28/00	41	14	5,400	5,794	221,400	237,536	214,659	90
		Total	111				599,989	639,616	552,866	
		Average								86
2001	Fort Richardson	07/10/01	7	14	5,793	5,680	40,551	39,757	26,050	66
		07/17/01	56	16	5,793	5,843	324,408	327,181	241,786	74
		07/25/01	42	15	5,793	6,365	243,306	267,331	237,211	89
		Total	105				608,265	634,269	505,047	
		Average								80
2002	Fort Richardson	07/12/02	6	18	6,000	5,852	36,000	35,109	21,112	60
		07/16/02	11	15	6,000	5,331	66,000	58,644	45,700	78
		07/23/02	12	14	6,000	5,937	72,000	71,241	60,738	85
		07/26/02	36	13	6,000	5,576	216,000	200,753	164,910	82
		07/30/02	32	18	6,000	5,771	192,000	184,672	162,332	88
		08/02/02	17	18	6,000	5,884	102,000	100,032	84,357	84
	Elmendorf	07/19/02	16	14	5,888	6,160	94,200	98,557	30,150	31
		07/23/02	12	14	5,269	5,863	63,232	70,350	28,140	40
		07/26/02	35	13	4,900	4,767	171,520	166,830	123,280	74
		07/30/02	32	18	4,950	5,825	158,388	186,394	138,288	74
		08/02/02	17	18	4,035	4,997	68,608	84,956	41,540	49
		Total	226				461,748	508,530	331,248	
		Average								65
2003	Fort Richardson	07/22/03	27	18	5,800	6,323	156,600	170,723	147,530	86
		07/29/03	55	13	5,800	6,240	319,000	343,177	293,695	86
		08/01/03	41	17	5,800	6,703	237,800	274,834	249,242	91
	Elmendorf	07/17/03	27	15	7,128	7,251	182,764	195,774	153,162	78
		Total	150				896,164	984,508	843,629	
		Average								86
2004	Fort Richardson	07/15/04	3	16	6,000	5,005	18,000	15,016	7,186	48
		07/20/04	26	14	6,000	5,941	156,000	154,461	110,634	72
		07/26/04	57	12	6,000	6,139	343,000	349,937	319,414	91
		07/30/04	40	13	6,000	5,396	240,000	215,859	195,000	90
		Total	126				757,000	735,273	632,234	
		Average								86
2005	Fort Richardson	07/15/05	0	17						
		07/20/05	14	16	5,811	4,968	81,354	69,550	56,165	81
		07/26/05	60	13	5,972	5,375	358,320	322,470	284,845	88
		08/02/05	31	11	5,972	5,365	185,132	166,324	154,087	93
		Total	105	57	17,755	15,708	624,806	558,344	495,097	
		Average								89
6-year average (1999–2004)										87

Note: ND = no data collected.

[a] Only ripe females are accounted for, and do not necessarily match the number of fish sacrificed during the egg take.

[b] Number of green eggs per female.

[c] Maximum average daily water temperature.

Table 14.-Hatchery-reared Ninilchik River Chinook salmon coded wire tag recoveries outside of Ninilchik River, 2005.

CWT recovery			CWT	Brood		Smolt release [a]		Age [b]	
Sample type	Location	No. of fish	code	year	Hatchery [c]	Date	Location	Freshwater	Ocean
Escapement	Anchor R	1	310260	2000	Ft. Rich.	06/13/01	Ninilchik R	0	4

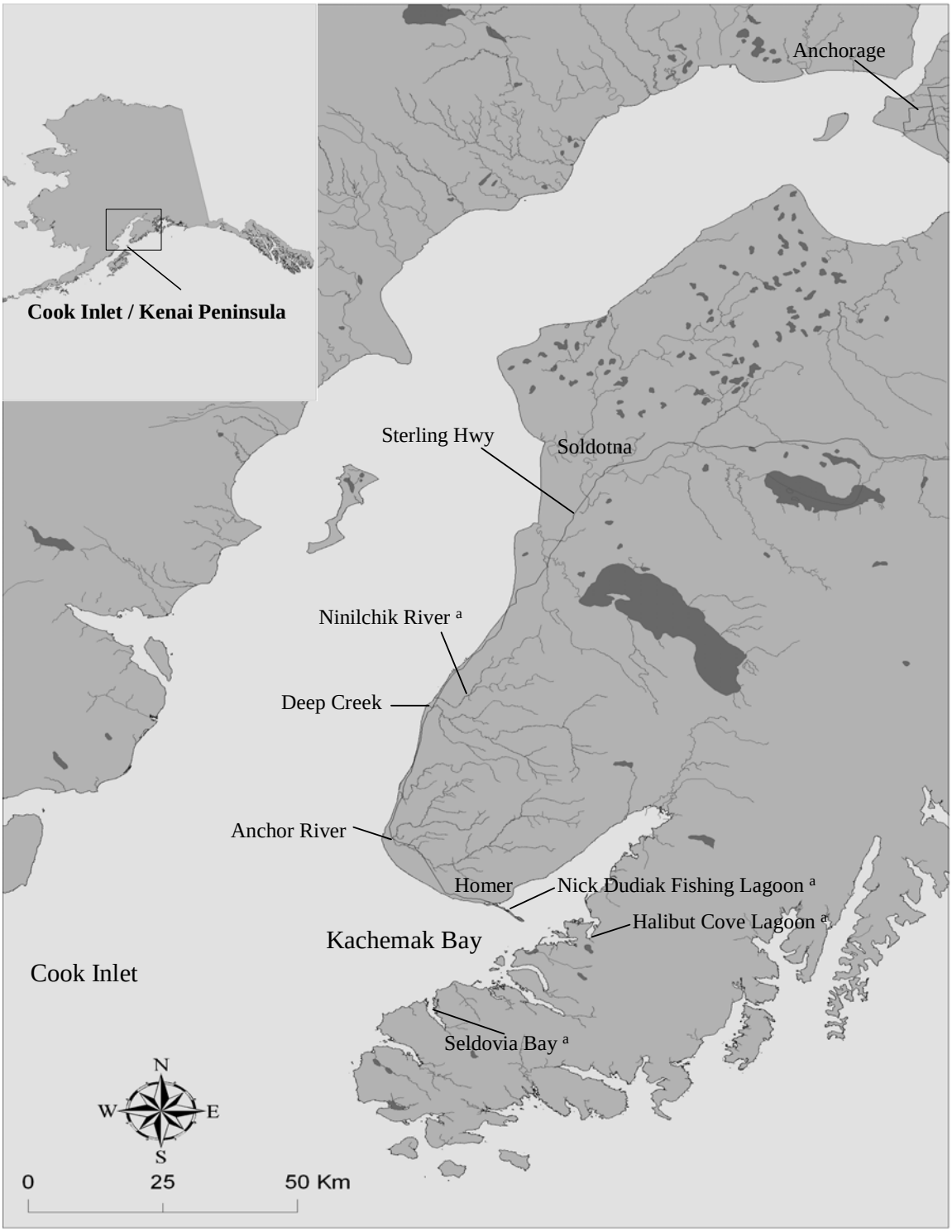
Note: CWT = coded wire tag.

[a] Chinook salmon smolt released in fresh water near the Ninilchik River weir site.

[b] Freshwater and ocean age were determined by comparing brood year, release year, and recovery year for this coded wire tagged fish. This age determined from CWT data correctly matched the age determined by a scale reader.

[c] Ft Rich = Fort Richardson.

FIGURES



[a] Stocking locations for hatchery-reared Ninilchik River Chinook salmon smolt.

Figure 1.-Map of Kenai Peninsula highway system, Ninilchik River, and Kachemak Bay Chinook salmon smolt stocking locations, 1999 and 2005.

