**Fishery Data Series No. 08-07**

# Ninilchik River Chinook Salmon Assessment, 2004

**by**

**Carol M. Kerkvliet**

**March 2008**

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

# Symbols and Abbreviations

The following symbols and abbreviations, and others approved for the Système International d'Unités (SI), are used without definition in the following reports by the Divisions of Sport Fish and of Commercial Fisheries: Fishery Manuscripts, Fishery Data Series Reports, Fishery Management Reports, and Special Publications. All others, including deviations from definitions listed below, are noted in the text at first mention, as well as in the titles or footnotes of tables, and in figure or figure captions.

**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 |
| mideye-to-fork | MEF |
| mideye-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, $\chi^2$, 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 |

*FISHERY DATA SERIES NO. 08-07*

# NINILCHIK RIVER CHINOOK SALMON ASSESSMENT, 2004

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# ABSTRACT

In 2004, the total number of Chinook salmon *Oncorhynchus tshawytscha* counted at the Ninilchik River was 2,061 of which 1,525 were wild and 536 were hatchery reared. The contribution of hatchery fish to the escapement was 25%. The wild Chinook salmon escapement corresponding to the Sustainable Escapement Goal counting period (July 8 through July 24) was 416. The median date of the wild component run was 17 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 757,000 Chinook salmon eggs were collected from 126 females. Egg survival to the eyed stage was 86%. Sixty four coded wire tags were decoded from Chinook salmon that were sacrificed at the weir, of which 63 originated from the Ninilchik River, and one originated from the Crooked Creek enhancement program. 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 the escapement of wild Chinook salmon is maintained.



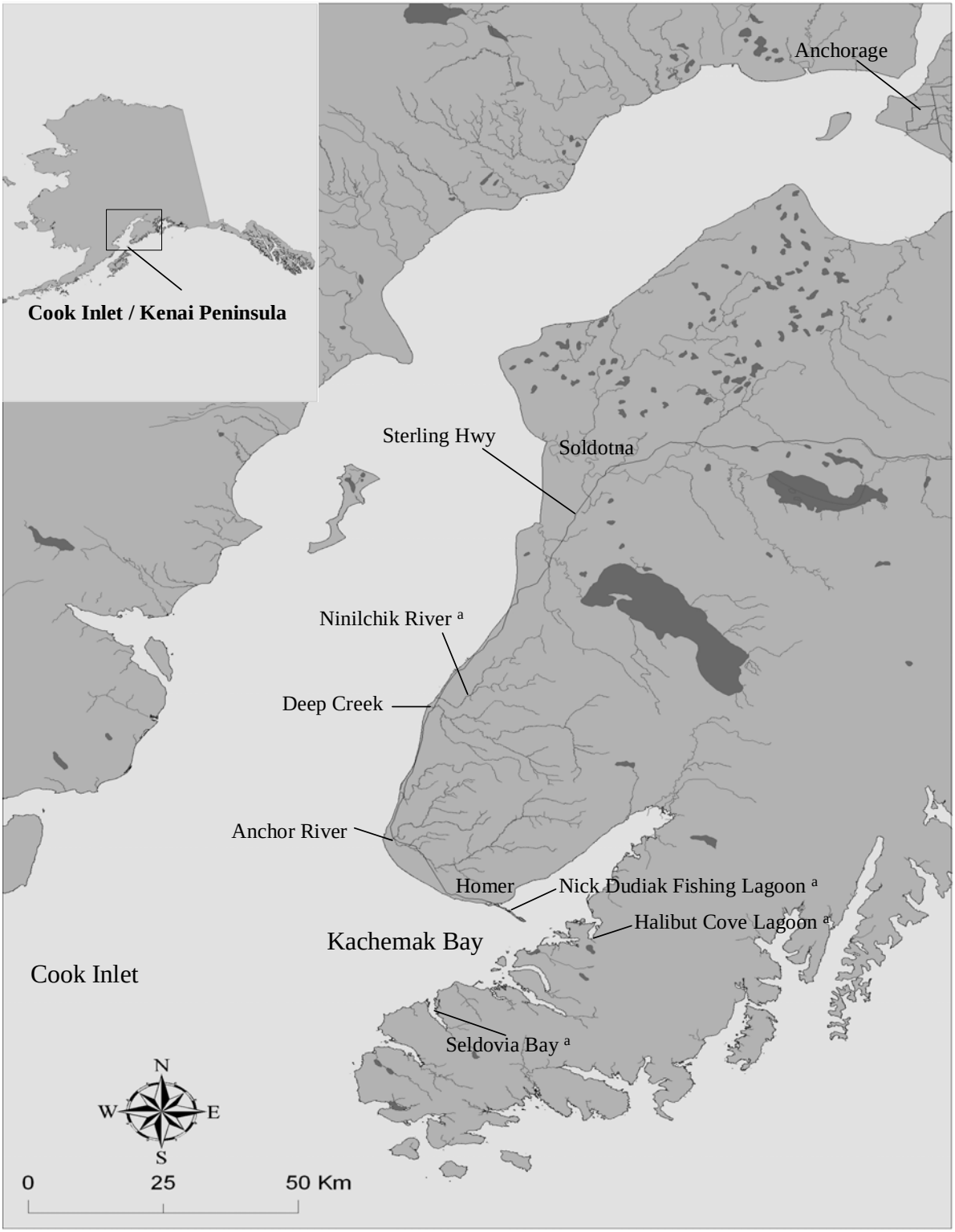
Key words: Chinook salmon, *Oncorhynchus tshawytscha*, Ninilchik River, wild, hatchery, supplementation, enhancement, run, escapement, weir, contribution, adipose finclip, and coded wire tag.


# INTRODUCTION

The Ninilchik River (Figure 1) is one of three streams in the Lower Cook Inlet (LCI) Management Area that support a popular sport fishery for Chinook salmon *Oncorhynchus tshawytscha*. In the mid 1980s the Alaska Department of Fish and Game (the Department), Division of Sport Fish recognized a potential to overexploit Ninilchik River Chinook salmon stocks because of the following conditions: (1) the increasing interest in sport fishing on the Kenai Peninsula; (2) the vulnerability of Ninilchik River to fishing pressure because of its small size (approximately 84 river km (rkm)) and easy access by road; and (3) its relatively small run size of Chinook salmon (approximately 1,500; Nelson 1995). The number of regulatory weekend openings has remained at three in the Ninilchik River since 1978. However, the fishery was extended by emergency order (EO) from 1991 to 1996 and from 2001 to 2003.

To protect the Ninilchik River Chinook salmon stock and respond to the increasing popularity of sport fishing on the Kenai Peninsula, the Department initiated a supplementation program of Chinook salmon on the Ninilchik River in 1987 with an egg take. Eggs from the first egg take were reared to smolt in a hatchery, then stocked back into the Ninilchik River in 1988 (Table 1). In future years, hatchery-reared Ninilchik River Chinook salmon smolt were also used to support terminal saltwater fisheries on Kachemak Bay at Halibut Cove Lagoon (Table 2), Seldovia Bay (Table 3), and the Nick Dudiak Fishing Lagoon (NDFL) on Homer Spit (Table 4), all of which were created to add fishing opportunities, while relieving fishing pressures on Kenai Peninsula wild Chinook salmon stocks.

In the first 12-years (1987-1998) of the supplementation program the Department operated a weir on the Ninilchik River from early July for 2 to 3 weeks to collect broodstock for egg takes (Table 5). To assess the magnitude of the hatchery component in the sport fish harvest, the Department conducted creel surveys from 1991 through 1993 (Table 6; Balland et al. 1994, Boyle and Alexandersdottir 1992, Boyle et al. 1993, Marsh 1995). Estimated percentages of the hatchery component in the Chinook salmon harvest were 77% (1991), 57% (1992) and 50% (1993). The following concerns were raised during evaluation of these creel survey results: (1) negative hatchery and wild smolt interactions, (2) straying of hatchery Chinook salmon, and (3) genetic impacts on the wild stock by potentially using second generation hatchery fish for brood-stock. These issues resulted in: (1) reduction in stocking levels from about 200,000 to 50,000




[a] Ninilchik River Chinook salmon smolt stocking locations.

**Figure 1.**—Kenai Peninsula highway system, Ninilchik River, and Kachemak Bay Chinook salmon stocking locations, 1999 and 2004.

**Table 1**.─Chinook salmon smolt releases to Ninilchik River from the Ninilchik River egg take project, 1988-2004.

| | Ninilchik River Stocking Location | | | | | |
|---|---|---|---|---|---|---|
| Release Year | Number of Smolt | Brood Year | Release Date | Hatchery | Mark Type[a] | Percent Marked |
| 1988 | 248,586 | | [b] | | Ad, CWT | 12 |
| 1989 | 200,203 | | [b] | | Ad, CWT | 9 |
| 1990 | 215,804 | | [b] | | Ad, CWT | 19 |
| 1991 | 87,992 | | [b] | | Ad, CWT | 24 |
| 1992 | 132,387 | | [b] | | Ad, CWT | 31 |
| 1993 | 184,585 | | [b] | | Ad, CWT | 23 |
| 1994 | 201,513 | | [b] | | Ad, CWT | 23 |
| 1995 | 54,662 | | [c] | | Ad, CWT | 99 |
| 1996 | 51,688 | | [c] | | Ad, CWT | 98 |
| 1997 | 50,292 | 1996 | 6/17 | [d] Fort Richardson | Ad, CWT, TM | 99 |
| 1998 | 48,798 | 1997 | 6/15 | [d] Fort Richardson | Ad, CWT, TM | 97 |
| 1999 | 49,853 | 1998 | 6/15 | [d] Fort Richardson | Ad, CWT, TM | 98 |
| 2000 | 51,298 | 1999 | 6/02 | [d] Fort Richardson | Ad, CWT, TM | 98 |
| 2001 | 54,770 | 2000 | 6/13 | [d] Fort Richardson | Ad, CWT, TM | 99 |
| 2002 | 54,631 | 2001 | 6/14 | [d] Fort Richardson | Ad, CWT, TM | 99 |
| 2003 | 47,997 | 2002 | 6/12 | [d] Fort Richardson | Ad, CWT, TM | 92 |
| 2004 [e] | 51,303 | 2002 | 5/12 | [d] Fort Richardson | Ad, CWT, TM | 100 |
| Mean (1995-2003) | 51,554 | | | | | |

[a] Ad = adipose finclip, CWT = Coded Wire Tag; TM = Thermal Mark.
[b] Smolt were released at various location in the river.
[c] Smolt held in Ninilchik Harbor intertidal-saltwater area prior to release in 1995 and 1996.
[d] From 1997-2004 smolt released approximately 4.5 rkm upstream of the mouth.
[e] Smolt were released as 1 check beginning in 2004.

Chinook salmon smolt, and (2) an increased marking of the hatchery component from 20 to 100% (Marsh 1995).

Beginning in 1994 season, the onsite creel survey was eliminated and harvest of Chinook salmon and fishing effort for all species were estimated by the Statewide Harvest Survey (SWHS; Howe et al. 1995). Inriver harvest sampling was also used from 1994 to 1996 to estimate the percentage of hatchery-reared Chinook salmon in the sport fishery harvest (Table 6; Marsh 1995,

**Table 2.–**Chinook salmon smolt releases to Halibut Cove Lagoon terminal saltwater fishery from the Ninilchik River egg take project, 1995-2004.

| | Halibut Cove Stocking Location | | | | | |
|---|---|---|---|---|---|---|
| Release Year | Number of Smolt | Brood Year | Release Date | Hatchery | Mark Type[a] | Percent Marked |
| 1995 | 37,208 | 1994 | 6/13 | Elmendorf | TM | 100 |
| 1996 | 105,975 | 1995 | 6/04 | Elmendorf | TM | 100 |
| 1997 | 78,133 | 1996 | 6/09 | Elmendorf | TM | 100 |
| 1998 | 65,893 | 1997 | 6/12 | Elmendorf | TM | 100 |
| 1999 | 79,221 | 1998 | 6/01 | Elmendorf | TM | 100 |
| 2000 | 83,277 | 1999 | 6/01 | Elmendorf | TM | 100 |
| 2001 | 106,719 | 2000 | 6/05 | Elmendorf | TM | 100 |
| 2002 | 106,279 | 2001 | 5/28 | Elmendorf | TM | 100 |
| 2003 | 106,844 | 2002 | 6/17 | Fort Richardson | TM | 100 |
| 2004 [b] | 103,771 | 2002 | 6/04 | Fort Richardson | TM | 100 |
| Mean (1995-2003) | 85,505 | | | | | |

[a] TM = thermal mark

[b] Smolt were released as 1 check beginning in 2004.

Marsh *Unpublished*). The estimated percentages of the hatchery component in the harvests were 45% in 1994 and 50% in 1995 and 1996, which were similar to the creel survey estimates reported in 1992 and 1993. The sport fish harvest was not sampled from 1997 through 1999.

In 1999, the Department began monitoring the beginning of the run by starting the weir in early May rather than in early July to better evaluate the effects of supplementation on wild Chinook salmon and found run timing of wild Chinook salmon was earlier than the hatchery component. Run timing differences created concerns that fishery openings may be targeting wild rather than hatchery Chinook salmon. To address targeting concerns, the Department sampled the fresh-water harvest in the 2000 and 2001 weekend-only fisheries to determine if the exploitation rate of the hatchery component was similar to prior estimates. The results showed 49 to 51% of the sport fish harvests were hatchery-reared Chinook salmon and the percentages were not significantly different between weekend openings, which was similar to estimates from 1992 to 1996 (Balland and Begich 2007; Begich 2006; Table 6). In 2000 and 2001, the sport harvest of hatchery-reared Chinook salmon on the third weekend was 45 and 39% respectively. In contrast, the inriver harvest samples collected in 2002 and 2003 on the third weekend opening consisted of 22 and 32% hatchery Chinook salmon respectively (Begich 2007). The management of Ninilchik River Chinook salmon has been refined as additional years of escapement and harvest data have become available.

**Table 3.–**Chinook salmon smolt releases to Seldovia Bay terminal saltwater fishery from the Ninilchik River egg take project, 1996-2004.

| | Seldovia Bay Stocking Location | | | | | |
|---|---|---|---|---|---|---|
| Release Year | Number of Smolt | Brood Year | Release Date | Hatchery | Mark Type[a] | Percent Marked |
| 1996 | 106,251 | 1995 | 6/12 | Elmendorf | TM | 100 |
| 1997 | 103,757 | 1996 | 6/06 | Elmendorf | TM | 100 |
| 1998 | 69,461 | 1997 | 6/09 | Elmendorf | TM | 100 |
| 1999 | 74,057 | 1998 | 5/28 | Elmendorf | TM | 100 |
| 2000 | 68,114 | 1999 | 6/06 | Elmendorf | TM | 100 |
| 2001 | 102,793 | 2000 | 6/07 | Elmendorf | TM | 100 |
| 2002 | 83,045 | 2001 | 5/28 | Elmendorf | TM | 100 |
| 2003 | 107,521 | 2002 | 6/11 | Fort Richardson | TM | 100 |
| 2004 [b] | 88,682 | 2003 | 5/18 | Elmendorf | TM | 100 |
| Mean (1996-2003) | 89,375 | | | | | |

[a] TM = thermal mark

[b] Smolt were released as 1 check beginning in 2004.

In 1993, a biological escapement goal (BEG) of 830 was adopted (Szarzi and Begich 2004a). The goal was based on average annual aerial and foot survey counts expanded estimates from 1966 to 1969 and 1977 to 1991. In 1998, a BEG range of 500 to 900 Chinook salmon was calculated based only on historic aerial survey counts and their relationship to the sport fishing harvest. After the Board of Fisheries (BOF) adopted the Sustainable Fisheries and Escapement Goal Policy in 2001 (BOF Escapement Goal Policy, 5 AAC 39.223. POLICY FOR STATEWIDE SALMON ESCAPEMENT GOALS), the BEG for Ninilchik River wild Chinook salmon was replaced by a Sustainable Escapement Goal (SEG). SEGs are established for salmon stocks by the department and stated as a range that takes into account data uncertainty and used in situations where a BEG cannot be estimated due to the absence of a stock specific catch estimate. 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*; Table 7). The July 8-24 dates used for the SEG period were selected because the weir was consistently operated during this period to capture fish for the annual egg takes from 1994-2000; however, it was not consistently operated through the entire run. Aerial survey flights were discontinued for the Ninilchik River in 2002.