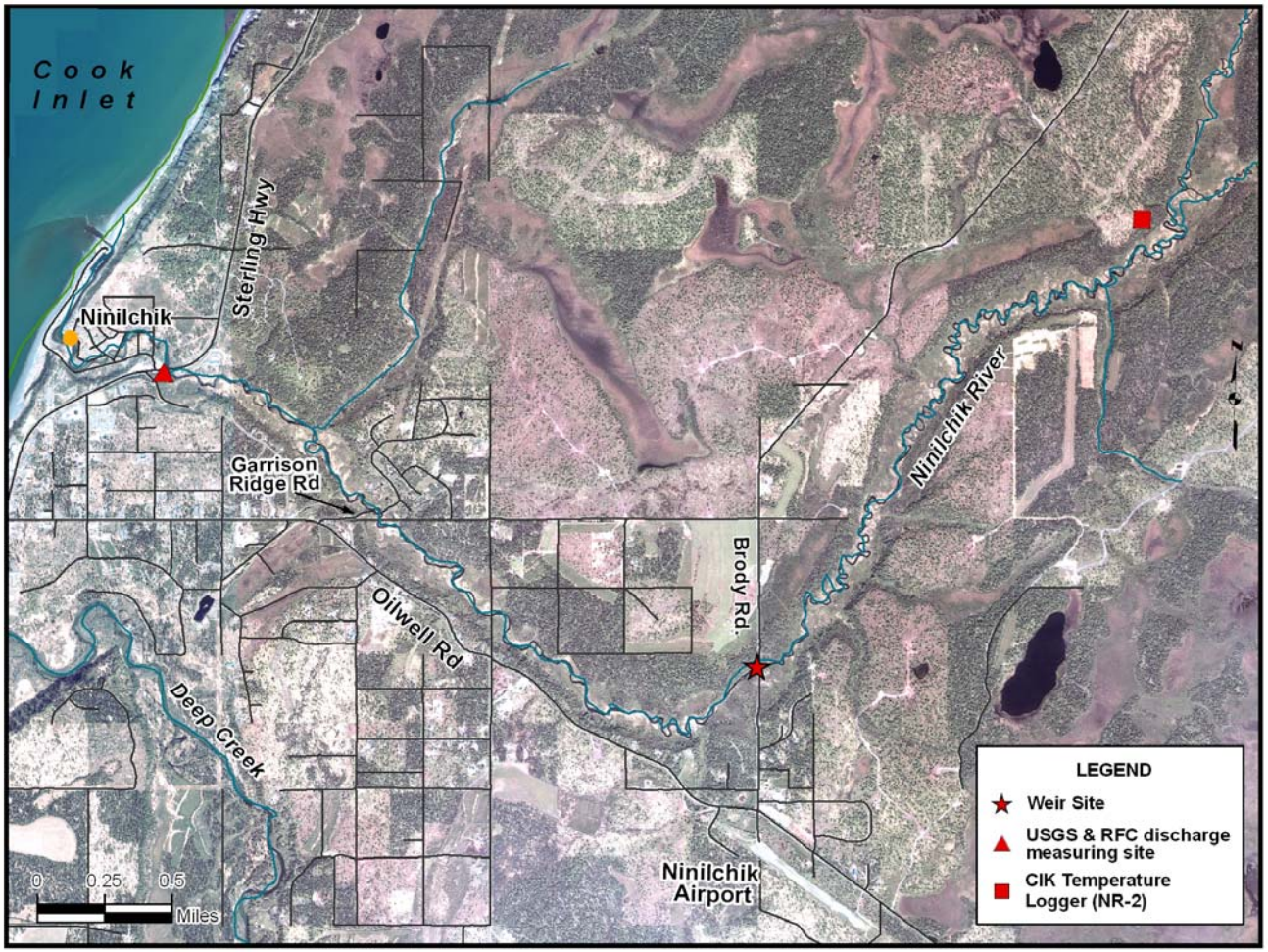
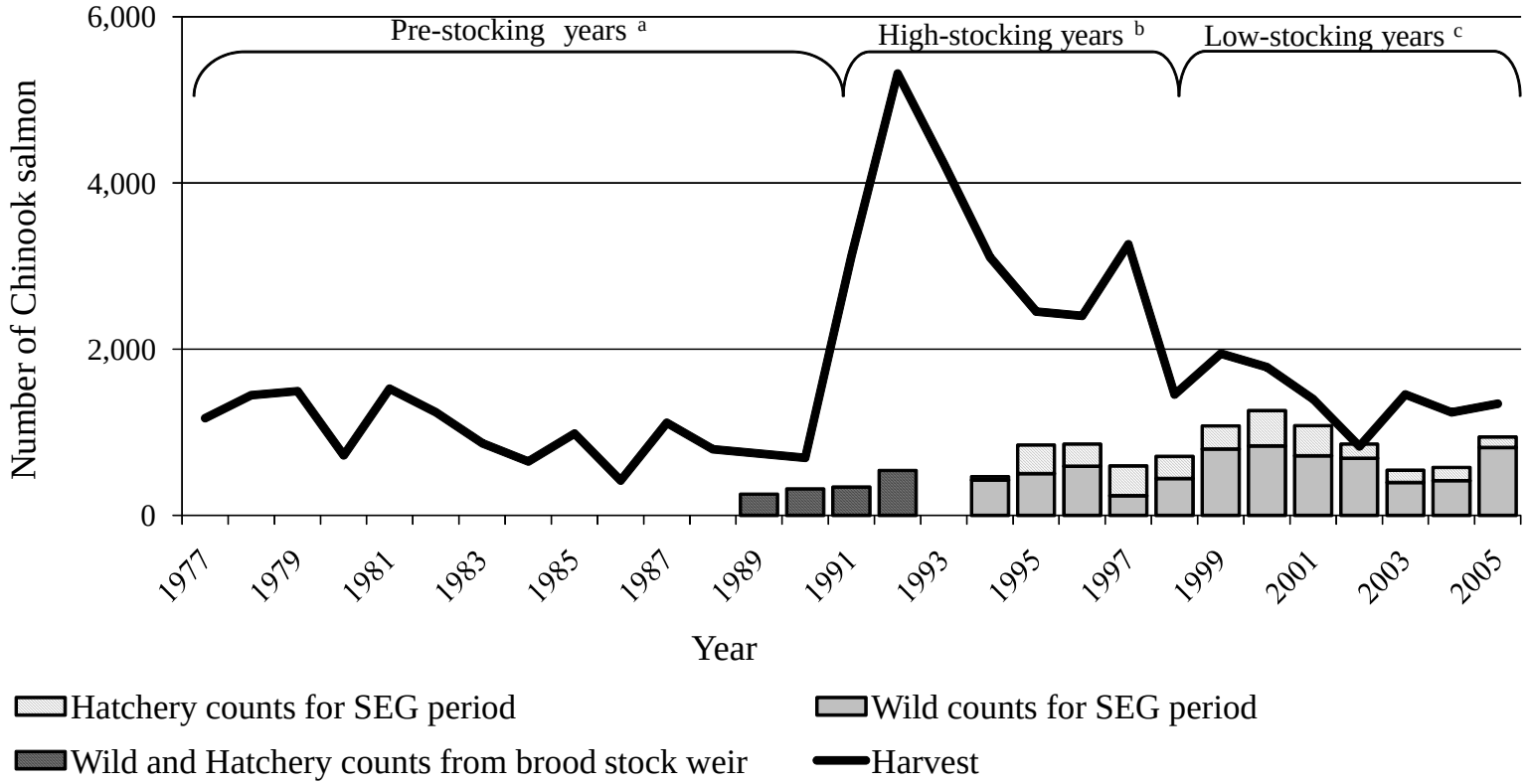


Figure 2.-Map of Ninilchik River weir sampling locations, 2005.



[a] Years before the Chinook salmon smolt stocking program affected the adult return.

[b] Years when adult Chinook salmon (predominantly ocean age 3) returned from the release of approximately 200,000 Chinook salmon smolt.

[c] Years when adult Chinook salmon (predominantly ocean age 3) returned from the release of approximately 50,000 Chinook salmon smolt.

Figure 3.-Comparison of Ninilchik River Chinook salmon sport harvest and escapement counts and how each responded to higher and lower levels of stocking with hatchery-reared Chinook salmon smolt, 1977–2005.

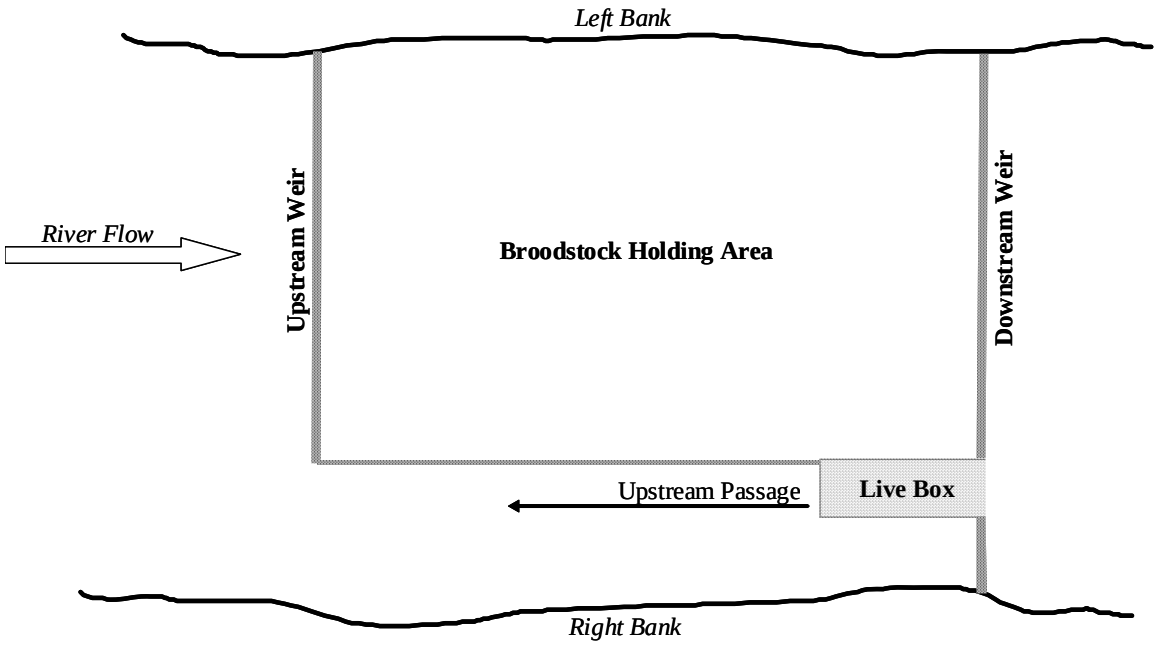


Figure 4.-The configuration of the Ninilchik River weirs and location of the broodstock holding area, 2005.