The effect of the supplementation program on producing fishing opportunities, while protecting wild Chinook salmon stocks, is evaluated by comparing the harvest and escapement for years before and after the influx of stocked Chinook salmon returned to the Ninilchik River. The

**Table 4.–**Chinook salmon smolt releases to Nick Dudiak Fishing Lagoon terminal saltwater fishery on Homer Spit from the Ninilchik River egg take project, 2000-2004.

| | Nick Dudiak Fishing Lagoon Stocking Location | | | | | |
|---|---|---|---|---|---|---|
| Release Year | Number of Smolt | Brood Year | Release Date | Hatchery | Mark Type[a] | Percent Marked |
| 2000 | 102,243 | 1999 | 5/31 | Elmendorf | TM | 100 |
| | 117,741 | 1999 | 6/07 | Elmendorf | TM | 100 |
| 2001 | 101,799 | 2000 | 5/25 | Elmendorf | TM | 100 |
| | 106,263 | 2000 | 6/08 | Elmendorf | TM | 100 |
| 2002 | 122,444 | 2001 | 5/30 | Elmendorf | TM | 100 |
| | 67,582 | 2001 | 6/06 | Elmendorf | TM | 100 |
| 2003 | 126,229 | 2002 | 5/28 | Fort Richardson | TM | 100 |
| | 80,063 | 2002 | 6/06 | Fort Richardson | TM | 100 |
| 2004 [b] | 95,105 | 2002 | [c] 6/07 | Fort Richardson | TM | 100 |
| | 47,932 | 2002 | [c] 6/10 | Fort Richardson | TM | 100 |
| | 25,706 | 2003 | 6/10 | Elmendorf | TM | 100 |
| Mean (2000-2003) | 206,091 | | | | | |

[a] TM = thermal mark

[b] Smolt were released as 1 check beginning in 2004.

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

following years are used for this evaluation: (1) Pre-stocking years (1977 to 1990; Figure 2). For clarification, pre-stocking years include 1988 (the first stocking year) and continue through 1990 because ocean age-3 adults from 1988 had not yet returned to the Ninilchik River. (2) High stocking years (1991 to 1997, when approximately 200,000 smolt were stocked), which overlap years when stocking levels were reduced in 1995 because ocean age-3 adults from the reduced stocking had not yet returned to the Ninilchik River. (3) Reduced stocking years began in 1998.

In the pre-stocking years, the average number of days fished and number of Chinook salmon harvested was 12,338 and 990, respectively (Table 6, Figure 2). Once hatchery-reared ocean age-3 Chinook salmon began to return from high stocking years, there was an approximate 1.5 fold (18,345/12,338) increase in the average number of days fished and a 3.4 fold (3,414/990) increase in the number of Chinook salmon harvested. When stocking levels were reduced, there was a subsequent decline in the average number of days fished (11,327) and average harvest (1,689) based on the Statewide Harvest Survey (Howe et al. 1995, 1996, 2001 a-d; Jennings et al. 2004, 2006a, b, 2007; Mills 1979-1980, 1981a-b, 1982-1994; Walker et al. 2003). With respect to pre-stocking and reduced-stocking years, more days were fished in pre-stocking years (12,388) than in years when stocking was reduced (11,327); however, the average number

**Table 5.**–Summary of weir counts for Chinook salmon at Ninilchik River weir, 1987-2004.

| Year | Weir Dates[a] | Run Component | Run Total | Run Percent | Egg Take Mortality[b] | CWT Recovery[c] | CWT Stray[d] | Escapement Total[e] | Escapement Percent |
|---|---|---|---|---|---|---|---|---|---|
| 1987[f] | NL | NL | NL | NL | NL | NL | NL | NL | NL |
| 1988[f] | NL | NL | NL | NL | NL | NL | NL | NL | NL |
| 1989 | 7/04 - 7/25 | Total[g] | 254 | - | - | - | - | - | - |
| 1990 | 7/06 - 7/27 | Total[g] | 315 | - | - | - | - | - | - |
| 1991 | 7/01 - 7/17 | Total[g] | 338 | - | - | 12 | - | - | - |
| 1992 | 6/30 - 7/14 | Total[g] | 539 | - | - | 59 | - | - | - |
| 1993[f] | NL | NL | NL | NL | NL | 38 | 1 | NL | NL |
| 1994 | 7/07 - 7/26 | Wild | 446 | 81 | - | - | - | 446 | - |
| | | Hatchery | 103 | 19 | - | 43 | 0 | 60 | - |
| | | Total[h] | 549 | 100 | 125 | 43 | 0 | 381 | - |
| 1995 | 7/04 - 8/01 | Wild | 725 | 63 | - | - | - | 725 | - |
| | | Hatchery | 425 | 37 | - | 135 | 0 | 290 | - |
| | | Total[h] | 1,150 | 100 | 194 | 135 | 0 | 821 | - |
| 1996 | 7/02 - 7/24 | Wild | 654 | 69 | - | - | - | 654 | - |
| | | Hatchery | 290 | 31 | - | 69 | 0 | 221 | - |
| | | Total[h] | 944 | 100 | 190 | 69 | 0 | 685 | - |
| 1997 | 7/01 - 8/11 | Wild | 579 | 53 | - | - | - | 579 | - |
| | | Hatchery | 517 | 47 | - | 181 | 2 | 336 | - |
| | | Total[h] | 1,096 | 100 | 132 | 181 | 2 | 783 | - |
| 1998 | 7/03 - 8/01 | Wild | 536 | 53 | - | - | - | 536 | 53 |
| | | Hatchery | 466 | 47 | - | 0 | 0 | 466 | 47 |
| | | Total[h] | 1,002 | 100 | 196 | 0 | 0 | 1,002 | 100 |
| 1999 | 5/18 - 8/13 | Wild | 1,644 | 72 | 68 | - | - | 1,576 | 73 |
| | | Hatchery | 641 | 28 | 26 | 42 | - | 573 | 27 |
| | | Total[i] | 2,285 | 100 | 94 | 42 | 0 | 2,149 | 100 |
| 2000 | 5/17 - 8/08 | Wild | 1,634 | 66 | 81 | - | - | 1,553 | 69 |
| | | Hatchery | 853 | 34 | 60 | 108 | 1 | 685 | 31 |
| | | Total | 2,487 | 100 | 141 | 108 | 1 | 2,238 | 100 |
| 2001 | 5/30 -8/05 | Wild | 1,414 | 68 | 175 | - | - | 1,239 | 70 |
| | | Hatchery | 673 | 32 | 0 | 130 | - | 543 | 30 |
| | | Total | 2,087 | 100 | 175 | 130 | 0 | 1,782 | 100 |
| 2002 | 5/23 -8/11 | Wild | 1,516 | 73 | 176 | - | - | 1,340 | 77 |
| | | Hatchery | 559 | 27 | 55 | 110 | - | 394 | 23 |
| | | Total | 2,075 | 100 | 231 | 110 | 0 | 1,734 | 100 |
| 2003 | 5/16 -8/05 | Wild | 1,258 | 75 | 131 | - | - | 1,127 | 77 |
| | | Hatchery | 425 | 25 | 52 | 37 | 5 | 336 | 23 |
| | | Total | 1,683 | 100 | 183 | 37 | 5 | 1,463 | 100 |
| 2004 | 5/18 -8/05 | Wild | 1,525 | 74 | 132 | - | - | 1,393 | 75 |
| | | Hatchery | 536 | 26 | 0 | 67 | 1 | 469 | 25 |
| | | Total | 2,061 | 100 | 132 | 67 | 1 | 1,862 | 100 |
| Mean (1999-2003) | | Wild | 1,493 | 71 | 126 | - | - | 1,367 | 73 |
| | | Hatchery | 630 | 29 | 39 | 85 | 1 | 506 | 27 |
| | | Total | 2,123 | 100 | 165 | 85 | 1 | 1,873 | 100 |

-continued-

**Table 5**.-Page 2 of 2.

[a] Weir operating dates.
[b] Total number of Chinook salmon sacrificed for egg take or died while being held for egg take.
[c] Number of Chinook salmon sacrificed for coded wire tag recovery.
[d] Number of Chinook salmon strays in Ninilchik River; included in the CWT recovery total.
[e] Escapement = (Total Return – [Sacrificed for Egg Take + CWT Recovery]).
[f] Data unavailable.
[g] Wild and hatchery-reared counts unavailable.
[h] Number of wild and hatchery-reared Chinook salmon used in egg take unavailable.
[i] Return include 37 wild and 19 hatchery-reared Chinook salmon captured in nets below the weir.

of Chinook salmon harvested was approximately 1.7 times higher in reduced stocking years (1,689) than in pre-stocking years (990).

Chinook salmon harvests have increased since supplementation began, and escapements of wild Chinook salmon have not dropped as low as 1997 (235 fish), based on weir counts during the SEG counting period (Table 7). Furthermore, when the effects of reduced stocking were realized, the average escapement of wild Chinook salmon during the SEG period from 1998 to 2003 was higher (average = 637) than the average escapement (average = 438) in earlier years (1994 to 1997) when stocking levels were high.

This report for the Ninilchik River Chinook salmon escapement is part of a continuing report series. The intent of this report series is to provide additional data to better evaluate the supplementation program, and insure the wild Chinook salmon escapement is managed according to the Sustainable Fisheries and Escapement Goal Policy.

# OBJECTIVES

1. Census the wild and hatchery Chinook salmon escapement into Ninilchik River in 2004.
2. Estimate the mean length at age of wild and hatchery-reared Chinook salmon escapement into Ninilchik River in 2004.

## TASKS

1. Collect, hold, and artificially spawn 105 male and 105 female wild Chinook salmon from Ninilchik River during July of 2004 to provide the necessary fertilized eggs for hatchery releases to the Ninilchik River and terminal saltwater fisheries at Nick Dudiak Fishing Lagoon on Homer Spit, Halibut Cove Lagoon, and Seldovia Bay.
2. In June 2004, release approximately 50,000 Chinook salmon smolt at Ninilchik River, 210,000 smolt at Nick Dudiak Fishing Lagoon on Homer Spit, 105,000 smolt at Halibut Cove Lagoon, and 105,000 smolt at Seldovia Bay.

**Table 6.–**Estimated angler effort, harvest, escapement, and stocking summary for Ninilchik River Chinook salmon, 1977-2004.

| | | Sport Fish Harvest[a] | | Escapement | | | | Stocking | | |
|---|---|---|---|---|---|---|---|---|---|---|
| | | | | | Survey[c] | | | Number of Smolt | | |
| Year | Angler Effort[a] | Freshwater Total | Percent Hatchery Fish[b] | Foot | Aerial[d] | Estimated[e] | Total Weir Count | Released[f] | Marked[g] | Percent Marked |
| 1977 | 11,350 | 1,168 | | 719 | 1,169 | 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 | | 248,586 | 30,809 | 12 |
| 1989 | 9,997 | 744 | | 241 | 280 | 400 | 254 | 200,203 | 18,772 | 9 |
| 1990 | 8,323 | 693 | | 414 | 288 | 840 | 315 | 215,804 | 40,319 | 19 |
| 1991 | 19,640 | 3,123 | 77 | 362 | 594 | 830 | 338 | 87,992 | 21,074 | 24 |
| 1992 | 27,816 | 5,316 | 57 | | | | 539 | 132,387 | 41,335 | 31 |
| 1993 | 20,466 | 4,235 | 50 | | 688 | 2,400 | | 184,585 | 42,960 | 23 |
| 1994 | 21,827 | 3,108 | 45 | 261 | 252 | | 539 | 201,513 | 45,535 | 23 |
| 1995 | 16,160 | 2,451 | 50 | | | | 1,150 | 54,662 | 54,115 | 99 |
| 1996 | 11,445 | 2,401 | 50 | | 158 | | 944 | 51,688 | 50,866 | 98 |
| 1997 | 11,064 | 3,263 | | | 393 | | 1,096 | 50,698 | 50,292 | 99 |
| 1998 | 10,994 | 1,453 | | | 316 | | 1,002 | 48,798 | 47,480 | 97 |
| 1999 | 15,344 | 1,945 | | | 357 | | 2,285 | 49,853 | 48,906 | 98 |
| 2000 | 12,432 | 1,782 | 49 | | 578 | | 2,487 | 51,298 | 50,016 | 98 |
| 2001 | 10,602 | 1,399 | 51 | | 268 | | 2,087 | 54,770 | 54,441 | 99 |
| 2002 | 9,572 | 830 | | | | | 2,075 | 54,631 | 54,139 | 99 |
| 2003 | 9,843 | 1,452 | | | | | 1,683 | 47,997 | 44,349 | 92 |
| 2004 | 10,500 | 2,961 | | | | | 2,061 | 51,303 | 51,252 | 100 |
| Mean (1999-2003) | 11,559 | 1,482 | 50 | | 401 | | 2,123 | 51,710 | 50,370 | 97 |
| Mean (1977-1990) | 12,338 | 990 | | 349 | 584 | 888 | | | | |
| Mean (1977-2003) | 13,701 | 1,727 | 54 | | 509 | | 1,200 | 108,467 | 43,463 | 40 |

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

[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 from foot and aerial survey (Szarzi and Begich 2004b). 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 released at various locations in the river from 1988-1994. From 1995-1996 smolt were held in an intertidal saltwater area of Ninilchik Harbor prior to release. Smolt from 1997-2004 were released approximately 4.5 rkm upstream of Ninilchik River mouth.

[h] Number with an adipose finclip and coded wire tag; since 1997 all released smolt have been thermal marked

**Table 7.–**Wild and hatchery-reared Chinook salmon counts at Ninilchik River weir, 1994-2004.

| | Wild Chinook Salmon | | | Hatchery Chinook Salmon | | |
|---|---|---|---|---|---|---|
| | Weir Counts | | | Weir Counts | | |
| Year | July 8-24 Subtotal[a] | Total | Percent of Total | July 8-24 Subtotal[a] | 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 |
| Mean (1994-1997) | 438 | | | 251 | | |
| Mean (1998-2003) | 637 | | | 276 | | |
| Mean (1999-2003) | 679 | 1,493 | 45 | 277 | 630 | 43 |
| Mean (1999-2004) | 636 | 1,499 | 42 | 257 | 615 | 40 |
| Mean (1994-2004) | 544 | | | 256 | | |
| SEG [b] | 400-850 | | | | | |

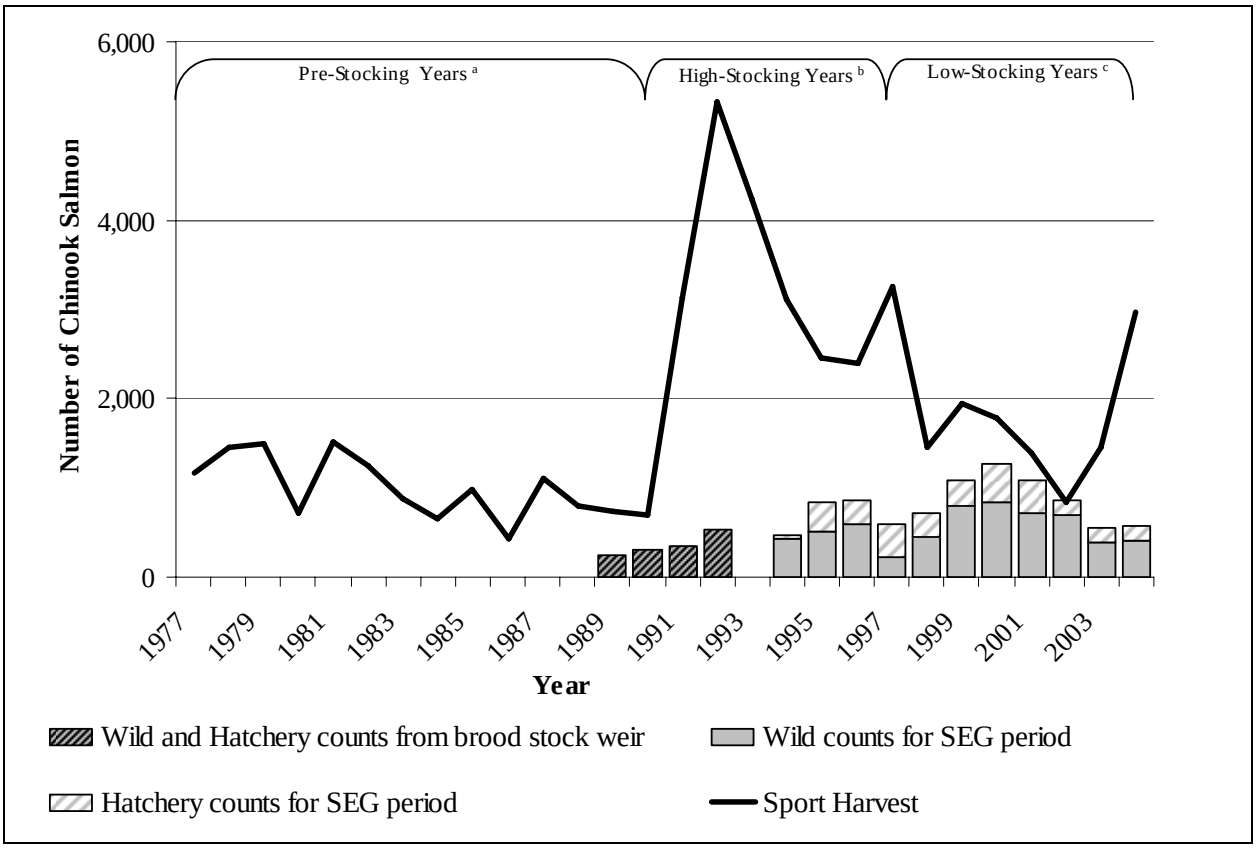
[a] July 8-24 = the Sustainable Escapement Goal (SEG) counting period.