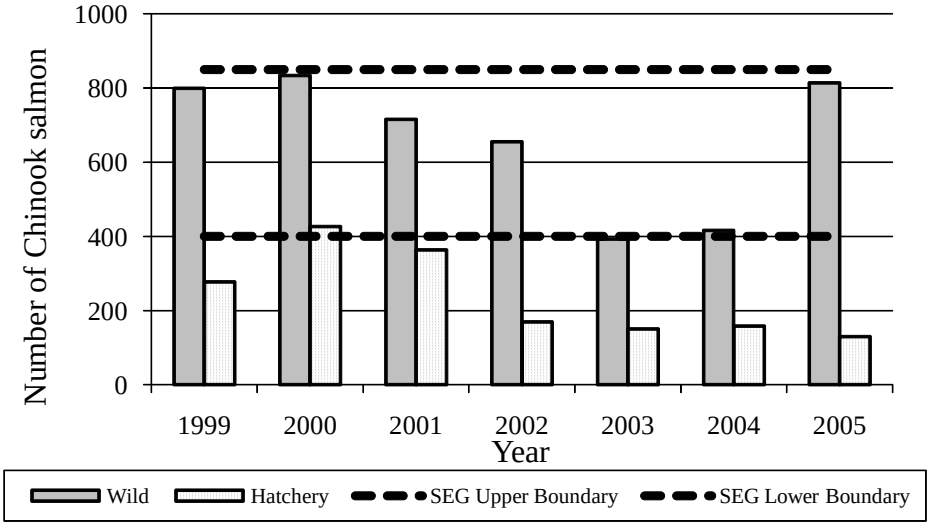


Figure 5.-Comparison of Ninilchik River Chinook salmon weir counts from July 8 to July 24 for 1999 to 2005 with the upper and lower range of the Sustainable Escapement Goal (SEG).

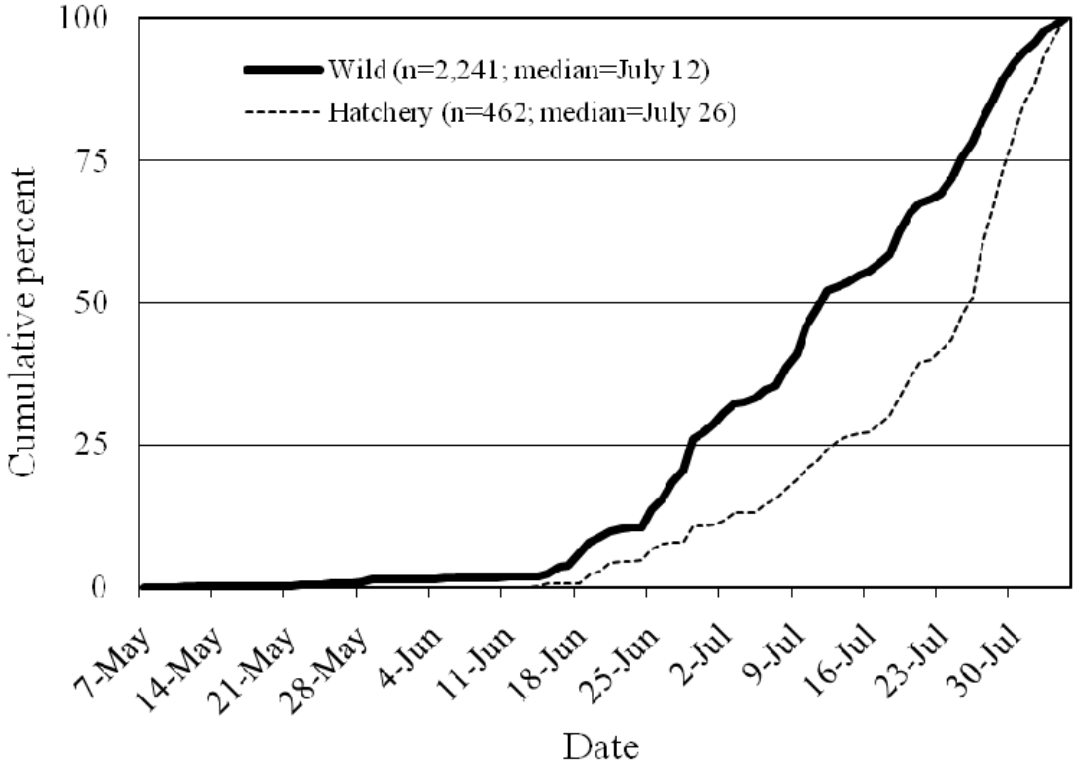
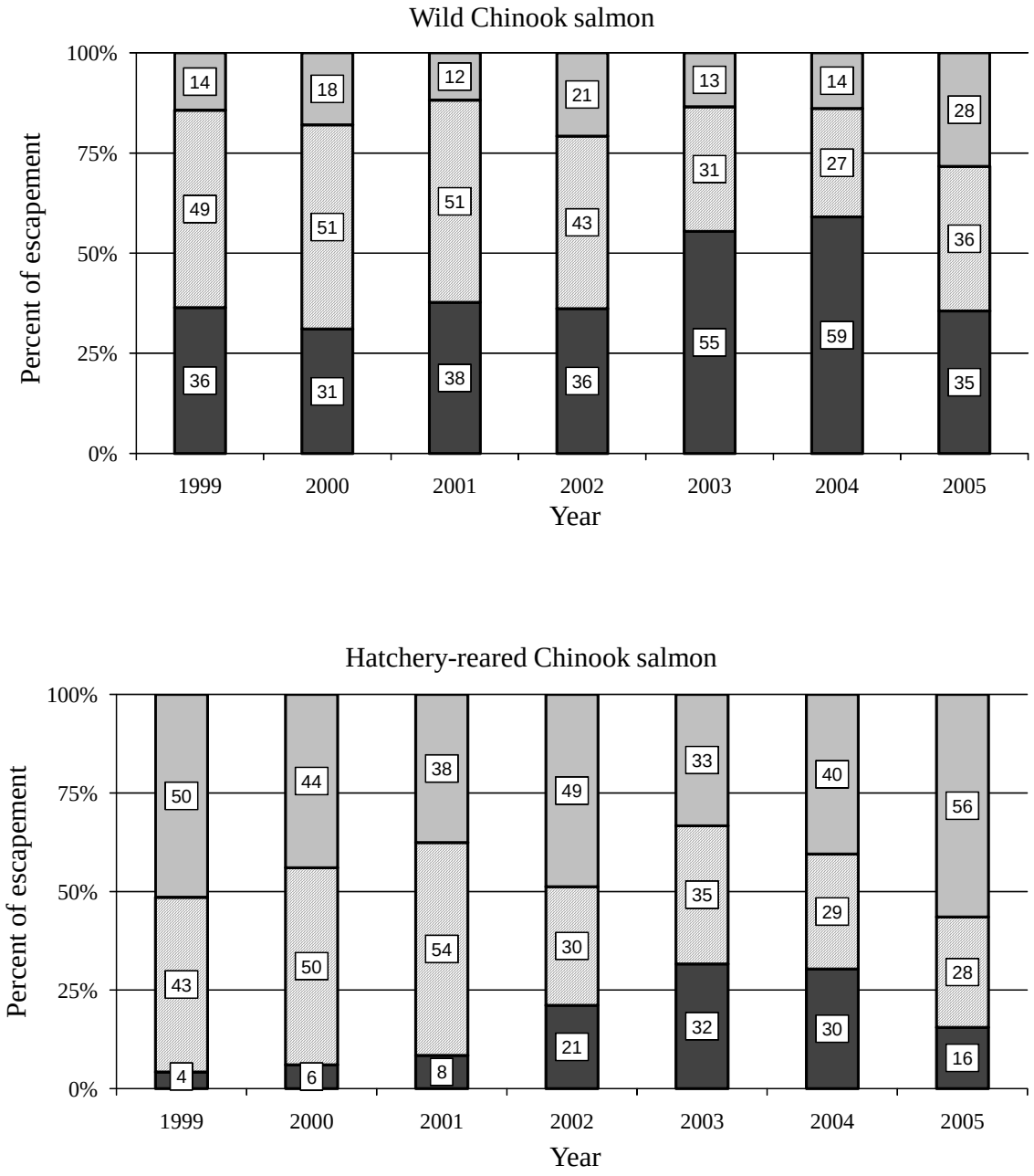


Figure 6.-Run timing of wild and hatchery-reared Chinook salmon at Ninilchik River weir, 2005.