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

# METHODS AND ANALYSIS

## ESCAPEMENT MONITORING

The 2004 Chinook salmon escapement was monitored on the Ninilchik River using two fixed picket weirs located approximately 4.5 rkm upstream of the mouth (Figure 3) from May 18 through August 5 through a joint effort by the Department and the U.S. Geological Survey (USGS) Science Center. The first weir was installed and operated by USGS for a steelhead project from May 18 through June 30. The USGS incorporated Chinook salmon monitoring into their field operations. On June 20, the department installed a second weir approximately 10 meters downstream of the USGS weir. The upstream and downstream weirs were used to create an area to hold a percentage of the escapement to ripen for subsequent egg takes (Figure 4).




[a] Years before the stocking program and the effect of stocking was realized from the adult Chinook salmon return.
[b] Years when adult Chinook salmon returned from the release of approximately 200,000 smolt.
[c] Years when the adult Chinook salmon returned from the reduced stocking level of approximately 50,000 smolt.

**Figure 2.–**Comparison between Chinook salmon sport fish harvest and escapement counts before and after the influx of stocked Chinook salmon returned as adults and were detected through the predominate age class (ocean age-3) to the Ninilchik River, 1977-2004.

Chinook salmon escapement was counted and biological samples collected as fish entered a trap 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. 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 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. The hatchery Chinook salmon escapement was calculated as the total number of hatchery

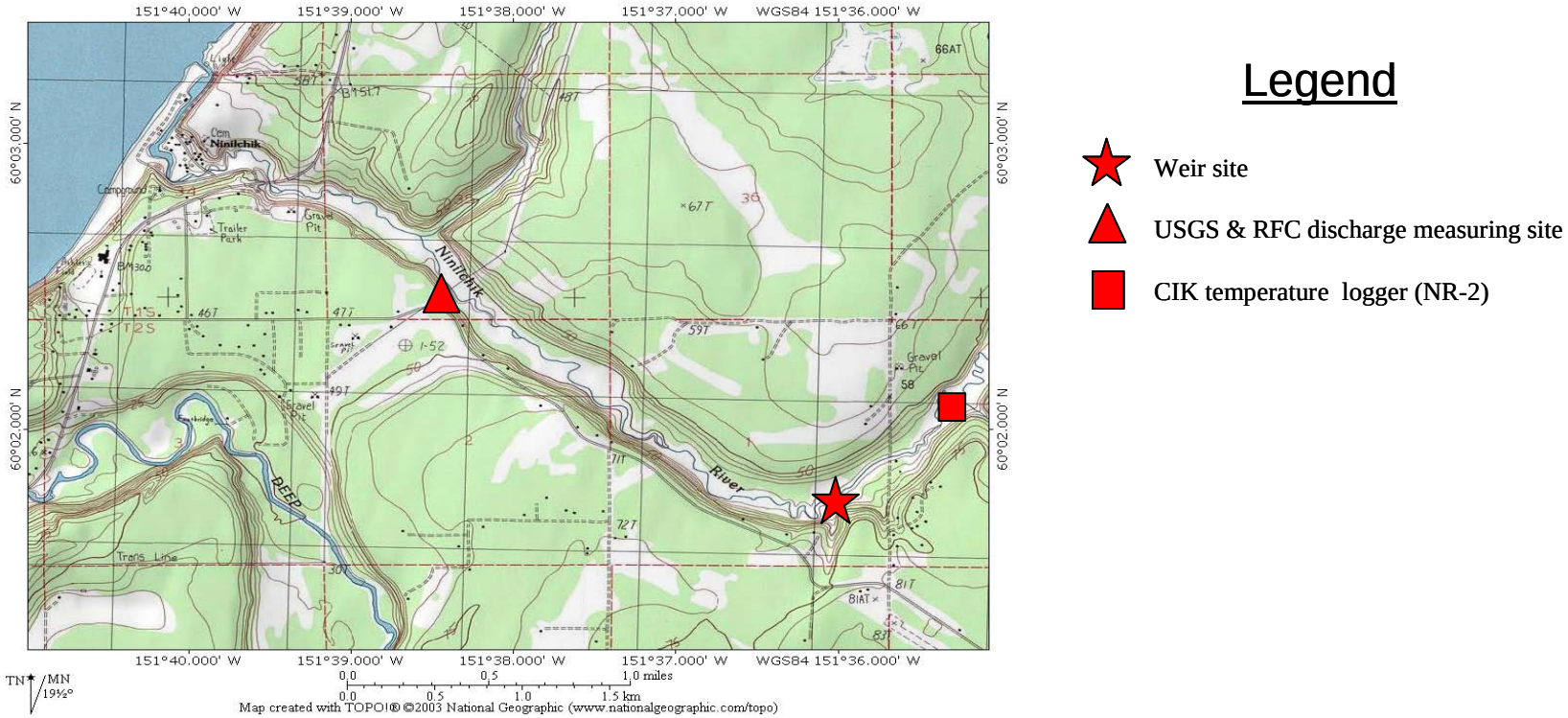



**Figure 3.**—Ninilchik River weir location, 2004.

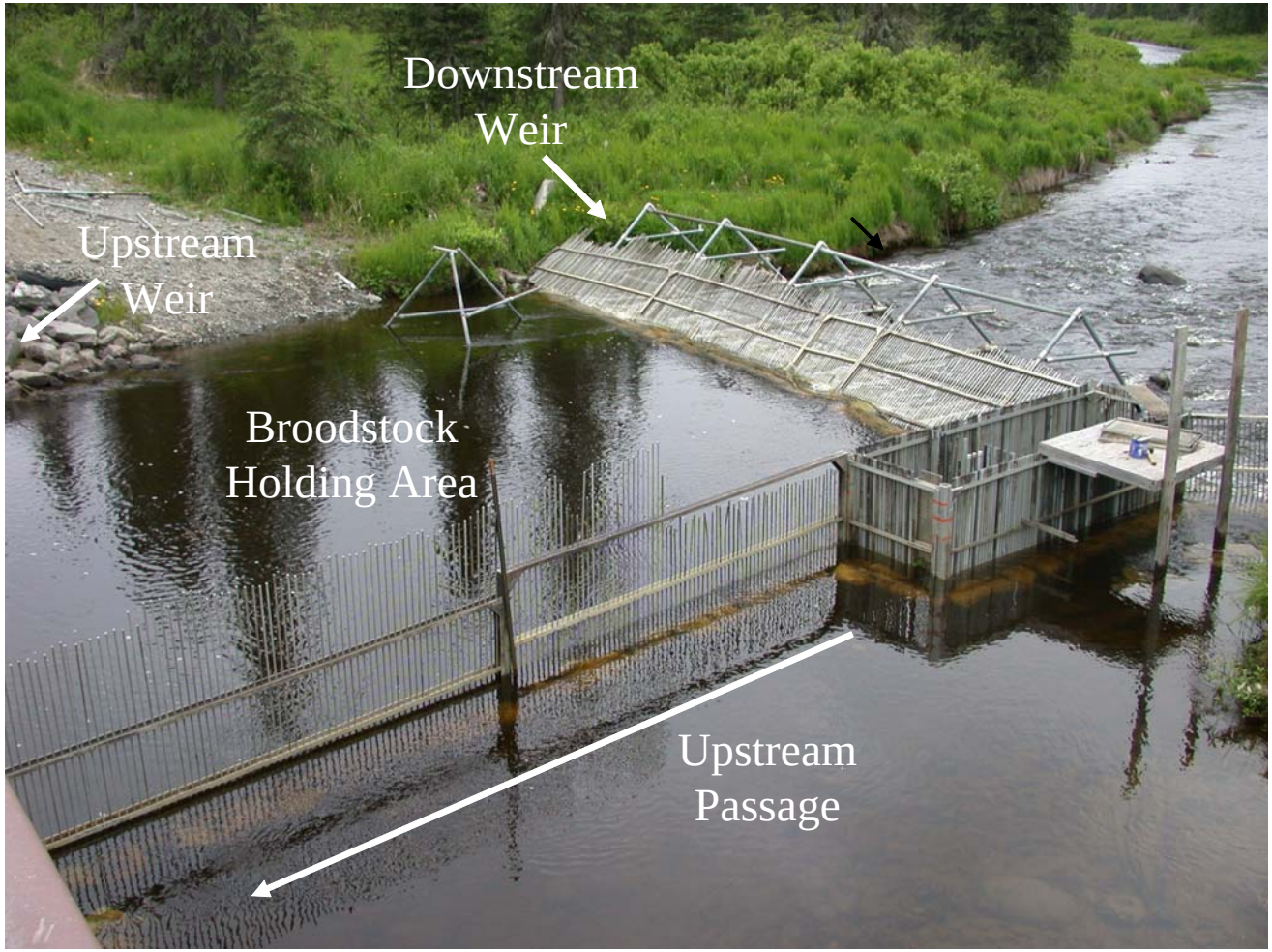



**Figure 4.**–The configuration of the Ninilchik River weirs and location of the broodstock holding area, 2004.

Chinook salmon counted through the weir minus those sacrificed for coded wire tag (CWT) analysis.

### RUN TIMING

Run timing was analyzed using cumulative percent weir counts of the wild and hatchery components. The date corresponding to the nearest 50% cumulative count identified the "median run timing date." Run timing curves created from weir counts from July 8-24 were used to compare run timing between years.

### 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 0.6 rkm upstream from the weir site.

The discharge data presented in this report, in units of cubic feet per second (cfs), were collected by two different agencies. USGS collected discharge data before September 20, 2003 and the National Weather Service, Alaska Pacific River Forecast Center (RFC) collected stage readings that were converted to discharge beginning in 2004 after USGS discontinued their gauge station (1521600; Meyer et al. 2004). Both agencies collected river data from the same location, approximately 0.9 rkm upstream of the mouth. The methods used to collect and check the data differed between USGS and RFC. The USGS gauge collected discharge data every hour and the data were subjected to rigorous quality control measure before being finalized and published. The USGS discharge data were retrieved on November 29, 2007 at 17:47:05 EST from the USGS National Water Information System web site (http://waterdata.usgs.gov/nwis). RFC contracted a local to collect a daily stage reading at approximately the same time each day (~ 1900 hours) using a wire weight gauge. The RFC hydrology program's mission is in forecasting stream flow and stages, and not necessarily collecting and posting data that are subjected to rigorous quality control and not formally published, and should be considered provisional.

### AGE, SEX AND LENGTH

The age composition and mean length at age of the escapement was estimated from subsampling the wild and hatchery-reared Chinook salmon escapement at the weir sites. We attempted to sample every fourth wild and hatchery Chinook salmon for age and length data. For aging, 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). Later, scales were pressed and age was determined using procedures described by Mosher (1969). Length was measured from mid-eye-to-fork of tail (MEFT). Because fish were sampled for age and length systematically throughout the immigration, the samples collected at the weir were pooled and used to estimate age composition for the escapement.

The proportion of Chinook salmon of age-sex class *j* in group *i* (wild vs. hatchery salmon in the escapement upstream of the weir) was estimated as a binomial proportion (Cochran 1977).

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

with variance estimated as:

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

where:

$n_{ij}$ = the number of fish of age-sex class $j$ in $n_i$,

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

$N_i$ = the number of fish of group $i$ in the weir count.

The number of fish by age-sex class in the escapement of each group was estimated by:

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

and its variance by:

$$V\hat{a}r(\hat{N}_{ij}) = N_i^2 V\hat{a}r(\hat{p}_{ij}). \tag{4}$$

The sex composition of the escapement was calculated by determining sex on all Chinook salmon that passed the weir based on visual characteristics (e.g., head shape and presence of ovipositor, eggs, or milt). The sex composition of each of the wild and hatchery components of the escapement is therefore known without error. Sex data were adjusted for fish sacrificed at the weir for egg takes and coded wire tag recoveries.

## EGG TAKES

Using the USGS and Department weir, crews were able to create an area to hold Chinook salmon to ripen for egg takes. The Department began holding Chinook salmon for egg takes on July 6. Egg takes were conducted on July 15, 20, 26, and 30 following the Department's standard egg take procedure[1]. 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 was 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. 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

The Chinook salmon eggs used for stocking are reared to smolt at the Fort Richardson and Elmendorf hatcheries. All smolt released into the Ninilchik River were thermal marked, adipose finclipped, and injected with a CWT by hatchery personnel. The percent CWT loss was also assessed before release by hatchery personnel. All smolt released into Halibut Cove Lagoon, Seldovia Bay, and the NDFL were thermal marked. The 2003 Statewide Stocking Plan (Loopstra 2003) was used to plan and schedule Lower Cook Inlet smolt releases.

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[1] Source: ADF&G. *Unpublished*. Generalized eggtake procedures for ADF&G Sport Fish hatchery program. Alaska Department of Fish and Game, Division of Sport Fish, Hatchery Program, Anchorage.

### STRAYING

Chinook salmon missing adipose fins were sampled systematically throughout the immigrations. In 2004, we removed the head from every eighth Chinook salmon that was missing an adipose fin. Heads were labeled with a numbered cinch strap, frozen, and sent to Department's Mark, Tag and Age Laboratory in Juneau for CWT analysis. Results were accessed from the Department tag lab website[1], using parameters specific to the Ninilchik River Chinook salmon project.

## RESULTS

### ESCAPEMENT MONITORING

In 2004, the total number of Chinook salmon counted past the Ninilchik River weir was 2,061 of which 1,525 were wild and 536 were hatchery reared (Tables 5-7, Appendix A1). After subtraction of fish sacrificed during egg takes (132) and for CWT recoveries (67) the total escapement of wild and hatchery Chinook salmon was 1,862 of which 75% (1,393/1,862) were wild and 25% (469/1,862) were hatchery reared.

### RUN TIMING

The median run timing for wild and hatchery Chinook salmon combined was July 5 (Table 8, Appendix A1). The wild component (median wild = July 4) was 17-days earlier than that of the hatchery component (median hatchery = July 21). Weir counts for the SEG counting period indicated only a 2-day run timing difference between the wild (median = July 17) and hatchery (median = July 19) components (Figure 5).

### WATER TEMPERATURE AND DISCHARGE

The average water temperature from May 24 to August 5 was 14$^{o}$C (Table 9, Figure 6). For the SEG counting period, the average water temperature was 14$^{o}$C. Water temperatures reached 19$^{o}$C on 6 days (June 26, and July 8 to 12) during the weir operation (Appendix B1). River discharge was low (mean = 87 cfs) throughout most of the weir operation and SEG counting period (mean = 63 cfs; Appendix C1).

### AGE, SEX AND LENGTH

Overall, ocean age-3 was the dominant age class for the wild (50.3%, SE = 3.9%) and the hatchery (62.8%, SE = 4.9%) Chinook salmon (Table 10; Figure 7). The percentage of wild ocean age-4 female (19.8%; SE = 2.9%) and male (9.0%; SE = 2.1%) Chinook salmon was higher than hatchery ocean age-4 female (2.7%; SE = 1.4) and male (0.9%; SE < 1.0%) Chinook salmon. In contrast, the percentage of hatchery ocean age-2 females (8.0%; SE = 2.3%) and males (23.9%; SE = 3.6%) was higher than in the wild ocean age-2 females (3.6%, SE = 1.4%) and males (17.4%, SE = 2.8%) Only hatchery-produced males were aged as ocean age-1, to represent 1.8% (SE = 1.1%) of the escapement. The age-sex composition did not change significantly over time for either the wild or hatchery components ($P > 0.05$).

The percentages of females to males were similar in the wild (44.6 to 55.4%) and hatchery (44.0 to 56.0%) components (Table 10, Figure 7). No significant differences were detected in length at ocean age between wild and hatchery Chinook salmon for females ($P > 0.05$) or males ($P > 0.05$).

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[1] Source: Online coded wire tag report, updated September 3, 2004 at 1:19:05 p.m. Alaska Department of Fish and Game, Mark Tag and Age Laboratory, Juneau. http://tagotoweb.adfg.state.ak.us/CWT/reports/d

**Table 8.–**Median run timing of wild and hatchery-reared Chinook salmon at Ninilchik River weir with a comparison of counts and dates for the weir counting period versus the SEG counting period, 1999-2004.

| | Wild Chinook Salmon | | | | | | |
|---|---|---|---|---|---|---|---|
| | Weir Counting Period | | | | SEG Counting Period[a] | | |
| Year | Start Date | End Date | Weir Count | Median Date | Weir Count | Median Date | Number of Days [b] |
| 1999 | 18-May | 13-Aug | 1,613 | 13-Jul | 799 | 16-Jul | 8 |
| 2000 | 17-May | 8-Aug | 1,634 | 12-Jul | 834 | 13-Jul | 5 |
| 2001 | 30-May | 5-Aug | 1,414 | 13-Jul | 716 | 15-Jul | 7 |
| 2002 | 23-May | 11-Aug | 1,516 | 17-Jul | 655 | 19-Jul | 11 |
| 2003 | 16-May | 5-Aug | 1,258 | 4-Jul | 393 | 16-Jul | 8 |
| 2004 | 18-May | 5-Aug | 1,525 | 4-Jul | 416 | 17-Jul | 9 |
| Mean (1999-2003) | | | 1,487 | 11-Jul | 679 | 15-Jul | 8 |
| Min (1999-2003) | | | 1,258 | 4-Jul | 393 | 13-Jul | 5 |
| Max (1999-2003) | | | 1,634 | 17-Jul | 834 | 19-Jul | 11 |

| | Hatchery Chinook Salmon | | | | | | |
|---|---|---|---|---|---|---|---|
| | Weir Counting Period | | | | SEG Counting Period[a] | | |
| Year | Start Date | End Date | Weir Count | Median Date | Weir Count | Median Date | Number of Days [b] |
| 1999 | 18-May | 13-Aug | 603 | 24-Jul | 277 | 21-Jul | 13 |
| 2000 | 17-May | 8-Aug | 853 | 24-Jul | 426 | 19-Jul | 11 |
| 2001 | 30-May | 5-Aug | 673 | 21-Jul | 363 | 17-Jul | 9 |
| 2002 | 23-May | 11-Aug | 559 | 24-Jul | 169 | 19-Jul | 11 |
| 2003 | 16-May | 5-Aug | 425 | 16-Jul | 150 | 16-Jul | 8 |
| 2004 | 18-May | 5-Aug | 536 | 21-Jul | 158 | 19-Jul | 11 |
| Mean (1999-2003) | | | 623 | 21-Jul | 277 | 18-Jul | 10 |
| Min (1999-2003) | | | 425 | 16-Jul | 150 | 16-Jul | 8 |
| Max (1999-2003) | | | 853 | 24-Jul | 426 | 21-Jul | 13 |

| | Total Chinook Salmon | | | | | | |
|---|---|---|---|---|---|---|---|
| | Weir Counting Period | | | | SEG Counting Period[a] | | |
| Year | Start Date | End Date | Weir Count | Median Date | Weir Count | Median Date | Number of Days [b] |
| 1999 | 18-May | 13-Aug | 2,216 | 17-Jul | 1,076 | 19-Jul | 11 |
| 2000 | 17-May | 8-Aug | 2,487 | 18-Jul | 1,260 | 18-Jul | 10 |
| 2001 | 30-May | 5-Aug | 2,087 | 15-Jul | 1,079 | 16-Jul | 8 |
| 2002 | 23-May | 11-Aug | 2,075 | 18-Jul | 824 | 19-Jul | 11 |
| 2003 | 16-May | 5-Aug | 1,683 | 8-Jul | 543 | 16-Jul | 8 |
| 2004 | 18-May | 5-Aug | 2,061 | 5-Jul | 574 | 17-Jul | 9 |
| Mean (1999-2003) | | | 2,110 | 15-Jul | 956 | 17-Jul | 10 |
| Min (1999-2003) | | | 1,683 | 8-Jul | 543 | 16-Jul | 8 |
| Max (1999-2003) | | | 2,487 | 18-Jul | 1,260 | 19-Jul | 11 |

[a] SEG = Sustainable Escapement Goal. The SEG counting period is July 8-24.

[b] Number of Days = number of days it took to reach the median date (e.g., July 8) within the SEG counting period

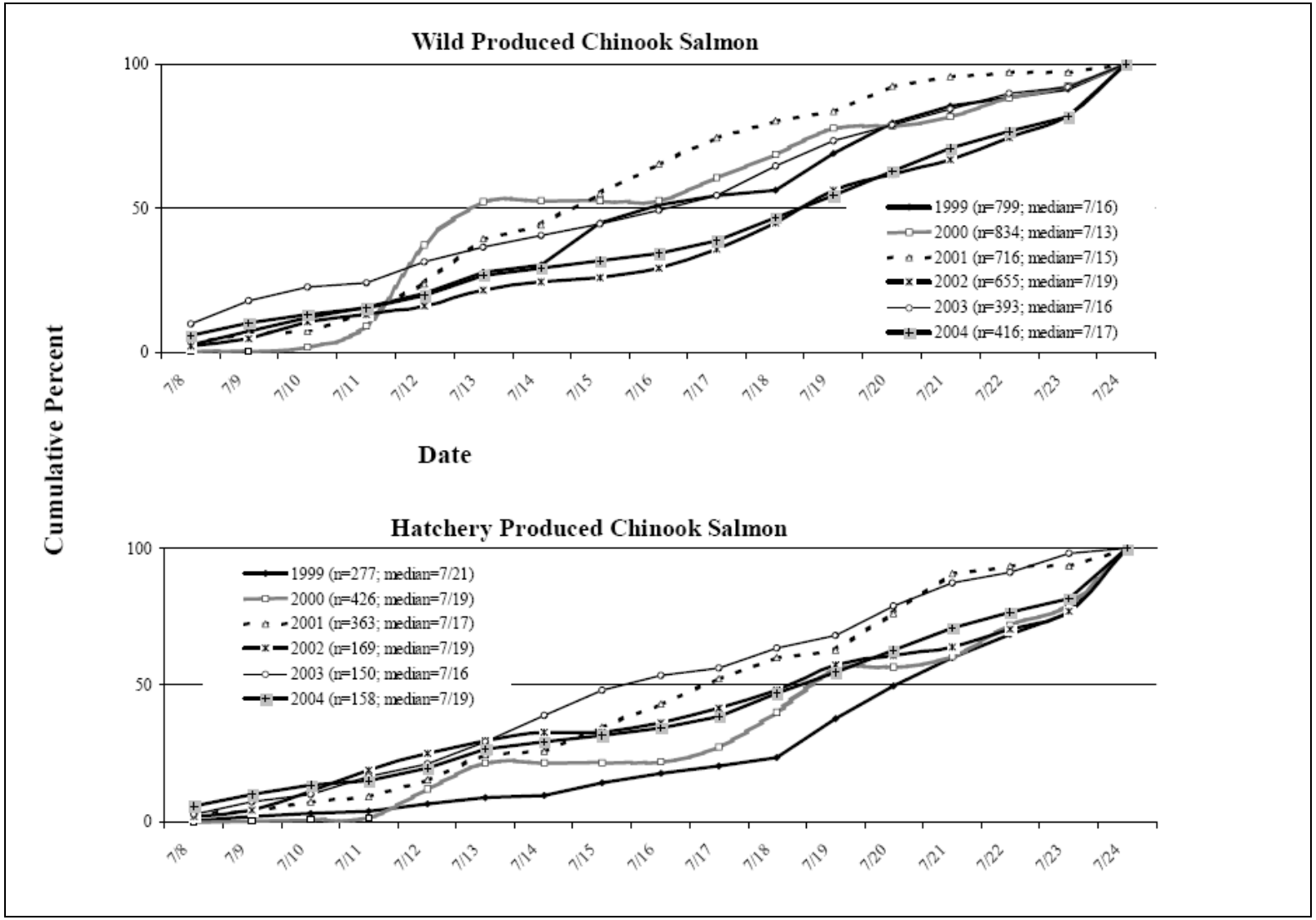


**Figure 5.**—Cumulative percent of wild and hatchery-reared Chinook salmon counted at Ninilchik River weir from July 8-24, for 1999-2004.

**Table 9.–**Water temperature (°C) and discharge (cfs) at Ninilchik River weir with a comparison of data for the weir counting period versus the SEG counting period, 1999-2004.

| | | | Water Temperature (°C) | | | | | |
|---|---|---|---|---|---|---|---|---|
| | Weir Dates | | During Weir Counting Period | | | During 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 |
| 5-Yr Avg (1999-2003) | | | 7 | 12 | 16 | 12 | 13 | 15 |
| 5-Yr Min (1999-2003) | | | 4 | 11 | 15 | 10 | 12 | 13 |
| 5-Yr Max (1999-2003) | | | 9 | 13 | 17 | 14 | 16 | 17 |

| | | | Discharge (cfs) | | | | | |
|---|---|---|---|---|---|---|---|---|
| | Weir Dates | | During Weir Counting Period | | | During SEG Counting Period[b] | | |
| Year [d] | 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 | 57 | 115 | 292 | 76 | 111 | 197 |
| 2002 | 23-May | 11-Aug | 46 | 73 | 155 | 46 | 61 | 105 |
| 2003 | 16-May | 5-Aug | 53 | 91 | 246 | 54 | 58 | 67 |
| 2004 | 18-May | 5-Aug | 54 | 87 | 261 | 54 | 63 | 73 |
| 5-Yr Avg (1999-2003) | | | 53 | 98 | 233 | 57 | 79 | 130 |
| 5-Yr Min (1999-2003) | | | 46 | 73 | 155 | 46 | 58 | 67 |
| 5-Yr Max (1999-2003) | | | 59 | 115 | 292 | 76 | 111 | 199 |

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

[b] Temperature data unavailable.

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

[d] Daily discharge for 1999-2003 was received from 2007-11-29 17:49:05 EST from http://waterdata.usgs.gov/nwis/dv. The provisional 2004 discharge data were provided by the National Weather Service, Alaska Pacific River Forecast Center.

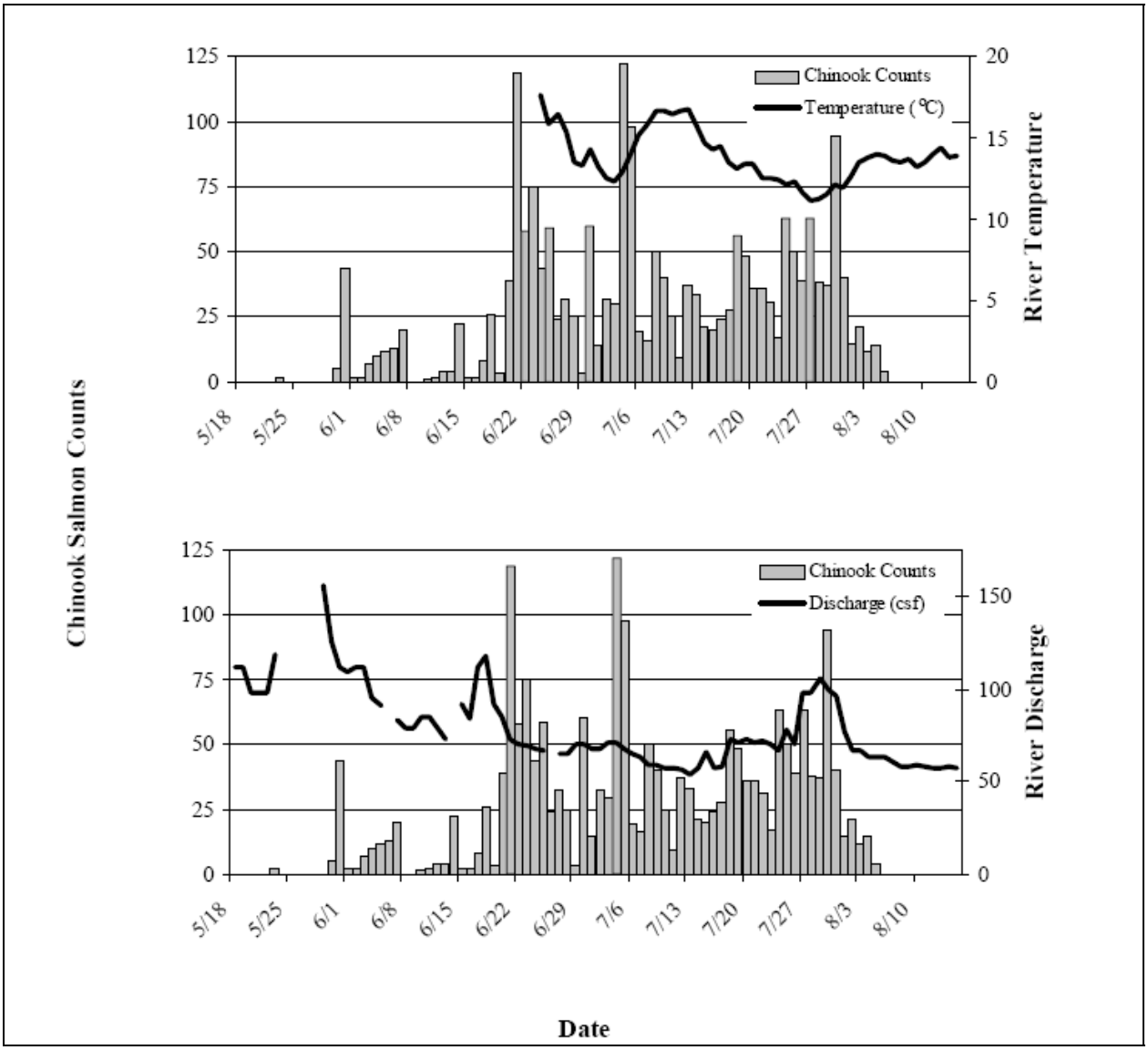


**Figure 6.**—Daily average water temperature ($^{o}$C) and discharge (cfs) at Ninilchik River weir compared to daily weir counts of Chinook salmon from May 18 to August 15, 2004.