Color code: *dark* = from start of weir operation to July 7; *diagonal stripe* = from July 8-24 (SEG Counting Period); *gray* = from July 25 to end of weir operation; *numbered white label* = % of escapement.

Figure 7.-The percent composition of Ninilchik River wild and hatchery Chinook salmon for early, middle, and late portions of the escapement, 1999–2005.

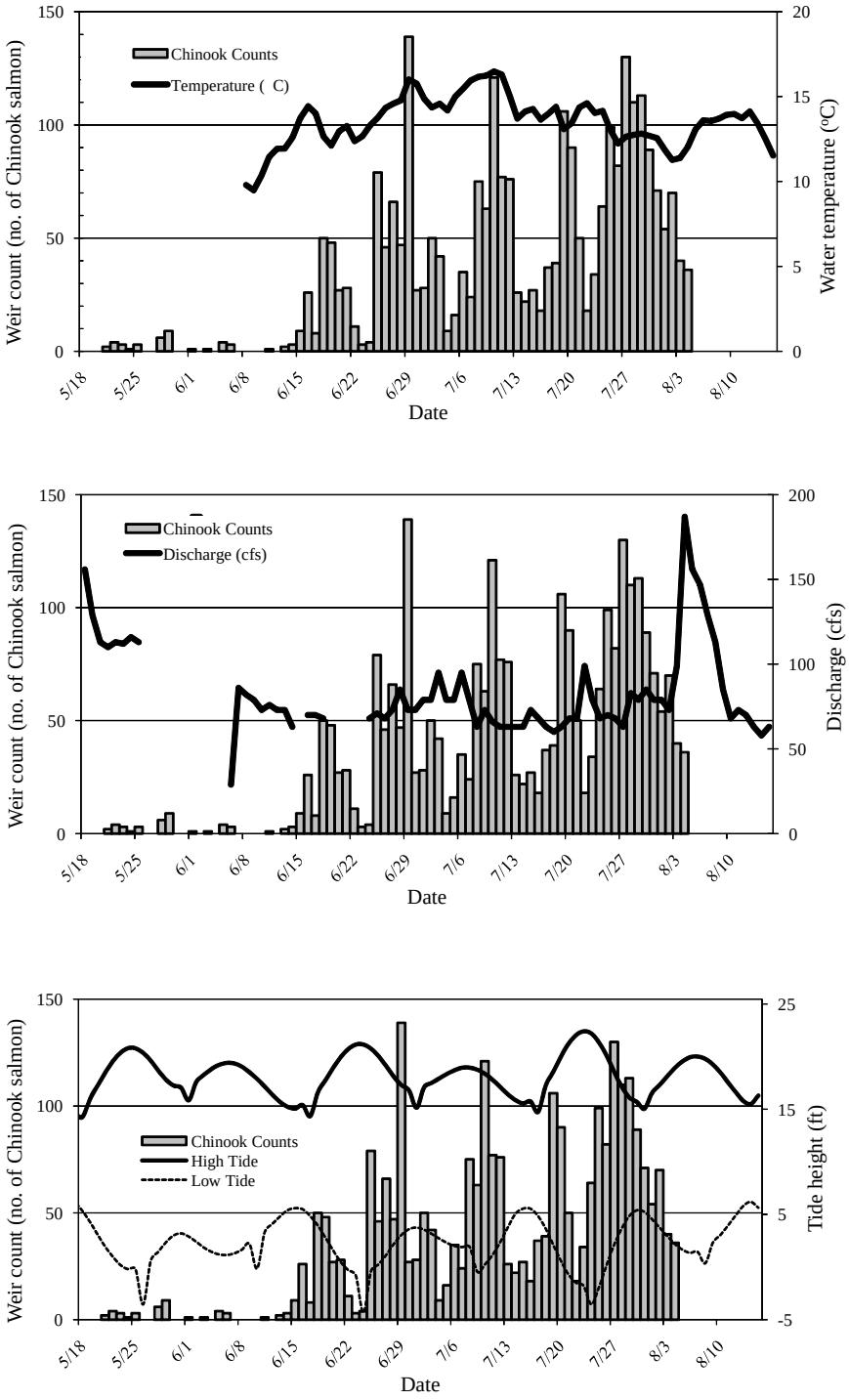


Figure 8.-Daily comparisons of Chinook salmon counts at Ninilchik River with average water temperature, discharge, and tide height for May 7 to August 4, 2005.

APPENDIX A. TIMELINES FOR NINILCHIK RIVER CHINOOK SALMON SUPPLEMENTATION AND MONITORING PROGRAMS

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 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 finclipped 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.
1999–2005	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 a subsection of the standard length 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 conducted during several years because of poor viewing conditions.
1974	Aerial survey conducted with both fixed and rotary wing aircraft. Escapement estimate produced as in 1962-1973.
1976–1988	Subsection for ground survey reduced to 7.7 rkm above mouth at Brody Road bridge. Escapement estimate produced as in 1962-1973.
1975	Rotary wing aircraft replaces fixed wing aircraft as the viewing platform for all aerial surveys. Escapement estimate produced as in 1962-1973.
1989	In addition to the aerial and foot survey, escapement data opportunistically collected from broodstock weir located at Garrison Road bridge (approximately 3 rkm). Weir not operational throughout the entire run.
1990–1993	In addition to the aerial and foot survey, escapement data collected opportunistically from broodstock weir located at Brody Road bridge. No attempt made to identify and enumerate hatchery-reared fish. Weir not operational throughout 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 at the weir was estimated by expanding recovered CWTs at the weir. The wild counts were obtained by subtracting the hatchery-reared estimate from the total number of Chinook salmon counted at the broodstock weir. Weir not operational throughout the entire run.
1995–1998	Foot survey discontinued as a cost savings measure in 1995. Escapement data collected at broodstock weir as in 1994.
1999–2000	In addition to the aerial survey, broodstock weir operated over the entire Chinook salmon run. This was the first year that 100% of hatchery-reared fish were identified by their 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 as a cost savings measure in 2001. Escapement data collected at broodstock weir similar to 1999.

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

Year (s)	Sport Harvest
1977-present	Alaska Statewide Harvest Survey conducted to produce estimates of total catch and harvest for Chinook salmon in Ninilchik River.
1991–1993	Creel surveys of freshwater harvest were conducted to estimate the hatchery-reared Chinook salmon harvest.
1994–1996 and 2000–2003	Inriver harvest sampling was conducted to estimate the percentage of hatchery-reared Chinook salmon in the harvest.

Year (s)	Escapement Goals
1993–1997	First escapement goal adopted (Biological Escapement Goal (BEG) = 830 wild Chinook salmon) was based on average annual aerial and foot survey average counts and expanded estimates from 1966 to 1969 and 1977 to 1991.
1998	The Alaska Board of Fisheries (BOF) adopted a new BEG range of 500 to 900 wild Chinook salmon, which was based on historic aerial survey counts and their relationship to the sport harvest.
2001	Escapement Goal Policy adopted, and BEG was replaced with a Sustainable Escapement Goal (SEG) range of 400 to 850 wild Chinook salmon calculated from 7 years (1994 to 2000) of weir counts collected from July 8 through July 24.

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

Year	Chinook Salmon Fishing Regulations Assume the regulations are carried forward unless otherwise stated.
1977	Harvest recording requirement. Open period: four 2-day weekend openings beginning in the last week of May. Open area: mouth upstream 2 miles Season limit: of 5 kings from fresh and salt water combined. Bag and size limit: 1 king salmon 20” or larger; 10 kings under 20”
1978	Open period changed to three 3-day weekend openings beginning in the last week of May.
1985	Bag and size limit: 1 king salmon 16” or larger; 10 kings under 16”
2001	Bag and size limit: 1 king salmon 20” or larger; 10 kings under 20”
2005	Bag and size limit: 2 king salmon 20” or larger, or which only 1 can be wild; 10 kings under 20” 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.