**Table 10.–**Estimated age, sex, and length composition of Ninilchik River wild and hatchery Chinook salmon escapements in 2004.

| | Wild | | | | | | Hatchery | | | | | | Egg Take | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | Ocean Age | | | | | | Ocean Age | | | | | | Ocean Age | | |
| | 1 | 2 | 3 | 4 | Total[a] | Sex[b] | 1 | 2 | 3 | 4 | Total[a] | Sex[b] | 3 | 4 | Total[a] |
| **Females** | | | | | | | | | | | | | | | |
| Number sampled | 0 | 6 | 45 | 33 | 84 | 680 | 0 | 9 | 46 | 3 | 58 | 236 | 82 | 26 | 132[c] |
| Estimated Percent | 0.0 | 3.6 | 26.9 | 19.8 | - | 44.6 | 0.0 | 8.0 | 40.7 | 2.7 | - | 44.0 | 75.9 | 24.1 | 100 |
| SE Percent | 0.0 | 1.4 | 3.3 | 2.9 | - | - | 0.0 | 2.3 | 4.1 | 1.4 | - | - | 1.8 | 1.8 | - |
| Estimated abundance | 0 | 55 | 411 | 301 | - | - | 0 | 43 | 218 | 14 | - | - | 100 | 32 | - |
| SE Abundance | 0.0 | 20.8 | 49.6 | 44.5 | - | - | 0.0 | 12.2 | 22.1 | 7.2 | - | - | 2.3 | 2.3 | - |
| Mean Length (mm) | - | 572 | 756 | 867 | 782 | - | - | 647 | 716 | 845 | 712 | - | 776 | 838 | 791 |
| SE Mean Length (mm) | - | 16.3 | 7.7 | 7.8 | 5.6 | - | - | 12.3 | 6.0 | 25.3 | 5.9 | - | 2.0 | 3.7 | 0.0 |
| **Males** | | | | | | | | | | | | | | | |
| Number sampled | 0 | 29 | 39 | 15 | 83 | 845 | 2 | 27 | 25 | 1 | 55 | 300 | ND | ND | ND |
| Estimated Percent | 0.0 | 17.4 | 23.4 | 9.0 | - | 55.4 | 1.8 | 23.9 | 22.1 | 0.9 | - | 56.0 | ND | ND | ND |
| SE Percent | 0.0 | 2.8 | 3.1 | 2.1 | - | - | 1.1 | 3.6 | 3.5 | 0.8 | - | - | ND | ND | ND |
| Estimated abundance | 0 | 265 | 356 | 137 | - | - | 9 | 128 | 119 | 5 | - | - | ND | ND | ND |
| SE Abundance | 0.0 | 42.3 | 47.3 | 31.9 | - | - | 5.9 | 19.2 | 18.7 | 4.2 | - | - | ND | ND | ND |
| Mean Length (mm) | - | 606 | 749 | 913 | 729 | - | 341 | 612 | 731 | 832 | 671 | - | ND | ND | ND |
| SE Mean Length (mm) | - | 10.0 | 10.2 | 25.4 | 7.6 | - | - | 6.2 | 8.9 | NA | 7.6 | - | ND | ND | ND |
| **Both Sexes Combined** | | | | | | | | | | | | | | | |
| Number sampled | 0 | 35 | 84 | 48 | 167 | 1,525 | 2 | 36 | 71 | 4 | 113 | 536 | - | - | - |
| Estimated Percent | 0.0 | 21.0 | 50.3 | 28.7 | - | - | 1.8 | 31.9 | 62.8 | 3.5 | - | - | - | - | - |
| SE Percent | 0.0 | 3.0 | 3.7 | 3.3 | - | - | 1.1 | 3.9 | 4.1 | 1.6 | - | - | - | - | - |
| Estimated abundance | 0 | 320 | 767 | 438 | - | - | 9 | 171 | 337 | 19 | - | | - | - | - |
| SE Abundance | 0.0 | 45.5 | 55.8 | 50.5 | - | - | 5.9 | 21.0 | 21.7 | 8.3 | - | - | - | - | - |
| Mean Length (mm) | - | 601 | 752 | 881 | 757 | - | 341 | 621 | 721 | 842 | - | 692 | - | - | - |
| SE Mean Length (mm) | - | 8.9 | 6.2 | 9.9 | 2.8 | - | - | 6.0 | 5.0 | 18.1 | - | 3.3 | - | - | - |

Note: NA = not available; ND = no data collected; "-" = value can't be calculated due to limitations of the data.

[a] A subsample of Chinook salmon (e.g., every 4th wild and hatchery-reared Chinook salmon) that passed through Ninilchik River weir were sampled for age and length data. 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] All Chinook salmon that passed through Ninilchik River weir were counted and sexed. Sex data were adjusted for fish sacrificed for egg takes and coded wire tag recoveries.

[c] Includes all female Chinook salmon sacrificed for egg takes (ripe + green).

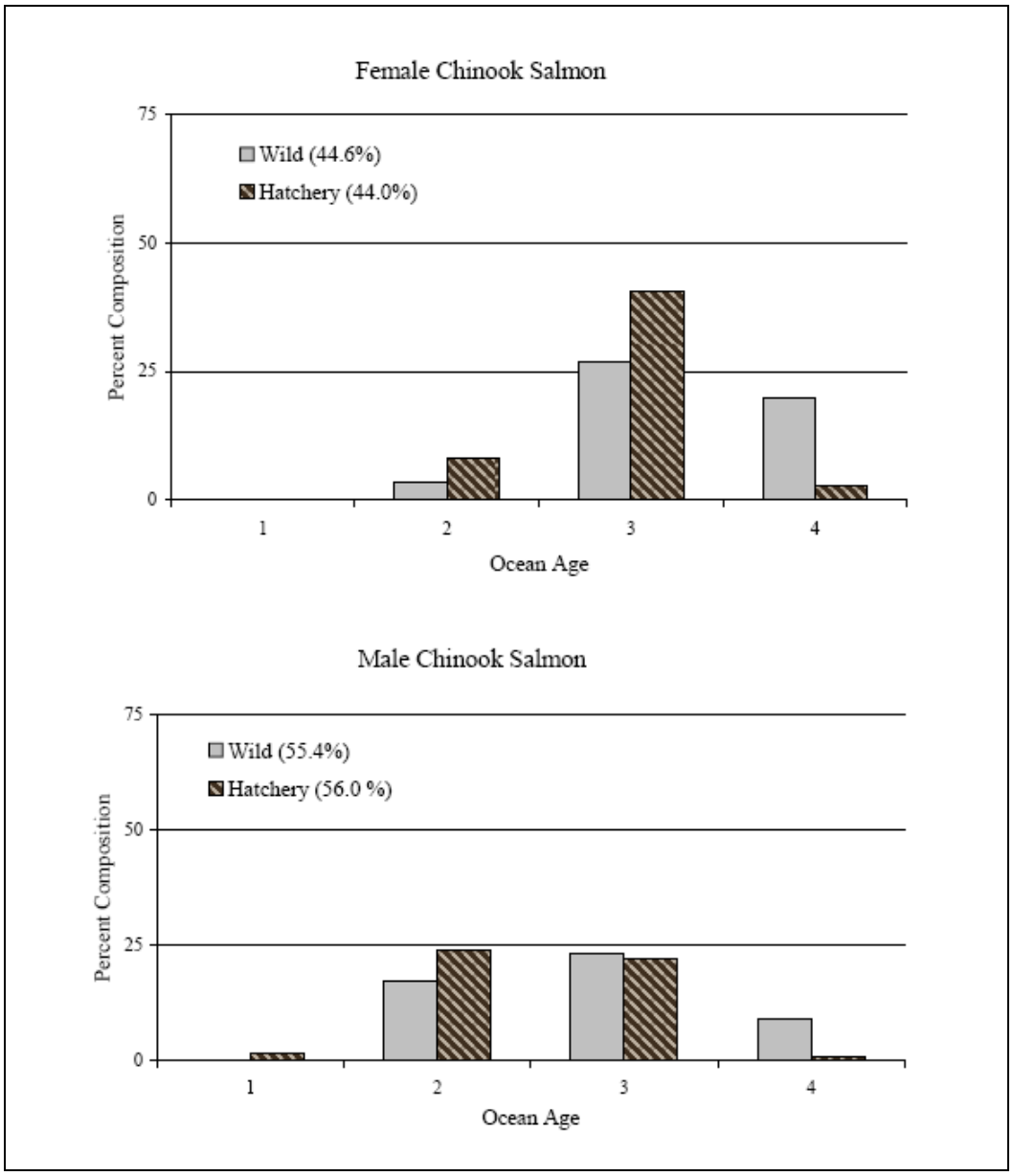


**Figure 7.**—Chinook salmon estimates of ocean age composition for the wild and hatchery components of the Ninilchik River 2004 escapement.

The known ages from decoded CWTs for hatchery produced Chinook salmon sampled at the weir site were used to compare the accuracy of scale aging (Table 11). Of the Chinook salmon scale samples aged as ocean age 2, 19% (4/21) were incorrect, and those aged as ocean age 3, 7% (2/28) were incorrect. Overall, 11% (6/52) of the scales were incorrectly aged based on CWT recovery data.

### EGG TAKES

Four egg takes were conducted in 2004 to collect approximately 757,000 Chinook salmon eggs from 126 females, which was 21 fish more than expected. Additional fish were necessary because of a lower than expected egg survival from the first and second egg takes (Table 12). The low percent survival from green eggs to eyed eggs (47.9%) for the first egg take on July 15 was caused by a handling error. The low egg survival (71.6%) for the second egg take on July 20 was attributed to low fertilization because a high percentage of the males used were not fully mature. Egg survival increased to 91.3% for the third egg take (July 26 and 90.3% for the fourth (July 30) egg take. 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 maximum water temperatures during the 2004 egg takes were: 16$^{o}$C (July 15), 14$^{o}$C (July 20), 12$^{o}$C (July 26), and 13$^{o}$C (July 30; Table 12; Appendix B1).

### SMOLT RELEASE AND MARKING

In 2004, a total of 412,499 Chinook salmon smolt originating from the Ninilchik River egg take project, reared at either the Fort Richardson or Elmendorf hatchery, were used in the LCI stocking program (Tables 1-4). Stocking goals were reached for the Ninilchik River, but not for the saltwater terminal fisheries. The goal for the Ninilchik River was 50,000 smolt and 51,303 smolt were stocked, of which all were marked with a CWT, adipose finclip, and thermal mark. The remaining 361,196 smolt were used to stock the following saltwater terminal fisheries: (1) the NDFL stocking goal was 210,000 smolt, 168,743 were stocked; (2) the Halibut Cove Lagoon goal was 105,000 and 103,771 were stocked; and (3) the Seldovia Bay goal was 105,000 and 88,682 were stocked.

### STRAYING

Of the 536 Chinook salmon counted through the weir with missing adipose fins, 67 were sacrificed for CWT analysis (Table 11; Appendix D1). Coded wire tags were successfully decoded from 64 samples, of which 63 were from smolt stocked in Ninilchik River and one had been stocked in Crooked Creek. No CWTs were detected in three Chinook salmon that were sacrificed because of missing adipose fins.

Twenty-three coded wire tagged Chinook salmon, stocked in the Ninilchik River as smolt, were recovered in other Cook Inlet areas (Table 13; Appendix D2). Chinook salmon strays from the Ninilchik River were recovered during escapement sampling on the Anchor River (6) and Deep Creek (15) and from the commercial harvest near the Ninilchik River (1) and Kasilof River (1). Of the strays recovered during escapement sampling, 9% (2/21) were ocean age-4, 62% ocean age-3, 14% ocean age-2 and 14% ocean age-1.

## DISCUSSION

In 2004, there were three weekend openings for Chinook salmon on the Ninilchik River with the first opening beginning on Memorial Day weekend. The bag limit for the Ninilchik River was

**Table 11.–**Coded wire tag data for Chinook salmon recovered at Ninilchik River weir, 2004.

| CWT Code[a] | Brood Year | Hatchery | Release Date | Release Site | Number of Samples Female | Number of Samples Male | Number of Samples Total | CWT-Age[b] Fresh Water | CWT-Age[b] Ocean | Scale Age Reading Correct[c] | Scale Age Reading Incorrect[d] | Scale Age Reading Unaged [e] |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 310282 | 2001 | Fort Richardson | 06/14/02 | Ninilchik R | 3 | 23 | 26 | 0 | 2 | 16 | 4 | 6 |
| 310251 | 2001 | Elmendorf | 06/05/02 | Crooked Cr | 0 | 1 | 1 | 0 | 2 | 1 | 0 | 0 |
| 310260 | 2000 | Fort Richardson | 06/13/01 | Ninilchik R | 23 | 13 | 36 | 0 | 3 | 28 | 2 | 6 |
| 310248 | 1999 | Fort Richardson | 06/02/00 | Ninilchik R | 1 | 0 | 1 | 0 | 4 | 1 | 0 | 0 |
| No tag[f] | - | - | - | - | 2 | 1 | 3 | - | - | ND | ND | ND |
| | | | | Total | 29 | 38 | 67 | | | 46 | 6 | 12 |

[a] CWT = coded wire tag

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

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

[d] Number of scale readings where age did not matched CWT age.

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

[f] CWT not detected and scales were not aged for these Chinook salmon with a missing adipose fin. "-" = value can't be calculated due to limitations of the data. ND = no data, because no attempts were made to collect it.

**Table 12.**–Egg take dates, number of females spawned, fecundity, and percent survival to the eyed stage, 1999-2004.

| Year | Hatchery[a] | Egg Take Dates | Females Spawned[b] | Maximum Water Temp. (°C)[c] | Fecundity[d] Assumed | Fecundity[d] Actual | Green Eggs Assumed | Green Eggs Actual | Eyed Eggs[e] Actual | Eyed Eggs[e] % Survival |
|---|---|---|---|---|---|---|---|---|---|---|
| 1999 | Fort Rich | 7-Jul | 6 | na | 6,000 | 6,399 | 36,000 | 38,396 | 34,707 | 90.4 |
| | | 14-Jul | 23 | na | 6,000 | 6,380 | 138,000 | 146,734 | 124,751 | 85.0 |
| | | 21-Jul | 41 | na | 6,000 | 6,179 | 246,000 | 253,329 | 217,827 | 86.0 |
| | | 27-Jul | 19 | na | 6,000 | 5,630 | 114,000 | 106,970 | 98,492 | 92.1 |
| | | Total | 89 | | | | 534,000 | 545,429 | 475,777 | |
| | | Average | 22 | | 6,000 | 6,147 | 133,500 | 136,357 | 118,944 | 87.2 |
| 2000 | Fort Rich | 7-Jul | 8 | 14 | 5,591 | 5,533 | 44,726 | 44,267 | 35,496 | 80.2 |
| | | 17-Jul | 10 | 14 | 5,381 | 5,660 | 53,815 | 56,598 | 49,257 | 87.0 |
| | | 24-Jul | 36 | 12 | 5,421 | 5,663 | 195,174 | 203,876 | 161,326 | 79.1 |
| | | 28-Jul | 24 | 14 | 5,400 | 5,900 | 129,600 | 141,606 | 127,624 | 90.1 |
| | | 28-Jul | 41 | 14 | 5,400 | 5,794 | 221,400 | 237,536 | 214,659 | 90.4 |
| | | Total | 119 | | | | 599,989 | 639,616 | 552,866 | |
| | | Average | 40 | 14 | 5,439 | 5,710 | 207,451 | 220,583 | 190,205 | 86.4 |
| 2001 | Fort Rich | 10-Jul | 7 | 14 | 5,793 | 5,680 | 40,551 | 39,757 | 26,050 | 65.5 |
| | | 17-Jul | 56 | 16 | 5,793 | 5,843 | 324,408 | 327,181 | 241,786 | 73.9 |
| | | 25-Jul | 42 | 15 | 5,793 | 6,365 | 243,306 | 267,331 | 237,211 | 88.7 |
| | | Total | 105 | | | | 815,716 | 854,852 | 695,252 | |
| | | Average | 35 | 15 | 5,793 | 5,962 | 202,755 | 211,423 | 168,349 | 81.3 |
| 2002 | Fort Rich | 12-Jul | 6 | 18 | 6,000 | 5,852 | 36,000 | 35,109 | 21,112 | 60.1 |
| | | 16-Jul | 11 | 15 | 6,000 | 5,331 | 66,000 | 58,644 | 45,700 | 77.9 |
| | | 23-Jul | 12 | 14 | 6,000 | 5,937 | 72,000 | 71,241 | 60,738 | 85.3 |
| | | 26-Jul | 36 | 13 | 6,000 | 5,576 | 216,000 | 200,753 | 164,910 | 82.1 |
| | | 30-Jul | 32 | 18 | 6,000 | 5,771 | 192,000 | 184,672 | 162,332 | 87.9 |
| | | 2-Aug | 17 | 18 | 6,000 | 5,884 | 102,000 | 100,032 | 84,357 | 84.3 |
| | Elmendorf | 19-Jul | 16 | 14 | 5,888 | 6,160 | 94,200 | 98,557 | 30,150 | 30.6 |
| | | 23-Jul | 12 | 14 | 5,269 | 5,863 | 63,232 | 70,350 | 28,140 | 40.0 |
| | | 26-Jul | 35 | 13 | 4,900 | 4,767 | 171,520 | 166,830 | 123,280 | 73.9 |
| | | 30-Jul | 32 | 18 | 4,950 | 5,825 | 158,388 | 186,394 | 138,288 | 74.2 |
| | | 2-Aug | 17 | 18 | 4,035 | 4,997 | 68,608 | 84,956 | 41,540 | 48.9 |
| | | Total | 226 | | | | 461,748 | 508,530 | 331,248 | |
| | | Average | 21 | 16 | 5,549 | 5,633 | 112,723 | 114,322 | 81,868 | 65.1 |
| 2003 | Fort Rich | 22-Jul | 27 | 18 | 5,800 | 6,323 | 156,600 | 170,723 | 147,530 | 86.4 |
| | | 29-Jul | 55 | 13 | 5,800 | 6,240 | 319,000 | 343,177 | 293,695 | 85.6 |
| | | 1-Aug | 41 | 17 | 5,800 | 6,703 | 237,800 | 274,834 | 249,242 | 90.7 |
| | Elmendorf | 17-Jul | 27 | 15 | 7,128 | 7,251 | 182,764 | 195,774 | 153,162 | 78.2 |
| | | Total | 150 | | | | 896,164 | 984,508 | 843,629 | |
| | | Average | 38 | 16 | 6,132 | 6,629 | 224,041 | 246,127 | 210,907 | 85.7 |
| 2004 | Fort Rich | 15-Jul | 3 | 16 | 6,000 | 5,005 | 18,000 | 15,016 | 7,186 | 47.9 |
| | | 20-Jul | 26 | 14 | 6,000 | 5,941 | 156,000 | 154,461 | 110,634 | 71.6 |
| | | 26-Jul | 57 | 12 | 6,000 | 6,139 | 343,000 | 349,937 | 319,414 | 91.3 |
| | | 30-Jul | 40 | 13 | 6,000 | 5,396 | 240,000 | 215,859 | 195,000 | 90.3 |
| | | Total | 126 | | | | 757,000 | 735,273 | 632,234 | |
| | | Average | 32 | 14 | 6,000 | 5,620 | 189,250 | 183,818 | 158,059 | 86.0 |
| 5-Year Average (1999-2003) | | | 31 | 15 | 5,783 | 6,016 | 176,094 | 185,762 | 154,055 | 87.2 |

[a] Fort Rich = Fort Richardson

[b] Note: only ripe females counted; these totals may not match the number of fish sacrificed for the egg take.

[c] Recorded during the egg take; na = not available

[d] Number of green eggs per female.

[e] At stocking.

**Table 13.–**Number of coded wire tag (CWT) recoveries of Chinook salmon released from Ninilchik River and recovered outside Ninilchik River drainage in 2004.

| CWT Recovery | | No.of | CWT | Brood | Release[a] | | CWT-Age[b] | | Scale Age Reading | | |
|---|---|---|---|---|---|---|---|---|---|---|---|
| Sample Type | Location | CWT | Code | Year | Date | Site | Fresh Water | Ocean | Correct[c] | Incorrect[d] | Unaged[e] |
| Escapement | Anchor River | 6 | 310260 | 2000 | 6/13/01 | Ninilchik R | 0 | 3 | 2 | 0 | 4 |
| | Deep Creek | 2 | 310248 | 1999 | 6/02/00 | Ninilchik R | 0 | 4 | 1 | 1 | 0 |
| | | 3 | 310256 | 2002 | 6/12/03 | Ninilchik R | 0 | 1 | 3 | 0 | 0 |
| | | 7 | 310260 | 2000 | 6/13/01 | Ninilchik R | 0 | 3 | 4 | 2 | 1 |
| | | 3 | 310282 | 2001 | 6/14/02 | Ninilchik R | 0 | 2 | 3 | 0 | 0 |
| | Sub-total | 21 | | | | | | | 13 | 3 | 5 |
| Commercial Harvest | Ninilchik | 1 | 310256 | 2002 | 6/12/03 | Ninilchik R | 0 | 1 | 0 | 0 | 1 |
| | Kasilof | 1 | 310282 | 2001 | 6/14/02 | Ninilchik R | 0 | 2 | 0 | 0 | 1 |
| | Sub-total | 2 | | | | | | | 0 | 0 | 2 |
| | Total | 23 | | | | | | | 13 | 3 | 7 |

[a] All Chinook salmon smolt raised at Fort Richardson Hatchery and released in fresh water near the Ninilchik River weir site.

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

[c] Number of scale readings where age matched CWT age.

[d] Number of scale readings where age did not matched CWT age.

[e] Number of scale samples that were not aged.

one Chinook salmon per day and one in possession 20 inches or longer. Emergency Order No. 2-KS-7-03-04 opened the Ninilchik River from the mouth to approximately 2 miles upstream to fishing for hatchery-reared Chinook salmon 7 days a week from May 29 through December 31. The EO was later rescinded by EO 2-KS-7-15-04, closing the fishery on July 16. The SWHS indicated angler effort (10,500 angler-days) in 2004 was slightly below the 5-year (1999-2003) average of 11,559 angler-days (Table 6, Jennings et al. 2006b), and the 2004 harvest (1,240 angler-days) was slightly below the 5-year average (1,482 angler-days).

The total number of Chinook salmon counted (2,061 fish) through the Ninilchik River weir in 2004 was slightly lower than the 5-year average of 2,123 fish from 1999 to 2003 (Tables 5 and 6). However, the contribution of the wild component (75%) to the escapement was slightly greater than the 5-year average (73%; Table 5), probably due to the early run timing of Chinook salmon in 2004. The early run timing is also reflected in the 2004 weir count during the SEG period. Although the number of wild Chinook salmon (416 fish) counted through the weir during the SEG period fell within the SEG range (400-850 fish; Table 7), only 27% (416/1,525) of the wild and 29% (158/536) of the hatchery components were counted, which is below the 5-year average (1999-2003) for wild (45%) and hatchery (43%) Chinook salmon.

Differences in run timing between wild and hatchery Chinook salmon, noted in previous years by Balland and Begich (2007) and Begich (2006), were also detected in 2004 (Table 8). Between year run timing differences are shown through median dates of passage through the weir during the SEG counting period (Figure 5). Based on the 5-year average (1999 to 2003) for the SEG counting period, the run timing for wild Chinook salmon is 3 days earlier (median date = July 15) than the run timing for hatchery-reared Chinook salmon (median date = July 18; Table 8).

Differences in run timing between the wild and hatchery component can be explained by a combination of when the egg takes are conducted and differences in rearing conditions. Radio-tagging results for Columbia Basin spring-summer Chinook salmon suggest that run timing is at least partially due to genetic adaptation (Keefer et al. 2004). On the Ninilchik River, egg takes are typically conducted later in the run (mid-July through early August) because efforts to take eggs earlier in the run required longer holding times to allow time for Chinook salmon to ripen, which led to increased mortality of held fish. Given the hypothesized genetic basis for run timing, it is reasonable to assume we are selecting for later run fish based on the dates when eggs are taken. Differences in run timing between wild and hatchery Chinook salmon may also be attributed to differences in rearing conditions between the Ninilchik River and hatcheries.

In 2004, the Ninilchik River was described as having warmer than usual water temperatures and lower than usual water levels. CIK documented 6 days (June 26, July 8-12) where water temperatures were 19$^{o}$ C at the lower river NR-2 site and voiced concerns that water temperature ascendances may pose a risk to migrating salmon as well as egg and fry survival (Mauger 2005).

In general, river temperature changes did not correspond to changes in daily Chinook salmon counts through the weir (Figure 6). However the adult Chinook salmon migration in 2004 was affected by a change in river conditions after a rainfall. For example, beginning on July 27 rain fall produced an approximate 30 cfs increase in discharge and approximate 0.5$^{o}$C decrease in water temperature, which coincided with the final pulse of 94 Chinook salmon through the weir on July 30 (Figure 6, Appendices A1, B1, and C1).

Currently there are insufficient data to fully evaluate the effects higher river temperatures may have on various life stages of Chinook salmon. The effect of high water temperature on green to eyed egg survival was evaluated using the 2000-2004 data and no significant correlation ($P > 0.05$) was detected between the maximum river temperatures on the days the eggs were taken and the percent survival to eyed stage at the hatchery (Table 12). Neitzel and Becker (1985) reported low death rates from cleavage eggs through emergence for Chinook salmon exposed to water temperatures 22$^{o}$C or below for exposure times up to 8 hours. Higher than usual river temperature had no observed effects on the adult salmon migration. As previously noted, the higher river temperatures on the July 15 and July 20 egg takes was not considered the primary cause of the lower egg survival. Although the temperature impacts were not apparent, they may affect rearing fish or incubating eggs inriver. Groot et al. (1995) documented temperature affecting egg development, alevin size, emergence timing, and fry size. Extended exposure to higher temperatures inriver could result in a lower survival of fertilized eggs. Under these conditions the eggs collected for supplementation may fair better, because hatchery water temperatures are controlled to maximize survival.

Aging scale samples from Chinook salmon late in the run at Ninilchik River weir can be difficult because of scale re-absorption. Comparison between the known age based on CWT data and the interpreted age based on scales, provide insights to the accuracy of reported interpreted ages. It is recommended that known and interpreted ages be compared yearly, and as more data become available, an aging correction factor can be calculated.

The 2004 CWT recoveries showed that Chinook salmon from Ninilchik River strayed into Anchor River and Deep Creek (Table 13, Appendix D2). Of the 798 Chinook salmon examined for missing adipose fins at the Anchor River escapement project, six were strays from Ninilchik River (Kerkvliet et al. *In prep*). Chinook salmon strays were also recovered during beach seine sampling for coho salmon *Oncorhynchus kisutch* in Deep Creek from July 27 through August 19 (Kerkvliet and Burwen *In prep*). Of the Chinook salmon captured while beach seining for coho salmon in Deep Creek, 22% (15/68) were strays from Ninilchik River (Kerkvliet et al. *In prep*). King and Breakfield (1998) reported 14% of the Chinook salmon catch from twice weekly samplings between May 29 and July 3, 1996 were strays from Ninilchik River. The percentages of strays from Ninilchik River to Deep Creek in 1996 and 2004 were notably higher than the 1 to 4% observed at Deep Creek weir from 1997-2000 (Begich 2006; King and Breakfield 1999; 2002).

It remains unclear why a higher number of Ninilchik River Chinook salmon strays were recovered in Deep Creek in 2004 than in prior years. The straying rate decline from 14% (1996) to 3% (1997) and 1.2% (1998) was partially attributed to the stocking reduction from 200,000 to 50,000 smolt stocked annually (King and Breakfield 1998), and differences in sample design. In 1999 and 2000, the straying rate of CWT-tagged Ninilchik River Chinook salmon to Deep Creek was 2 and 4% respectively (Begich 2002; Begich and Evans 2005). There were obvious sample design differences between years. In 2004, CWTs were recovered in beach seine samples; from 1997 through 2000, CWTs were primarily recovered from a weir live box and some also came from gillnet samples upstream of the weir. One possible explanation for the higher percentage of strays in 2004 may be differences in run timing and/or spawning areas. If strays arrive later and spawn lower in the watershed than wild Deep Creek Chinook salmon stock this would create a sampling bias. However, currently there is not enough data to satisfactorily explain these differences.

Although Ninilchik River's escapement goals were met in 2004, fishery managers continued to monitor the run of both the wild and hatchery Chinook salmon to insure that the wild fish were not overexploited. This author advises the continued sampling of the freshwater harvest of Ninilchik River Chinook salmon in the future to ensure the exploitation rate on wild Chinook salmon remains within a recommended range. Furthermore, I also support continuation of the Chinook salmon assessment at Ninilchik River weir to ensure escapement levels are maintained.

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# APPENDIX A. WEIR COUNTS

**Appendix A1.–**Daily and cumulative counts of wild and hatchery Chinook salmon at the Ninilchik River weir, 2004.

| | Wild Count | | | Hatchery Count | | | Total Count | | |
|---|---|---|---|---|---|---|---|---|---|
| Date | Daily | Cumulative | Percent | Daily | Cumulative | Percent | Daily | Cumulative | Percent |
| 5/18 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 5/19 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 5/20 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 5/21 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 5/22 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 5/23 | 2 | 2 | 0 | 0 | 0 | 0 | 2 | 2 | 0 |
| 5/24 | 0 | 2 | 0 | 0 | 0 | 0 | 0 | 2 | 0 |
| 5/25 | 0 | 2 | 0 | 0 | 0 | 0 | 0 | 2 | 0 |
| 5/26 | 0 | 2 | 0 | 0 | 0 | 0 | 0 | 2 | 0 |
| 5/27 | 0 | 2 | 0 | 0 | 0 | 0 | 0 | 2 | 0 |
| 5/28 | 0 | 2 | 0 | 0 | 0 | 0 | 0 | 2 | 0 |
| 5/29 | 0 | 2 | 0 | 0 | 0 | 0 | 0 | 2 | 0 |
| 5/30 | 4 | 6 | 0 | 1 | 1 | 0 | 5 | 7 | 0 |
| 5/31 | 39 | 45 | 3 | 5 | 6 | 1 | 44 | 51 | 2 |
| 6/1 | 2 | 47 | 3 | 0 | 6 | 1 | 2 | 53 | 3 |
| 6/2 | 2 | 49 | 3 | 0 | 6 | 1 | 2 | 55 | 3 |
| 6/3 | 7 | 56 | 4 | 0 | 6 | 1 | 7 | 62 | 3 |
| 6/4 | 8 | 64 | 4 | 2 | 8 | 1 | 10 | 72 | 3 |
| 6/5 | 11 | 75 | 5 | 1 | 9 | 2 | 12 | 84 | 4 |
| 6/6 | 10 | 85 | 6 | 3 | 12 | 2 | 13 | 97 | 5 |
| 6/7 | 18 | 103 | 7 | 2 | 14 | 3 | 20 | 117 | 6 |
| 6/8 | 0 | 103 | 7 | 0 | 14 | 3 | 0 | 117 | 6 |
| 6/9 | 0 | 103 | 7 | 0 | 14 | 3 | 0 | 117 | 6 |
| 6/10 | 1 | 104 | 7 | 0 | 14 | 3 | 1 | 118 | 6 |
| 6/11 | 2 | 106 | 7 | 0 | 14 | 3 | 2 | 120 | 6 |
| 6/12 | 4 | 110 | 7 | 0 | 14 | 3 | 4 | 124 | 6 |
| 6/13 | 4 | 114 | 7 | 0 | 14 | 3 | 4 | 128 | 6 |
| 6/14 | 19 | 133 | 9 | 3 | 17 | 3 | 22 | 150 | 7 |
| 6/15 | 2 | 135 | 9 | 0 | 17 | 3 | 2 | 152 | 7 |
| 6/16 | 2 | 137 | 9 | 0 | 17 | 3 | 2 | 154 | 7 |
| 6/17 | 7 | 144 | 9 | 1 | 18 | 3 | 8 | 162 | 8 |
| 6/18 | 23 | 167 | 11 | 3 | 21 | 4 | 26 | 188 | 9 |
| 6/19 | 3 | 170 | 11 | 0 | 21 | 4 | 3 | 191 | 9 |
| 6/20 | 37 | 207 | 14 | 2 | 23 | 4 | 39 | 230 | 11 |
| 6/21 | 115 | 322 | 21 | 4 | 27 | 5 | 119 | 349 | 17 |
| 6/22 | 56 | 378 | 25 | 2 | 29 | 5 | 58 | 407 | 20 |
| 6/23 | 64 | 442 | 29 | 11 | 40 | 7 | 75 | 482 | 23 |
| 6/24 | 41 | 483 | 32 | 3 | 43 | 8 | 44 | 526 | 26 |
| 6/25 | 51 | 534 | 35 | 8 | 51 | 10 | 59 | 585 | 28 |
| 6/26 | 20 | 554 | 36 | 4 | 55 | 10 | 24 | 609 | 30 |
| 6/27 | 32 | 586 | 38 | 0 | 55 | 10 | 32 | 641 | 31 |
| 6/28 | 21 | 607 | 40 | 4 | 59 | 11 | 25 | 666 | 32 |
| 6/29 | 1 | 608 | 40 | 2 | 61 | 11 | 3 | 669 | 32 |
| 6/30 | 43 | 651 | 43 | 17 | 78 | 15 | 60 | 729 | 35 |
| 7/1 | 13 | 664 | 44 | 1 | 79 | 15 | 14 | 743 | 36 |
| 7/2 | 24 | 688 | 45 | 8 | 87 | 16 | 32 | 775 | 38 |
| 7/3 | 20 | 708 | 46 | 10 | 97 | 18 | 30 | 805 | 39 |