Year	Emergency Orders
1991	E.O. added a fourth 3-day weekend (June 15, 16, 17) E.O. extended the fishery to from June 17 to June 24
1992	E.O. extended fishery by 10 days
1993	E.O. opened the fishery continuously from June 15 through June 28.
1994	E.O. opened the fishery continuously from June 14 through June 27.
1995	E.O. extended fishery by 14 days.
1996	E.O. No. 2-KS-1-20-96 extended the Chinook salmon fishery on the Ninilchik River on a continual basis between Saturday, June 15 through Monday, June 24. Effective June 15, 12:01 a.m. through Monday June 24, 1996.
2001	E.O. No. 2-KS-7-05-02 opened the Ninilchik River downstream of the regulatory marker for an additional 3-day weekend, June 16, 2001, 12:01 a.m. to June 18, 2001, 11:59 p.m.

-continued-

Year	Emergency Orders
2002	E.O. No. 2-KS-7-08-02 opened the Ninilchik River from its mouth to the downstream edge of the Sterling Highway bridge, from Saturday, June 15, 12:01 a.m. to Monday, June 17, 11:59 p.m., 2002, to sport fishing for hatchery king salmon only. The daily bag and possession limit was 1 fish 20 inches or greater in length or 10 fish under 20 inches. Only unbaited artificial lures were permitted.
2003	E.O. No. 2-KS-7-03-03 opened the Ninilchik River from its mouth to the downstream edge of the Sterling Highway bridge, from Saturday, June 14, 2003, 12:01 a.m., to Monday, June 30, 2003, 11:59 p.m. to sport fishing for hatchery king salmon only. The daily bag and possession limit was 1 fish 20 inches or greater in length and 10 fish under 20 inches. Use of only one single hook was allowed.
2004	E.O. No. 2-KS-7-03-04 opened the Ninilchik River from its mouth upstream to the regulatory marker located approximately 2 miles upstream, to fishing for hatchery king salmon 7 days per week. Bait was allowed. Only one, single hook could be used. A person could not possess a king salmon that had been filleted, headed, mutilated or otherwise disfigured in a manner that prevented identification of hatchery or wild origin until permanently transported away from the fishing site if the fish was taken from the riverbank. "Fishing site" meant the riverbank where the fish was hooked and removed from the water. The emergency order was effective 12:01 a.m., Saturday, May 29, 2004 until 11:59 p.m. December 31, 2004.

APPENDIX B. NINILCHIK RIVER CHINOOK SALMON CODED WIRE TAG RECOVERY DATA BY BROOD YEAR

Appendix B1.-Coded wire tag data of hatchery-reared Ninilchik River Chinook salmon recovered from escapement projects and hatcheries, by stocking level, brood years 1987-2002.

		Code wire tag recoveries (number of Chinook salmon)																		
		Brood years with larger numbers of stocked smolt [a]								Brood years with lower number of stocked smolt [b]										
Recovery locations		1987	1988	1989	1990	1991	1992	1993	Subtotal	1994	1995	1996	1997	1998	1999	2000	2001	2002	Subtotal	Total
Lower Cook Inlet	Anchor River								0					1		9			10	10
	Deep Creek					1	14	8	23	9	13	67	23	8	10	10	3	3	146	169
	Ninilchik				6	80	93	101	280	66	56	164	82	139	100	83	61	11	762	1,042
	Subtotal	0	0	0	6	81	107	109	303	75	69	231	105	148	110	102	64	14	918	1,221
Upper Cook Inlet	Crooked Creek	16	1	11					28			1							1	29
	Soldotna							1	1										0	1
	Subtotal	16	1	11	0	0	0	1	29	0	0	1	0	0	0	0	0	0	1	30
Prince William Sound	Wally Noerenberg			1					1										0	1
	Unknown Port										1			1					2	2
Total		16	1	12	6	81	107	110	333	75	69	232	105	148	110	102	64	14	919	1,252

Note: Smolt were released at various locations in the river from 1988 to 1994; smolt were held in Ninilchik Harbor intertidal-saltwater area prior to release in 1995 and 1996; Smolt were released approximately 4.5 rkm upstream of Ninilchik River mouth from 1997 to 2004.

[a] Approximately 200,000 Chinook salmon smolt stocked, of which approximately 20% were adipose finclipped and coded wire tagged.

[b] Approximately 50,000 Chinook salmon smolt stocked, of which 100% were adipose finclipped, coded wire tagged, and thermal marked.

Appendix B2.-Coded wire tag data of hatchery-reared Ninilchik River Chinook salmon from freshwater sport harvests, by stocking level, brood years 1987–2002.

		Code wire tag recoveries (number of Chinook salmon)																			
		Brood years with larger numbers of stocked smolt [a]								Brood years with lower number of stocked smolt [b]											
Recovery locations		1987	1988	1989	1990	1991	1992	1993	Subtotal	1994	1995	1996	1997	1998	1999	2000	2001	2002	Subtotal	Total
Lower Cook Inlet	Anchor Point								0										0	0
	Deep Creek								0	2									2	2
	Ninilchik			29	5	105	79	13	231	1		2							3	234
	Homer	81	28	46	1				156				4	1			1		6	162
	Subtotal	81	28	75	6	105	79	13	387	3	0	2	4	1	0	0	1	0	11	398
Upper Cook Inlet	Anchorage	1							1	1									1	2
	Palmer								0				1						1	1
	Crooked Creek	1							1										0	1
	Soldotna					3			3	3	1								4	7
	Subtotal	2	0	0	0	3	0	0	5	4	1	0	1	0	0	0	0	0	6	11
Total		83	28	75	6	108	79	13	392	7	1	2	5	1	0	0	1	0	17	409

Note: Smolt were released at various locations in the river from 1988 to 1994; smolt were held in Ninilchik Harbor intertidal-saltwater area prior to release in 1995 and 1996; Smolt were released approximately 4.5 rkm upstream of Ninilchik River mouth from 1997 to 2004.

[a] Approximately 200,000 Chinook salmon smolt stocked, of which approximately 20% were adipose finclipped and coded wire tagged.

[b] Approximately 50,000 Chinook salmon smolt stocked, of which 100% were adipose finclipped, coded wire tagged, and thermal marked.

Appendix B3.-Coded wire tag data of hatchery-reared Ninilchik River Chinook salmon from saltwater sport and commercial harvests, by stocking level, brood years 1987–2002.

		Code wire tag recoveries (number of Chinook salmon)																		
		Brood years with larger numbers of stocked smolt [a]								Brood years with lower number of stocked smolt [b]										
Recovery locations		1987	1988	1989	1990	1991	1992	1993	Subtotal	1994	1995	1996	1997	1998	1999	2000	2001	2002	Subtotal	Total
Lower Cook Inlet	Anchor Point							1	1	4	8	9	4		1				26	27
	Deep Creek					3	12	13	27	11	20	15	1						47	74
	Ninilchik						1	1	2	24	26	4	1	7		1	1	1	65	67
	Homer	2		1	1	1	1	1	7	1	4		2	1					8	15
	Subtotal	2	0	1	1	4	14	16	37	40	58	28	8	8	1	1	1	1	146	183
Upper Cook Inlet	Kasilof						1		1	16	14	1	1	3			1		36	37
	Kenai								0	1	7								8	8
	Soldotna						2		2	1	1	2							4	6
	Subtotal	0	0	0	0	0	3	0	3	18	22	3	1	3	0	0	1	0	48	51
Kodiak	Kodiak								0	2	7	5							14	14
Prince William Sound	Valdez		1						1										0	1
	Cordova								0						1				1	1
Southeast Alaska	Yakutat							1	1										0	1
	Pelican								0		1								1	1
	Hoonah								0		1		1						2	2
	Ketchikan							1	1										0	1
	Sitka								0	1		2		1		1			5	5
	Subtotal	0	1	0	0	0	0	2	3	1	2	2	1	1	1	1	0	0	9	12
Total		2	1	1	1	4	17	18	44	61	89	38	10	12	2	2	2	1	217	261

Note: Smolt were released at various locations in the river from 1988 to 1994; smolt were held in Ninilchik Harbor intertidal-saltwater area prior to release in 1995 and 1996; Smolt were released approximately 4.5 rkm upstream of Ninilchik River mouth from 1997 to 2004.

[a] Approximately 200,000 Chinook salmon smolt stocked, of which approximately 20% were adipose finclipped and coded wire tagged.

[b] Approximately 50,000 Chinook salmon smolt stocked, of which 100% were adipose finclipped, coded wire tagged, and thermal marked.