-continued-

**Appendix A1.**—Page 2 of 2.

| | Wild Count | | | Hatchery Count | | | Total Count | | |
|---|---|---|---|---|---|---|---|---|---|
| Date | Daily | Cumulative | Percent | Daily | Cumulative | Percent | Daily | Cumulative | Percent |
| 7/4 | 101 | 809 | 53 | 21 | 118 | 22 | 122 | 927 | 45 |
| 7/5 | 65 | 874 | 57 | 33 | 151 | 28 | 98 | 1,025 | 50 |
| 7/6 | 12 | 886 | 58 | 7 | 158 | 29 | 19 | 1,044 | 51 |
| 7/7 | 12 | 898 | 59 | 4 | 162 | 30 | 16 | 1,060 | 51 |
| 7/8 | 41 | 939 | 62 | 9 | 171 | 32 | 50 | 1,110 | 54 |
| 7/9 | 33 | 972 | 64 | 7 | 178 | 33 | 40 | 1,150 | 56 |
| 7/10 | 20 | 992 | 65 | 5 | 183 | 34 | 25 | 1,175 | 57 |
| 7/11 | 6 | 998 | 65 | 3 | 186 | 35 | 9 | 1,184 | 57 |
| 7/12 | 30 | 1,028 | 67 | 7 | 193 | 36 | 37 | 1,221 | 59 |
| 7/13 | 22 | 1,050 | 69 | 11 | 204 | 38 | 33 | 1,254 | 61 |
| 7/14 | 17 | 1,067 | 70 | 4 | 208 | 39 | 21 | 1,275 | 62 |
| 7/15 | 16 | 1,083 | 71 | 4 | 212 | 40 | 20 | 1,295 | 63 |
| 7/16 | 20 | 1,103 | 72 | 4 | 216 | 40 | 24 | 1,319 | 64 |
| 7/17 | 21 | 1,124 | 74 | 7 | 223 | 42 | 28 | 1,347 | 65 |
| 7/18 | 43 | 1,167 | 77 | 13 | 236 | 44 | 56 | 1,403 | 68 |
| 7/19 | 36 | 1,203 | 79 | 12 | 248 | 46 | 48 | 1,451 | 70 |
| 7/20 | 23 | 1,226 | 80 | 13 | 261 | 49 | 36 | 1,487 | 72 |
| 7/21 | 23 | 1,249 | 82 | 13 | 274 | 51 | 36 | 1,523 | 74 |
| 7/22 | 22 | 1,271 | 83 | 9 | 283 | 53 | 31 | 1,554 | 75 |
| 7/23 | 9 | 1,280 | 84 | 8 | 291 | 54 | 17 | 1,571 | 76 |
| 7/24 | 34 | 1,314 | 86 | 29 | 320 | 60 | 63 | 1,634 | 79 |
| 7/25 | 29 | 1,343 | 88 | 21 | 341 | 64 | 50 | 1,684 | 82 |
| 7/26 | 24 | 1,367 | 90 | 15 | 356 | 66 | 39 | 1,723 | 84 |
| 7/27 | 32 | 1,399 | 92 | 31 | 387 | 72 | 63 | 1,786 | 87 |
| 7/28 | 24 | 1,423 | 93 | 14 | 401 | 75 | 38 | 1,824 | 89 |
| 7/29 | 11 | 1,434 | 94 | 26 | 427 | 80 | 37 | 1,861 | 90 |
| 7/30 | 45 | 1,479 | 97 | 49 | 476 | 89 | 94 | 1,955 | 95 |
| 7/31 | 20 | 1,499 | 98 | 20 | 496 | 93 | 40 | 1,995 | 97 |
| 8/1 | 8 | 1,507 | 99 | 7 | 503 | 94 | 15 | 2,010 | 98 |
| 8/2 | 9 | 1,516 | 99 | 12 | 515 | 96 | 21 | 2,031 | 99 |
| 8/3 | 4 | 1,520 | 100 | 8 | 523 | 98 | 12 | 2,043 | 99 |
| 8/4 | 4 | 1,524 | 100 | 10 | 533 | 99 | 14 | 2,057 | 100 |
| 8/5 | 1 | 1,525 | 100 | 3 | 536 | 100 | 4 | 2,061 | 100 |
| Total | 1,525 | | | 536 | | | 2,061 | | |

# APPENDIX B. RIVER TEMPERATURE

**Appendix B1.–**Ninilchik River water temperatures from June 24 to October 11, 2004.

| | Water Temperature (°C)[a] | | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | June | | | July | | | August | | | September | | | October | | |
| Date | Min | Mean | Max | Min | Mean | Max | Min | Mean | Max | Min | Mean | Max | Min | Mean | Max |
| 1 | ND | ND | ND | 12.6 | 13.2 | 14.9 | 10.5 | 12.6 | 14.9 | 9.7 | 10.4 | 11.1 | 4.3 | 4.5 | 4.8 |
| 2 | ND | ND | ND | 11.7 | 12.5 | 13.1 | 11.1 | 13.5 | 16.1 | 10.0 | 10.5 | 11.1 | 3.4 | 3.7 | 4.0 |
| 3 | ND | ND | ND | 11.4 | 12.3 | 13.1 | 11.4 | 13.8 | 15.8 | 10.0 | 10.4 | 11.1 | 3.4 | 3.9 | 4.5 |
| 4 | ND | ND | ND | 11.4 | 12.9 | 14.3 | 12.9 | 14.0 | 14.9 | 8.0 | 9.1 | 10.0 | 4.5 | 4.9 | 5.4 |
| 5 | ND | ND | ND | 11.7 | 14.0 | 16.9 | 12.3 | 13.9 | 15.8 | 6.9 | 8.0 | 9.2 | 4.8 | 5.4 | 6.0 |
| 6 | ND | ND | ND | 12.9 | 15.2 | 17.5 | 11.4 | 13.6 | 15.8 | 6.3 | 7.8 | 9.7 | 4.8 | 5.3 | 6.0 |
| 7 | ND | ND | ND | 12.9 | 15.7 | 18.4 | 11.1 | 13.5 | 15.8 | 5.7 | 7.5 | 9.4 | 5.1 | 5.4 | 6.0 |
| 8 | ND | ND | ND | 14.0 | 16.6 | 19.0 | 11.4 | 13.7 | 15.8 | 5.4 | 7.1 | 8.9 | 4.8 | 5.4 | 6.0 |
| 9 | ND | ND | ND | 14.0 | 16.7 | 19.3 | 12.0 | 13.2 | 14.6 | 4.8 | 6.5 | 7.7 | 5.1 | 5.5 | 6.0 |
| 10 | ND | ND | ND | 13.7 | 16.5 | 19.0 | 11.4 | 13.5 | 16.1 | 6.6 | 7.4 | 8.3 | 5.1 | 5.5 | 6.0 |
| 11 | ND | ND | ND | 14.0 | 16.6 | 19.3 | 12.0 | 13.9 | 15.8 | 6.0 | 7.3 | 8.9 | 4.8 | 5.0 | 5.4 |
| 12 | ND | ND | ND | 14.3 | 16.8 | 19.3 | 12.9 | 14.4 | 16.1 | 5.7 | 7.3 | 8.9 | | | |
| 13 | ND | ND | ND | 14.0 | 15.7 | 17.5 | 11.7 | 13.8 | 15.8 | 6.0 | 7.1 | 8.3 | | | |
| 14 | ND | ND | ND | 12.9 | 14.7 | 16.3 | 12.0 | 13.9 | 16.1 | 4.3 | 5.8 | 7.1 | | | |
| 15 | ND | ND | ND | 12.6 | 14.3 | 16.1 | 11.1 | 13.2 | 14.6 | 3.4 | 5.0 | 6.3 | | | |
| 16 | ND | ND | ND | 12.9 | 14.4 | 15.8 | 11.7 | 14.1 | 16.3 | 2.8 | 4.2 | 5.4 | | | |
| 17 | ND | ND | ND | 12.9 | 13.5 | 15.2 | 12.3 | 14.2 | 15.8 | 2.5 | 3.7 | 4.8 | | | |
| 18 | ND | ND | ND | 12.0 | 13.1 | 14.3 | 12.6 | 14.2 | 15.8 | 1.9 | 2.9 | 3.7 | | | |
| 19 | ND | ND | ND | 11.7 | 13.4 | 15.2 | 12.6 | 13.6 | 14.9 | 3.4 | 3.8 | 4.3 | | | |
| 20 | ND | ND | ND | 12.6 | 13.4 | 14.0 | 12.6 | 13.5 | 14.6 | 4.3 | 4.6 | 5.1 | | | |
| 21 | ND | ND | ND | 11.4 | 12.6 | 13.4 | 11.1 | 12.9 | 15.2 | 4.3 | 5.0 | 5.7 | | | |
| 22 | ND | ND | ND | 11.7 | 12.5 | 13.1 | 11.7 | 13.0 | 14.0 | 5.4 | 5.7 | 6.3 | | | |
| 23 | ND | ND | ND | 11.1 | 12.4 | 14.0 | 11.1 | 12.5 | 13.7 | 4.8 | 5.5 | 6.3 | | | |
| 24 | 16.3 | 17.6 | 18.4 | 10.8 | 12.1 | 13.4 | 10.8 | 12.4 | 14.6 | 3.7 | 4.4 | 5.1 | | | |
| 25 | 13.1 | 15.9 | 18.4 | 11.1 | 12.3 | 13.4 | 11.1 | 12.9 | 14.9 | 2.8 | 3.3 | 4.3 | | | |
| 26 | 13.7 | 16.5 | 19.3 | 11.1 | 11.6 | 12.3 | 12.0 | 12.8 | 13.7 | 2.5 | 2.7 | 2.8 | | | |
| 27 | 14.3 | 15.3 | 17.5 | 10.8 | 11.1 | 11.7 | 10.5 | 11.7 | 12.9 | 2.2 | 2.7 | 3.1 | | | |
| 28 | 12.9 | 13.5 | 14.6 | 10.5 | 11.2 | 12.0 | 9.7 | 11.1 | 12.6 | 2.8 | 3.3 | 4.0 | | | |
| 29 | 11.7 | 13.3 | 15.5 | 10.5 | 11.5 | 12.6 | 8.6 | 10.6 | 12.6 | 3.7 | 3.9 | 4.0 | | | |
| 30 | 12.3 | 14.3 | 16.6 | 11.1 | 12.1 | 13.4 | 8.3 | 10.3 | 12.0 | 3.7 | 4.0 | 4.5 | | | |
| 31 | | | | 10.3 | 11.9 | 13.7 | 8.0 | 9.9 | 11.4 | | | | | | |

Note: ND = no data collected.

[a] Data collected by Cook Inlet Keepers using a remote temperature logger located approximately 0.1 rkm upstream from the Ninilchik River weir (Mauger 2005).

# APPENDIX C. RIVER DISCHARGE

**Appendix C1.–**Ninilchik River daily discharge (cfs) measurements, May 18 to August 5, 2004.

| | Discharge (cfs)[a] | | | |
|---|---|---|---|---|
| Date | May | Jun | Jul | Aug |
| 1 | [b] | 109 | 68 | 77 |
| 2 | [b] | 112 | 68 | 67 |
| 3 | [b] | 112 | 71 | 67 |
| 4 | [b] | 95 | 71 | 63 |
| 5 | [b] | 91 | 68 | 63 |
| 6 | [b] | - | 65 | [c] |
| 7 | [b] | 83 | 63 | [c] |
| 8 | [b] | 79 | 59 | [c] |
| 9 | [b] | 79 | 59 | [c] |
| 10 | [b] | 85 | 57 | [c] |
| 11 | [b] | 85 | 57 | [c] |
| 12 | [b] | 79 | 56 | [c] |
| 13 | [b] | 73 | 54 | [c] |
| 14 | [b] | 79 | 57 | [c] |
| 15 | [b] | 92 | 66 | [c] |
| 16 | [b] | 84 | 57 | [c] |
| 17 | [b] | 112 | 58 | [c] |
| 18 | 112 | 118 | 73 | [c] |
| 19 | 112 | 92 | 71 | [c] |
| 20 | 98 | 85 | 73 | [c] |
| 21 | 98 | 73 | 71 | [c] |
| 22 | 98 | 70 | 72 | [c] |
| 23 | 119 | 69 | 70 | [c] |
| 24 | 168 | 68 | 67 | [c] |
| 25 | 234 | 67 | 78 | [c] |
| 26 | - | - | 70 | [c] |
| 27 | 261 | 65 | 98 | [c] |
| 28 | - | 65 | 98 | [c] |
| 29 | 156 | 70 | 106 | [c] |
| 30 | 126 | 70 | 100 | [c] |
| 31 | 112 | | 96 | [c] |
| Average | 141 | 84 | 71 | 67 |
| Minimum | 98 | 65 | 54 | 63 |
| Maximum | 261 | 118 | 106 | 77 |

Note: Outlined numbers represent the SEG counting period.

[a] Provisional data collected by the National Weather Service Alaska Pacific Weather Forecast Center. Discharges measured approximately 0.9 river miles upstream from Ninilchik River mouth.