APPENDIX C. NINILCHIK RIVER CHINOOK SALMON WEIR COUNTS, 2005

Appendix C1.-Daily and cumulative counts of wild and hatchery Chinook salmon at Ninilchik River weir, 2005.

	Weir count (number of fish)								
	Wild Chinook salmon			Hatchery-reared Chinook salmon			Total Chinook salmon		
		Cumulative			Cumulative			Cumulative	
Date	Daily	Number	Percent	Daily	Number	Percent	Daily	Number	Percent
5/07	0	0	0	0	0	0	0	0	0
5/08	0	0	0	0	0	0	0	0	0
5/09	0	0	0	0	0	0	0	0	0
5/10	0	0	0	0	0	0	0	0	0
5/11	1	1	0	0	0	0	1	1	0
5/12	0	1	0	0	0	0	0	1	0
5/13	0	1	0	0	0	0	0	1	0
5/14	0	1	0	0	0	0	0	1	0
5/15	0	1	0	0	0	0	0	1	0
5/16	0	1	0	0	0	0	0	1	0
5/17	0	1	0	0	0	0	0	1	0
5/18	0	1	0	0	0	0	0	1	0
5/19	0	1	0	0	0	0	0	1	0
5/20	0	1	0	0	0	0	0	1	0
5/21	2	3	0	0	0	0	2	3	0
5/22	4	7	0	0	0	0	4	7	0
5/23	3	10	0	0	0	0	3	10	0
5/24	1	11	0	0	0	0	1	11	0
5/25	3	14	1	0	0	0	3	14	1
5/26	0	14	1	0	0	0	0	14	1
5/27	0	14	1	0	0	0	0	14	1
5/28	6	20	1	0	0	0	6	20	1
5/29	9	29	1	0	0	0	9	29	1
5/30	0	29	1	0	0	0	0	29	1
5/31	0	29	1	0	0	0	0	29	1
6/01	1	30	1	0	0	0	1	30	1
6/02	0	30	1	0	0	0	0	30	1
6/03	1	31	1	0	0	0	1	31	1
6/04	0	31	1	0	0	0	0	31	1
6/05	4	35	2	0	0	0	4	35	1
6/06	3	38	2	0	0	0	3	38	1
6/07	0	38	2	0	0	0	0	38	1
6/08	0	38	2	0	0	0	0	38	1
6/09	0	38	2	0	0	0	0	38	1
6/10	0	38	2	0	0	0	0	38	1
6/11	1	39	2	0	0	0	1	39	1
6/12	0	39	2	0	0	0	0	39	1
6/13	2	41	2	0	0	0	2	41	2
6/14	2	43	2	1	1	0	3	44	2
6/15	7	50	2	2	3	1	9	53	2
6/16	26	76	3	0	3	1	26	79	3
6/17	8	84	4	0	3	1	8	87	3
6/18	50	134	6	0	3	1	50	137	5
6/19	41	175	8	7	10	2	48	185	7
6/20	24	199	9	3	13	3	27	212	8
6/21	21	220	10	7	20	4	28	240	9

-continued-

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Date	Weir count (number of fish)								
	Wild Chinook salmon			Hatchery-reared Chinook salmon			Total Chinook salmon		
		Cumulative			Cumulative			Cumulative	
	Daily	Number	Percent	Daily	Number	Percent	Daily	Number	Percent
6/22	10	230	10	1	21	5	11	251	9
6/23	3	233	10	0	21	5	3	254	9
6/24	3	236	11	1	22	5	4	258	10
6/25	70	306	14	9	31	7	79	337	12
6/26	42	348	16	4	35	8	46	383	14
6/27	65	413	18	1	36	8	66	449	17
6/28	47	460	21	0	36	8	47	496	18
6/29	126	586	26	13	49	11	139	635	23
6/30	27	613	27	0	49	11	27	662	24
7/01	27	640	29	1	50	11	28	690	26
7/02	46	686	31	4	54	12	50	740	27
7/03	36	722	32	6	60	13	42	782	29
7/04	9	731	33	0	60	13	9	791	29
7/05	15	746	33	1	61	13	16	807	30
7/06	29	775	35	6	67	15	35	842	31
7/07	19	794	35	5	72	16	24	866	32
7/08	68	862	38	7	79	17	75	941	35
7/09	55	917	41	8	87	19	63	1,004	37
7/10	112	1,029	46	9	96	21	121	1,125	42
7/11	70	1,099	49	7	103	22	77	1,202	44
7/12	68	1,167	52	8	111	24	76	1,278	47
7/13	18	1,185	53	8	119	26	26	1,304	48
7/14	18	1,203	54	4	123	27	22	1,326	49
7/15	25	1,228	55	2	125	27	27	1,353	50
7/16	17	1,245	56	1	126	27	18	1,371	51
7/17	31	1,276	57	6	132	29	37	1,408	52
7/18	32	1,308	58	7	139	30	39	1,447	54
7/19	91	1,399	62	15	154	33	106	1,553	57
7/20	74	1,473	66	16	170	37	90	1,643	61
7/21	38	1,511	67	12	182	39	50	1,693	63
7/22	16	1,527	68	2	184	40	18	1,711	63
7/23	26	1,553	69	8	192	42	34	1,745	65
7/24	55	1,608	72	9	201	44	64	1,809	67
7/25	80	1,688	75	19	220	48	99	1,908	71
7/26	66	1,754	78	16	236	51	82	1,990	74
7/27	89	1,843	82	41	277	60	130	2,120	78
7/28	78	1,921	86	32	309	67	110	2,230	83
7/29	82	2,003	89	31	340	74	113	2,343	87
7/30	62	2,065	92	27	367	79	89	2,432	90
7/31	45	2,110	94	26	393	85	71	2,503	93
8/01	38	2,148	96	16	409	89	54	2,557	95
8/02	45	2,193	98	25	434	94	70	2,627	97
8/03	26	2,219	99	14	448	97	40	2,667	99
8/04 [a]	22	2,241	100	14	462	100	36	2,703	100
Total	2,241			462			2,703		

[a] Weir pulled 8/04/2005.

APPENDIX D. NINILCHIK RIVER TEMPERATURE, DISCHARGE, AND TIDE HEIGHT DATA, 2005

Appendix D1.-Daily mean, minimum, and maximum water temperatures, Ninilchik River, June 24 through October 11, 2005.

	Daily water temperatures (^{o} C)														
	June			July			August			September			October		
Date	Mean	Min	Max	Mean	Min	Max	Mean	Min	Max	Mean	Min	Max	Mean	Min	Max
1				15	14	16	12	11	13	10	9	12	7	6	7
2				14	12	17	11	11	11	9	8	11	6	6	7
3				15	12	17	11	11	12	9	9	10	6	5	6
4				14	13	16	12	11	14	9	8	9	5	5	5
5				15	13	18	13	11	15	9	9	10	5	5	5
6				15	13	18	14	12	16	10	9	11	5	4	5
7				16	13	19	14	11	16	10	9	11	5	4	5
8	10	9	10	16	14	19	14	11	16	10	8	10	5	5	6
9	9	9	11	16	14	19	14	12	16	9	9	10	5	5	5
10	10	9	12	16	14	19	14	12	16	10	9	11	4	3	5
11	11	10	13	16	14	19	14	11	16	10	9	10	3	2	4
12	12	10	14	15	14	17	14	12	16	10	10	11			
13	12	10	14	14	12	15	13	13	15	10	9	11			
14	13	10	15	14	12	17	13	12	13	10	9	10			
15	14	11	17	14	12	16	12	11	13	9	9	9			
16	14	12	17	14	13	15	12	11	13	9	9	9			
17	14	12	16	14	12	16	12	11	13	9	8	9			
18	13	12	14	14	13	16	12	11	12	9	8	9			
19	12	10	14	13	13	14	13	11	15	8	8	9			
20	13	11	15	13	11	16	13	11	14	8	8	9			
21	13	11	16	14	12	16	13	12	15	7	7	8			
22	12	12	14	15	13	16	11	10	13	8	7	8			
23	13	10	15	14	12	16	11	11	13	8	8	9			
24	13	11	16	14	13	15	11	10	12	8	8	9			
25	14	11	16	13	12	14	11	10	13	8	7	9			
26	14	12	17	12	11	13	11	10	13	7	7	8			
27	15	12	17	13	11	14	11	9	12	7	7	7			
28	15	12	18	13	11	14	11	10	11	7	6	7			
29	16	14	19	13	12	14	11	10	12	7	6	7			
30	16	14	17	13	11	14	12	11	14	7	6	7			
31				13	11	14	11	10	12						

Source: Mauger (2005).