[b] Preproject

[c] Postproject

# APPENDIX D. CODED WIRE TAG DATA

**Appendix D1.**─Coded wire tag (CWT) data for Chinook salmon recovered at Ninilchik River weir, 2004.

| Sample Identifiers | | | | | | Age[a] | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | | | | Actual | | Scale | | | | |
| CWT[b] No. | Head No. | Brood Year | Hatchery[c] | Release Date[d] | Recovery Date | Fw | O | Fw | O | Er | Sex | Length (mm) |
| [e] | 277121 | - | - | - | 7/08/04 | - | - | 0 | 1 | - | M | 341 |
| [e] | 277122 | - | - | - | 7/09/04 | - | - | 0 | 3 | - | F | 714 |
| [e] | 277150 | - | - | - | 7/28/04 | - | - | 1 | 3 | - | F | 782 |
| 310282 | 277104 | 2001 | Ft. Rich. | 6/14/02 | 6/23/04 | 0 | 2 | 1 | 2 | 0 | F | 670 |
| 310282 | 277109 | 2001 | Ft. Rich. | 6/14/02 | 6/30/04 | 0 | 2 | 1 | 2 | 0 | M | 628 |
| 310282 | 277111 | 2001 | Ft. Rich. | 6/14/02 | 7/02/04 | 0 | 2 | 1 | 2 | 0 | F | 658 |
| 310282 | 277112 | 2001 | Ft. Rich. | 6/14/02 | 7/03/04 | 0 | 2 | 1 | 2 | 0 | M | 595 |
| 310282 | 277117 | 2001 | Ft. Rich. | 6/14/02 | 7/05/04 | 0 | 2 | 1 | 2 | 0 | M | 643 |
| 310282 | 277118 | 2001 | Ft. Rich. | 6/14/02 | 7/05/04 | 0 | 2 | 1 | 2 | 0 | M | 573 |
| 310282 | 277134 | 2001 | Ft. Rich. | 6/14/02 | 7/21/04 | 0 | 2 | i | 2 | 0 | M | 684 |
| 310282 | 277136 | 2001 | Ft. Rich. | 6/14/02 | 7/23/04 | 0 | 2 | 0 | 2 | 0 | M | 646 |
| 310282 | 277138 | 2001 | Ft. Rich. | 6/14/02 | 7/24/04 | 0 | 2 | 0 | 2 | 0 | M | 632 |
| 310282 | 277140 | 2001 | Ft. Rich. | 6/14/02 | 7/24/04 | 0 | 2 | 0 | 2 | 0 | M | 606 |
| 310282 | 277142 | 2001 | Ft. Rich. | 6/14/02 | 7/25/04 | 0 | 2 | 0 | 2 | 0 | M | 575 |
| 310282 | 277153 | 2001 | Ft. Rich. | 6/14/02 | 7/29/04 | 0 | 2 | 0 | 2 | 0 | M | 623 |
| 310282 | 277154 | 2001 | Ft. Rich. | 6/14/02 | 7/30/04 | 0 | 2 | 0 | 2 | 0 | M | 659 |
| 310282 | 277158 | 2001 | Ft. Rich. | 6/14/02 | 7/30/04 | 0 | 2 | 0 | 2 | 0 | M | 637 |
| 310282 | 277162 | 2001 | Ft. Rich. | 6/14/02 | 7/31/04 | 0 | 2 | 0 | 2 | 0 | M | 540 |
| 310282 | 277165 | 2001 | Ft. Rich. | 6/14/02 | 8/03/04 | 0 | 2 | 0 | 2 | 0 | M | 626 |
| 310282 | 277108 | 2001 | Ft. Rich. | 6/14/02 | 6/29/04 | 0 | 2 | 0 | 3 | 1 | M | 622 |
| 310282 | 277114 | 2001 | Ft. Rich. | 6/14/02 | 7/04/04 | 0 | 2 | 0 | 3 | 1 | M | 631 |
| 310282 | 277128 | 2001 | Ft. Rich. | 6/14/02 | 7/17/04 | 0 | 2 | i | 3 | 1 | M | 702 |
| 310282 | 277167 | 2001 | Ft. Rich. | 6/14/02 | 8/04/04 | 0 | 2 | i | 3 | 1 | M | 711 |
| 310282 | 277106 | 2001 | Ft. Rich. | 6/14/02 | 6/25/04 | 0 | 2 | i | i | - | M | 680 |
| 310282 | 277110 | 2001 | Ft. Rich. | 6/14/02 | 6/30/04 | 0 | 2 | i | i | - | M | 660 |
| 310282 | 277133 | 2001 | Ft. Rich. | 6/14/02 | 7/20/04 | 0 | 2 | i | i | - | F | 691 |
| 310282 | 277135 | 2001 | Ft. Rich. | 6/14/02 | 7/22/04 | 0 | 2 | i | i | - | M | 709 |
| 310282 | 277149 | 2001 | Ft. Rich. | 6/14/02 | 7/28/04 | 0 | 2 | i | i | - | M | 690 |
| 310282 | 277152 | 2001 | Ft. Rich. | 6/14/02 | 7/29/04 | 0 | 2 | i | i | - | M | 628 |
| 310260 | 277101 | 2000 | Ft. Rich. | 6/13/01 | 6/04/04 | 0 | 3 | 0 | 3 | 0 | F | 764 |
| 310260 | 277113 | 2000 | Ft. Rich. | 6/13/01 | 7/04/04 | 0 | 3 | 0 | 3 | 0 | F | 748 |
| 310260 | 277115 | 2000 | Ft. Rich. | 6/13/01 | 7/04/04 | 0 | 3 | 0 | 3 | 0 | F | 772 |
| 310260 | 277120 | 2000 | Ft. Rich. | 6/13/01 | 7/06/04 | 0 | 3 | 0 | 3 | 0 | F | 707 |
| 310260 | 277123 | 2000 | Ft. Rich. | 6/13/01 | 7/10/04 | 0 | 3 | 0 | 3 | 0 | F | 690 |
| 310260 | 277125 | 2000 | Ft. Rich. | 6/13/01 | 7/13/04 | 0 | 3 | 0 | 3 | 0 | F | 775 |
| 310260 | 277131 | 2000 | Ft. Rich. | 6/13/01 | 7/19/04 | 0 | 3 | 0 | 3 | 0 | F | 748 |
| 310260 | 277132 | 2000 | Ft. Rich. | 6/13/01 | 7/20/04 | 0 | 3 | 0 | 3 | 0 | F | 773 |
| 310260 | 277137 | 2000 | Ft. Rich. | 6/13/01 | 7/24/04 | 0 | 3 | 0 | 3 | 0 | F | 736 |
| 310260 | 277146 | 2000 | Ft. Rich. | 6/13/01 | 7/27/04 | 0 | 3 | 0 | 3 | 0 | F | 776 |
| 310260 | 277151 | 2000 | Ft. Rich. | 6/13/01 | 7/29/04 | 0 | 3 | 0 | 3 | 0 | F | 723 |
| 310260 | 277155 | 2000 | Ft. Rich. | 6/13/01 | 7/30/04 | 0 | 3 | 0 | 3 | 0 | F | 680 |

-continued-

**Appendix D1**.–Page 2 of 2.

| Sample Identifiers | | | | | | Age[a] | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| CWT [b] | Head | Brood | | Release | Recovery | Actual | | Scale | | | | Length |
| No. | No. | Year | Hatchery[c] | Date[d] | Date | Fw | O | Fw | O | Er | Sex | (mm) |
| 310260 | 277156 | 2000 | Ft. Rich. | 6/13/01 | 7/30/04 | 0 | 3 | 0 | 3 | 0 | F | 783 |
| 310260 | 277160 | 2000 | Ft. Rich. | 6/13/01 | 7/31/04 | 0 | 3 | 0 | 3 | 0 | F | 744 |
| 310260 | 277163 | 2000 | Ft. Rich. | 6/13/01 | 8/01/04 | 0 | 3 | 0 | 3 | 0 | F | 720 |
| 310260 | 277164 | 2000 | Ft. Rich. | 6/13/01 | 8/02/04 | 0 | 3 | i | 3 | 0 | F | 682 |
| 310260 | 277166 | 2000 | Ft. Rich. | 6/13/01 | 8/04/04 | 0 | 3 | 0 | 3 | 0 | F | 731 |
| 310260 | 277148 | 2000 | Ft. Rich. | 6/13/01 | 7/27/04 | 0 | 3 | 0 | 2 | 1 | F | 613 |
| 310260 | 277103 | 2000 | Ft. Rich. | 6/13/01 | 6/21/04 | 0 | 3 | i | i | - | F | ND |
| 310260 | 277127 | 2000 | Ft. Rich. | 6/13/01 | 7/16/04 | 0 | 3 | i | i | - | F | 733 |
| 310260 | 277139 | 2000 | Ft. Rich. | 6/13/01 | 7/24/04 | 0 | 3 | i | i | - | F | 761 |
| 310260 | 277159 | 2000 | Ft. Rich. | 6/13/01 | 7/30/04 | 0 | 3 | i | i | - | F | 802 |
| 310260 | 277105 | 2000 | Ft. Rich. | 6/13/01 | 6/23/04 | 0 | 3 | 0 | 3 | 0 | M | 834 |
| 310260 | 277116 | 2000 | Ft. Rich. | 6/13/01 | 7/05/04 | 0 | 3 | 0 | 3 | 0 | M | 784 |
| 310260 | 277126 | 2000 | Ft. Rich. | 6/13/01 | 7/14/04 | 0 | 3 | 0 | 3 | 0 | M | 717 |
| 310260 | 277130 | 2000 | Ft. Rich. | 6/13/01 | 7/19/04 | 0 | 3 | 0 | 3 | 0 | M | 777 |
| 310260 | 277141 | 2000 | Ft. Rich. | 6/13/01 | 7/25/04 | 0 | 3 | 0 | 3 | 0 | M | 714 |
| 310260 | 277143 | 2000 | Ft. Rich. | 6/13/01 | 7/25/04 | 0 | 3 | 0 | 3 | 0 | M | 765 |
| 310260 | 277144 | 2000 | Ft. Rich. | 6/13/01 | 7/26/04 | 0 | 3 | 0 | 3 | 0 | M | 768 |
| 310260 | 277145 | 2000 | Ft. Rich. | 6/13/01 | 7/27/04 | 0 | 3 | i | 3 | 0 | M | 690 |
| 310260 | 277147 | 2000 | Ft. Rich. | 6/13/01 | 7/27/04 | 0 | 3 | 0 | 3 | 0 | M | 791 |
| 310260 | 277157 | 2000 | Ft. Rich. | 6/13/01 | 7/30/04 | 0 | 3 | 0 | 3 | 0 | M | 714 |
| 310260 | 277161 | 2000 | Ft. Rich. | 6/13/01 | 7/31/04 | 0 | 3 | 0 | 3 | 0 | M | 738 |
| 310260 | 277107 | 2000 | Ft. Rich. | 6/13/01 | 6/28/04 | 0 | 3 | i | i | - | M | 840 |
| 310260 | 277124 | 2000 | Ft. Rich. | 6/13/01 | 7/12/04 | 0 | 3 | i | i | - | M | 729 |
| 310251 | 277129 | 2001 | Elm. | 6/05/02 | 7/18/04 | 0 | 2 | 0 | 2 | 0 | M | 642 |
| 310248 | 277102 | 1999 | Ft. Rich. | 6/02/00 | 6/14/04 | 0 | 3 | 0 | 4 | 1 | F | 860 |
| 310248 | 277119 | 1999 | Ft. Rich. | 6/02/00 | 7/05/04 | 0 | 4 | 0 | 4 | 0 | F | 885 |

[a] "Actual" age determined from CWT data; "Scale" age interprated by scale reading, "i" = illegible scale annuli, could not be aged; Fw = Freshwater age; O = Ocean age; Er = Age Error = (Actual Ocean age) - (Interprated Ocean age)

[b] CWT = coded wire tag

[c] Ft Rich = Fort Richardson Hatchery; Elm = Elmendorf Hatchery

[d] All smolt released at Ninilchik R, except CWT No. 310251. It was released at Crooked Ck.

[e] No CWT detected in this Chinook salmon with a missing adipose fin.

**Appendix D2.**─Coded wired tag (CWT) data for Ninilchik River Chinook salmon recovered outside of the Ninilchik River drainage, 2004.

| Sample Identifiers | | | | | | | | Age[a] | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | | Release | Recovery | | | Actual[a] | | Scale[a] | | | | |
| CWT No. | Head No. | Brood Year | Hatchery[b] | Date[c] | Location[d] | Method[e] | Date | Fwa | O[a] | Fwa | O[a] | Er[a] | Sex[f] | Length (mm) |
| 310260 | 517751 | 2000 | Ft. Rich. | 06/13/01 | Anchor R. | Esc. | 06/11/04 | 0 | 3 | 0 | 3 | 0 | F | 693 |
| 310260 | 517752 | 2000 | Ft. Rich. | 06/13/01 | Anchor R. | Esc. | 06/11/04 | 0 | 3 | ND | ND | - | M | 724 |
| 310260 | 517754 | 2000 | Ft. Rich. | 06/13/01 | Anchor R. | Esc. | 06/18/04 | 0 | 3 | ND | ND | ND | U | ND |
| 310260 | 517761 | 2000 | Ft. Rich. | 06/13/01 | Anchor R. | Esc. | 07/29/04 | 0 | 3 | ND | ND | - | F | 765 |
| 310260 | 517762 | 2000 | Ft. Rich. | 06/13/01 | Anchor R. | Esc. | 07/30/04 | 0 | 3 | ND | ND | - | F | 657 |
| 310260 | 517753 | 2000 | Ft. Rich. | 06/13/01 | Anchor R. | Esc. | 06/06/04 | 0 | 3 | 0 | 3 | 0 | F | 705 |
| 310248 | 53754 | 1999 | Ft. Rich. | 06/02/00 | Deep Ck. | Esc. | 07/29/04 | 0 | 4 | 0 | 3 | -1 | F | 790 |
| 310248 | 53760 | 1999 | Ft. Rich. | 06/02/00 | Deep Ck. | Esc. | 08/12/04 | 0 | 4 | i | 4 | 0 | F | 815 |
| 310260 | 53745 | 2000 | Ft. Rich. | 06/13/01 | Deep Ck. | Esc. | 07/27/04 | 0 | 3 | i | 3 | 0 | F | 770 |
| 310260 | 53747 | 2000 | Ft. Rich. | 06/13/01 | Deep Ck. | Esc. | 07/27/04 | 0 | 3 | 0 | 3 | 0 | F | 737 |
| 310260 | 53750 | 2000 | Ft. Rich. | 06/13/01 | Deep Ck. | Esc. | 07/29/04 | 0 | 3 | 0 | 2 | -1 | F | 715 |
| 310260 | 53752 | 2000 | Ft. Rich. | 06/13/01 | Deep Ck. | Esc. | 07/29/04 | 0 | 3 | i | 3 | 0 | M | 637 |
| 310260 | 53755 | 2000 | Ft. Rich. | 06/13/01 | Deep Ck. | Esc. | 07/29/04 | 0 | 3 | 0 | 3 | 0 | U | 769 |
| 310260 | 53757 | 2000 | Ft. Rich. | 06/13/01 | Deep Ck. | Esc. | 08/10/04 | 0 | 3 | 0 | 4 | 1 | M | 810 |
| 310260 | 53758 | 2000 | Ft. Rich. | 06/13/01 | Deep Ck. | Esc. | 08/10/04 | 0 | 3 | i | i | - | M | 815 |
| 310282 | 53748 | 2001 | Ft. Rich. | 06/14/02 | Deep Ck. | Esc. | 07/27/04 | 0 | 2 | 0 | 2 | 0 | M | 650 |
| 310282 | 53751 | 2001 | Ft. Rich. | 06/14/02 | Deep Ck. | Esc. | 07/29/04 | 0 | 2 | 0 | 2 | 0 | M | 657 |
| 310282 | 53767 | 2001 | Ft. Rich. | 06/14/02 | Deep Ck. | Esc. | 08/19/04 | 0 | 2 | 0 | 2 | 0 | F | 653 |
| 310256 | 53749 | 2002 | Ft. Rich. | 06/12/03 | Deep Ck. | Esc. | 07/27/04 | 0 | 1 | i | 1 | 0 | M | 403 |
| 310256 | 53753 | 2002 | Ft. Rich. | 06/12/03 | Deep Ck. | Esc. | 07/29/04 | 0 | 1 | i | 1 | 0 | F | 404 |
| 310256 | 53756 | 2002 | Ft. Rich. | 06/12/03 | Deep Ck. | Esc. | 08/12/04 | 0 | 1 | i | 1 | 0 | M | 372 |
| 310282 | 519654 | 2001 | Ft. Rich. | 06/14/02 | Kasilof | C.H. | 06/28/04 | 0 | 2 | ND | ND | ND | U | ND |
| 310256 | 519656 | 2002 | Ft. Rich. | 06/12/03 | Ninilchik | C.H. | 06/30/04 | 0 | 1 | ND | ND | ND | U | ND |

[a] "Known" age determined from CWT data; "Scale" age interpreted by scale reading, "i" = illegible scale annuli, could not age; FW = Freshwater; O = Ocean age; Er = Age Error = (Known Ocean age) – (Interpreted Ocean age); ND = No Data.

[b] Ft. Rich. = Fort Richardson Hatchery

[c] All smolt released at Ninilchik River.

[d] Freshwater stream or nearest community to the marine waters where the Chinook salmon was recovered.

[e] Esc. = Escapement Project; C.H.= Commercial Harvest (tag recovered at a commercial fish processing facility).

[f] Sex code: F = Female, M = Male, U = undetermined.