Appendix D2.-Daily discharge measurements at approximately 1.9 river kilometers upstream from Ninilchik River mouth, 2005.

	Daily discharge (cfs) [a]							
Date	April	May	June	July	August	September	October	November
1		381	187	95	99	79	147	121
2		364	187	79	187	73	147	113
3		289	187	79	156	91	147	445
4		261	43	95	147	99	138	414
5		261	-	79	129	129	138	721
6		210	29	63	113	166	129	
7		210	86	73	85	187	113	
8		187	82	66	68	147	129	
9		162	79	63	73	138	121	
10		166	73	63	70	552	113	
11		156	76	63	63	445	121	
12	576	156	73	63	58	388	106	
13	606	127	73	73	63	234	113	
14	421	123	63	68	73	147	121	
15	425	113	73	63	70	129	113	
16	381	113	70	60	68	187	177	
17	503	118	68	63	68	425	156	
18	437	156	86	68	73	445	129	
19	350	129	-	68	73	425	129	
20	445	113	79	99	73	353	388	
21	486	110	-	79	63	156	353	
22	503	113	68	68	68	164	275	
23	791	112	71	70	92	172	166	
24	917	116	68	68	95	445	121	
25	761	113	73	63	85	367	99	
26	646	-	85	83	79	327	85	
27	350	-	73	79	73	205	92	
28	461	-	73	85	73	187	129	
29	445	-	79	79	73	166	147	
30	576	-	79	79	79	166	147	
31		-	187	73	73	79	147	

[a] Provisional data provided by the National Weather Service, Alaska Pacific Weather Forecast Center.

Appendix D3.–Daily high and low tides heights from Deep Creek, Alaska, May 1 through August 31, 2005.

Date	Daily tide height (ft)											
	May						June					
	High			Low			High			Low		
	A.M.	P.M.	Av,	A.M.	P.M.	Av,	A.M.	P.M.	Av,	A.M.	P.M.	Av,
1	16.1	15.7	15.9	6.2	1.3	3.8	15.4	15.4	15.4	2.5	2.4	2.5
2	15.6	15.6	15.6	5.6	1.4	3.5	18.4	15.9	17.2	1.0	2.9	2.0
3	16.8	16.2	16.5	3.9	1.1	2.5	19.0	16.6	17.8	-0.4	3.2	1.4
4	18.2	17.2	17.7	1.8	0.8	1.3	19.5	17.3	18.4	-1.5	3.5	1.0
5	19.5	18.2	18.9	-0.2	0.7	0.3	19.8	17.7	18.8	-2.1	3.6	0.8
6	20.5	19.0	19.8	-1.8	0.9	-0.5	19.9	18.0	19.0	-2.4	3.8	0.7
7	21.2	19.5	20.4	-2.9	1.3	-0.8	19.8	18.0	18.9	-2.4	4.1	0.9
8	21.4	19.5	20.5	-3.3	1.9	-0.7	19.5	17.7	18.6	-2.0	4.4	1.2
9	21.2	19.1	20.2	-3.2	2.7	-0.3	18.9	17.2	18.1	-1.4	4.9	1.8
10	20.5	18.4	19.5	-2.5	3.7	0.6	18.2	16.7	17.5	-0.6	-0.6	-0.6
11	19.6	17.3	18.5	-1.5	-1.5	-1.5	17.3	16.1	16.7	5.4	0.3	2.9
12	18.4	16.2	17.3	4.7	-0.2	2.3	16.2	15.7	16.0	5.9	1.4	3.7
13	17.0	15.0	16.0	5.8	1.2	3.5	15.1	15.4	15.3	6.3	2.4	4.4
14	15.6	14.2	14.9	6.8	2.5	4.7	14.1	15.5	14.8	6.4	3.5	5.0
15	14.3	14.0	14.2	7.6	3.5	5.6	13.4	15.8	14.6	6.0	4.3	5.2
16	13.4	14.3	13.9	7.8	4.2	6.0	13.4	16.5	15.0	5.1	5.0	5.1
17	13.2	15.1	14.2	7.1	4.3	5.7	13.9	13.9	13.9	3.6	5.2	4.4
18	13.8	13.8	13.8	5.7	4.1	4.9	17.3	15.0	16.2	1.9	5.1	3.5
19	16.2	14.8	15.5	3.9	3.8	3.9	18.4	16.2	17.3	0.0	4.7	2.4
20	17.5	16.1	16.8	1.9	3.4	2.7	19.5	17.4	18.5	-1.8	4.1	1.2
21	18.7	17.3	18.0	0.0	3.0	1.5	20.6	18.4	19.5	-3.3	3.4	0.1
22	19.9	18.3	19.1	-1.7	2.8	0.6	21.4	19.1	20.3	-4.4	2.9	-0.8
23	20.9	18.9	19.9	-3.1	2.6	-0.3	21.9	19.5	20.7	-4.9	2.4	-1.3
24	21.5	19.2	20.4	-4.0	2.7	-0.7	21.8	19.6	20.7	-4.8	-4.8	-4.8
25	21.7	19.0	20.4	-4.3	3.0	-0.7	21.2	19.4	20.3	2.3	-4.0	-0.9
26	21.3	18.5	19.9	-4.0	-4.0	-4.0	20.0	19.2	19.6	2.3	-2.7	-0.2
27	20.5	17.8	19.2	3.4	-3.1	0.2	18.5	18.8	18.7	2.4	-1.0	0.7
28	19.2	17.3	18.3	3.9	-1.9	1.0	16.8	18.5	17.7	2.6	0.9	1.8
29	17.7	17.0	17.4	4.4	-0.6	1.9	15.5	18.2	16.9	2.5	2.7	2.6
30	16.4	17.2	16.8	4.4	0.7	2.6	14.7	18.0	16.4	2.1	4.2	3.2
31	15.5	17.7	16.6	3.8	1.7	2.8						

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Day	Daily tide height (ft)											
	July						August					
	High			Low			High			Low		
	A.M.	P.M.	Av,	A.M.	P.M.	Av,	A.M.	P.M.	Av,	A.M.	P.M.	Av,
1	14.7	14.7	14.7	1.4	5.2	3.3	16.6	15.6	16.1	1.4	6.8	4.1
2	18.0	15.3	16.7	0.6	5.6	3.1	17.2	16.5	16.9	0.6	6.0	3.3
3	18.1	16.0	17.1	-0.2	5.6	2.7	18.0	17.4	17.7	-0.1	5.1	2.5
4	18.3	16.7	17.5	-0.8	5.3	2.3	18.8	18.1	18.5	-0.7	4.2	1.8
5	18.6	17.2	17.9	-1.2	4.9	1.9	19.5	18.7	19.1	-1.1	3.5	1.2
6	18.9	17.6	18.3	-1.5	4.6	1.6	19.8	19.2	19.5	-1.2	3.0	0.9
7	19.1	17.9	18.5	-1.5	4.4	1.5	19.8	19.3	19.6	-0.8	2.8	1.0
8	19.1	17.9	18.5	-1.4	4.3	1.5	19.4	19.3	19.4	-0.1	-0.1	-0.1
9	18.8	17.8	18.3	-0.9	-0.9	-0.9	18.5	19.1	18.8	2.8	0.9	1.9
10	18.2	17.6	17.9	-0.2	-0.2	-0.2	17.4	18.7	18.1	2.9	2.3	2.6
11	17.3	17.4	17.4	0.7	0.7	0.7	16.1	18.1	17.1	3.2	3.8	3.5
12	16.3	17.1	16.7	1.9	1.9	1.9	14.8	17.6	16.2	3.5	5.4	4.5
13	15.1	16.9	16.0	3.3	3.3	3.3	13.7	17.0	15.4	3.8	6.9	5.4
14	14.1	16.7	15.4	4.6	4.6	4.6	13.3	16.8	15.1	3.7	7.8	5.8
15	13.4	16.8	15.1	4.4	5.8	5.1	14.2	17.5	15.9	2.8	7.6	5.2
16	13.4	17.2	15.3	3.6	6.6	5.1	15.9	15.9	15.9	1.0	6.3	3.7
17	14.3	14.3	14.3	2.2	6.6	4.4	18.9	17.8	18.4	-0.9	4.4	1.8
18	18.0	15.6	16.8	0.5	5.9	3.2	20.6	19.6	20.1	-2.7	2.4	-0.2
19	19.1	17.1	18.1	-1.4	4.7	1.7	22.1	21.1	21.6	-4.0	0.5	-1.8
20	20.5	18.6	19.6	-3.1	3.4	0.2	23.2	22.3	22.8	-4.4	-0.8	-2.6
21	21.7	19.8	20.8	-4.4	2.1	-1.2	23.4	22.8	23.1	-4.1	-1.5	-2.8
22	22.5	20.7	21.6	-5.0	1.1	-2.0	22.8	22.7	22.8	-2.9	-2.9	-2.9
23	22.7	21.2	22.0	-4.9	0.4	-2.3	21.5	22.0	21.8	-1.5	-1.0	-1.3
24	22.2	21.3	21.8	-4.0	-4.0	-4.0	19.6	20.8	20.2	-0.7	1.3	0.3
25	20.9	20.9	20.9	-2.4	-2.4	-2.4	17.4	19.1	18.3	0.5	3.7	2.1
26	19.2	20.1	19.7	-0.3	-0.3	-0.3	15.4	17.4	16.4	2.0	6.1	4.1
27	17.2	19.1	18.2	1.2	2.1	1.7	14.0	15.9	15.0	3.4	7.9	5.7
28	15.4	18.0	16.7	2.0	4.4	3.2	13.7	15.2	14.5	4.1	8.8	6.5
29	14.2	17.1	15.7	2.6	6.2	4.4	14.6	14.6	14.6	3.7	8.3	6.0
30	14.0	16.5	15.3	2.6	7.3	5.0	15.5	15.8	15.7	2.8	7.1	5.0
31	14.6	14.6	14.6	2.2	7.4	4.8	16.6	16.9	16.8	1.7	5.8	3.8

Source: NOAA Tides & currents website [Internet], 2005. Available from: http://tidesandcurrents.noaa.gov.

APPENDIX E. CHINOOK SALMON CODED WIRE TAG RECOVERIES AT NINILCHIK RIVER WEIR, 2005

Appendix E1.-Coded wired tag recoveries of hatchery-reared Ninilchik River Chinook salmon at Ninilchik River weir, 2005.

Sample identifiers						Age						
						Actual [a]		Scale [b]				
CWT No.	Head No.	Brood Yr	Hatchery [c]	Ninilchik R release date	Recovery date	Fw [d]	Oc [e]	Fw [d]	Oc [e]	Error [f]	Sex	Length (mm)
ND	221967		Ft. Rich.		11-Jul-05			0	2	-	F	610
ND	221982		Ft. Rich.		24-Jul-05			0	3	-	F	785
ND	277180		Ft. Rich.		02-Aug-05			0	2	-	M	690
ND	277184		Ft. Rich.		04-Aug-05			i	i	-	M	690
310318	221966	2002	Ft. Rich.	12-Jun-04	09-Jul-05	1	1	1	1	0	M	390
310318	221970	2002	Ft. Rich.	12-Jun-04	13-Jul-05	1	1	1	1	0	M	330
310318	221986	2002	Ft. Rich.	12-Jun-04	26-Jul-05	1	1	1	1	0	M	405
310318	221998	2002	Ft. Rich.	12-Jun-04	29-Jul-05	1	1	1	1	0	M	0
310318	277170	2002	Ft. Rich.	12-Jun-04	07-Jul-05	1	1	1	1	0	M	375
310318	277179	2002	Ft. Rich.	12-Jun-04	02-Aug-05	1	1	1	1	0	M	365
310282	221978	2001	Ft. Rich.	14-Jun-02	20-Jul-05	0	3	0	2	1	F	670
310282	221983	2001	Ft. Rich.	14-Jun-02	25-Jul-05	0	3	0	2	1	M	665
310282	221985	2001	Ft. Rich.	14-Jun-02	25-Jul-05	0	3	0	2	1	M	560
310282	221968	2001	Ft. Rich.	14-Jun-02	03-Jul-05	0	3	0	3	0	F	760
310282	277169	2001	Ft. Rich.	14-Jun-02	06-Jul-05	0	3	0	3	0	F	770
310282	221965	2001	Ft. Rich.	14-Jun-02	09-Jul-05	0	3	0	3	0	M	840
310282	221971	2001	Ft. Rich.	14-Jun-02	13-Jul-05	0	3	0	3	0	F	780
310282	221972	2001	Ft. Rich.	14-Jun-02	13-Jul-05	0	3	0	3	0	F	710
310282	221973	2001	Ft. Rich.	14-Jun-02	14-Jul-05	0	3	0	3	0	0	750
310282	221974	2001	Ft. Rich.	14-Jun-02	17-Jul-05	0	3	0	3	0	F	710
310282	221975	2001	Ft. Rich.	14-Jun-02	18-Jul-05	0	3	0	3	0	F	740
310282	221976	2001	Ft. Rich.	14-Jun-02	19-Jul-05	0	3	0	3	0	F	810
310282	221977	2001	Ft. Rich.	14-Jun-02	19-Jul-05	0	3	0	3	0	F	740
310282	221979	2001	Ft. Rich.	14-Jun-02	20-Jul-05	0	3	0	3	0	M	775
310282	221980	2001	Ft. Rich.	14-Jun-02	21-Jul-05	0	3	0	3	0	M	740
310282	221984	2001	Ft. Rich.	14-Jun-02	25-Jul-05	0	3	0	3	0	M	765
310282	221987	2001	Ft. Rich.	14-Jun-02	26-Jul-05	0	3	0	3	0	M	795
310282	221992	2001	Ft. Rich.	14-Jun-02	27-Jul-05	0	3	0	3	0	F	800
310282	221994	2001	Ft. Rich.	14-Jun-02	28-Jul-05	0	3	0	3	0	F	790
310282	221996	2001	Ft. Rich.	14-Jun-02	28-Jul-05	0	3	0	3	0	M	790
310282	221999	2001	Ft. Rich.	14-Jun-02	29-Jul-05	0	3	0	3	0	F	800
310282	277172	2001	Ft. Rich.	14-Jun-02	30-Jul-05	0	3	0	3	0	F	830
310282	277173	2001	Ft. Rich.	14-Jun-02	31-Jul-05	0	3	0	3	0	F	800
310282	277174	2001	Ft. Rich.	14-Jun-02	31-Jul-05	0	3	0	3	0	F	810
310282	277175	2001	Ft. Rich.	14-Jun-02	31-Jul-05	0	3	0	3	0	M	740
310282	277182	2001	Ft. Rich.	14-Jun-02	03-Aug-05	0	3	0	3	0	F	800
310282	277183	2001	Ft. Rich.	14-Jun-02	04-Aug-05	0	3	0	3	0	F	685
310282	277176	2001	Ft. Rich.	14-Jun-02	01-Aug-05	0	3	0	4	-1	F	850
310282	277181	2001	Ft. Rich.	14-Jun-02	03-Aug-05	0	3	0	4	-1	F	835
310282	221969	2001	Ft. Rich.	14-Jun-02	12-Jul-05	0	3	i	i	-	F	680
310282	221995	2001	Ft. Rich.	14-Jun-02	28-Jul-05	0	3	i	i	-	F	790
310282	221997	2001	Ft. Rich.	14-Jun-02	29-Jul-05	0	3	i	i	-	F	705
310282	277178	2001	Ft. Rich.	14-Jun-02	02-Aug-05	0	3	i	i	-	F	740
310260	221981	2000	Ft. Rich.	13-Jun-01	23-Jul-05	0	4	0	4	0	F	770
310260	277168	2000	Ft. Rich.	13-Jun-01	30-Jul-05	0	4	0	3	1	F	790
310260	277171	2000	Ft. Rich.	13-Jun-01	30-Jul-05	0	4	0	3	1	F	790
310260	221993	2000	Ft. Rich.	13-Jun-01	28-Jul-05	0	4	i	i	-	M	790
310260	222000	2000	Ft. Rich.	13-Jun-01	29-Jul-05	0	4	i	i	-	F	765
310256	221989	2002	Ft. Rich.	12-Jun-03	27-Jul-05	0	2	0	2	0	M	565
310256	221991	2002	Ft. Rich.	12-Jun-03	27-Jul-05	0	2	0	2	0	M	545
310256	221988	2002	Ft. Rich.	12-Jun-03	27-Jul-05	0	2	0	1	1	M	395
310193	221990	2002	Ft. Rich.	12-Jun-03	27-Jul-05	0	2	0	2	0	M	580
310193	277177	2002	Ft. Rich.	12-Jun-03	01-Aug-05	0	2	0	2	0	M	620

-continued-

Note ND = no data (no coded wire tag was detected for this Chinook salmon with a missing adipose fin); "-" = value cannot be computed due to limitations of the data; i = scale annuli illegible; not aged.

[a] Actual age determined from coded wire tag data.

[b] Age determined by scale reader.

[c] Ft. Rich = Fort Richardson hatchery. Place where Chinook salmon smolt were reared and coded wire tagged.

[d] Fw = freshwater age.

[e] Oc = ocean age.

[f] Age error = the difference between the actual age and age determined by a scale reader.